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Sustainability Assessment of P-fertilizers from secondary raw materials

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Hennig Brand
phosphorous=light bearer

Phosphorus: 350 years after its discovery, this vital element is running out

9 janvier 2019, 17:07 CET

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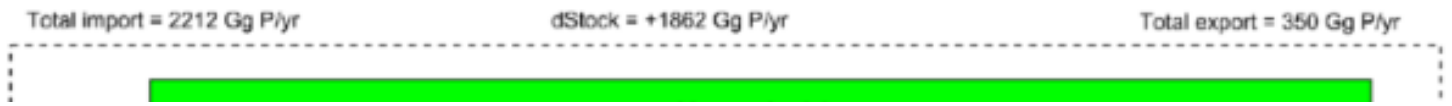

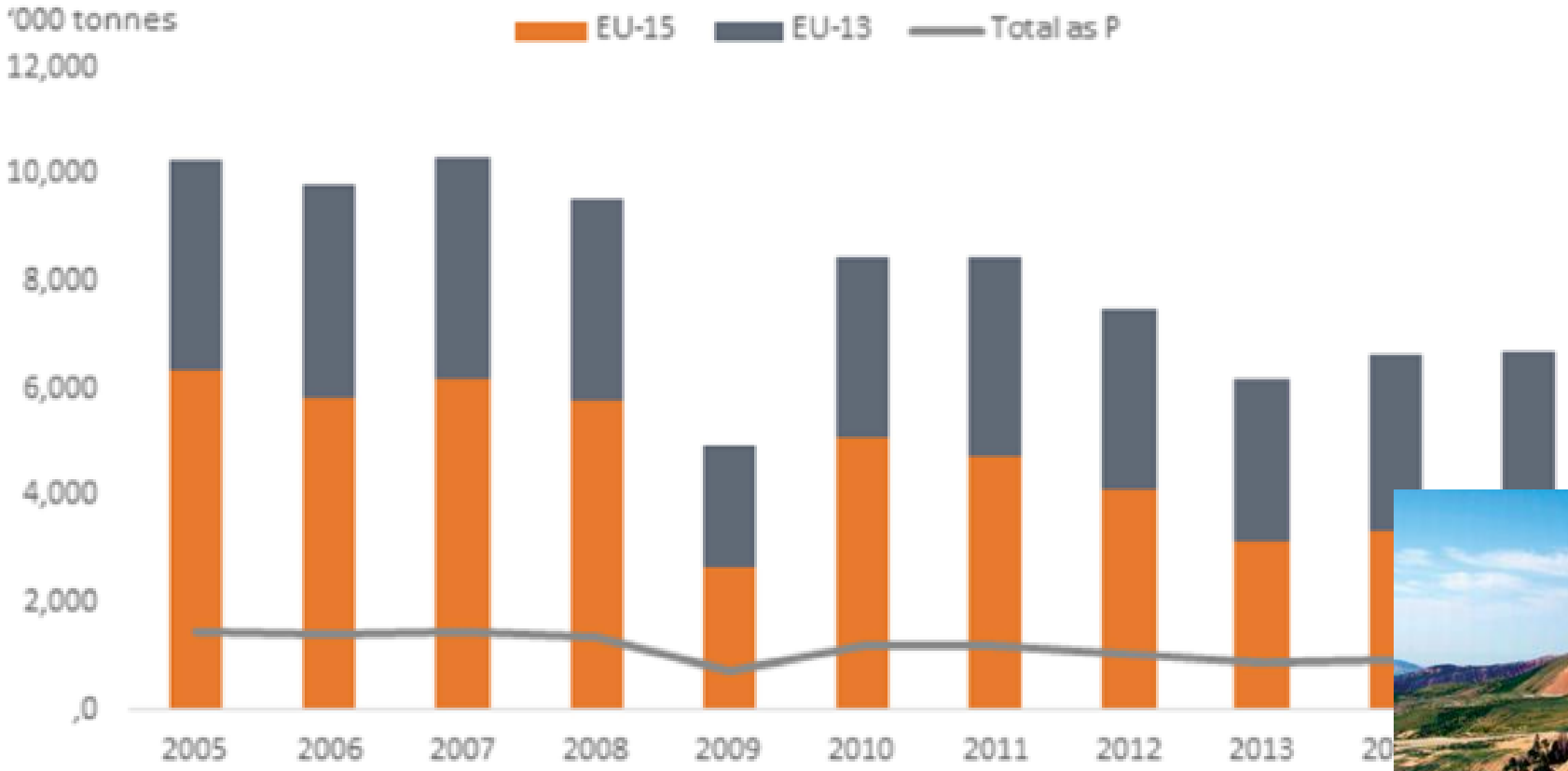

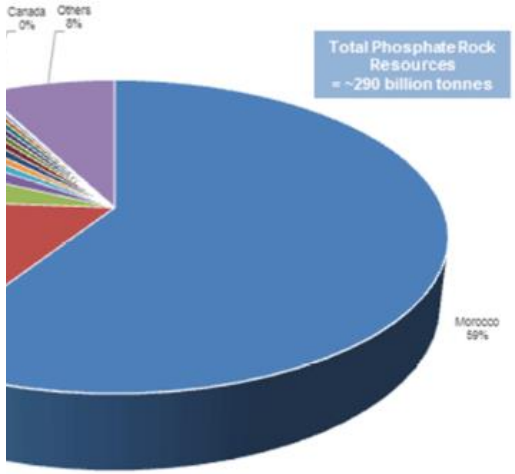

urces (Source: IFDC, 2010)

Figure 12: Phosphate rock apparent consumption for all applications in Euro (Sources: IFA, GTIS, Fertecon)

Ott and Rechberger 2012)

Source: Schoumans

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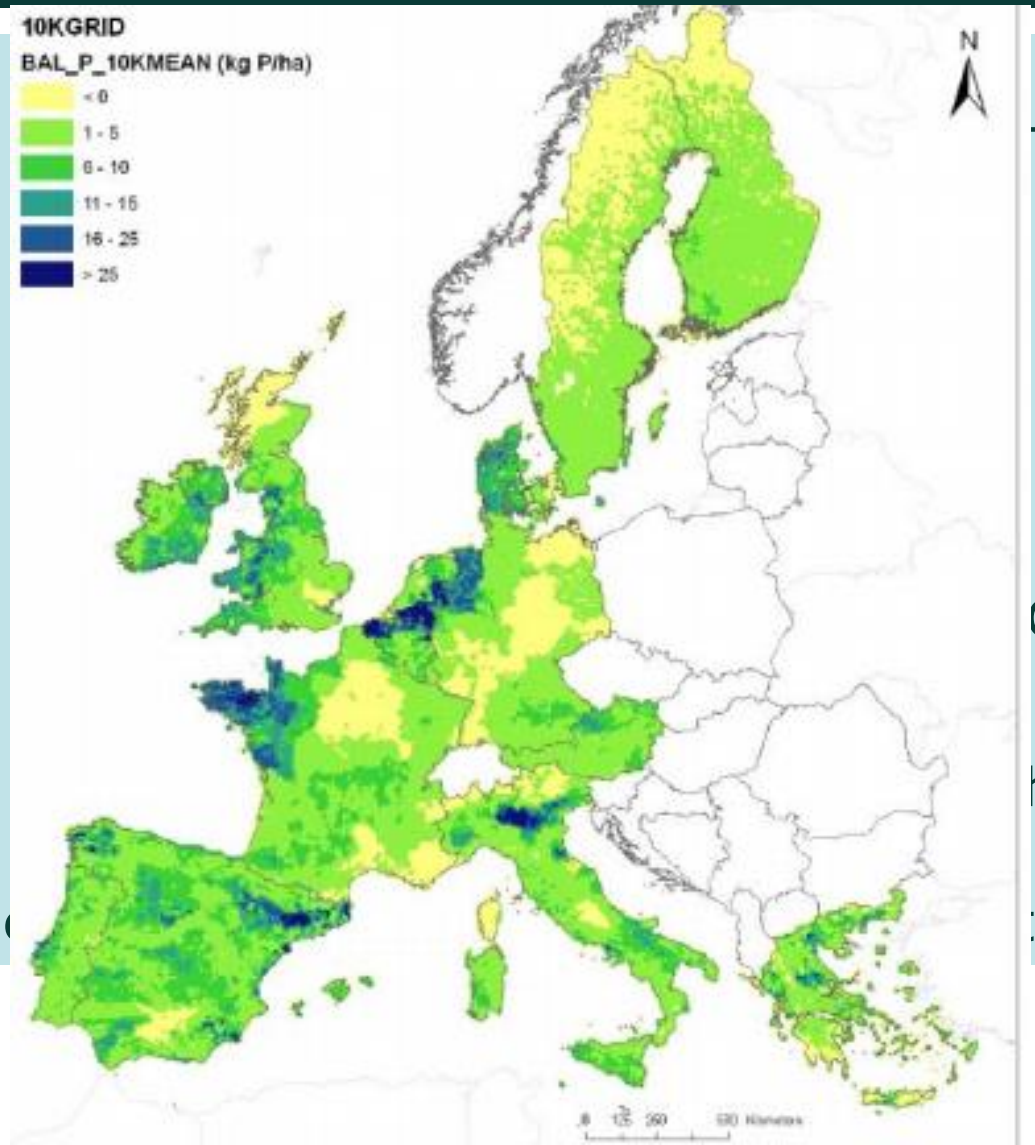
BACKGROUND I

