



Counting the chickens before they are hatched: Assessing GHG mitigation potentials and associated costs in agriculture

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15. Ökobilanz-Plattform Land- und Ernährungswirtschaft:

Klimaschutz in der Landwirtschaft: Methoden und Tools für
eine umfassende Bewertung



Assessing GHG reduction potentials

[L'industrie c'est fou] Un masque anti-rot pour vachement réduire les émissions de méthane

HC SIMON CHODORGE | TECHNO ET INNOVATIONS , INTERNATIONAL , ROYAUME-UNI , L'USINE AGRO , ENVIRONNEMENT

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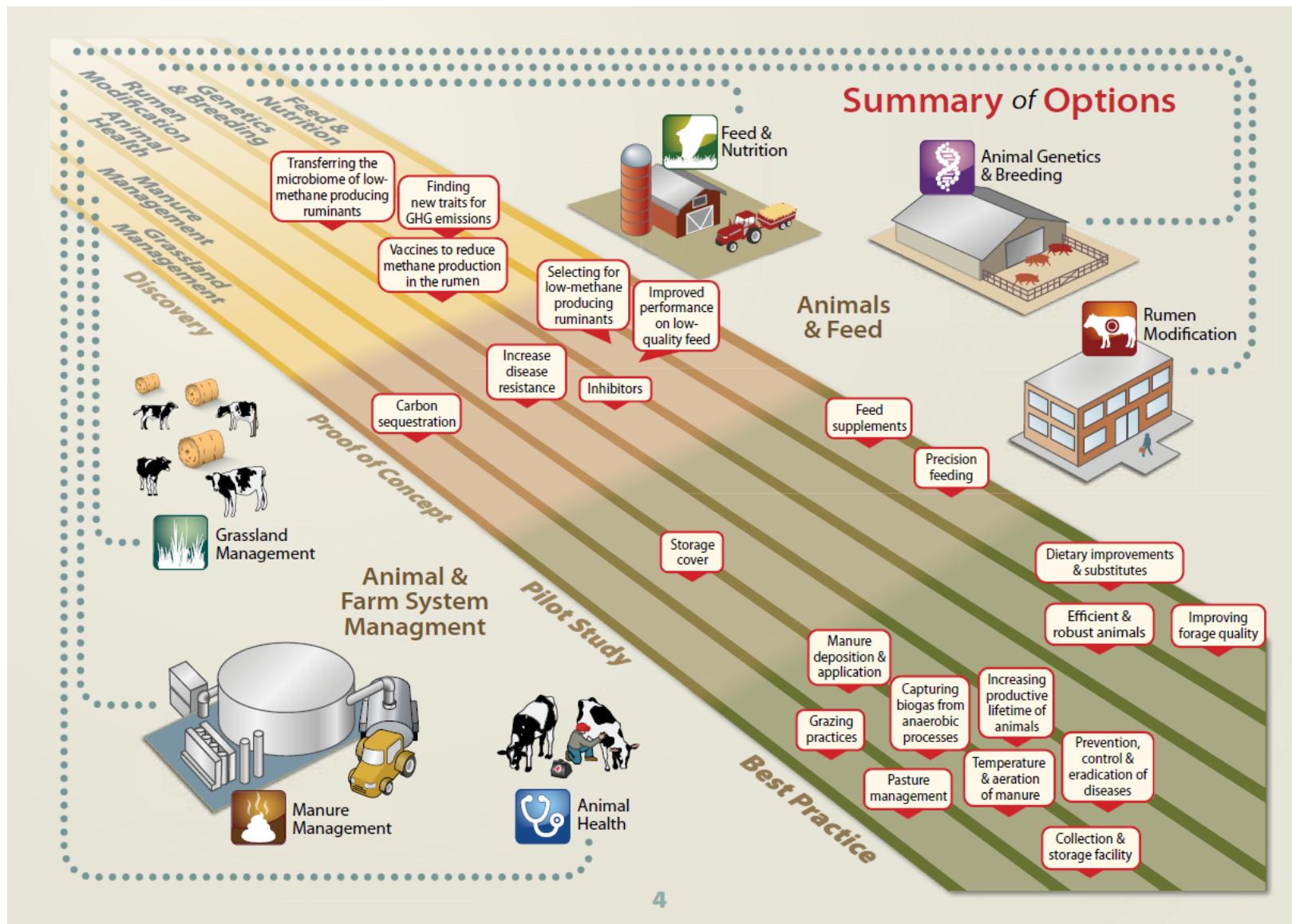
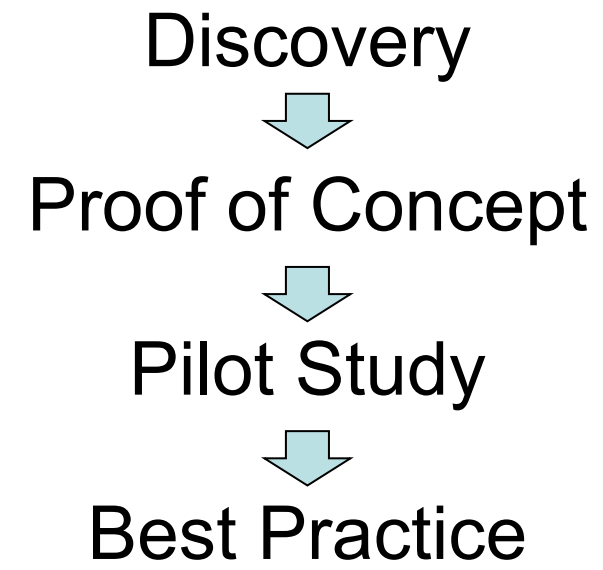
Le secteur des "wearables" continue de s'intéresser aux animaux. Avec un masque anti-rot destiné aux vaches, la start-up britannique souhaite réduire l'empreinte climatique des élevages.



Encore en phase de prototypage, la technologie de Zelp (pour Zero Emissions Livestock Project) souhaite réduire l'empreinte environnementale des vaches.

