Manure management technologies and mitigation of GHGs: opportunities & limitations

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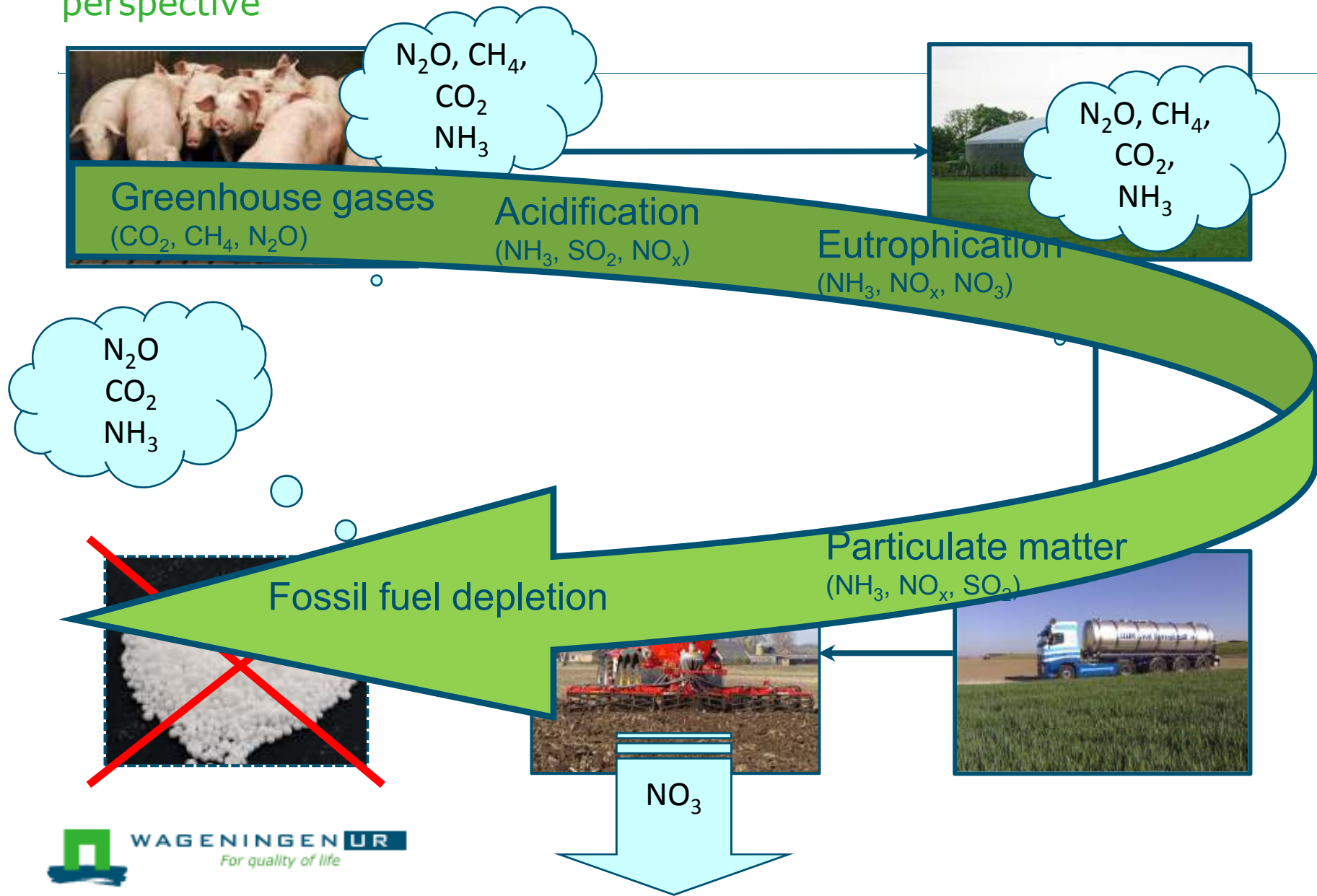
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← **Urine**
Faeces →