High people and animal dense region (e.g. The Netherlands)



. -5 / +2 € tonne^{-1})

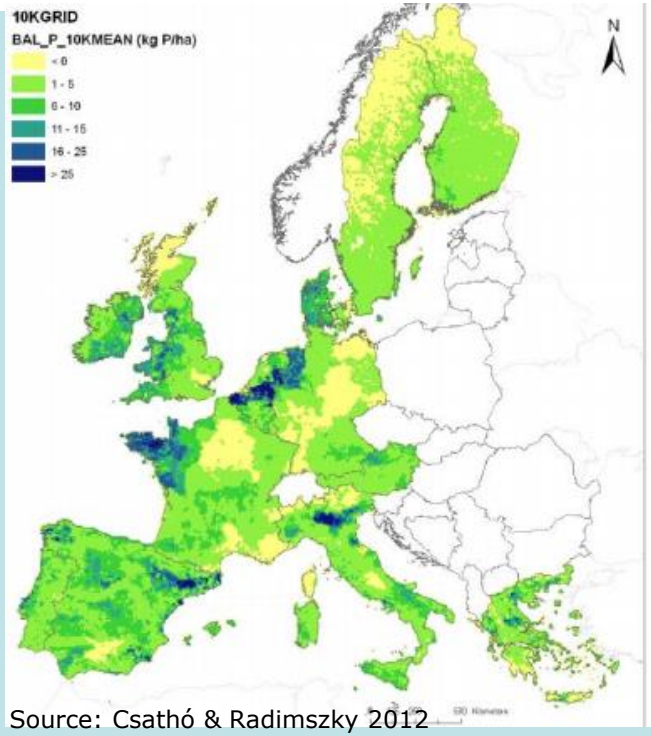
mic value

material

Germany (high cost)

h municipal waste and ash disposed of

he value of the fertilising material (focus on P)



Source: Csathó & Radimszky 2012

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BACKGROUND II

Context

- Revision of EU fertiliser **regulation** (Regulation (EU) 2019/1009)
- Laying down **technical criteria** for market access of fertilising products originating from organic & secondary raw materials, as part of EU circular economy
- JRC working on: Criteria + Market analysis + **LCA + LCC**