© Zelp

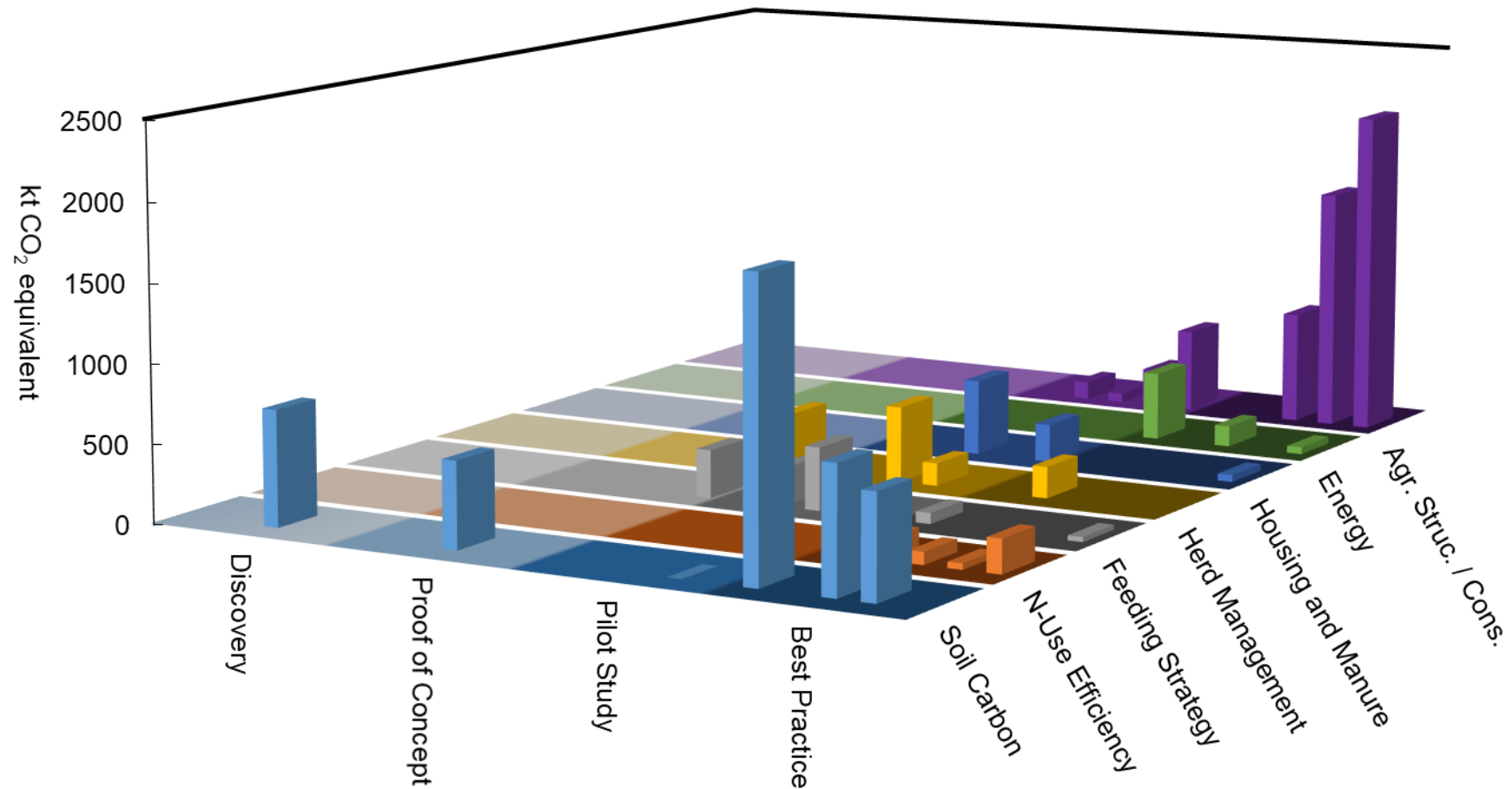




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Source: GRA & SAI 2014

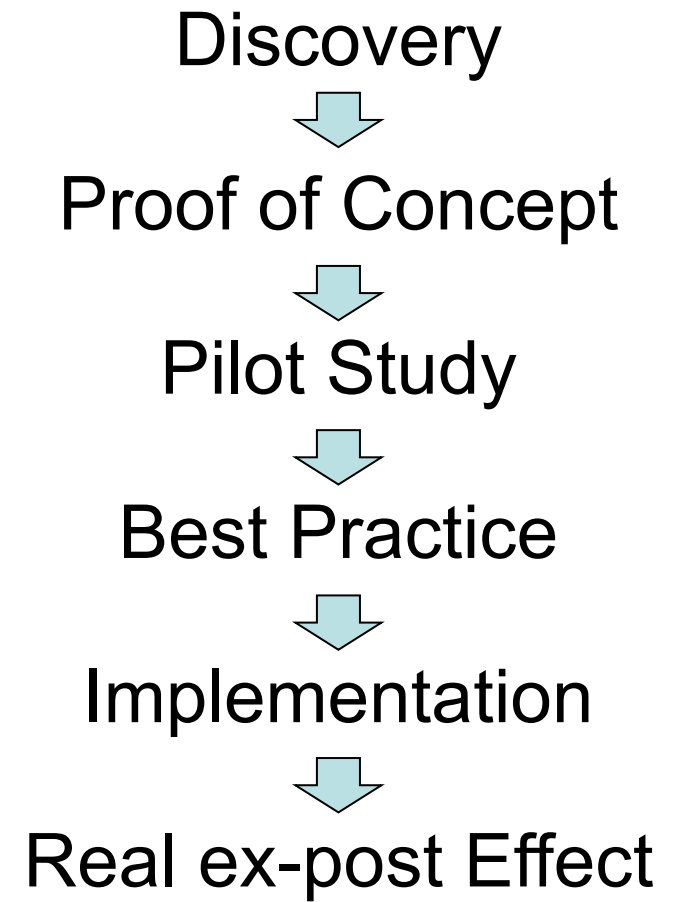
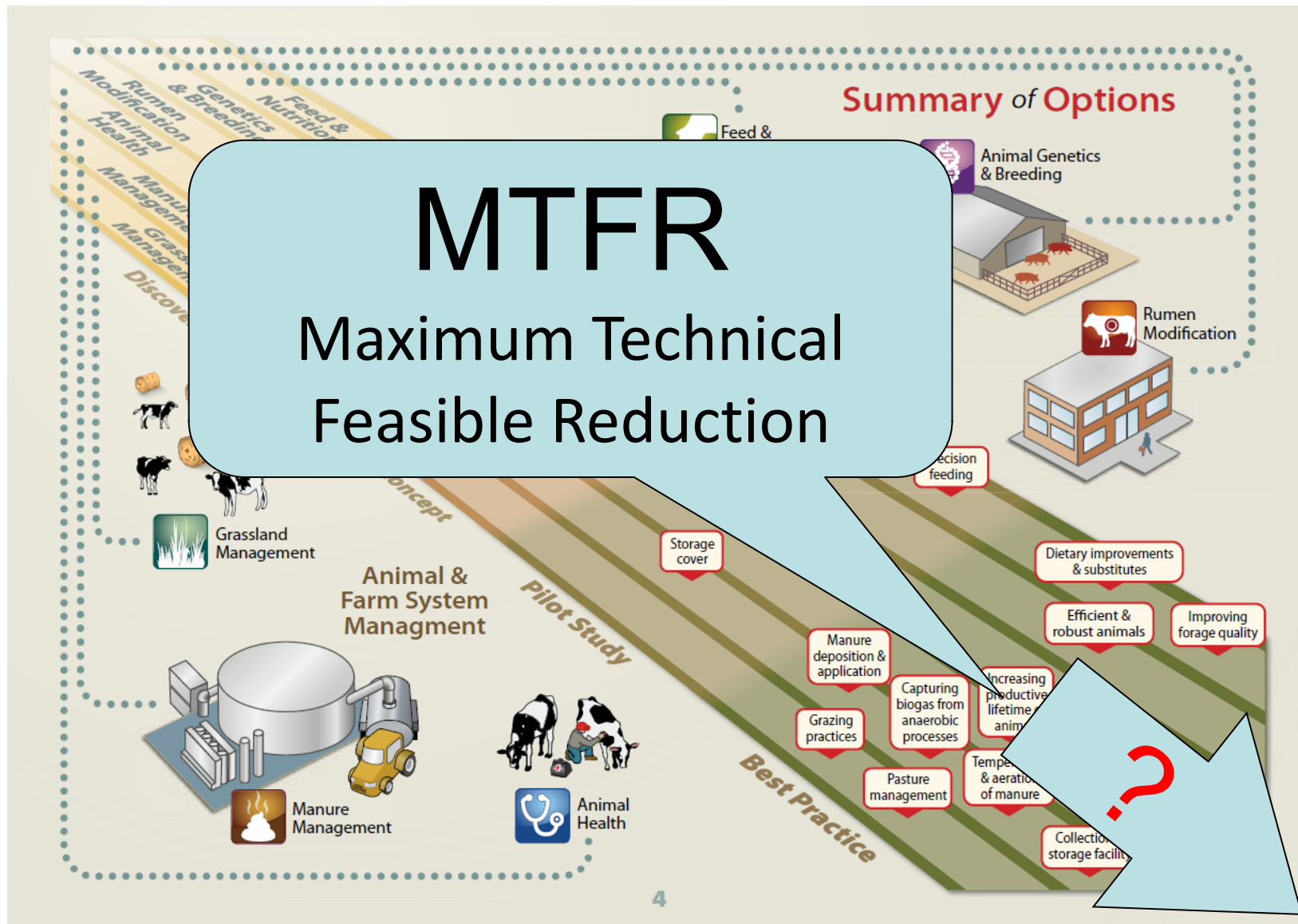
Reduction potentials for agricultural GHG-Emissions in Switzerland



Interaction of measures

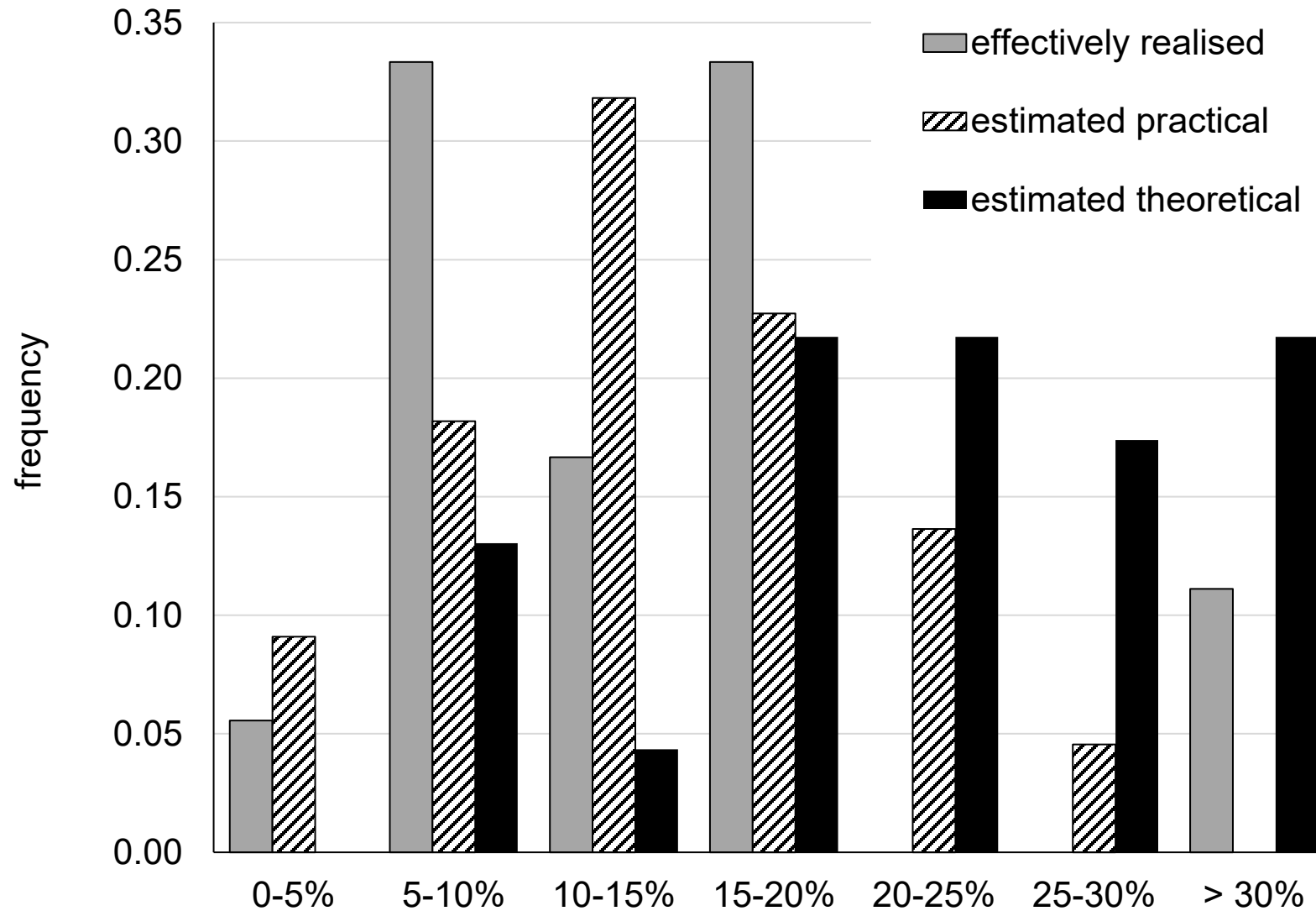
Mainly three possible mechanisms:

- **Changing livestock populations**
e.g. agroforestry, cattle longevity
- **Nitrogen cascade**
e.g. N-optimised pig-feeding, coverage of slurry tanks, biogas plants
- **Availability of biomass**
e.g. manure, biomass for C-sequestration, biomass for energy production



Source: GRA & SAI 2014

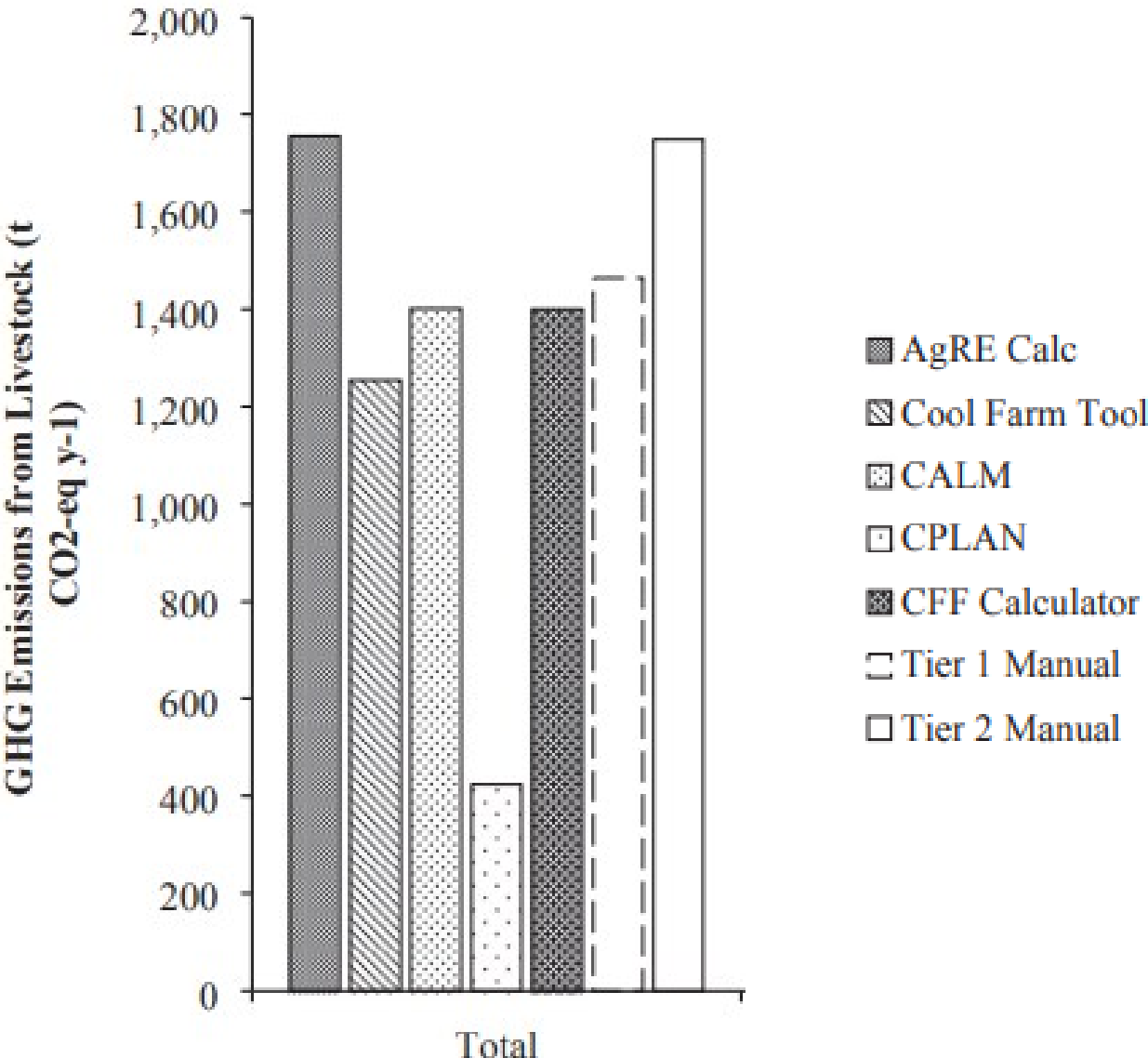
Estimated and achieved emission reductions



