biogasmax

A DRIVING FORCE

14th September 2010

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Life Cycle Assessment of biomethane public transport

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Outline

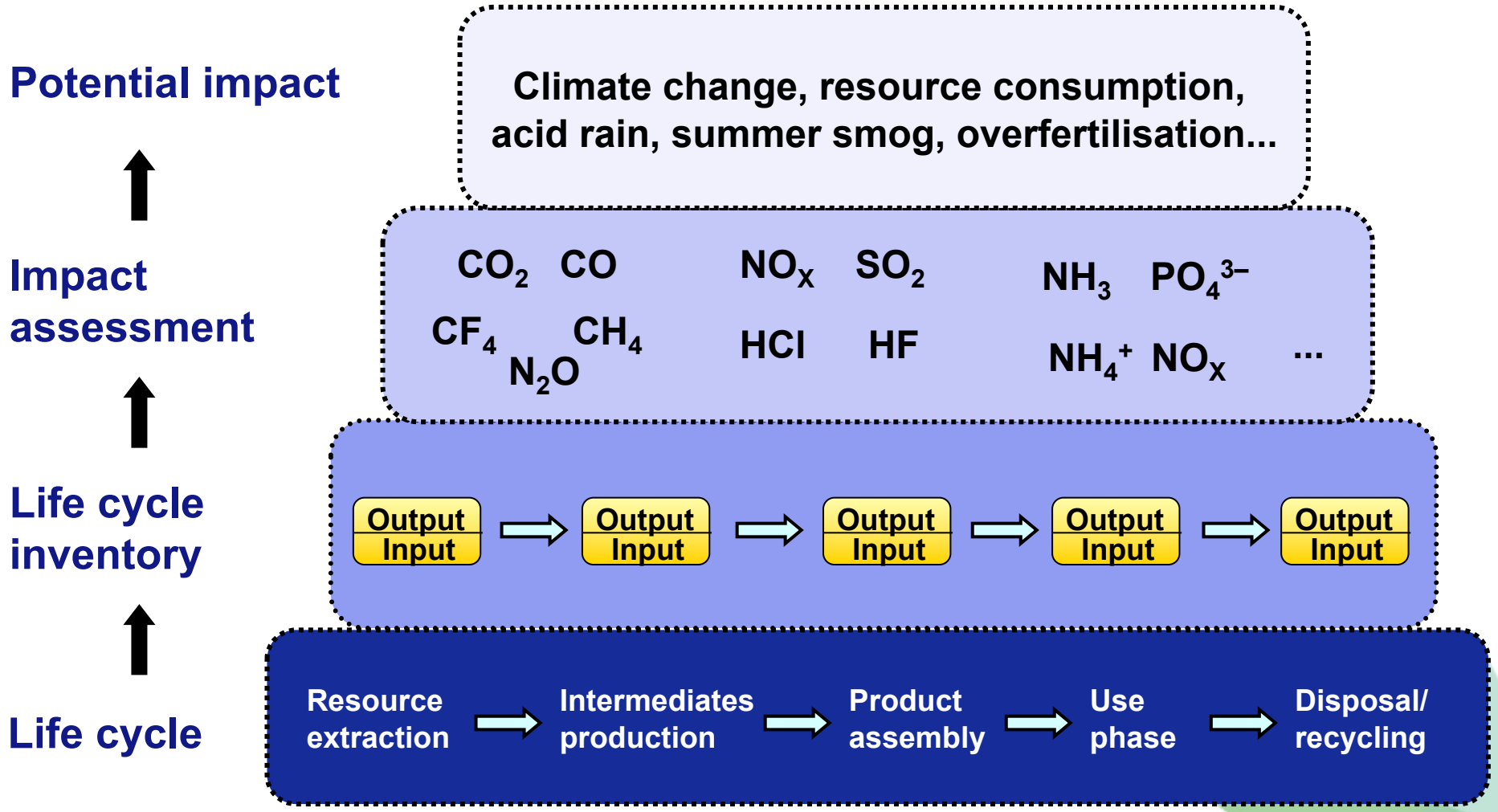
- Life Cycle Assessment methodology
  - Product systems
  - Multitude of environmental impacts
- Biomethane from an environmental point of view
  - Overview
  - Feedstock generation
  - Digestion
  - Upgrading
  - Distribution
  - Use

LCA – product systems

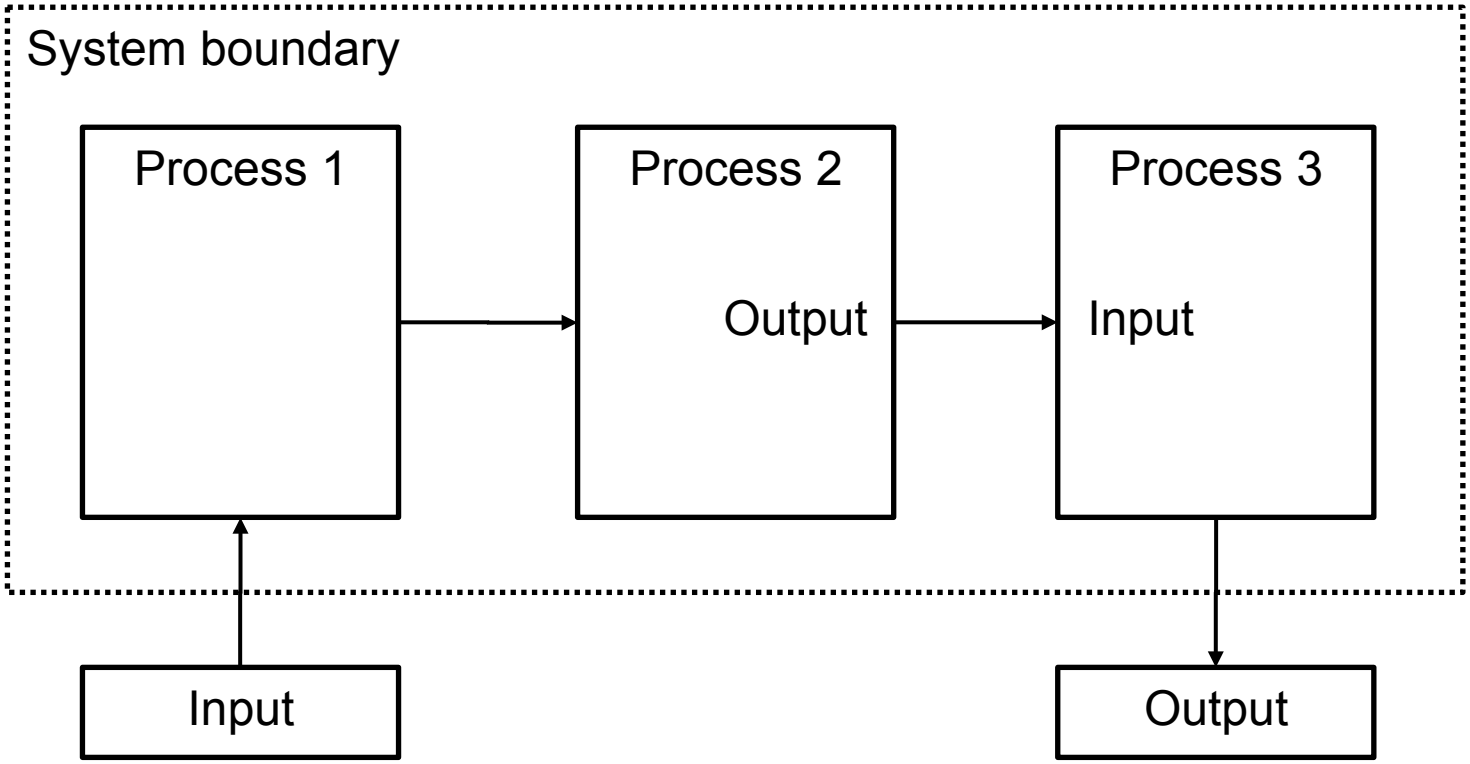
- „Cradle to grave“ approach
  - Resource extraction and processing
  - Materials production, product assembly
  - Use phase
  - End-of-life

