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Refinement of chapter 5.B.2
Anaerobic digestion at biogas facilities

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KTBL   THÜNEN

History

- May 2016:   TFEIP meeting in Zagreb. Discussion on revised chapter 5.B.2. for EMEP 2016 guidebook:

  - Need of improvement for existing revised chapter

- August 2016: final version of improved chapter sent to chairs of Ag & N-panel

- Mai 2017: TFEIP meeting in Krakow. Discussion of improved chapter 5.B.2

  - Further improvement needed to link 5.B.2 to 3.B. and 3.D.

Major changes 2016

- Technology description shortened/restricted to described methodology

- EF were checked and decided to stick to Cuhls et al.
  (other options not possible within time frame)

  ➡ General structure not changed

- Calculations and EF were transformed to be based on N-mass in feedstock (instead fresh matter)

- Information on N-content of various feedstocks for AD is given in case only fresh matter masses are known.

- Tier 1 method introduced (was missing so far)

- For emission control, reference is given to chapter 3B (storage)

- Clear linkages to chapter 3B (slurries entering AD) and 3D (digestate spreading) introduced.

Further refinement (for this meeting)

- Improve links to 3.B. for manure and 3.D for energy crops and organic waste

- Add TAN-flow to 5.B.2 for manure

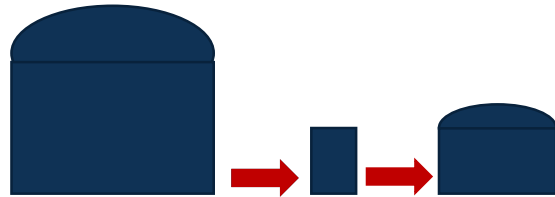- Account for mineralization of organic N to TAN for manure during digestion

Links between 5.B. and chapter 3

5.B **Energy crops / Waste material**

Activity data from national statistics transferred into Ntot flow

$N_{tot, sub}$

$N_{tot, dig}$

3.D

Calculation and reporting of emissions from application :
3Da2c Other organic fertilisers applied to soils.

Manures

Ntot and TAN flow **per animal category**

TAN_{sub}
$N_{tot, sub}$
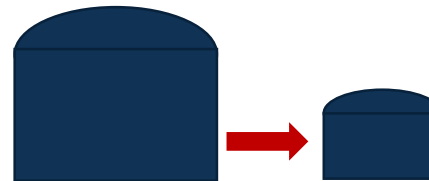
TAN_{dig}

3.B

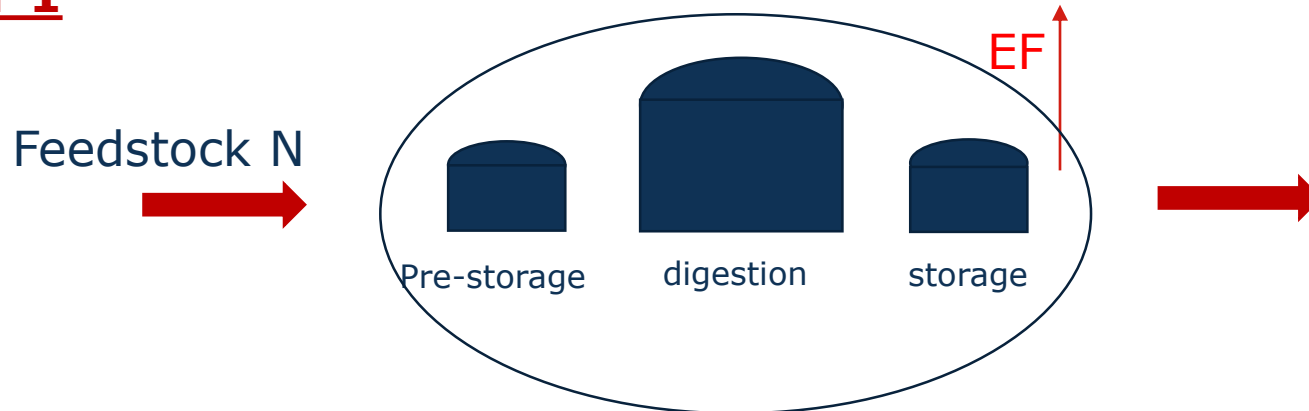Calculation of emissions from application **per animal category**