Source: Bretscher et al. 2025

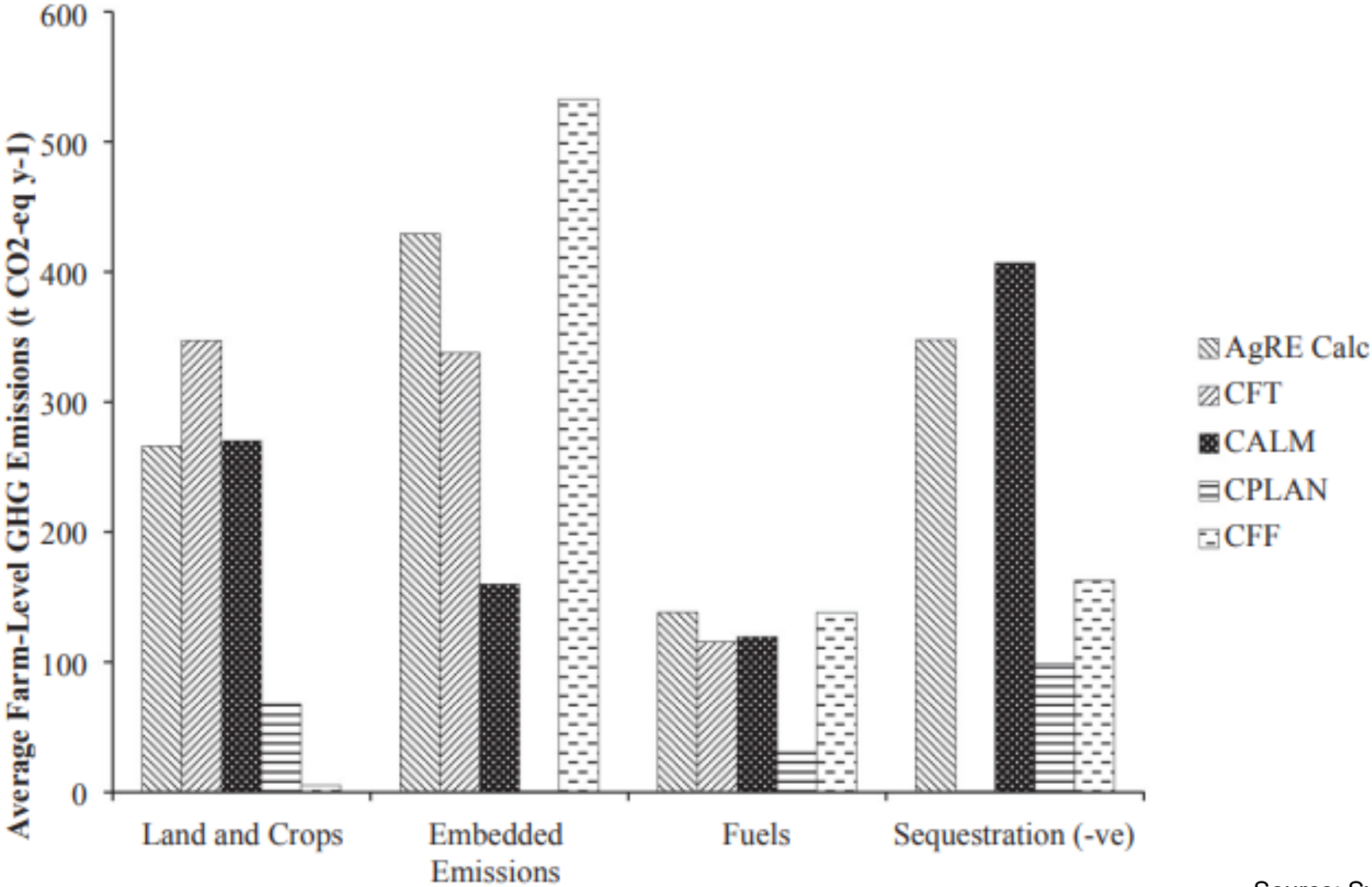
Representing measures in accounting tools / models

Scope and system boundaries



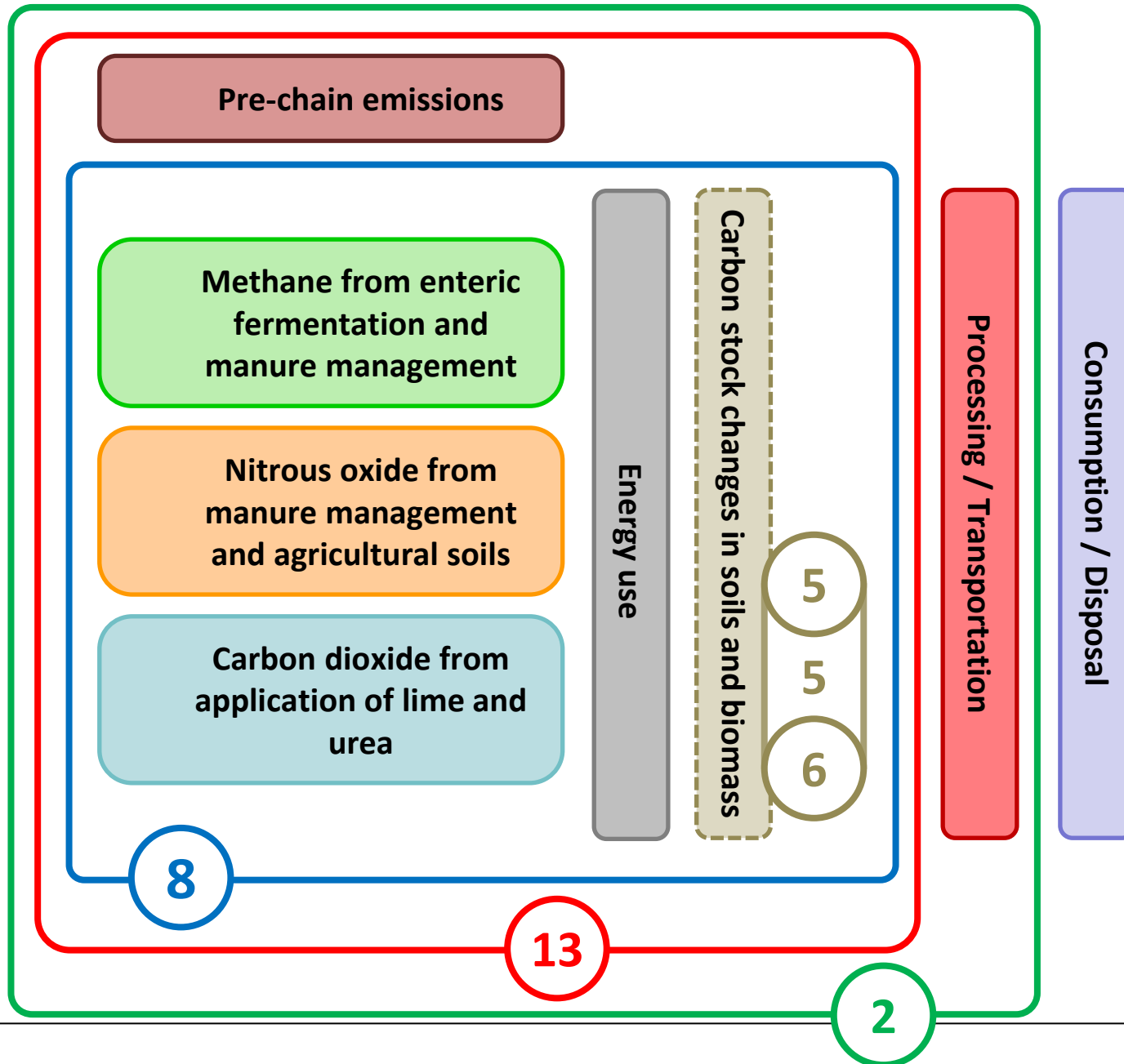
Source: Sykes et al. 2017

Scope and system boundaries



Source: Sykes et al. 2017

Scope and system boundaries



In various cases the users of the tools **do not even know** if and if yes, how certain mechanisms are implemented.

Source: Bretscher et al. 2025

Scope: Consequential system interactions

Tabelle 2: Kenngrößen von zwei Milchproduktionsbetrieben des AgroCO2ncept Projektes (basierend auf Zosso et al.)

	Emissionen (t CO ₂ -Äq./Jahr)	Effizienz (kg CO ₂ -Äq./kg Milch)	zugekauftes Kraftfutter (GJ/GVE)	durch Futterbau belegte Ackerfläche (ha/GVE)
Betrieb 1	526	0,79	5,5	0,49
Betrieb 2	298	1,00	0,0	0,10

Source: Bretscher und Felder, Agrarbericht 2023

Single-farm perspective is limited:

→ System interactions

→ Feed-food competition; area competition;
competition for biomass



Source: Zumwald et al. 2019

Scope: Consequential system interactions

Consequential system interactions:

Feed-Food Competition: **8**

Land-Use Competition: **1**

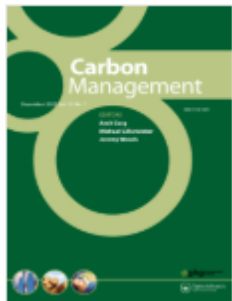
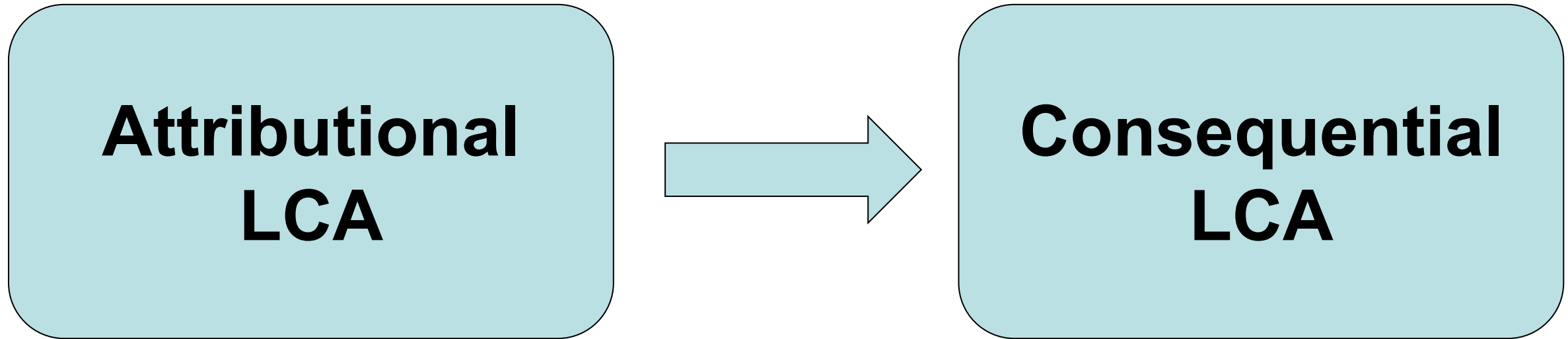
Both: **6**

The farm-level GHG-accounting is embedded/accompanied in/by a national/regional land-use strategy: **13**

The farm-level GHG-accounting is embedded/accompanied in/by a national/regional biomass strategy: **4**

Source: Bretscher et al. 2025

Scope: Consequential system interactions



Editorial

The most important GHG accounting concept you may not have heard of: the attributional-consequential distinction