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BACKGROUND III

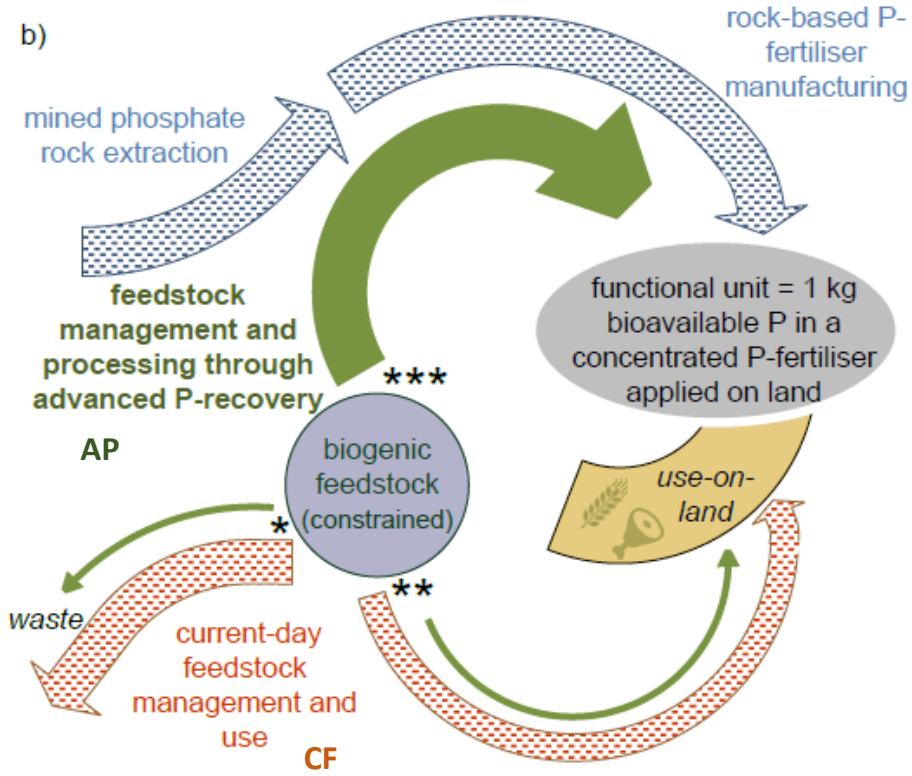
Analysis of literature

Existing studies on P-fertilisers derived from secondary raw material show contrasting results (mostly **negative**) for P-recovery

- **Allocation** procedures often used – mass & substance balances **broken**
- Waste management function often **forgotten** (counterfactual)
- Primary data often **not representing** state-of-the-art
- **Externalities** not included (only conventional market cost)

Main novelties Of this study

EXTENDED BOUNDARY APPROACH



comparison of system impacts

advanced P-recovery manufacturing and use **AP** ⟷ rock phosphate based manufacturing and use (R) + current-day feedstock management and use **CF**

Tonini D, Huygens D, Saveyn HGM, 2019. Environmental and health co-benefits for advanced phosphorous recovery. Nature Sustainability 2, 1051–1061.

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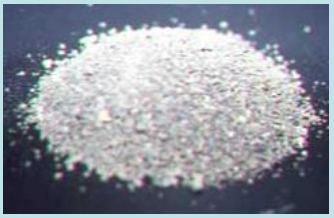
CASE STUDY

P-fertiliser from secondary raw materials

Raw material

Sewage sludge struvite



precipitation

Poultry manure P-rich ash

Sewage sludge SSP-like

Combustion

Meat & Bone Meal SSP-like

Pig manure P-rich biochar

Pyrolysis

Rock phosphate SSP

REFERENCE

SSP = Single Super Phosphate

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SCOPE

Functional Unit:

1 kg of phosphorous bioavailable applied on-land as concentrated P fertiliser (> 4% P content)

Feedstock: manure, sewage sludge, meat and bone meal

Reference of comparison: Single Super Phosphate (mineral P-fertilizer)

Geographic scope: EU-27 (population and livestock dense regions in the EU)