- Modular inclusion of other product systems

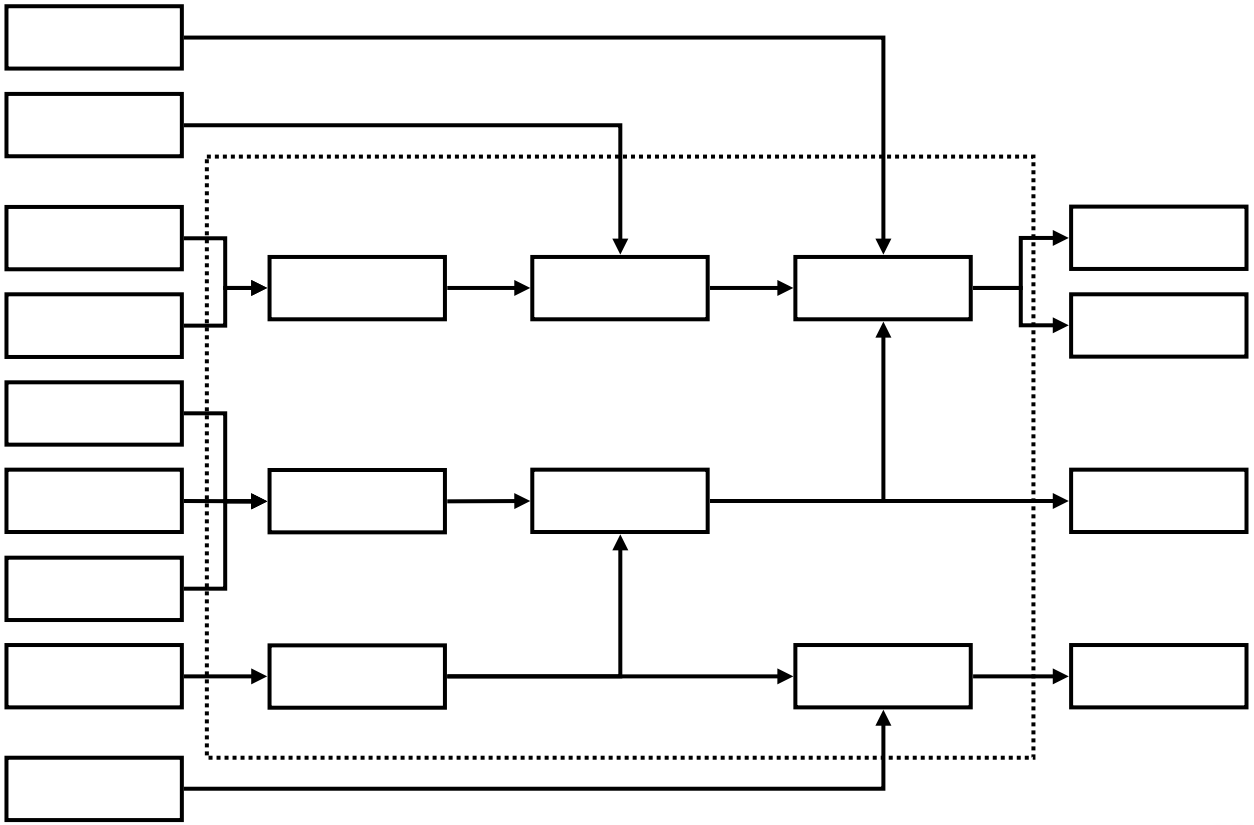
LCA – product systems



LCA – product systems



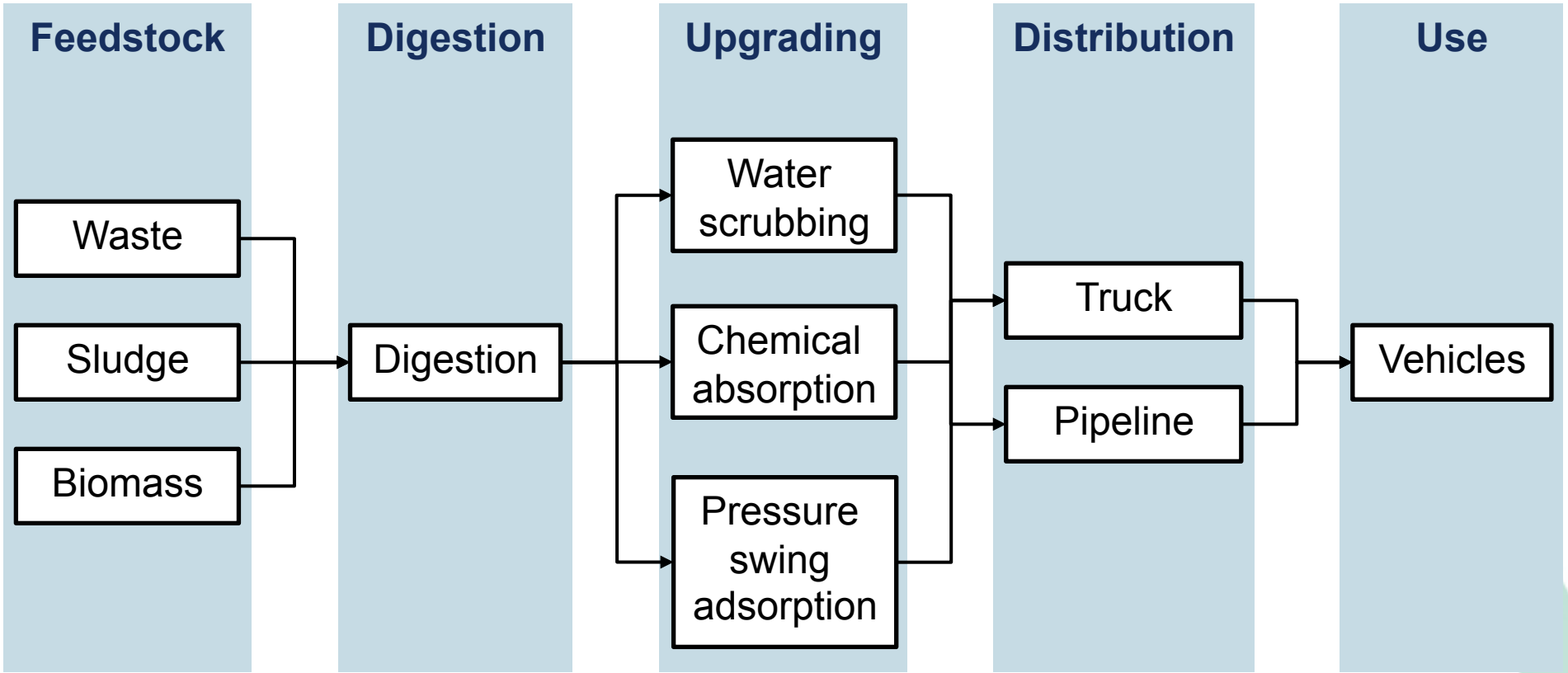
LCA – product systems



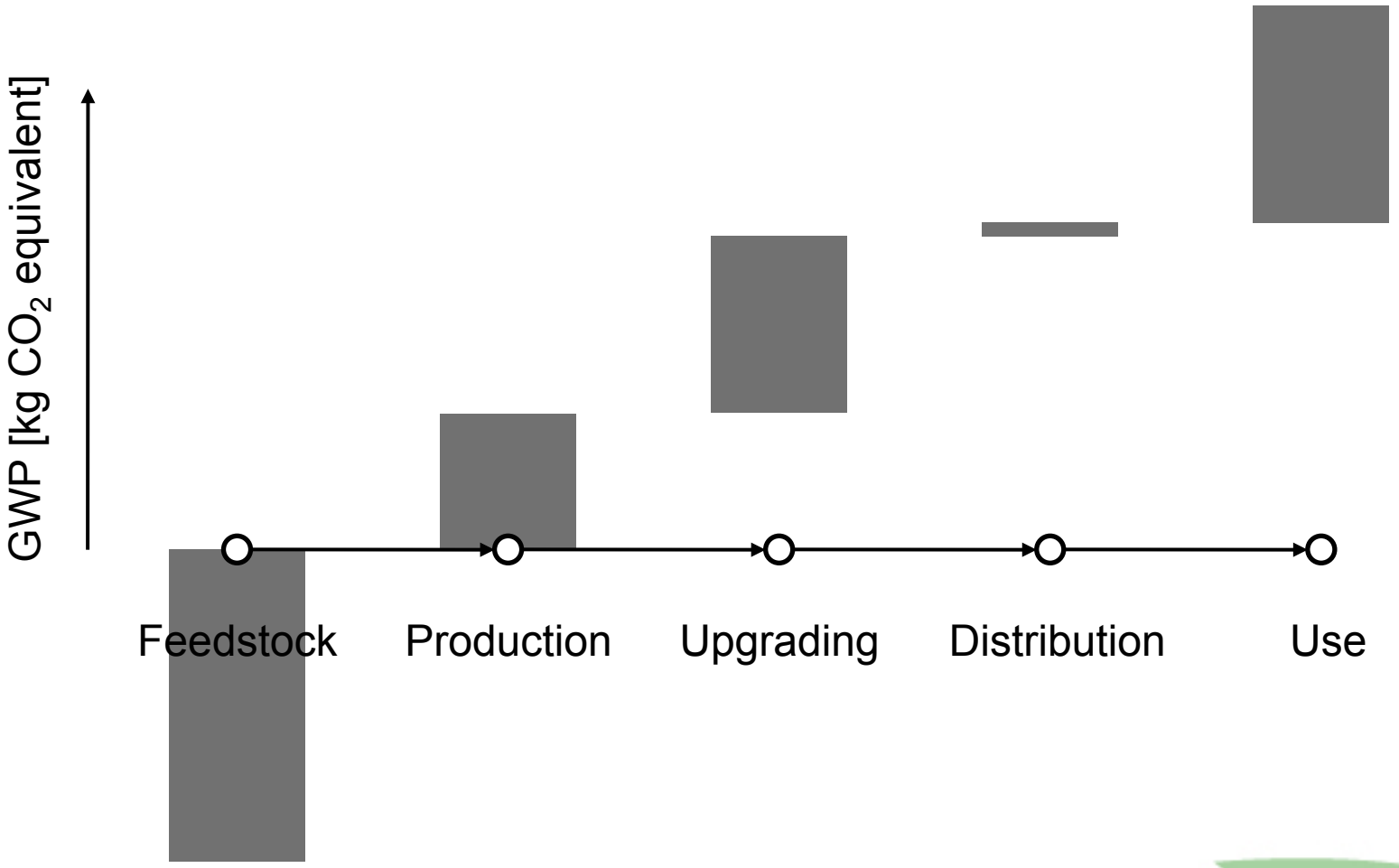
LCA – environmental impacts

- „Environment“ more than just climate
- Impact categories in Biogasmax
  - Global Warming Potential (GWP_{100})
  - Eutrophication Potential (EP)
  - Acidification Potential (AP)
  - Photochemical Ozone Creation Potential (POCP)
  - Fossil Primary Energy Demand (PE_{fossil})
- Presentation limited to climate impacts
  - Full report coming soon

Biomethane – overview



Environmental impact (climate)



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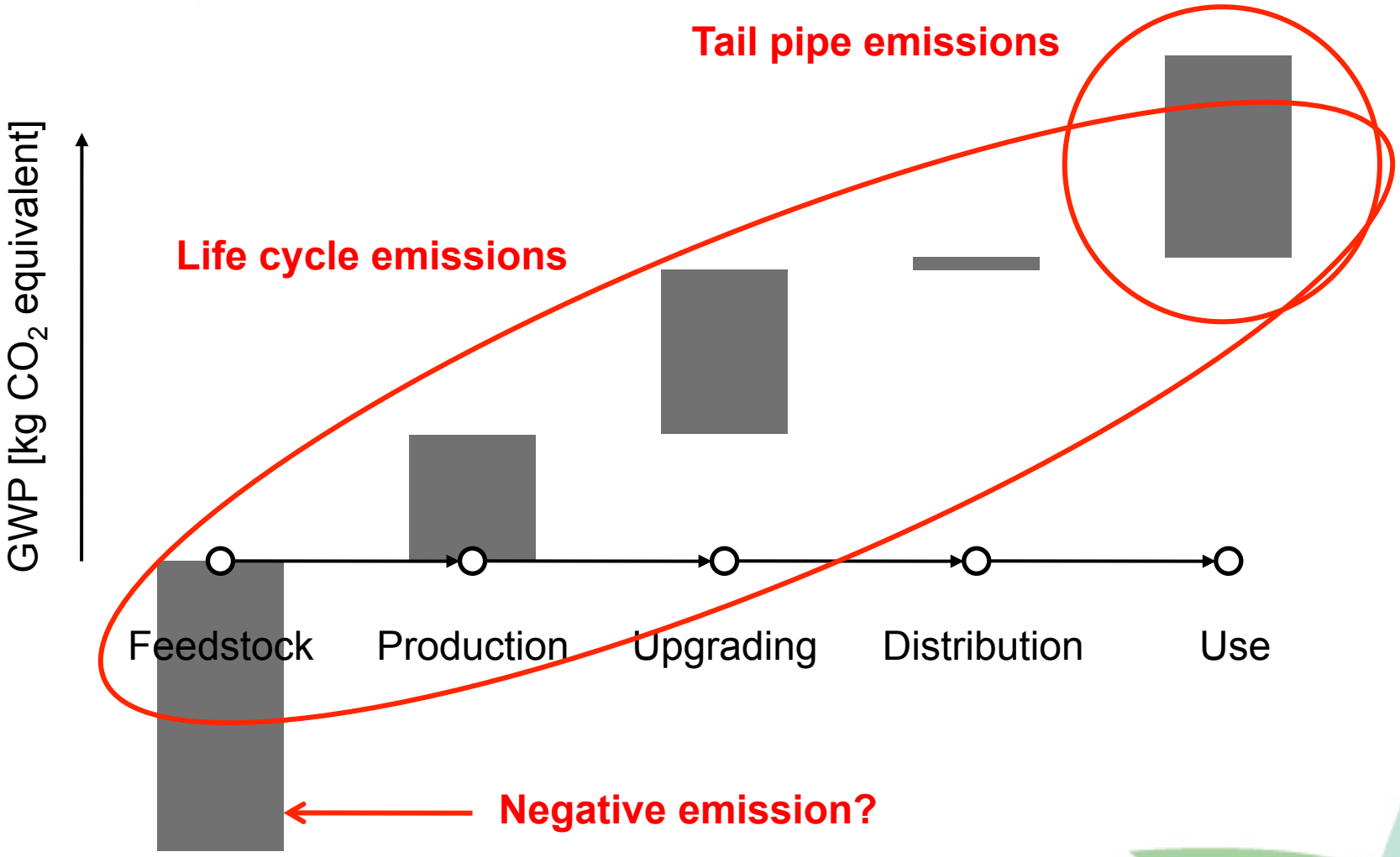
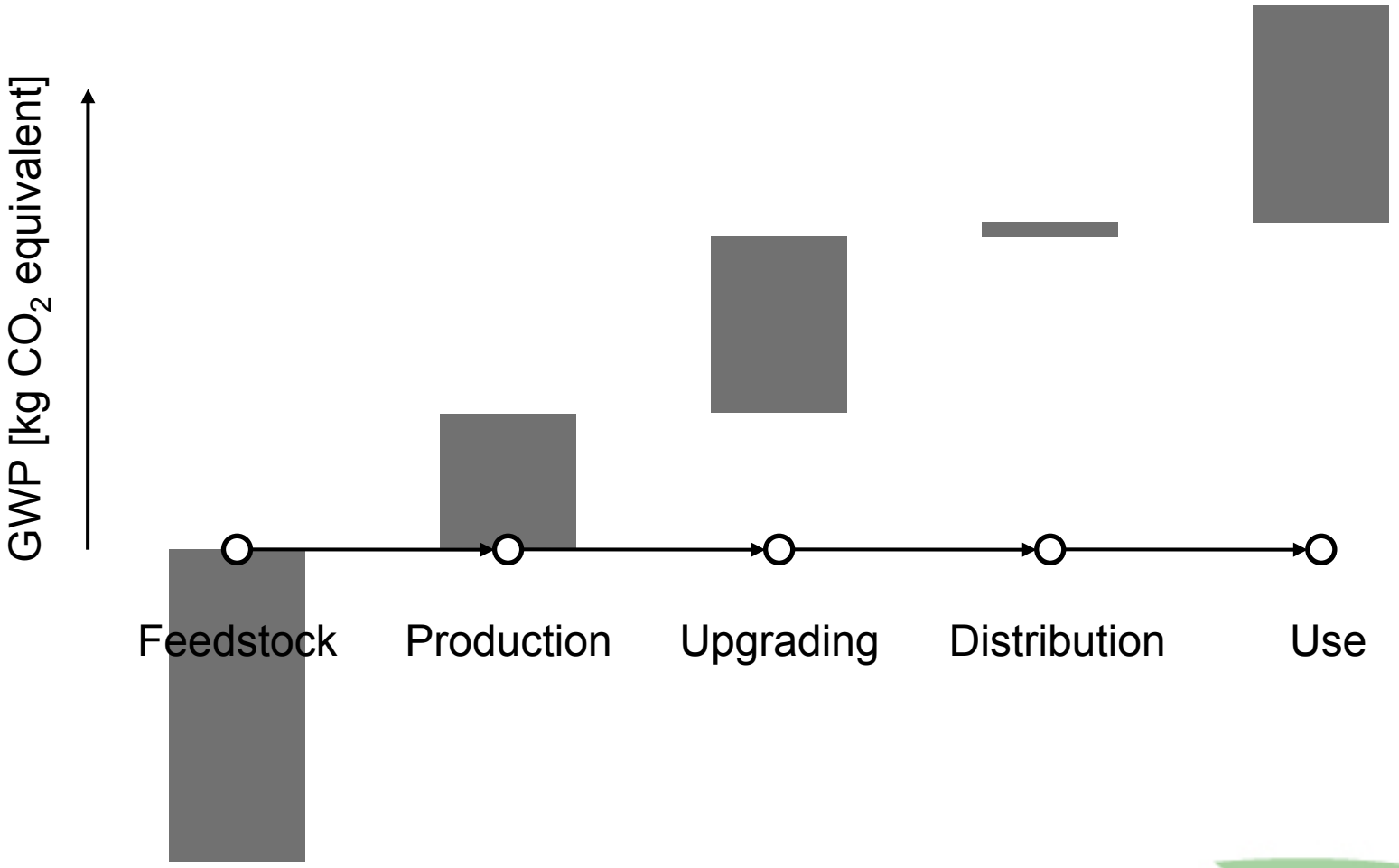