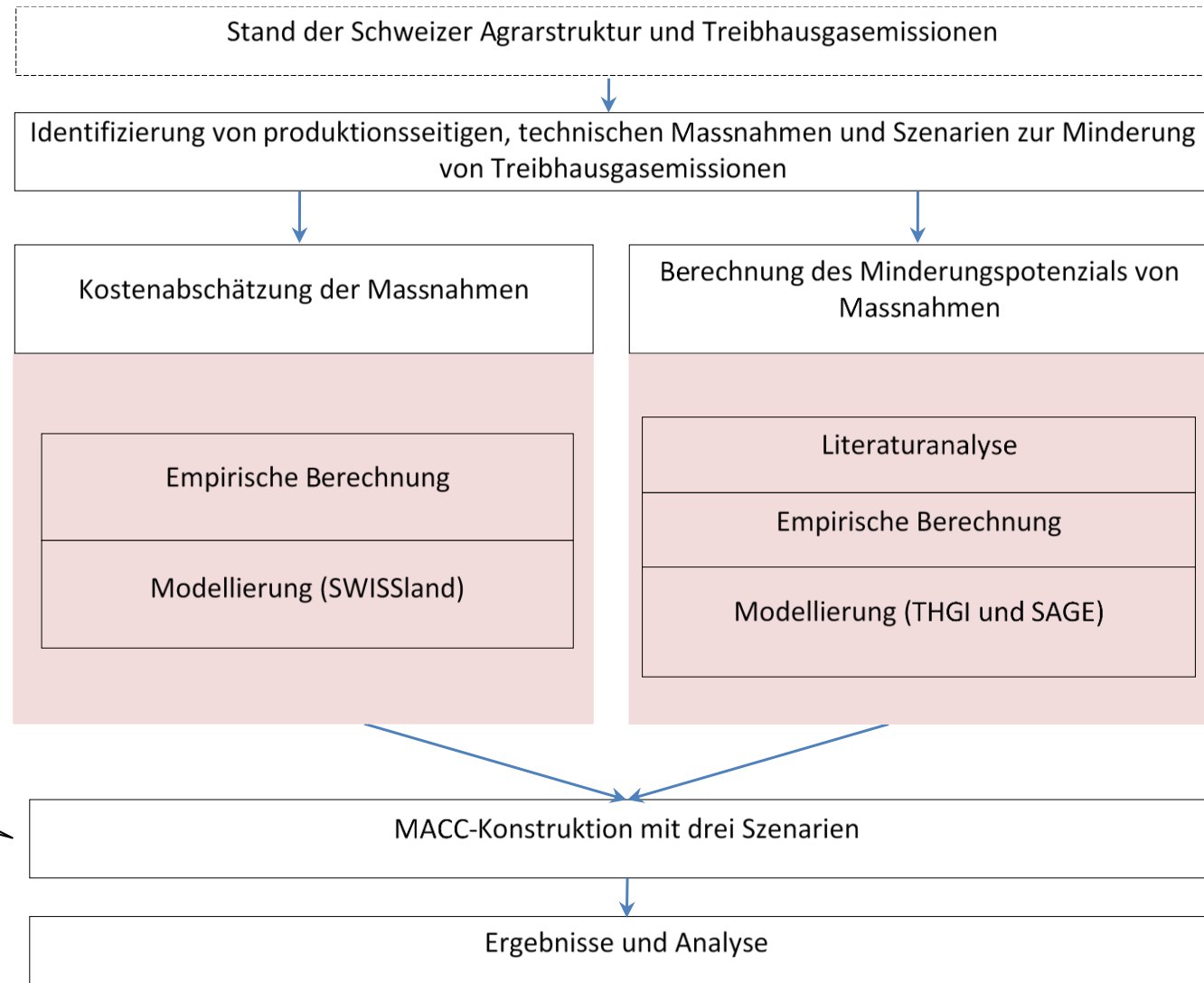
Matthew Brander  

Pages 337-339 | Published online: 19 Jun 2022

Source: Brander et al. 2022

Assessing mitigation costs

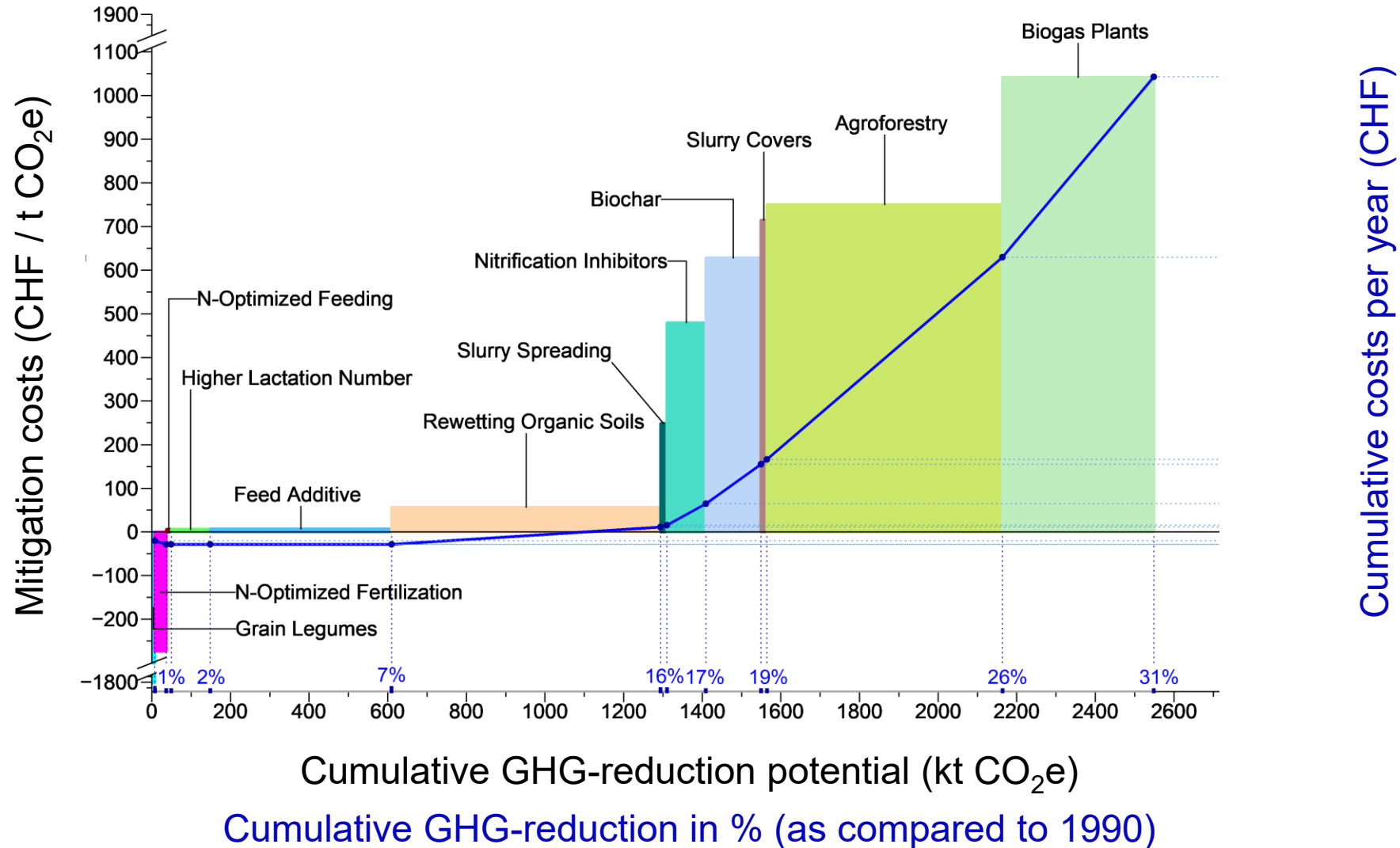
Developing a marginal abatement cost curve