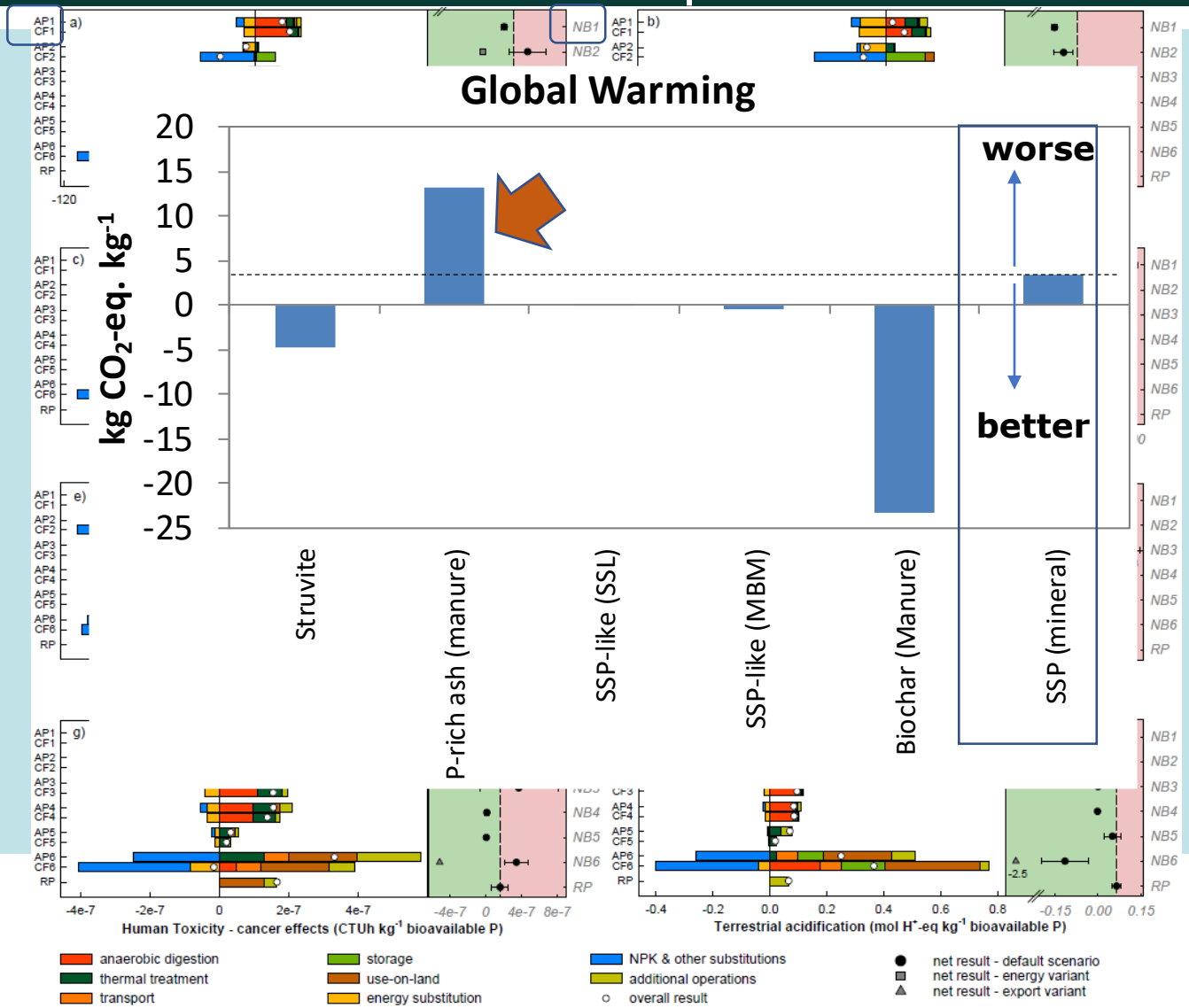
Technology: established and close to commercialization (TRL > 7-8)

Tool: EASETECH

Target Audience: DG Grow (EU Commission), private industries

LIFE CYCLE ASSESSMENT

Environmental impacts



Lower impact for all circular products except manure-ash

Overall, circular products achieved **better performances in most** of the indicators

Tonini D, Huygens D, Saveyn HGM, 2019. Environmental and health co-benefits for advanced phosphorous recovery. Nature Sustainability 2, 1051–1061.