Feedstock generation

- Municipal organic waste
  - Life cycle accounted for in original product system
  - Waste considered “burden free” in biomethane system
- Sewage sludge
  - Same as municipal waste
- Dedicated biomass production
  - Feedstock produced exclusively for digestion to biogas
  - Environmental burden of production attributed to biomethane

Environmental impact (climate)



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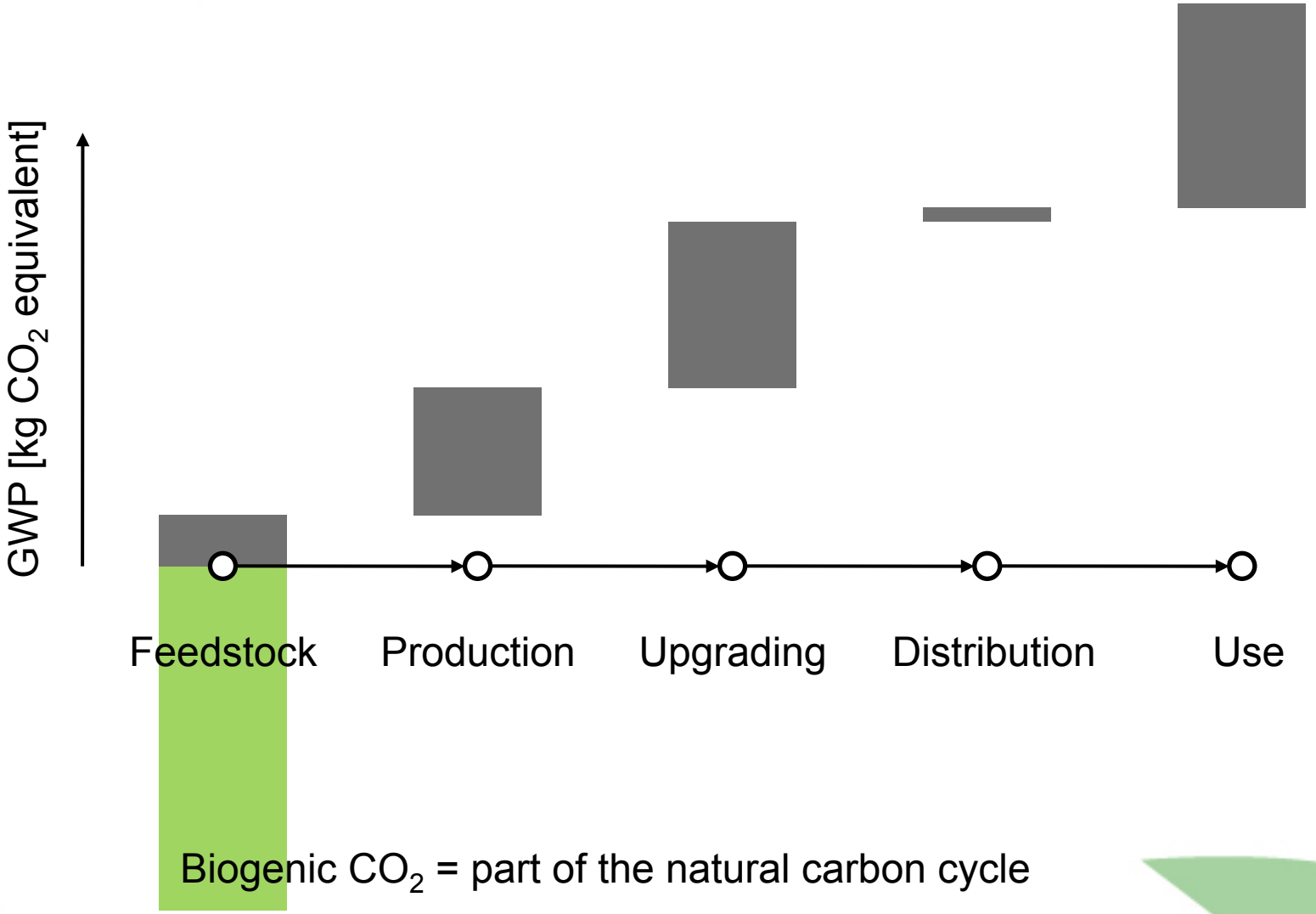

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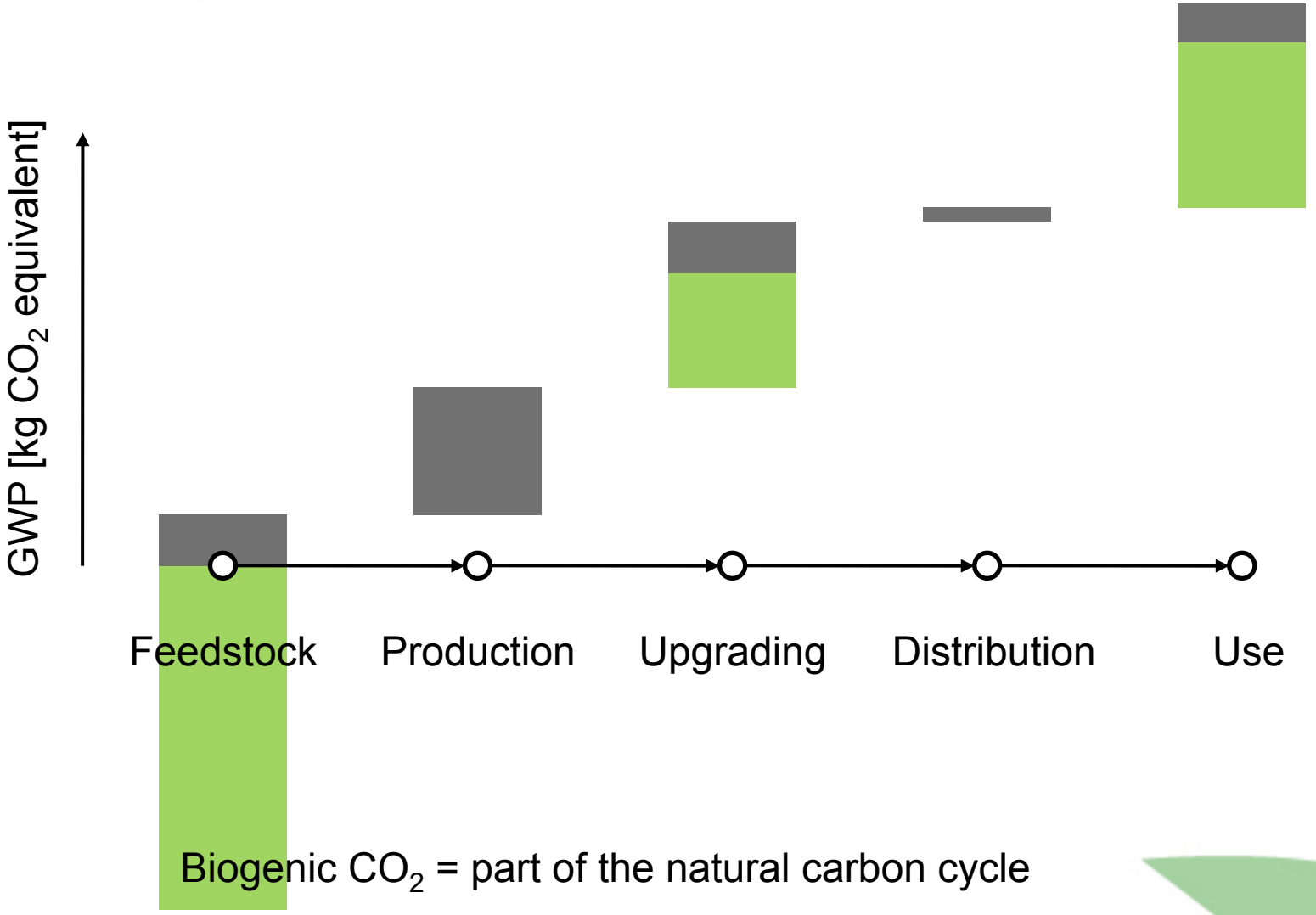
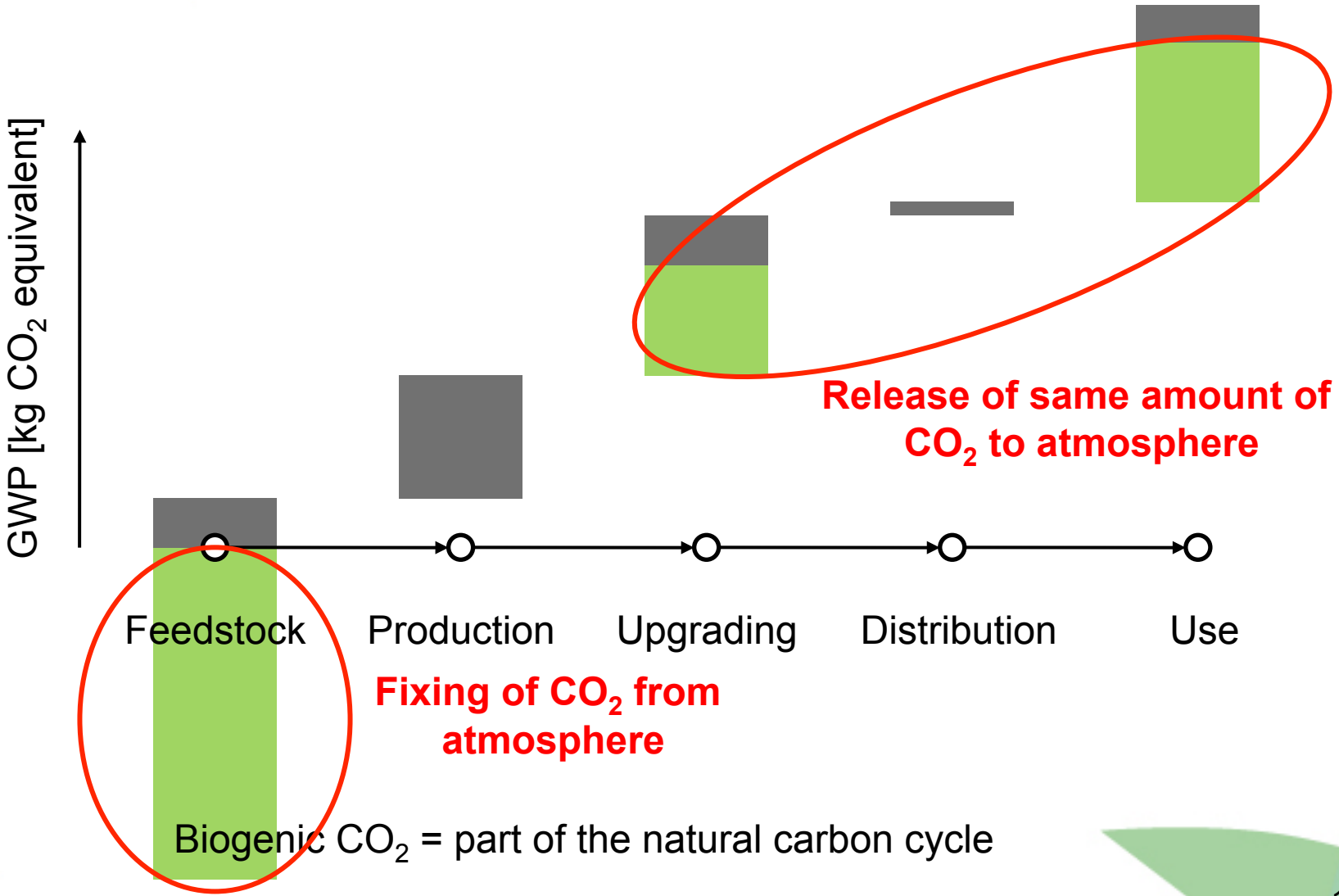