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Introduction (1/2) Contribution of MM to GHG emissions

- Manure management (MM) = storage, processing, and application of liquid (slurry) or solid manure

- MM contributes

  - ~17% to agricultural greenhouse gas (GHG) emissions in Europe, mainly swine and cattle slurry (EEA, 2012)

  - Up to 53% of agricultural N_2O emissions (Chadwick et al, 2011)

- Mainly CH_4 and N_2O, lesser extent CO_2

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N_2O, CH_4, CO_2, NH_3

N_2O, CH_4, CO_2, NH_3

Greenhouse gases (CO_2, CH_4, N_2O)

Acidification (NH_3, SO_2, NO_x)

Eutrophication (NH_3, NO_x, NO_3)

N_2O CO_2 NH_3

Particulate matter (NH_3, NO_x, SO_2)

Fossil fuel depletion

NO_3

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Aim & methods

- Aim: Show GHG mitigation opportunities & limitations (shifting of emissions and environmental impacts)

- Methods

  - life cycle assessment (LCA): modelling of environmental impact from cradle to grave

  - Impact categories: GHG emissions, Acidification, Eutrophication, Particulate matter, and Fossil Fuel Depletion

Mitigation opportunities?

1. Don't make manure

2. In-house/ outside storage

    - Segregating urine and faeces (keeping separate)