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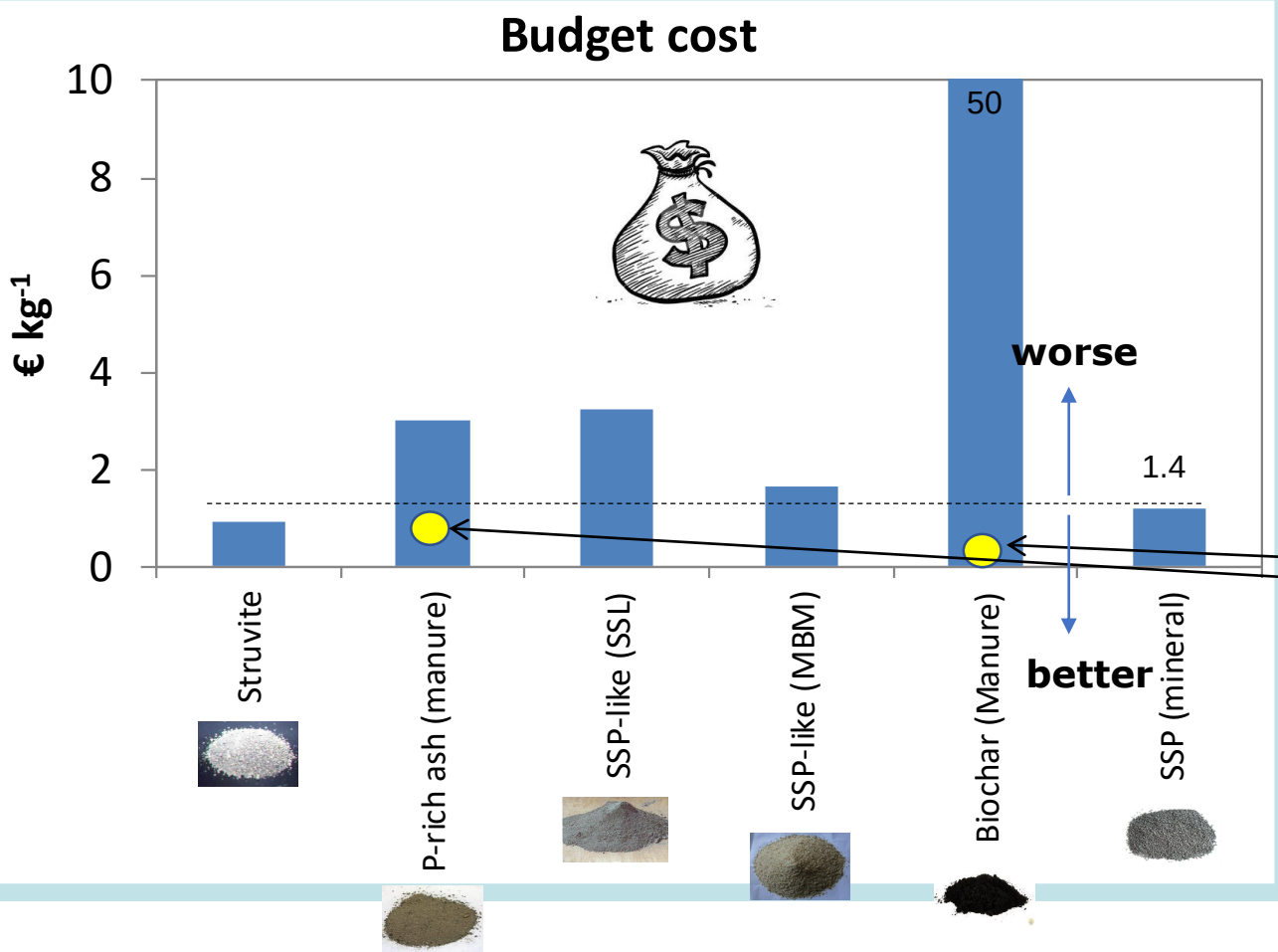
LIFE CYCLE COSTING

Budget cost



Budget costs = market costs + taxes

Higher costs of implementation for all circular products except struvite

If manure is exported in the current-day-management (long-distance transport)