- Reference
- Low-cost
- High-cost

MTFR

Marginal abatement cost curve for the reference scenario

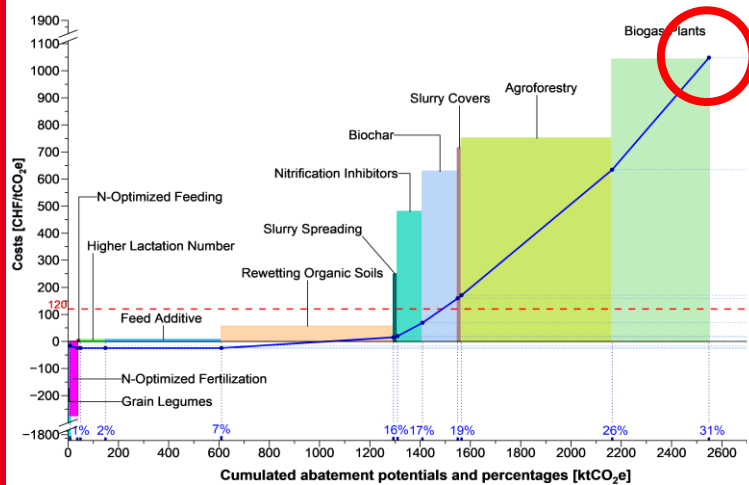


Source: Based on Hao et al. 2026

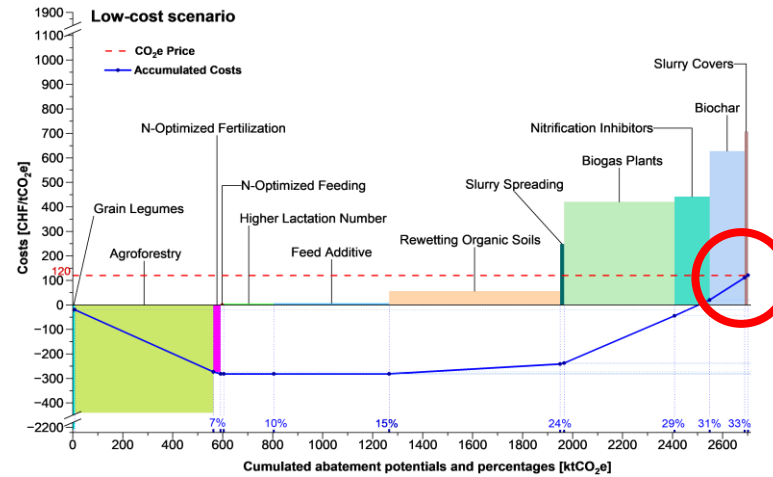
MACC: Comparison of scenarios

High variability of costs due to different implementation assumptions

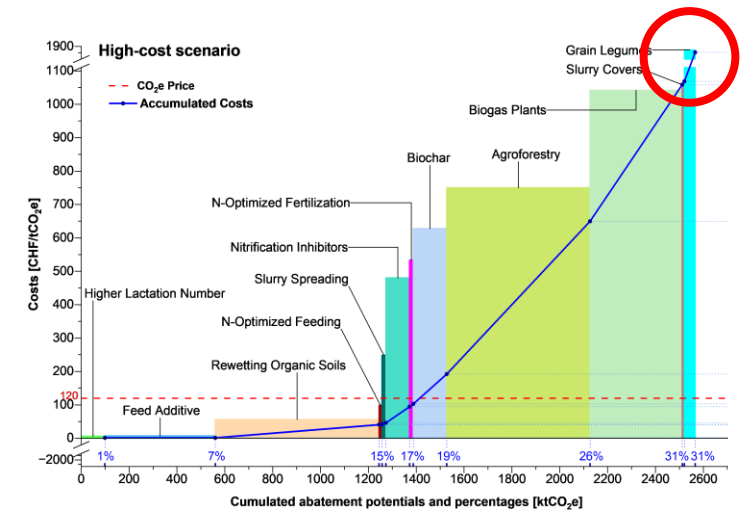
Reference



Low-cost



High-cost



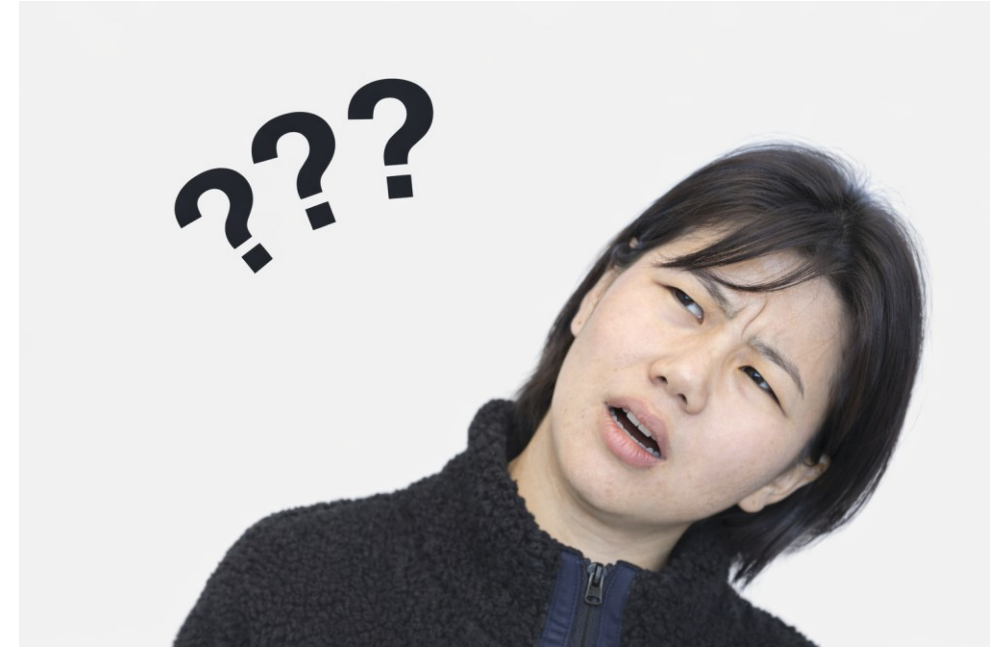
Costs: 87 - 1'124 Mio. CHF

Source: Based on Hao et al. 2026

Various cost terms

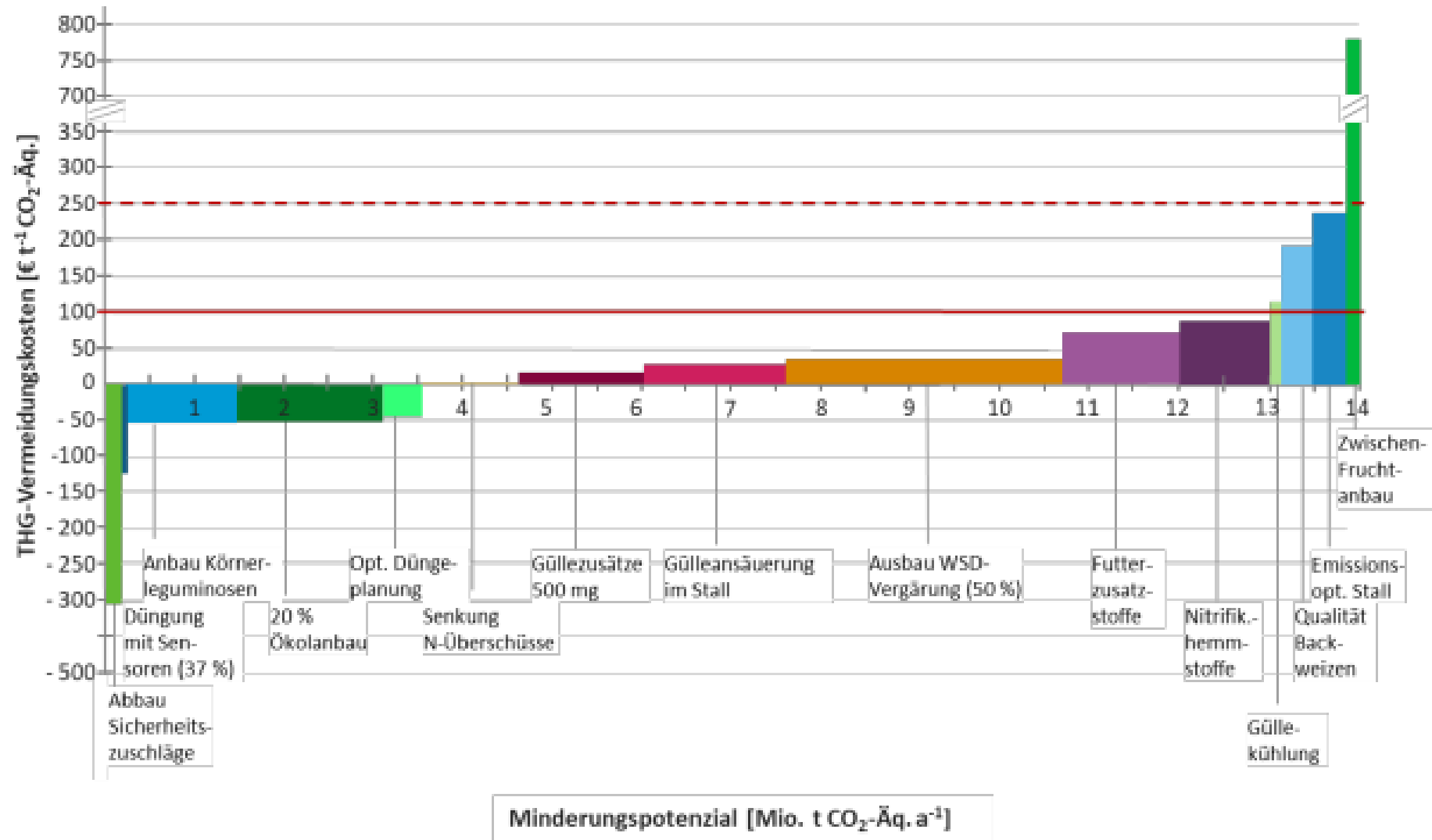
Direct costs
Input costs
Labor costs
Operational costs
Production costs
Shadow costs
Opportunity costs
Transaction costs
Application costs
Monitoring costs
Administrative costs
Learning costs
Investment costs
Capital costs
Risk-related costs
Uncertainty costs

...



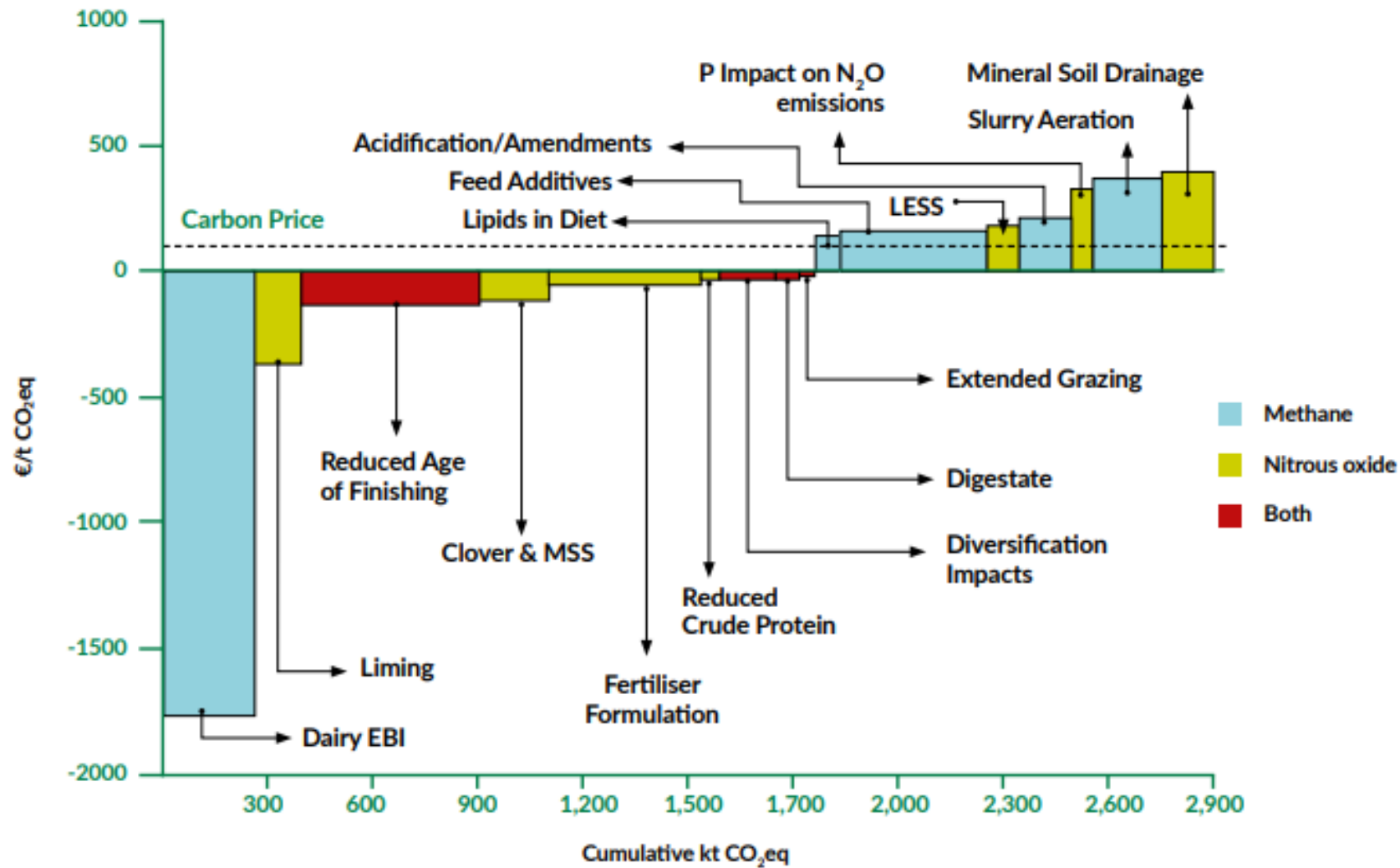
Who pays the bill?
→ Cost perspectives

Negative Costs in MACCs?



Source: Dreisbach et al. 2025

Negative Costs in MACCs?



Source: Lanigan et al. 2023

Negative Costs in MACCs?

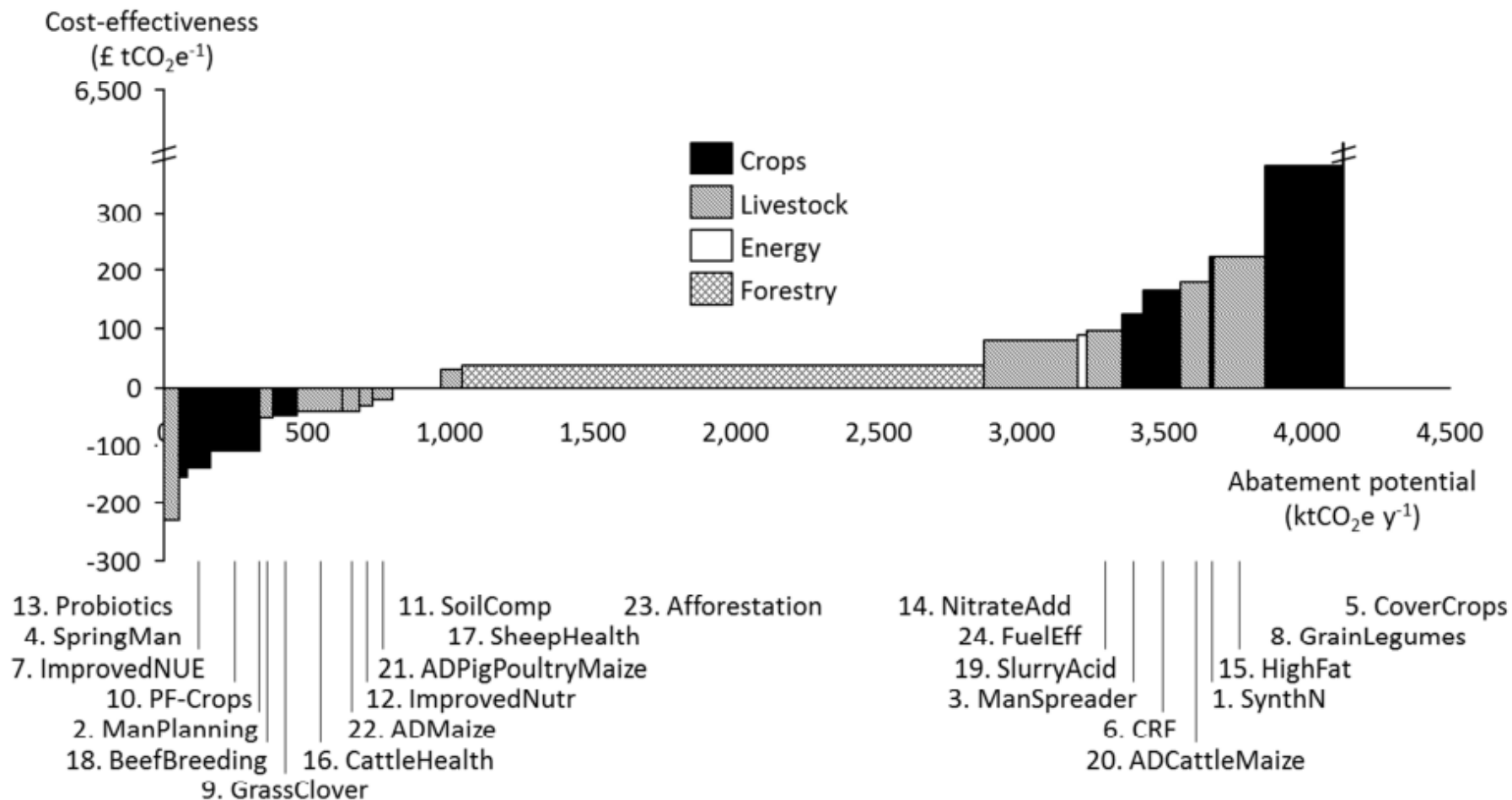
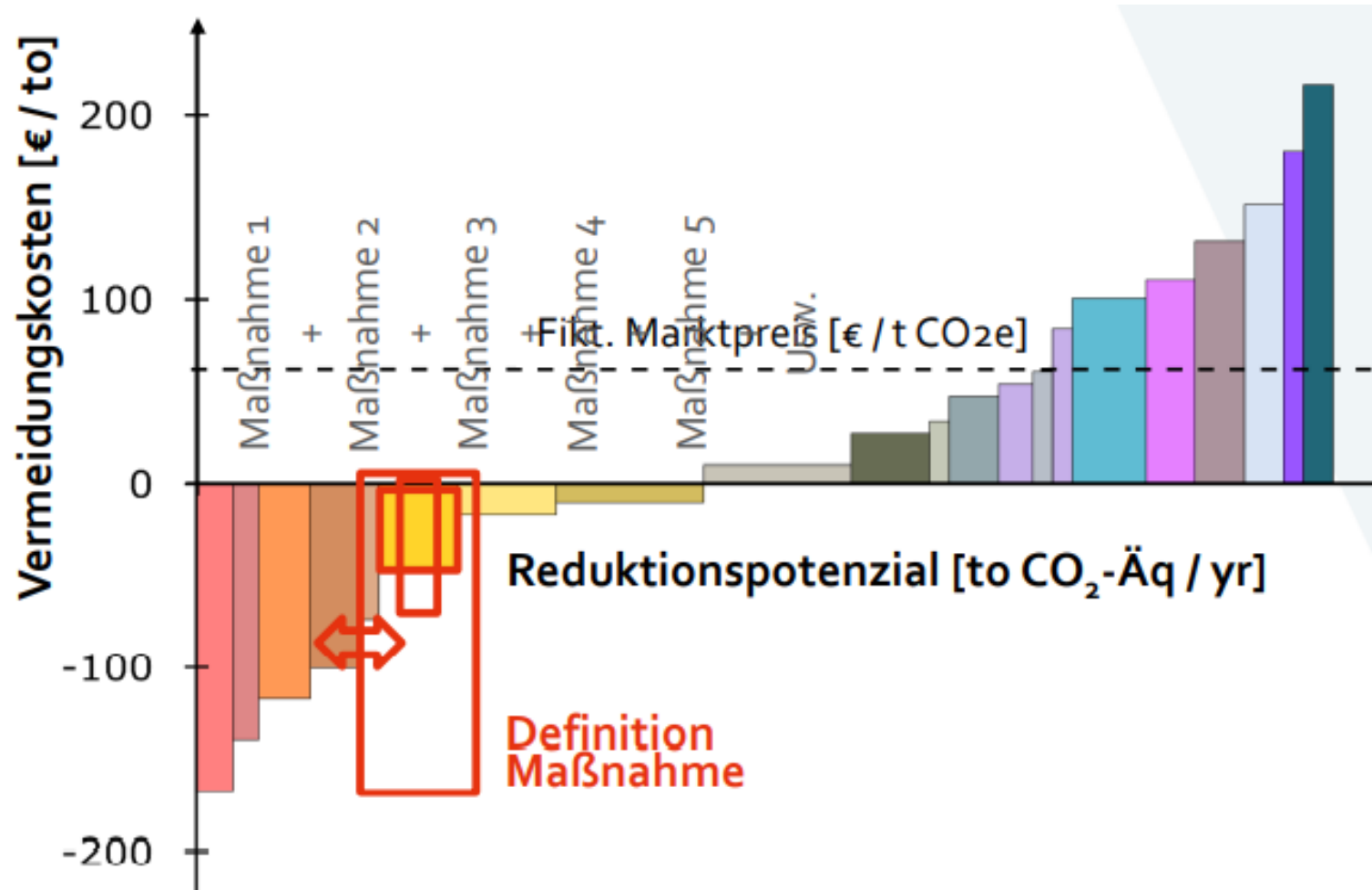