Biogenic CO_2 = part of the natural carbon cycle

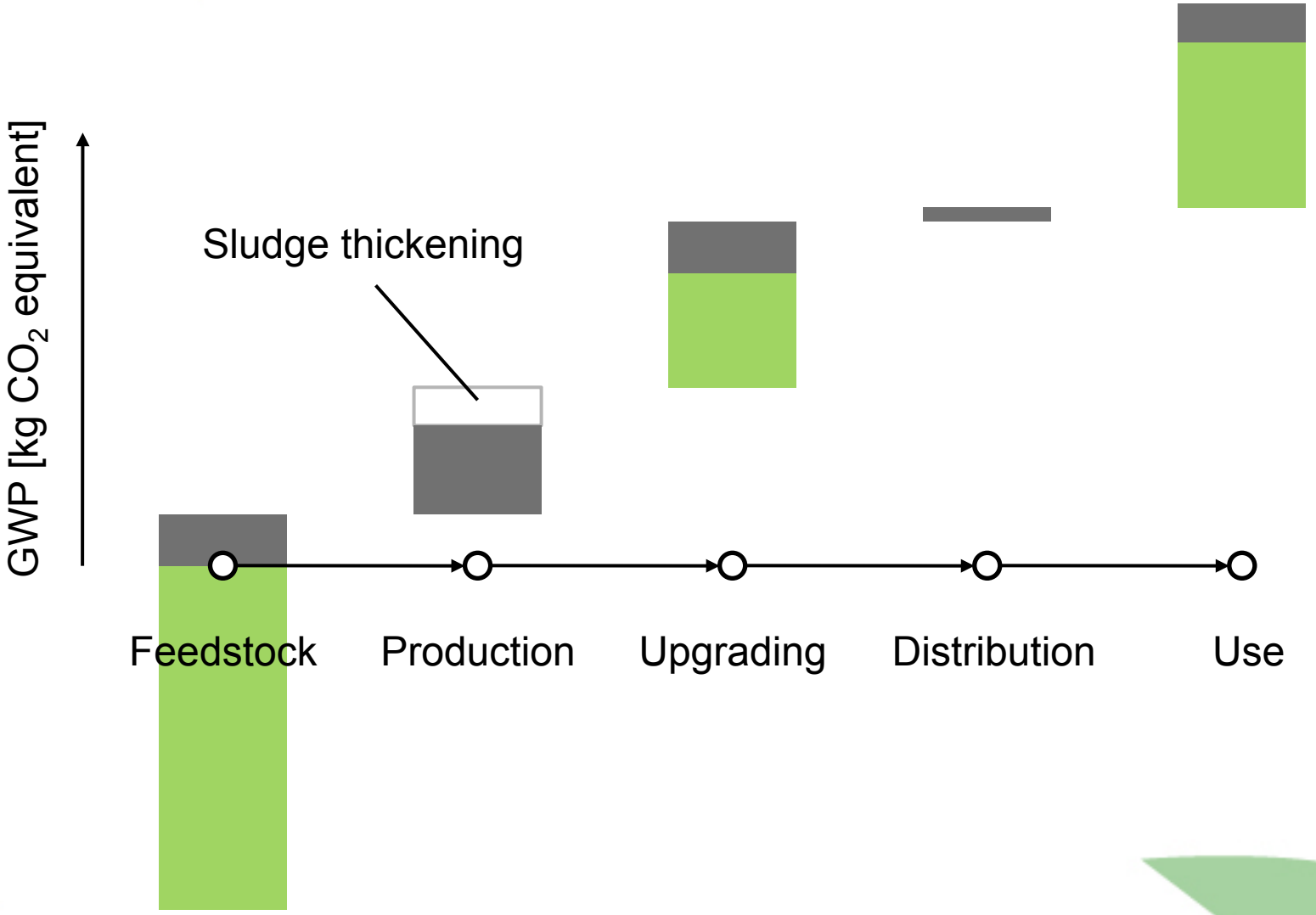
Environmental impact (climate)



Digestion

- Heat management
  - Dry matter content of slurry defines heat demand
  - Impact depends on type of fuel, combustion conditions
- Biogas slip from digester
  - Potentially important GWP and POCP contribution
- Residue valorisation
  - Fertiliser
  - Combustible
  - Filler material

Environmental impact (climate)



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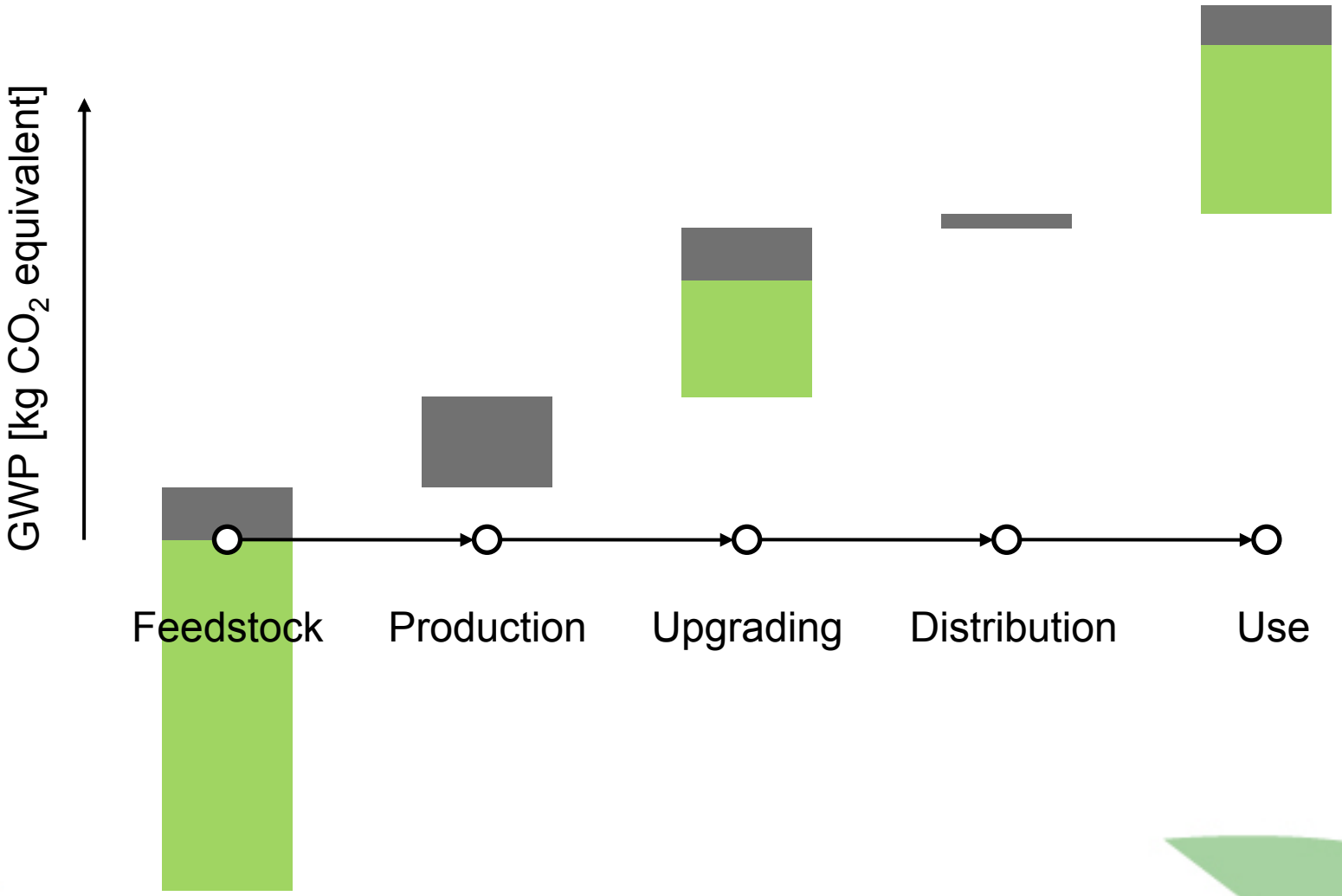

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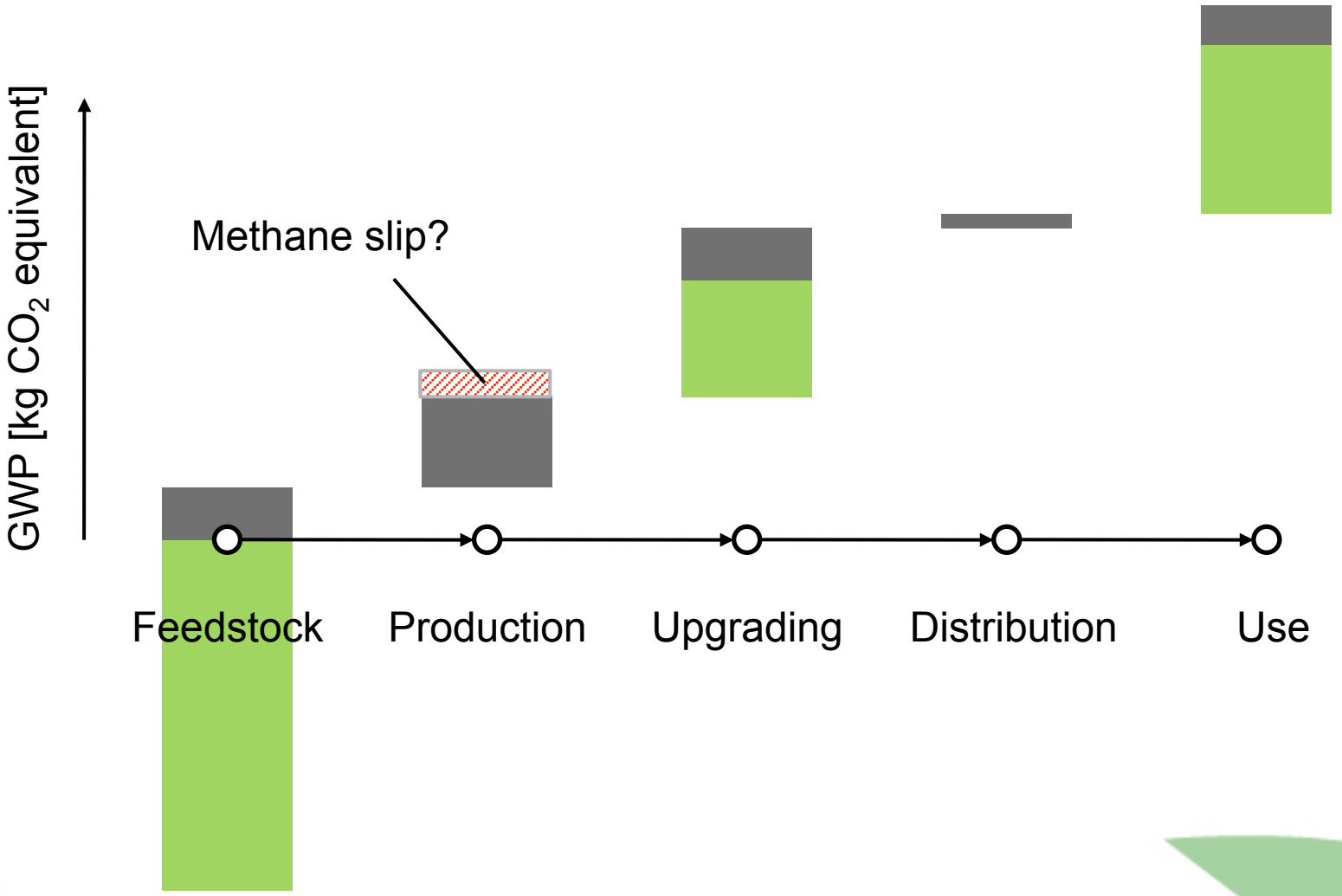