NH_3

Reporting:
3Da2a Livestock manure applied to soils

- ## Tier 1

Feedstock N →

EF

Pre-storage · digestion · storage →

All emissions calculated based on total N in feedstock

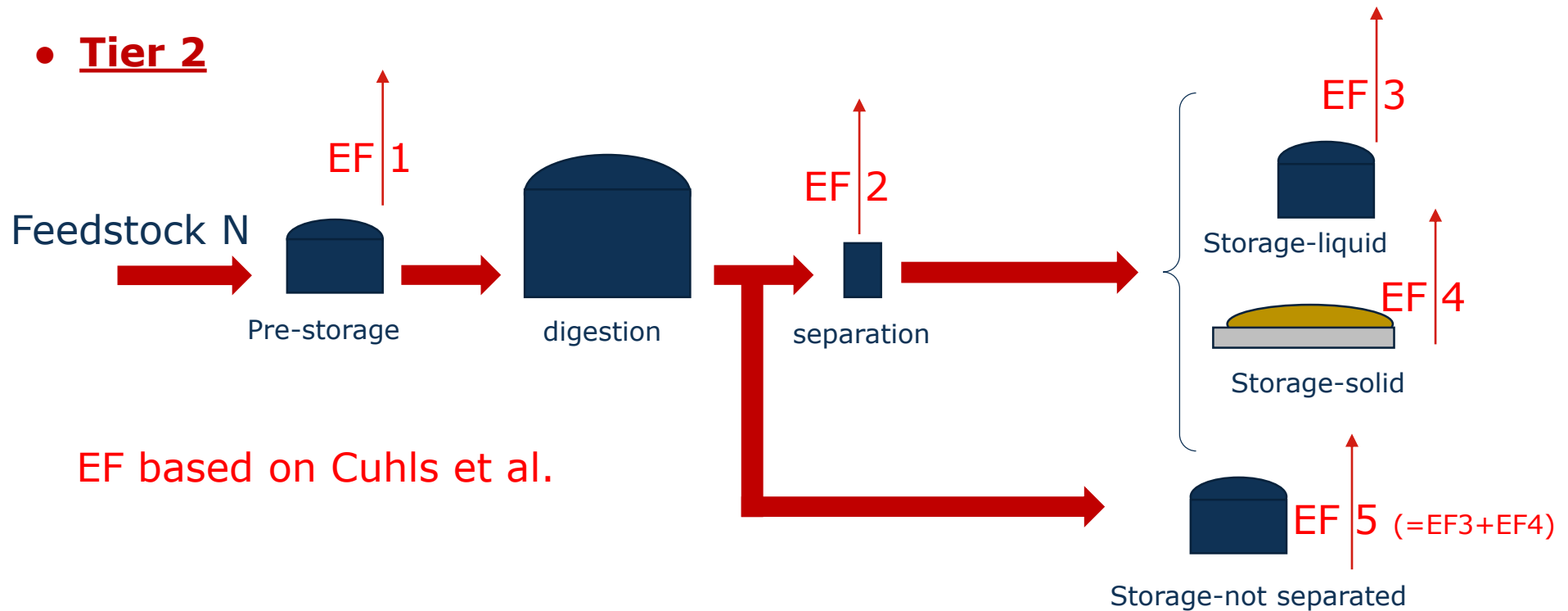$$E_{NH3} = AR_{feedstock} \times EF_{NH3\text{-}N,\,Tier\,1} \times 17/14 \tag{1}$$

If Tier 1 is used in 3.B:

- Emissions in 3.B. calculated on based on animal places
- Care needs to be taken to avoid double counting of N excreted by animals!!

➡ No consideration of digestate from manures in 3.B

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Calculation of emissions in chapter 5.B

- **Tier 2**

Feedstock N

EF 1 — Pre-storage

digestion

EF 2 — separation

Storage-liquid — EF 3

Storage-solid — EF 4

Storage-not separated — EF 5 (=EF3+EF4)

EF based on Cuhls et al.

All emissions calculated based on total N **in feedstock**

$$E_{NH3} = AR_{feedstock} \times \sum_{stages} EF_{NH3\text{-}N,\ stage\ i} \times 17/14 \qquad (2)$$

Calculation of N in digestate after storage

For energy crops and waste

$$N_{tot,dig} = N_{tot,sub} - (E_{NH3} \times 14/17) \qquad (3)$$

with:

$N_{tot,dig}$: N_{tot} in digestate after storage in kg a^{-1}

$N_{tot,sub}$: N_{tot} of the feedstock entering 5.B.2 in kg a^{-1}

E_{NH3}: NH_3 emitted in kg a^{-1}, calculated in equation (1) or (2)

⟶ **3Da2c**

For manures

$$TAN_{dig} = TAN_{sub} + f_{min} \times (N_{tot} - TAN_{sub}) - (E_{NH3} \times 14/17) \qquad (4)$$

with

TAN_{dig} : TAN in digestate after storage in kg a^{-1}

TAN_{sub} : TAN in manure entering 5.B.2 in kg a^{-1}

f_{min}: relative share of organic N entering the digester that is mineralized to TAN in kg kg^{-1}

E_{NH3}: NH_3 emitted in kg a^{-1}, calculated from total N in equation (2)

⟶ **3B**

➢ Germany: Survey showed, that mean TAN in digestion of manure rises from 45% to 62% ⟶ $f_{min} = 0.32$

Further steps

- Thorough review on emission factors (now: only based on one study)
  - If possible: TAN for every step based rather than based on Ntot in feedstock

- Discussion needed on:
  - Consideration of separation
  - Use of digestates for other purposes than agriculture (fertilization)

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Revision should be aligned with IPCC revision process