Figure ES 2 Marginal abatement cost curve (with interactions, 2030, UK, CFP, d.r. 3.5%), note that the C price in 2030 is £78 t CO₂e⁻¹

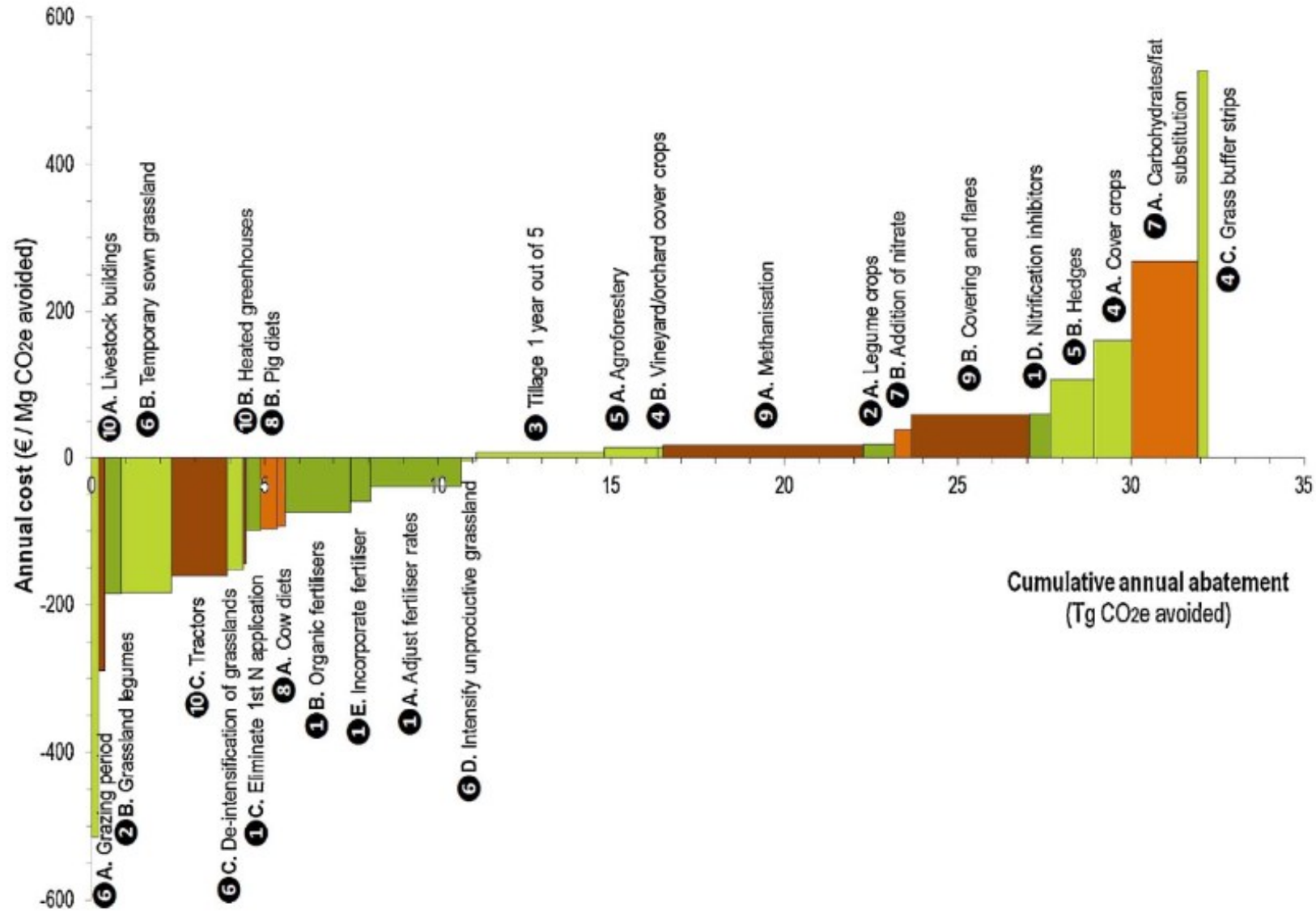
Source: Eory et al. 2015

Negative Costs in MACCs?



Source: Fritz 2021

Negative Costs in MACCs?



Source: Pellerin et al. 2013

Various cost terms

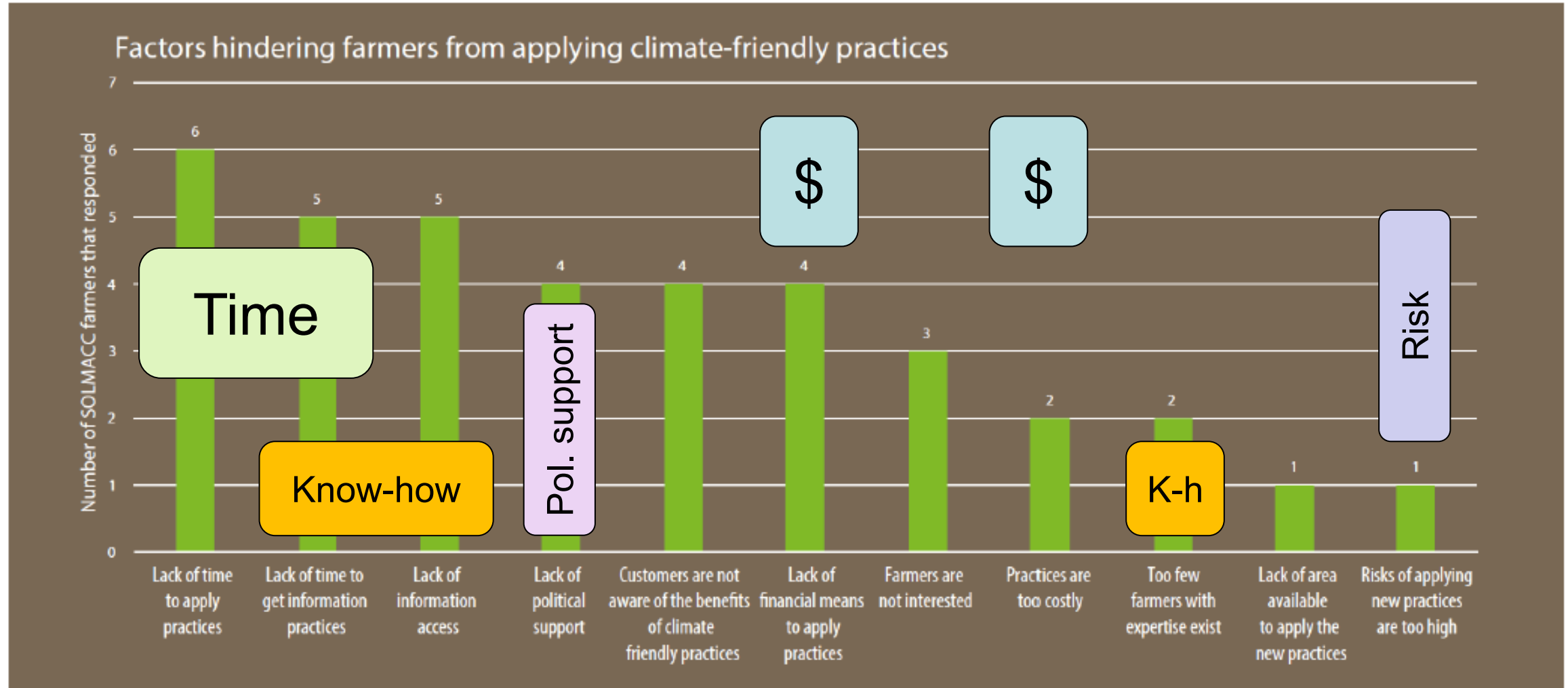
Direct costs
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...



Non-monetary barriers?

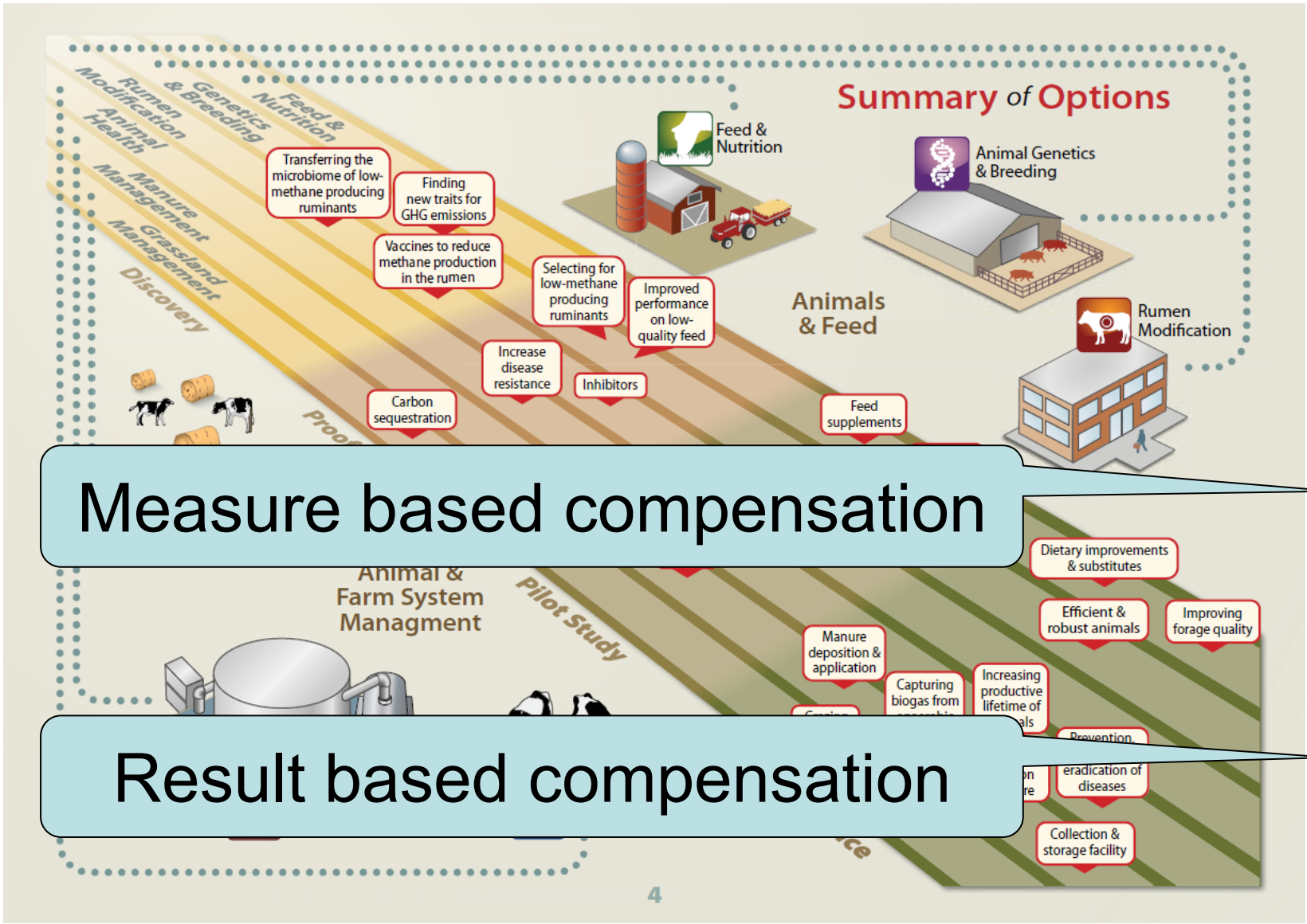
Non-monetary barriers?