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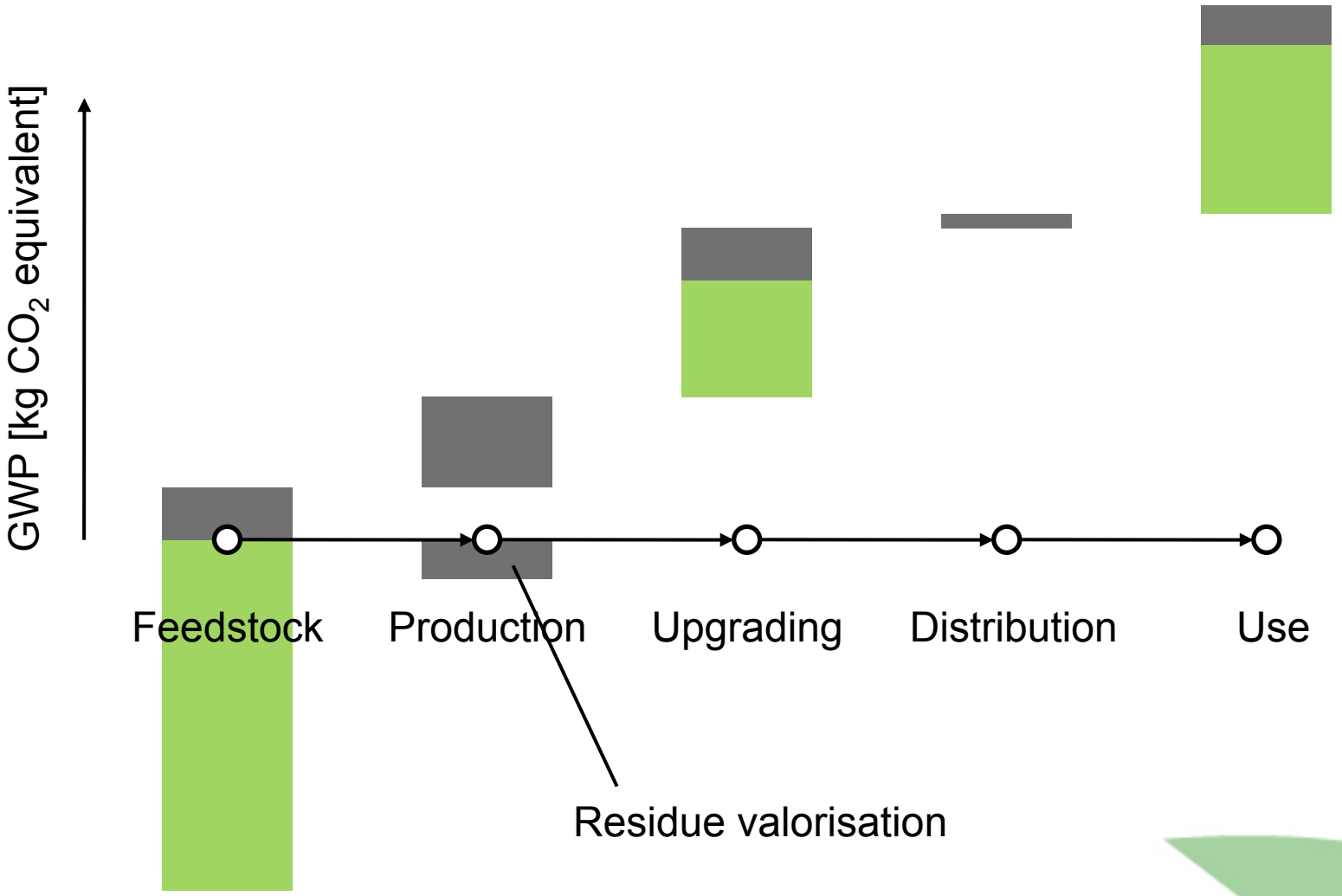

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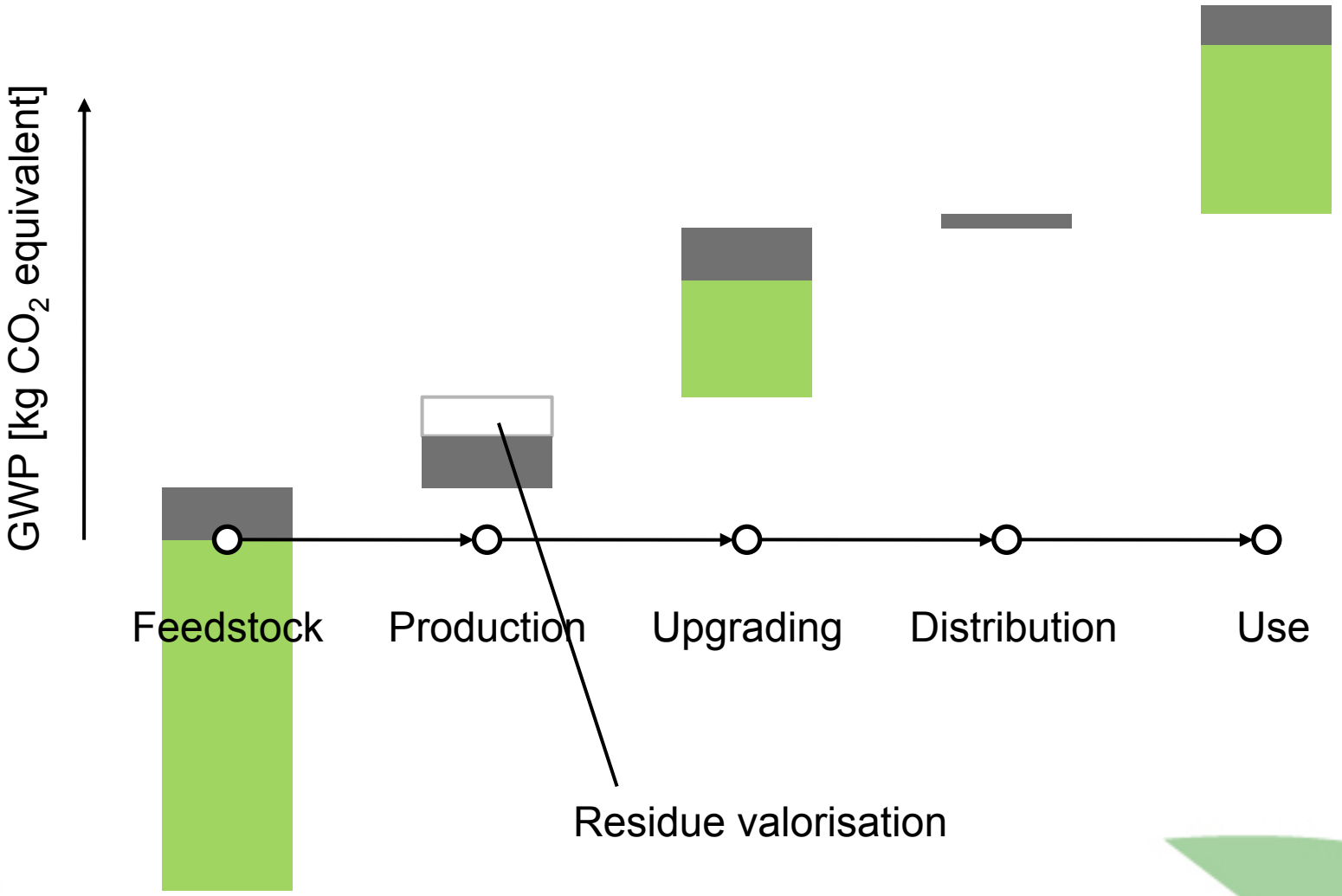

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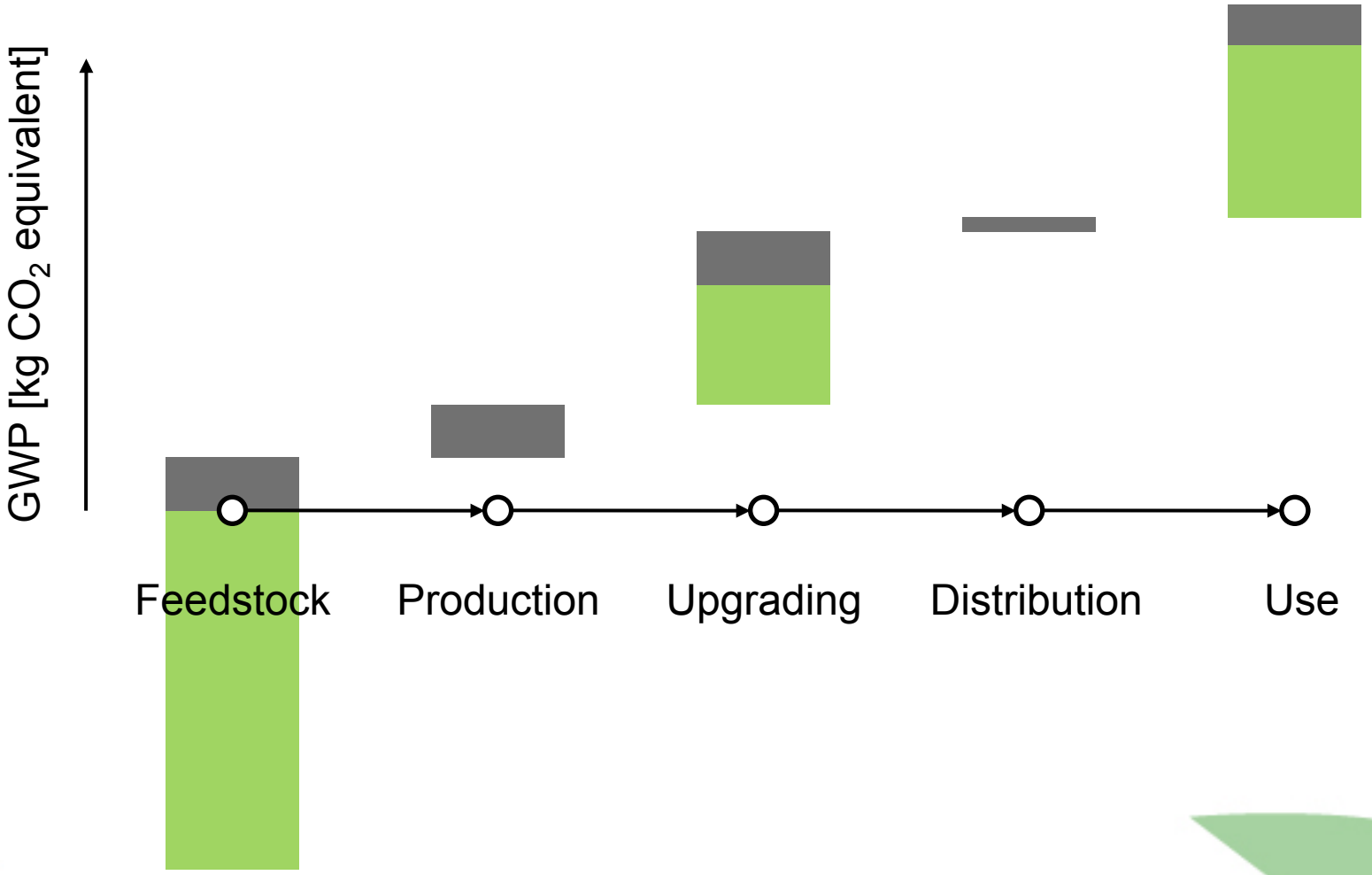
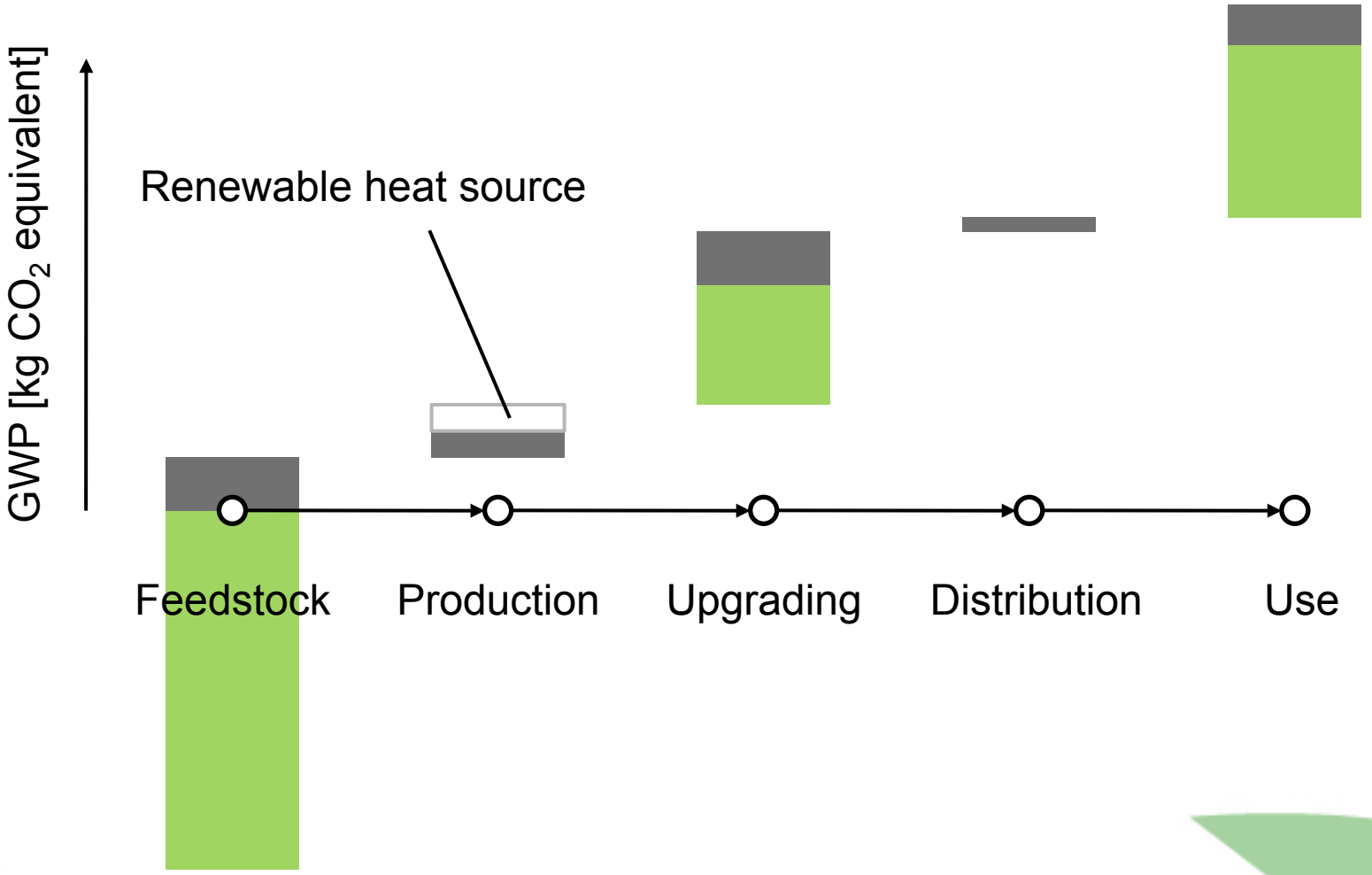