    - Cover storages

    - Reduce storage time/ temp

3. Manure processing

    - Anaerobic digestion

    - Separation of liquids and solids

    - Filtration
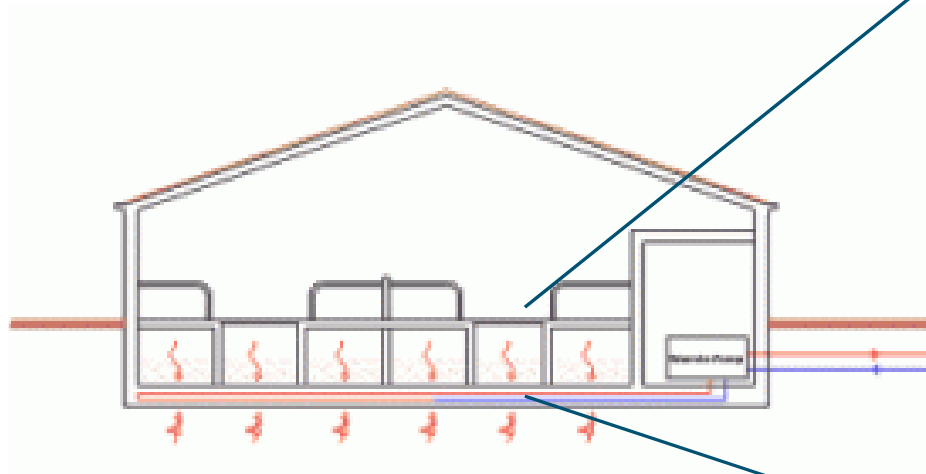
    - Biological treatment

    - Nutrient removal

4. Field application

    - Broadcast spreading→ not consistent

Mitigation opportunities & limitations
Segregating urine & faeces

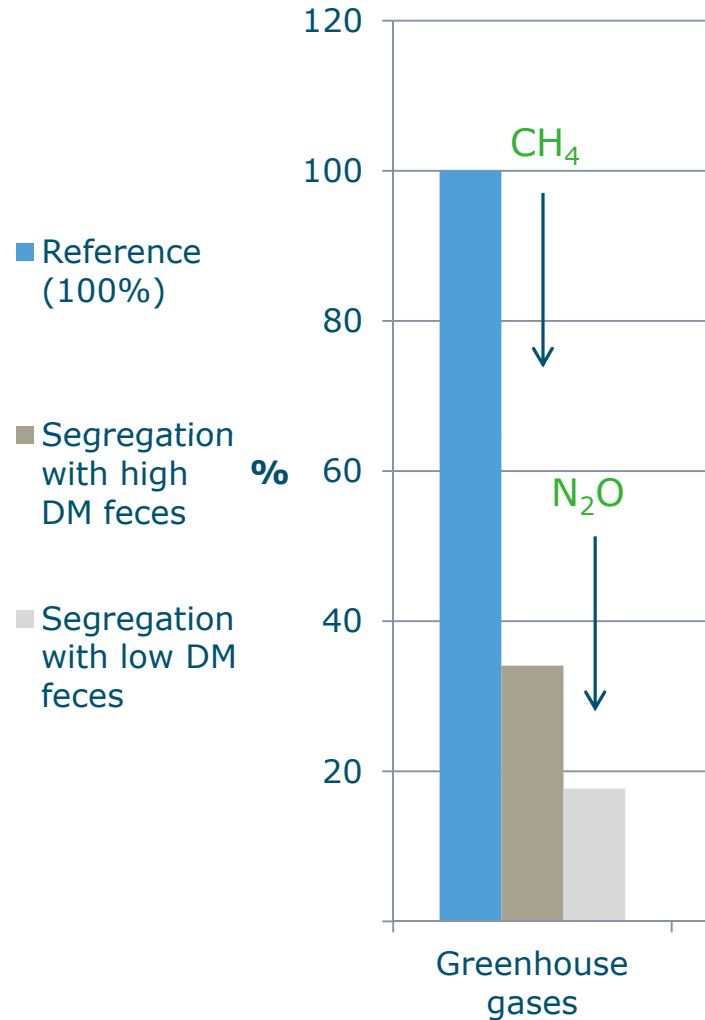# Mitigation opportunities & limitations (1/4)
Segregating urine & faeces

- Scenarios compared
    1. Reference MM
    2. Segregation high DM
        - High DM faeces→ open storage/ spreading + incorporation
        - Urine→ closed storage/ injection
    3. Segregation low DM
        - Low DM faeces→ closed storage/ injection
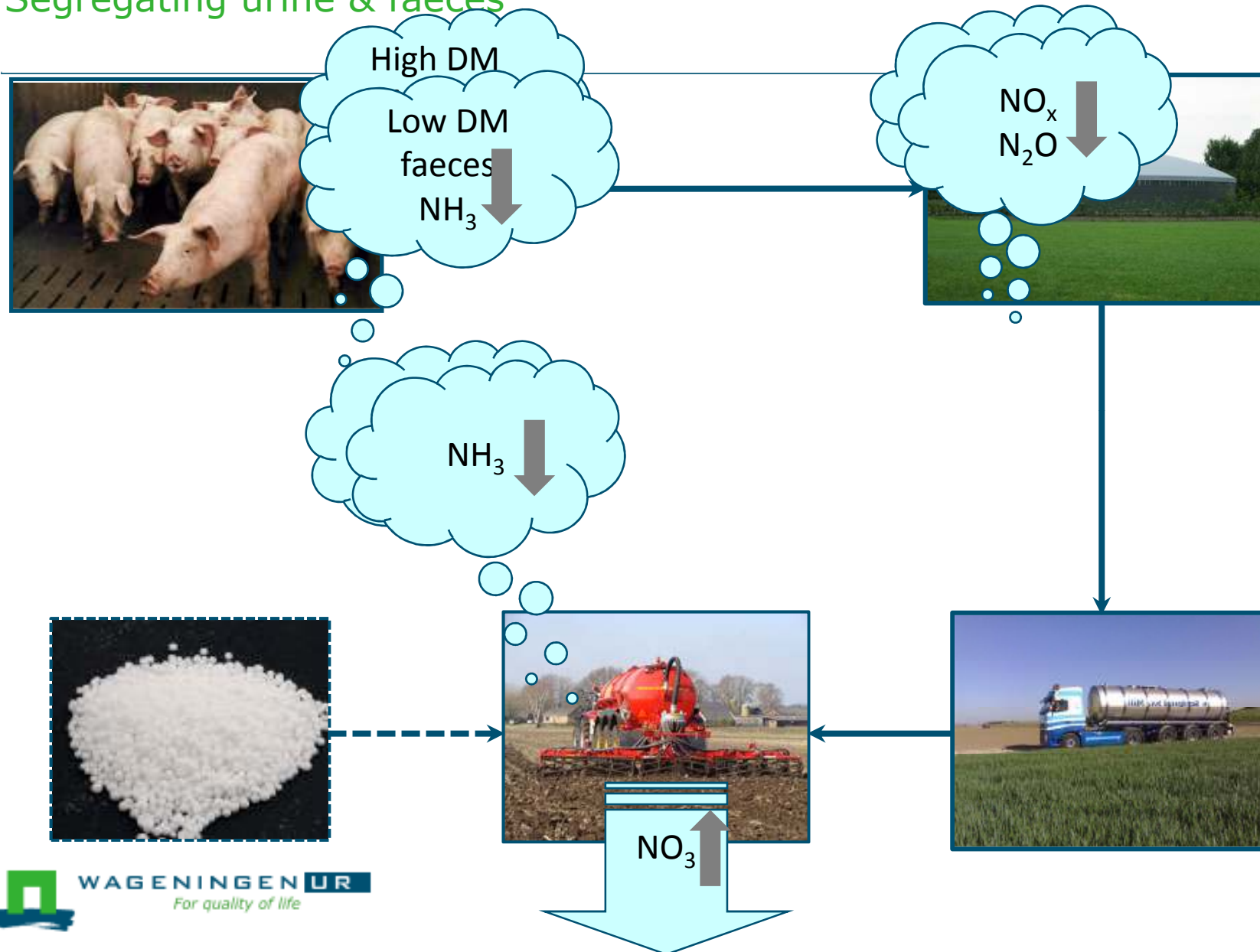   - Urine→ closed storage/ injection