Quelle: SOLMACC (2017); Viable climate-friendly farming

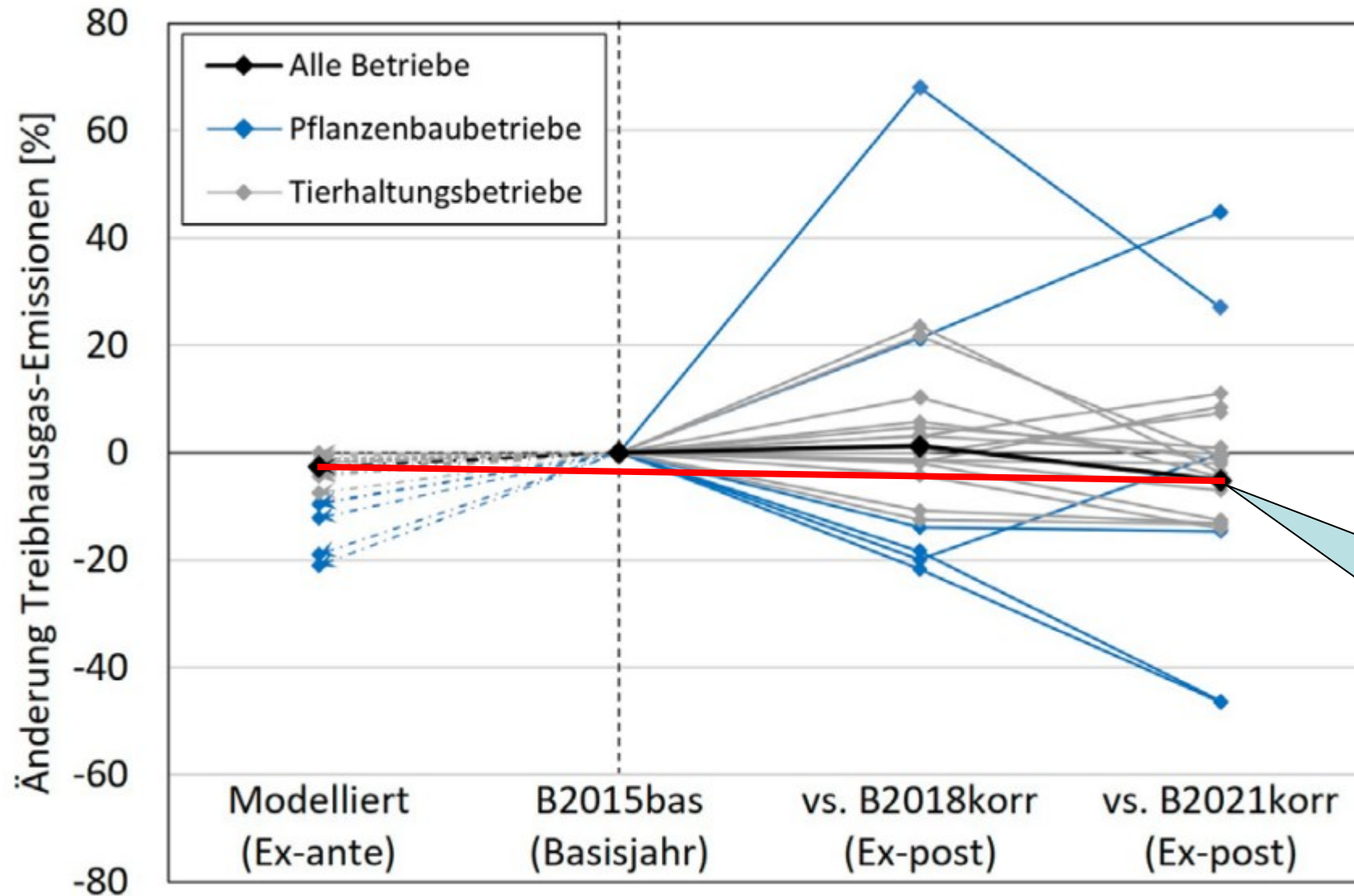
Source: Grieses et al. 2017

Compensation for mitigation costs



Source: GRA & SAI 2014

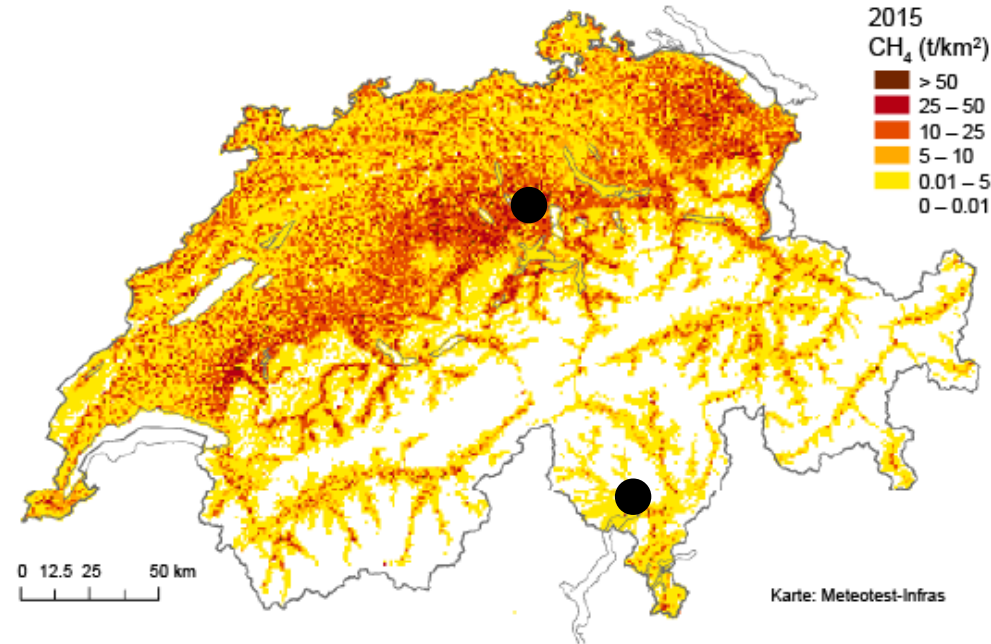
Compensation, benchmarking and reward mechanisms



Average over many farms

Source: Zosso et al. 2024

Compensation, benchmarking and reward mechanisms



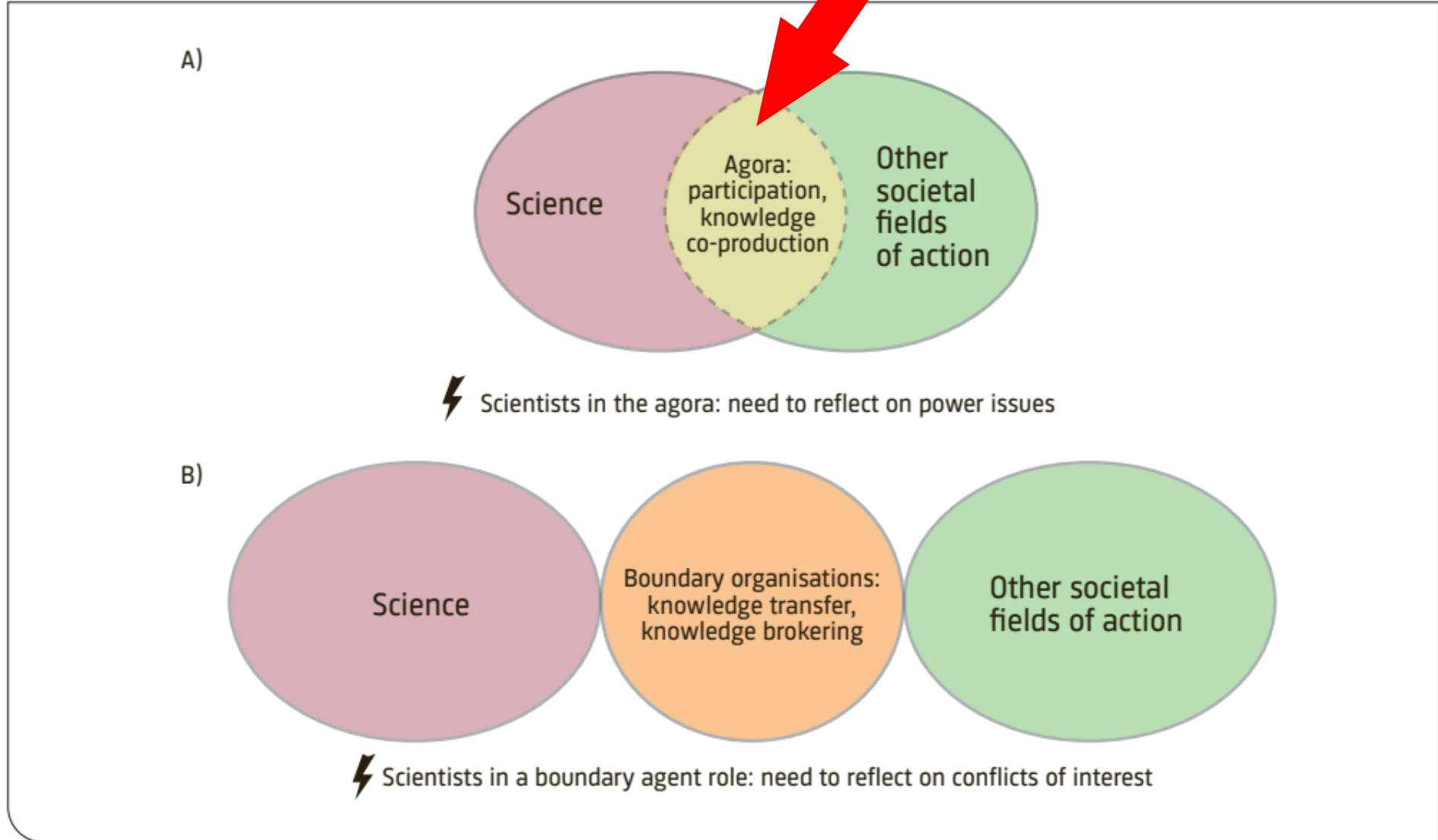
What is under the control of the farmer?

More than half of the tools (12 of 22) could not distinguish between the **influence of local site conditions** (climate, soil, topography) and the **influence of farm management**.