Digestion

- District heating
  - Mostly waste heat from industry → considered "renewable"
- Landfill gas
  - Contains ca. 40% methane and lots of impurities
  - Combustion for heat rather than upgrading
  - Landfill emissions allocated based on revenue shares generated from waste disposal and gas sales

Environmental impact (climate)



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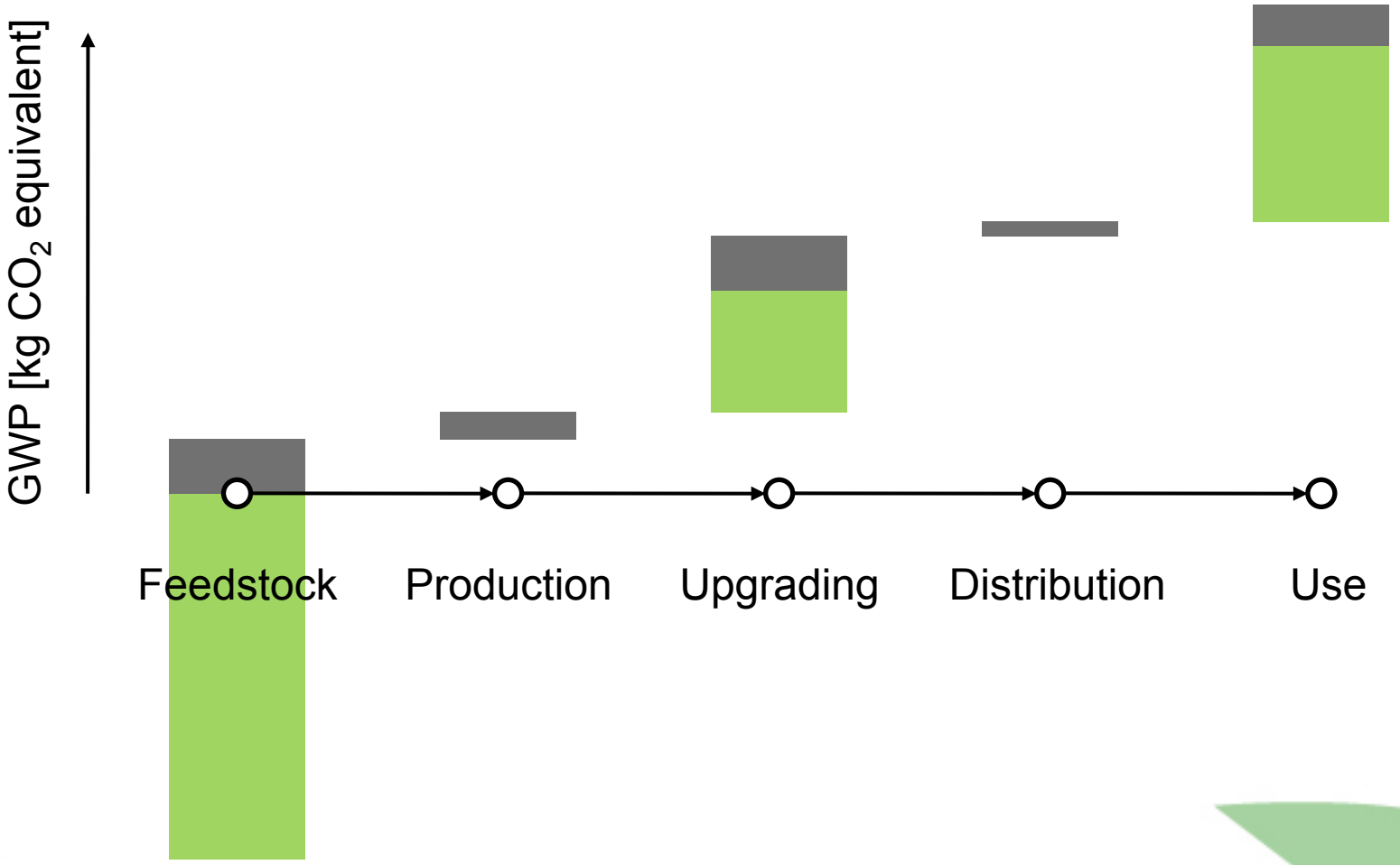
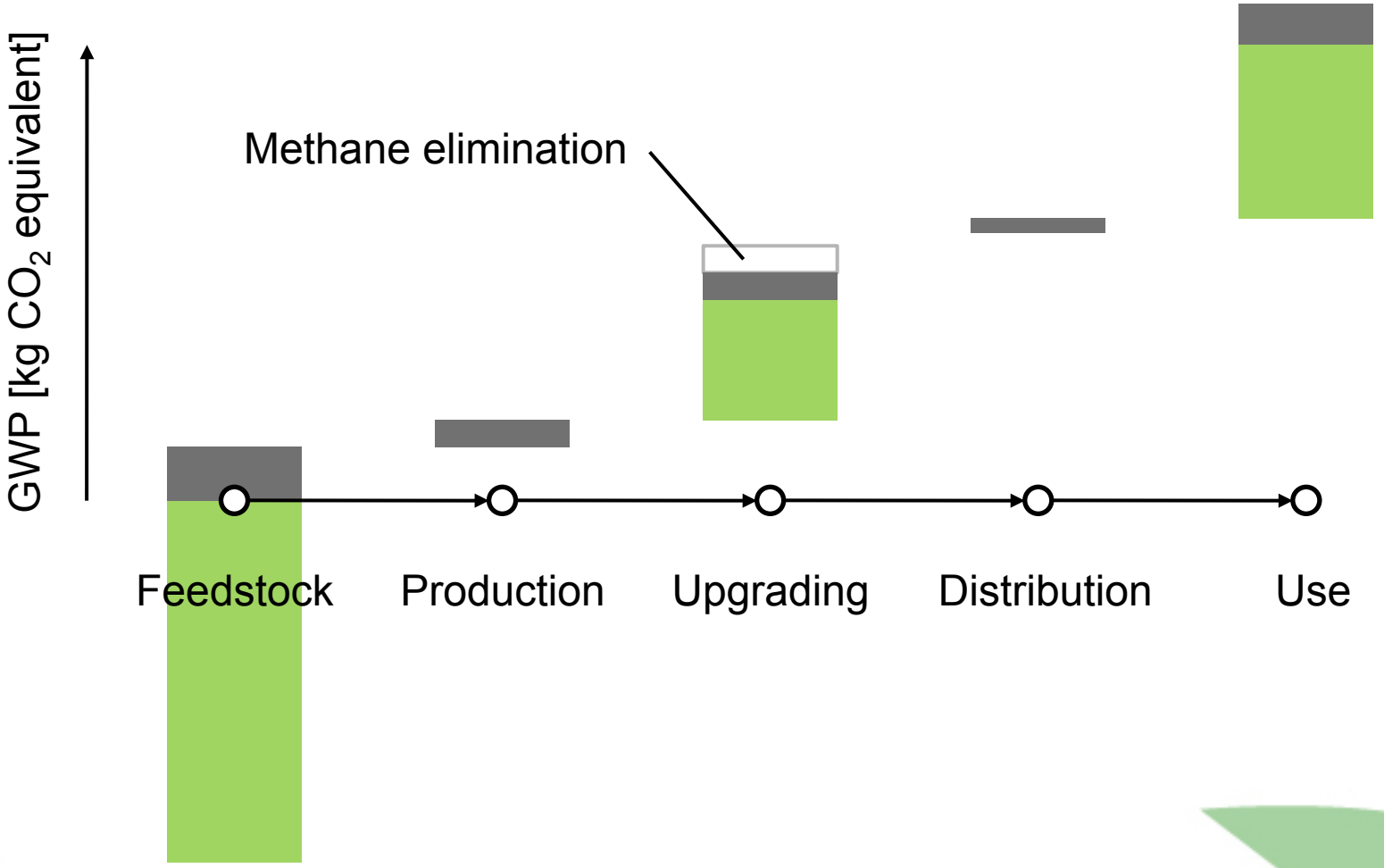


Upgrading

- Water scrubbing, PSA
  - Electricity consumption decisive
- Chemical absorption
  - Heat consumption decisive
- Methane slip
  - Important GWP and POCP contribution
  - Several mitigation measures exist
- Conditioning
  - Addition of fossil materials reduces advantage

Environmental impact (climate)