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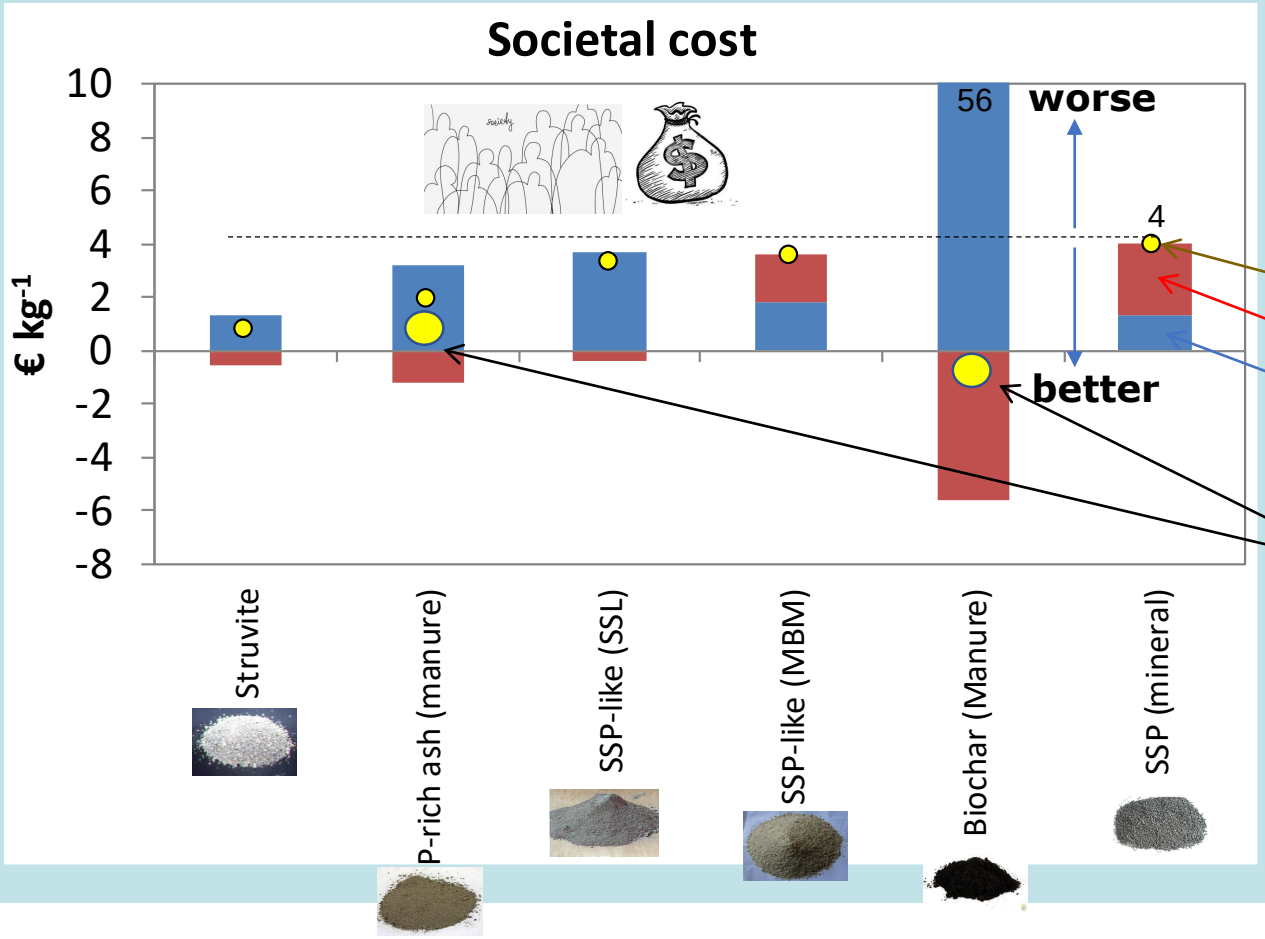
LIFE CYCLE COSTING

Societal cost



Lower societal costs of implementation for all circular products except biochar

Total (Societal cost)

External costs (emission cost as shadow price)

Budget costs (as shadow price & corrected for taxes)

If manure is exported in the current-day-management (long-distance transport)

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CIRCULAR ECONOMY

Appropriate accounting (boundary)

MAJOR FLAW OF PREVIOUS STUDIES
+ POOR DATA
+ EXTERNALITIES

Waste Treatment function
(+ energy)

Waste Treatment function
(+ energy)
(+ product delivery)

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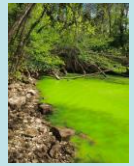
CONCLUSION

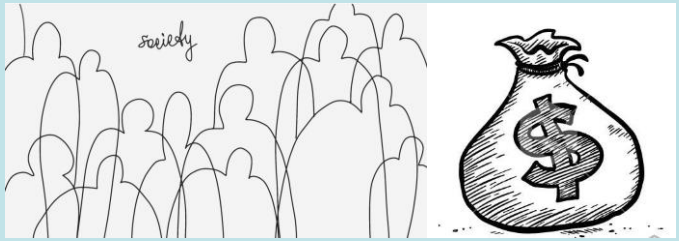
- Environmental impacts: **LOWER** for most circular scenarios




- Budget cost: **HIGHER** for most circular scenarios

- Societal cost: **LOWER** for most circular scenarios

Circular economy solutions promising from a **(societal) cost** perspective



Thank You!

Any questions?

news & views

NUTRIENT RECOVERY

Closing the phosphorus cycle

Phosphorus recovery is as important for closing the phosphorus cycle as its discovery 350 years ago was for food production. A new analysis highlights costs and benefits of creating value from the wastes generated by our food systems and modern lifestyles.

nature sustainability

ANALYSIS

https://doi.org/10.1038/s41893-019-0416-x

Environmental and health co-benefits for advanced phosphorus recovery

Davide Tonini, Hans G. M. Saveyn and Dries Huygens *

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JRC SCIENCE FOR POLICY REPORT

Technical proposals for selected new fertilising materials under the Fertilising Products Regulation (Regulation (EU) 2019/1009)

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