Source: Bretscher et al. 2025

Conclusions / Outlook

Conclusions

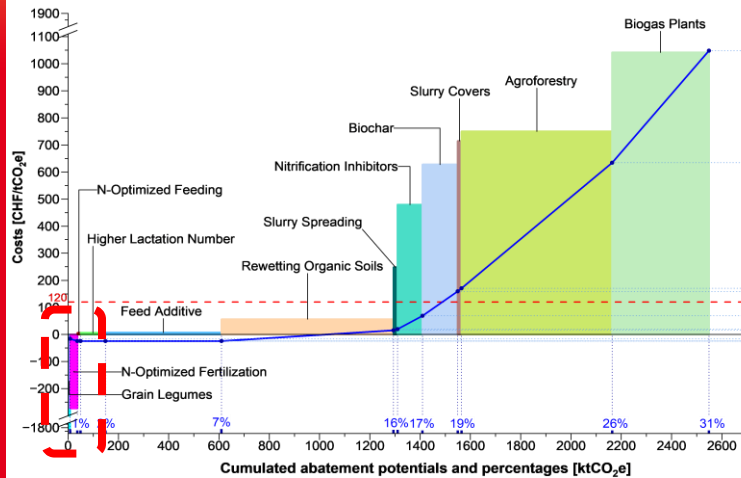


Quelle: Pohl et al. 2010

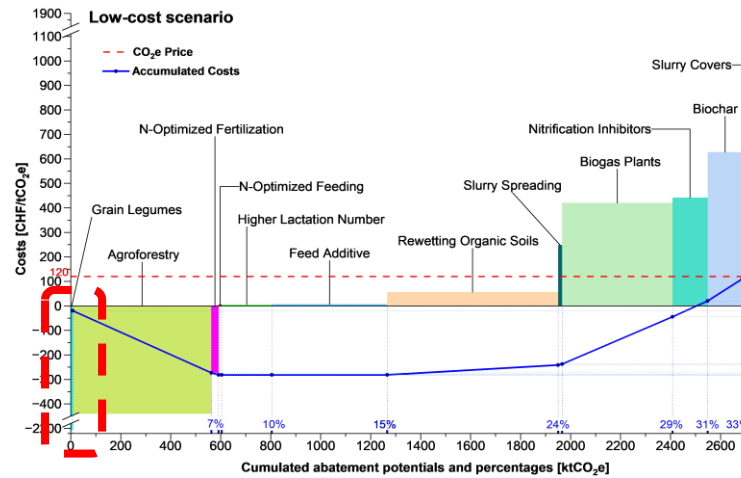
MACC: Comparison of scenarios

Example 1: Leguminous crops

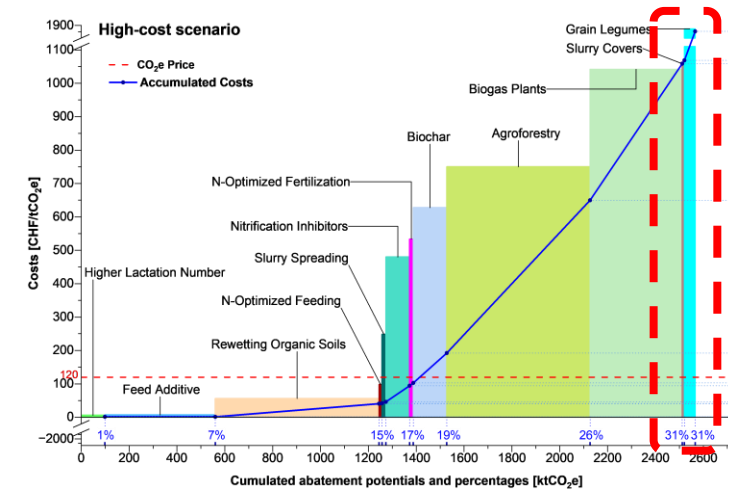
Referenzszenario



Kostengünstiges Szenario



Kostenintensives Szenario



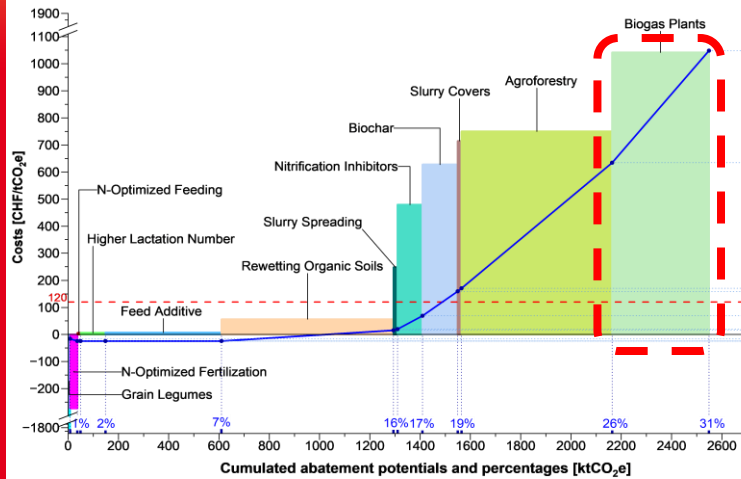
Recommendation:

- Promote of local processing and marketing of Swiss organic pulses.

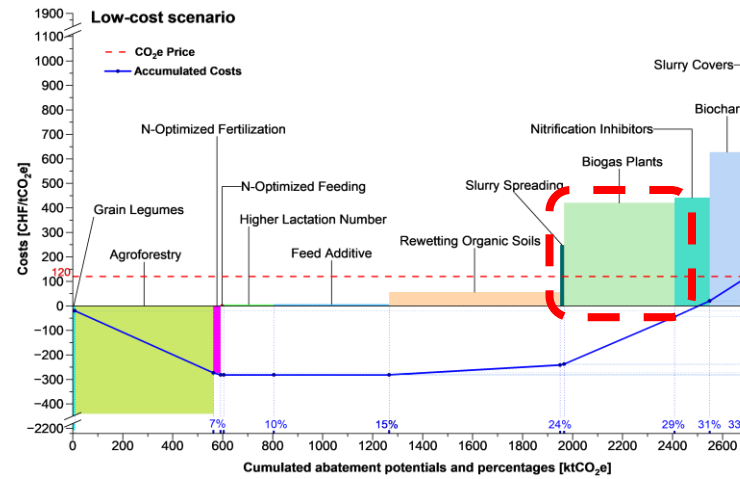
MACC: Comparison of scenarios

Example 2: Biogas plants

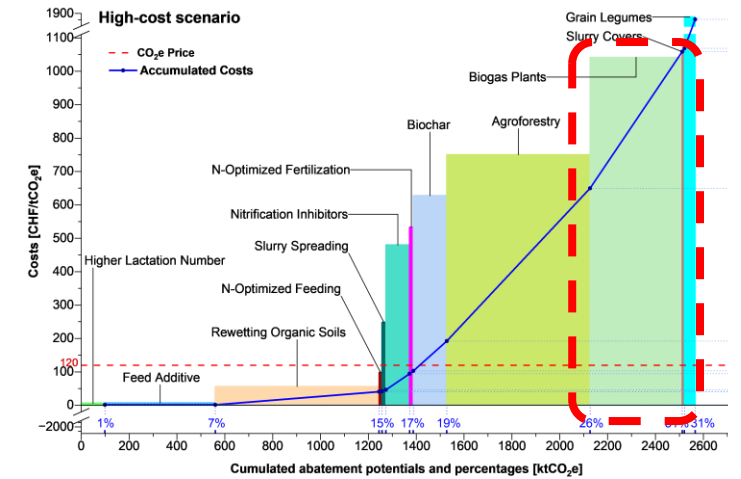
Referenzszenario



Kostengünstiges Szenario



Kostenintensives Szenario

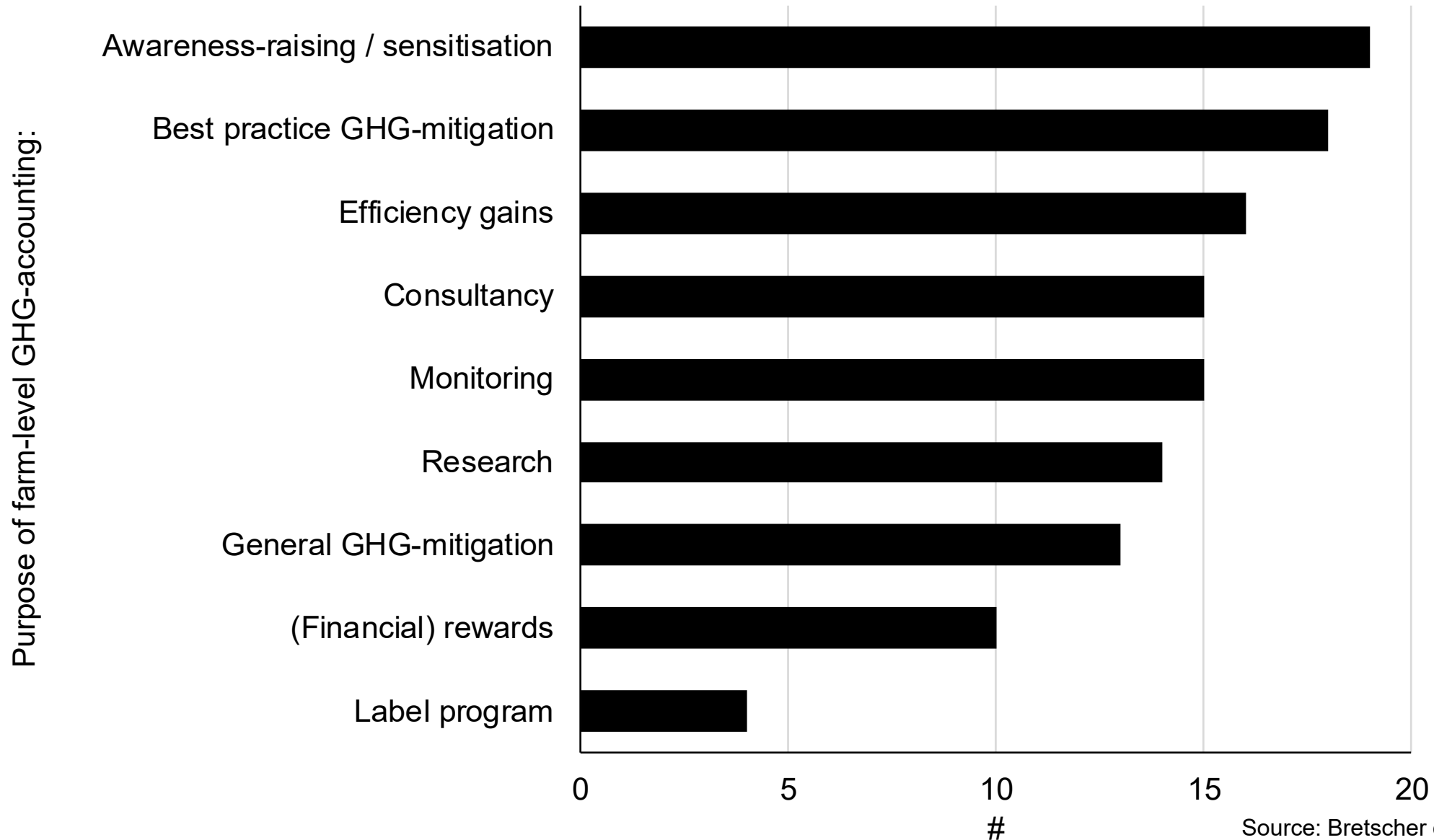


Recommendations:

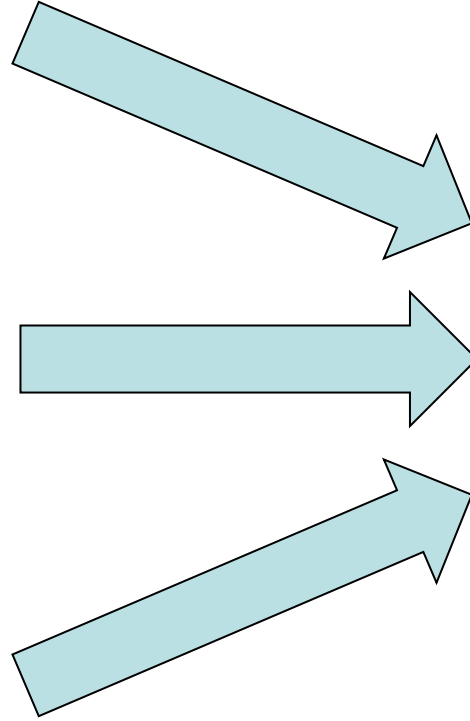
- Minimise leakage.
- Promote farmers cooperation in order to build larger plants and take advantage of effects of scale.

Source: Based on Hao et al. 2026

Purpose and background of farm-level GHG accounting



Source: Bretscher et al. 2025

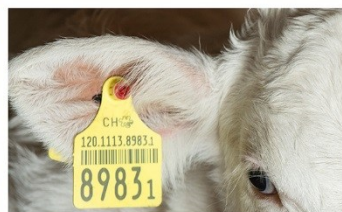




Thank you for your attention

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Literature 1

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