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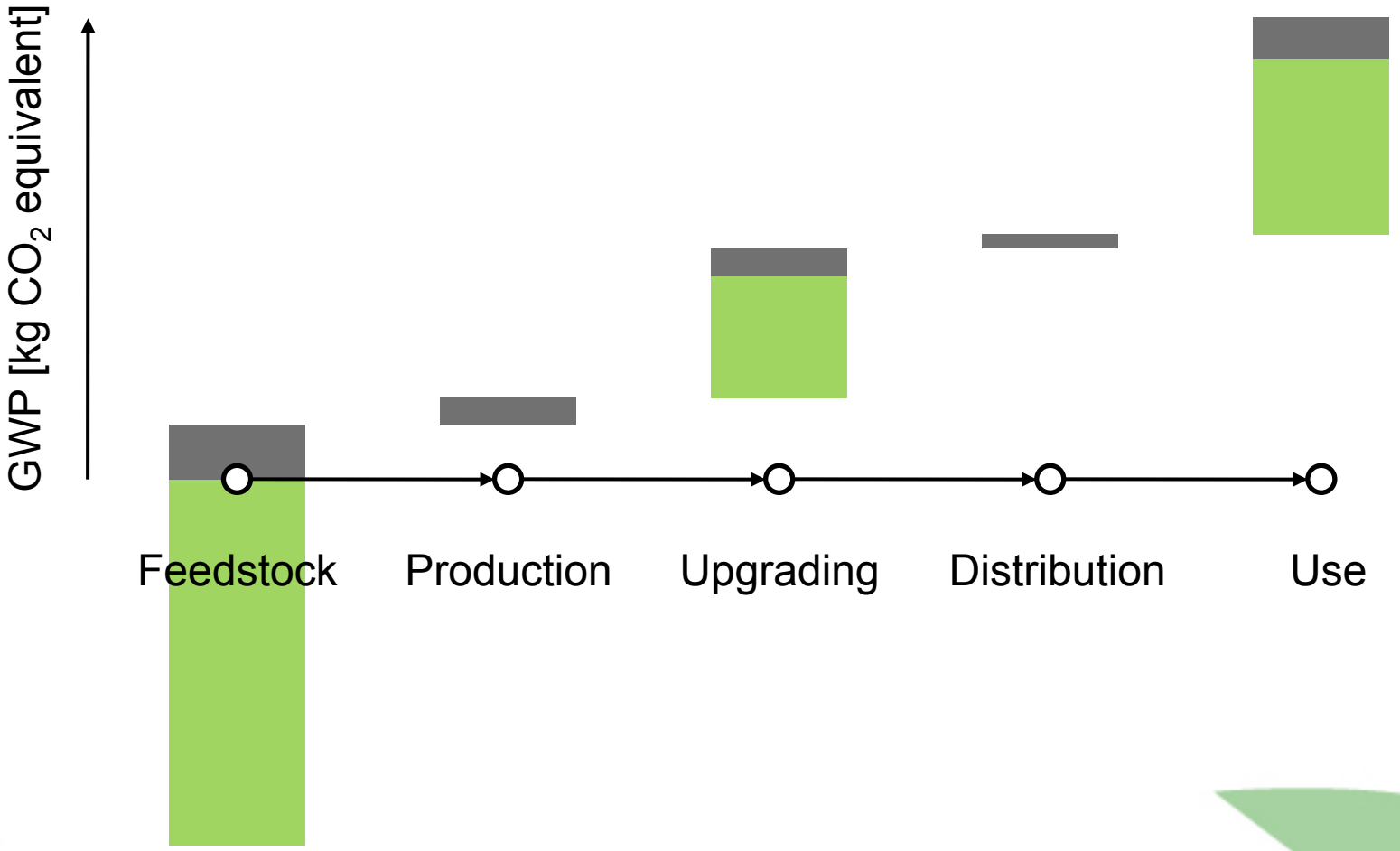
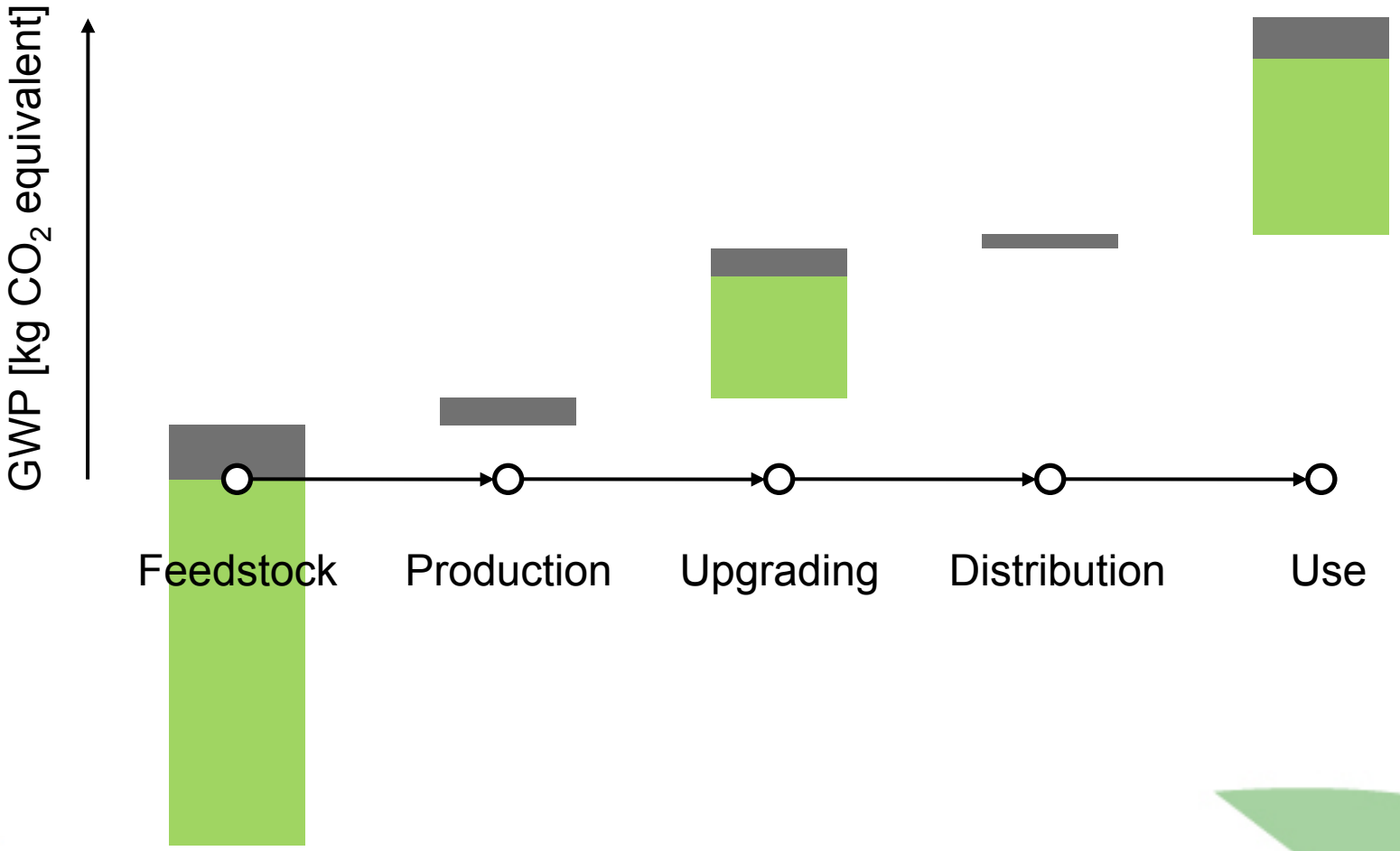


Distribution

- Pipeline transport
  - Little influence on overall result
  - Methane slip potentially important GWP, POCP contribution
- Truck transport
  - Higher impact than pipeline transport but no dominant factor in life cycle
- Filling stations
  - Impact sensitive to power grid mix
  - Methane slip potentially important GWP, POCP contribution

Environmental impact (climate)



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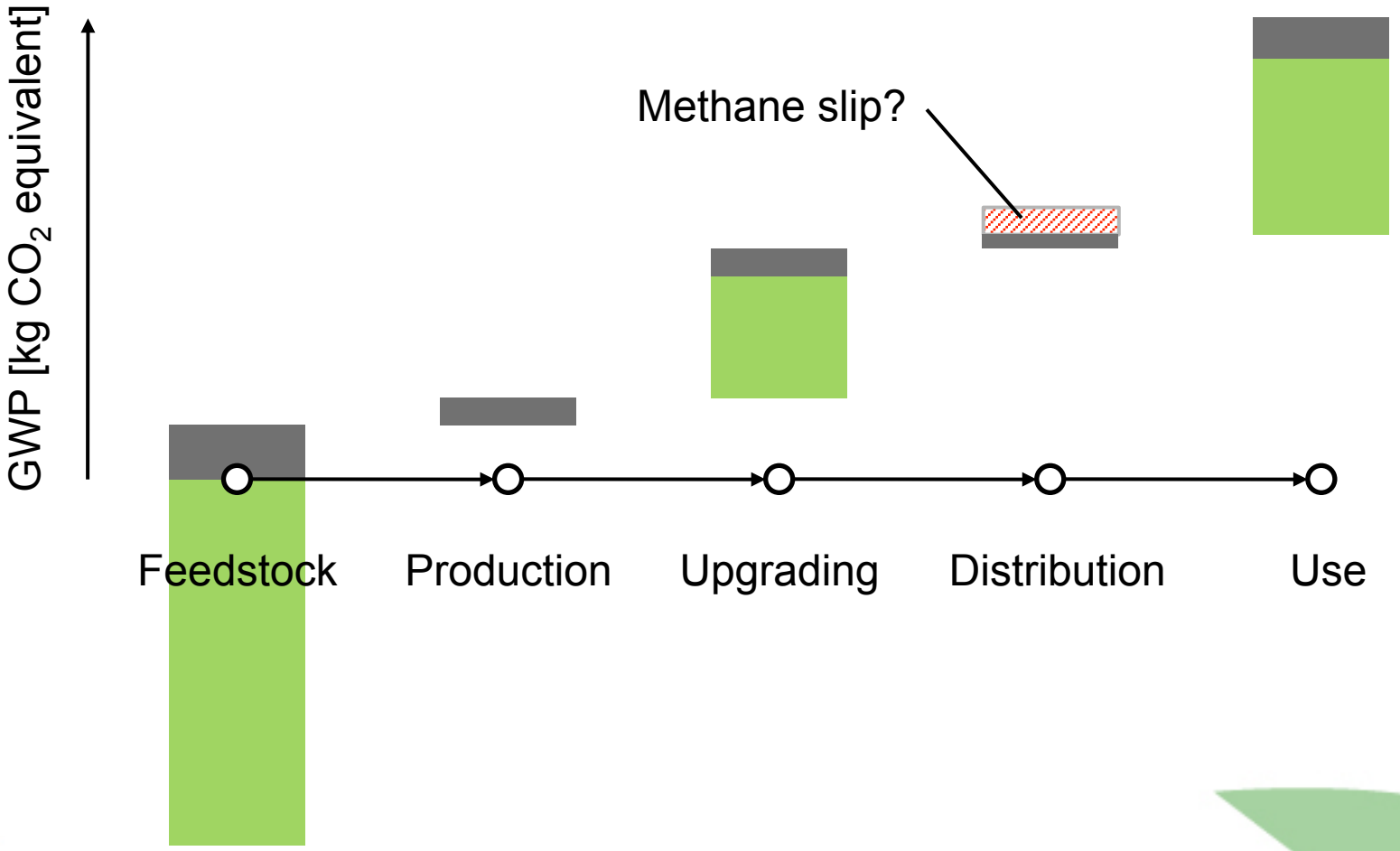
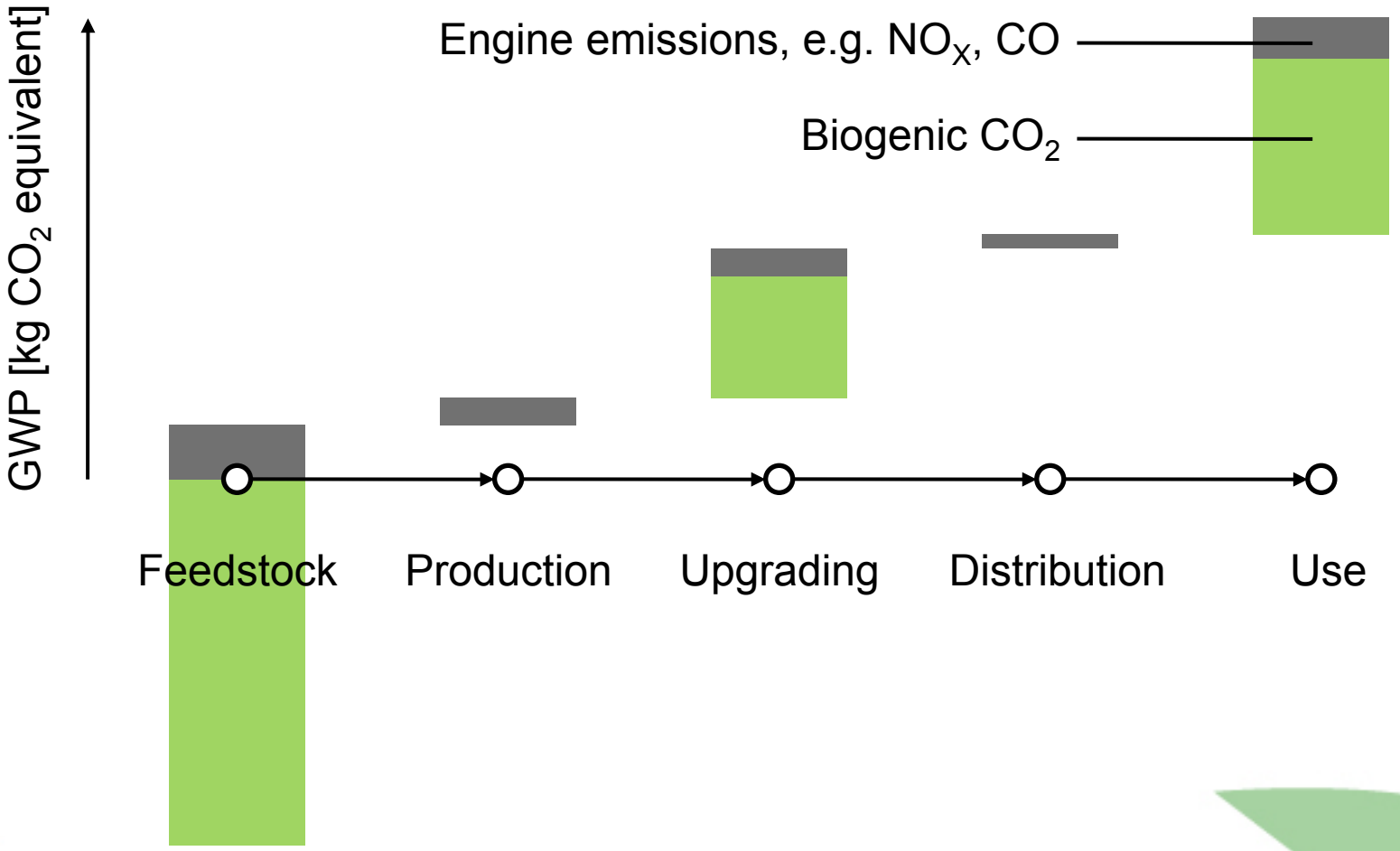