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Mitigation opportunities & limitations (2/4)
Segregating urine & faeces

Segregating urine & faeces

High DM

Low DM
faeces
NH_3

NO_x
N_2O

NH_3

NO_3

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Mitigation opportunities & limitations (4/4)
Segregating urine & faeces

Main conclusion segregating urine & faeces:

- Opportunity: Keep urine and faeces separate to reduce GHGs (~19% of agricultural GHGs in NL)

- Further process high DM faeces

- Limitations: Look at all related environmental impact categories and life cycle stages to consider shifting of emissions

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Mitigation opportunities & limitations
Anaerobic digestion

Mitigation opportunities & limitations
Anaerobic digestion

Main conclusions anaerobic digestion:

- Opportunities: Mono-digestion of pig manure reduces some GHGs (~2% of agricultural GHGs in NL), and produces bio-energy

- Co-digestion with wastes/ residues increases bio-energy and reduces GHGs and other impacts

- Limitation: Co-digestion increased GHG emission and other impacts when competing with feedstocks; through land use change

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Mitigation opportunities & limitations
Manure processing

Mitigation opportunities & limitations
Manure processing

Main conclusions manure processing

- Opportunity: With anaerobic digestion, processing reduces GHGs

- Limitations: Production of concentrate increased environmental impact through storage and processing

Conclusions Opportunities & Limitations

- LCA essential for showing opportunities & limitations to mitigate GHGs

- Opportunities

  - Segregating urine and faeces reduces GHGs up to 82% compared to conventional MM (De Vries et al, 2013)

  - Anaerobic mono digestion and co-digestion with roadside grass (residual) reduces GHGs (De Vries et al, 2012a)

- Limitations

  - Shifting of N emissions to other environmental impact categories/ life cycle stages→ Bias to look only at GHGs

  - Anaerobic co-digestion: competition with feed leading to land use changes and increased GHG emission

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End

'Don't get biased when GHG emissions are the highest'!

Look at all related impacts

Thank you!

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