Use

- Vehicles
  - Busses
  - Heavy duty vehicles, e.g. garbage trucks
  - Cabs, private cars

Environmental impact (climate)



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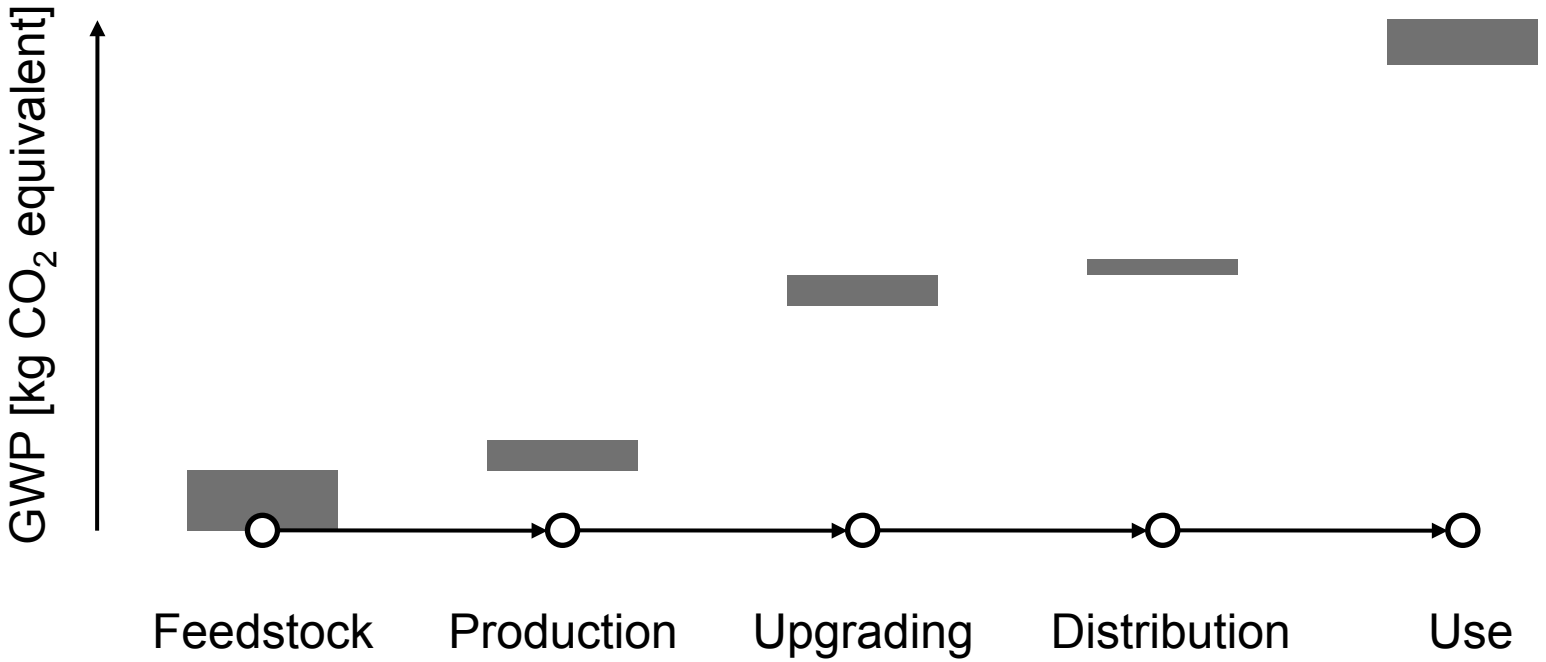

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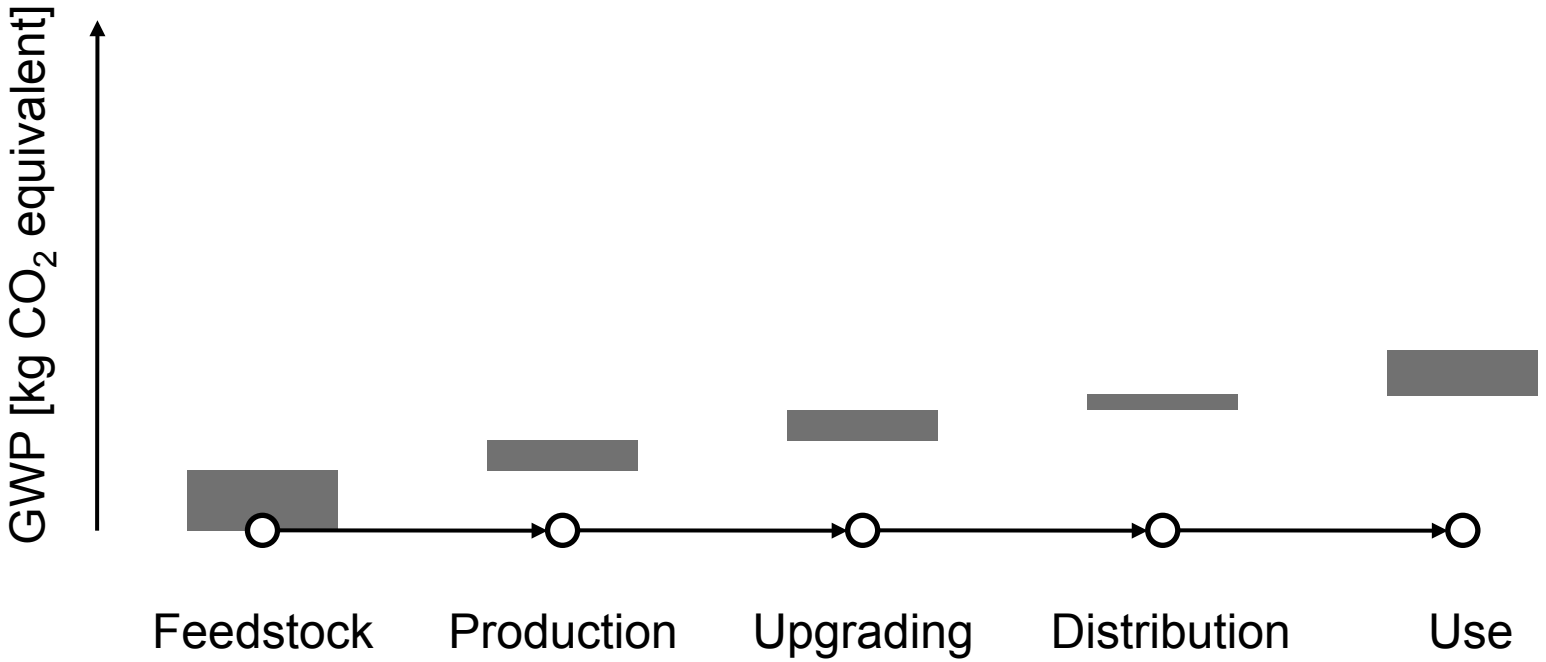

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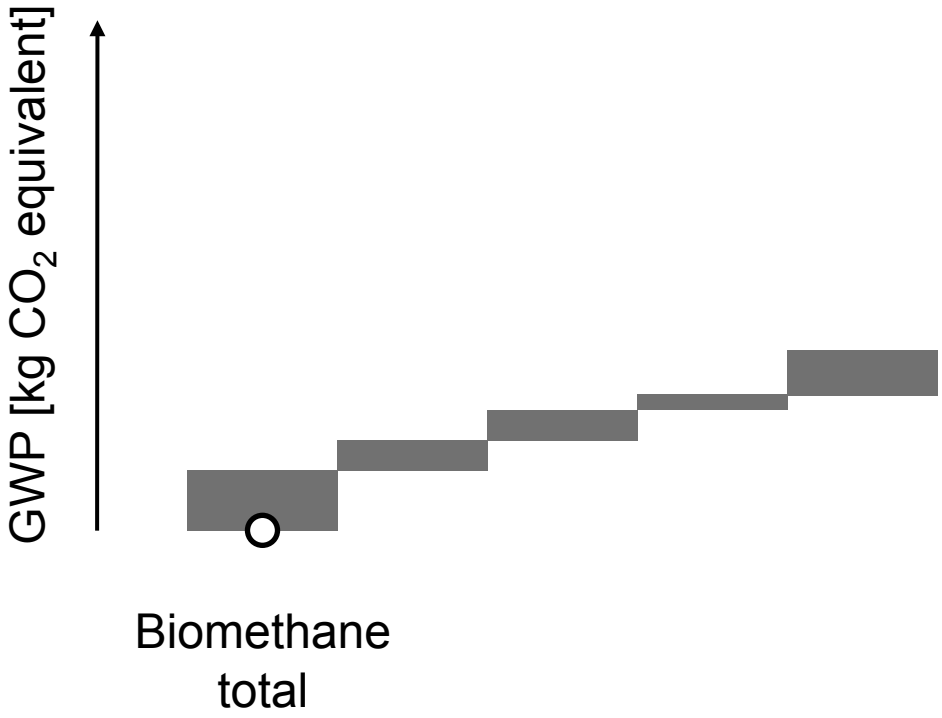

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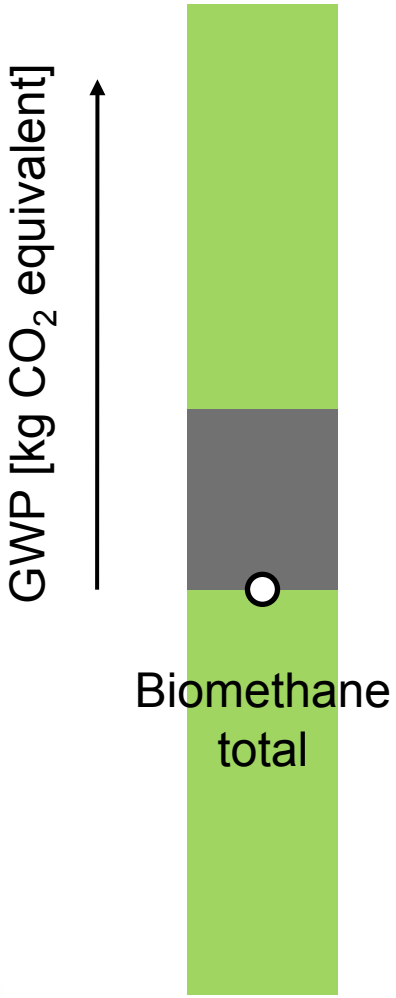

Conclusion

- Climate/carbon neutrality of Biomethane
  - Low climate impact, though not 100% climate neutral
  - Considerable improvement potential (technology just stretching into market)
- Critical points for climate impact
  - Reduction of methane slip at every stage
  - Valorisation of by-products
- Presentation limited to climate impacts
  - Other impacts may (and do) behave differently

Contact

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