BIOREFINE CLUSTER EUROPE

European Sustainable Nutrient Initiative - ESNI 2020

Life Cycle Assessment of Wheat production: Influence of nutrient supply

Saicha Gerbinet

Brussels, 26th November, 2020

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Life Cycle Assessment of Wheat production: Influence of nutrient supply

Organic v co en onal ?

Only the nutrient supply!

Case study: wheat production in France

➔ Use of LCA

Life Cycle Assessment of Wheat production: Influence of nutrient intake

1. Definition of 6 scenarios

2. Detailed analysis of the base case

3. Comparison

The 6 scenarios

1. Base case = conventional agriculture in France
2. 100 % Mineral
3. Manure (170 kg N/ha)
   - Based on the EU nitrates directive = maximum amount of organic fertilizers
4. Manure (250 kg N/ha)
   - Exception for region with high livestock
5. Intermediate
   - Organic fertilizers = the quantity to obtain the P
6. Mineral with improve Nitrogen Use Efficiency (NUE).
   - Precision farming
   - Inhibitors

Mineral fertilizers use to obtain same nutriments

Same yield

Higher yield

The 6 scenarios

	Convetionnal	Manure (170 kg N/ha/yr)	Manure (250 kg N/ha/yr)	Mineral	Inter-mediate	Mineral - improved NUE	Unit
Yields (t/ha)	7100					7266	kg/yr
Straw	4297					4398	kd DM

The 6 scenarios

	Convetionnal	Manure (170 kg N/ha/yr)	Manure (250 kg N/ha/yr)	Mineral	Inter-mediate	Mineral - improved NUE	Unit
Yields (t/ha)			7100			7266	kg/yr
Straw			4297			4398	kd DM
Herbicide application			0.46				kg/ha
Pesticide application			0.90				kg/ha
Fungicide application			0.65				kg/ha

The 6 scenarios

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Yields (t/ha)			7100			7266	kg/yr
Straw			4297			4398	kd DM
Herbicide application			0.46				kg/ha
Pesticide application			0.90				kg/ha
Fungicide application			0.65				kg/ha
Total N mineral equivalent. as N	167	167	167	167	167	< 167	kg/ha
Total P mineral equivalent. as P_2O_5	33	96	141	33	33	33	kg/ha
Total K mineral equivalent. as K_2O	64	260	383	64	90	64	kg/ha
NUE	77	68	65	78	74	87	%

The 6 scenarios

	Convetionnal	Manure (170 kg N/ha/yr)	Manure (250 kg N/ha/yr)	Mineral	Inter-mediate	Mineral - improved NUE	Unit
Yields (t/ha)			7100			7266	kg/yr
Straw			4297			4398	kd DM
% Of straw remove			52				%
N-fertilizer. as N	163	117	93	167	150	152	kg/ha
Applied organic	1.90	22.95	33.75		7.92		ton/ha
N in organic (total)	11.12	170.00	250.00		58.66		kg/ha
N in organic (mineral equivalent)	4.14	50.03	73.58		17.27		kg/ha
Herbicide application			0.46				kg/ha
Pesticide application			0.90				kg/ha
Fungicide application			0.65				kg/ha
Total N mineral equivalent. as N	167	167	167	167	167	< 167	kg/ha
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Yields (t/ha)			7100			7266	kg/yr
Straw			4297			4398	kd DM
% Of straw remove			52				%
N-fertilizer. as N	163	117	93	167	150	152	kg/ha
P-fertilizer. as P_2O_5	25	0	0	33	0	33	kg/ha
K-fertilizer. as K_2O	42	0	0	64	0	64	kg/ha
Applied organic	1.90	22.95	33.75		7.92		ton/ha
N in organic (total)	11.12	170.00	250.00		58.66		kg/ha
P_2O_5 in organic (total)	6.78	95.63	140.64		33.00		kg/ha
K_2O in organic (total)	11.88	260.15	382.57	0	89.77	0	kg/ha
N in organic (mineral equivalent)	4.14	50.03	73.58		17.27		kg/ha
P_2O_5 in organic (mineral equivalent)	7.92	95.63	140.64		33.00		kg/ha
K_2O in organic (mineral equivalent)	21.54	260.15	382.57		89.77		kg/ha
Herbicide application			0.46				kg/ha
Pesticide application			0.90				kg/ha
Fungicide application			0.65				kg/ha
Total N mineral equivalent. as N	167	167	167	167	167	< 167	kg/ha
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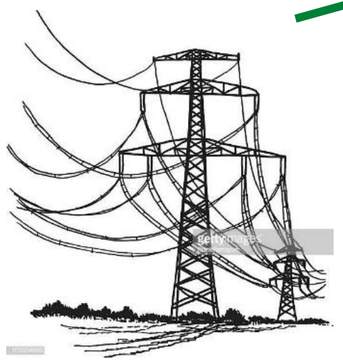
NUE	77	68	65	78	74	87	%

Goals and scope

Functional unit = 1 kg of wheat

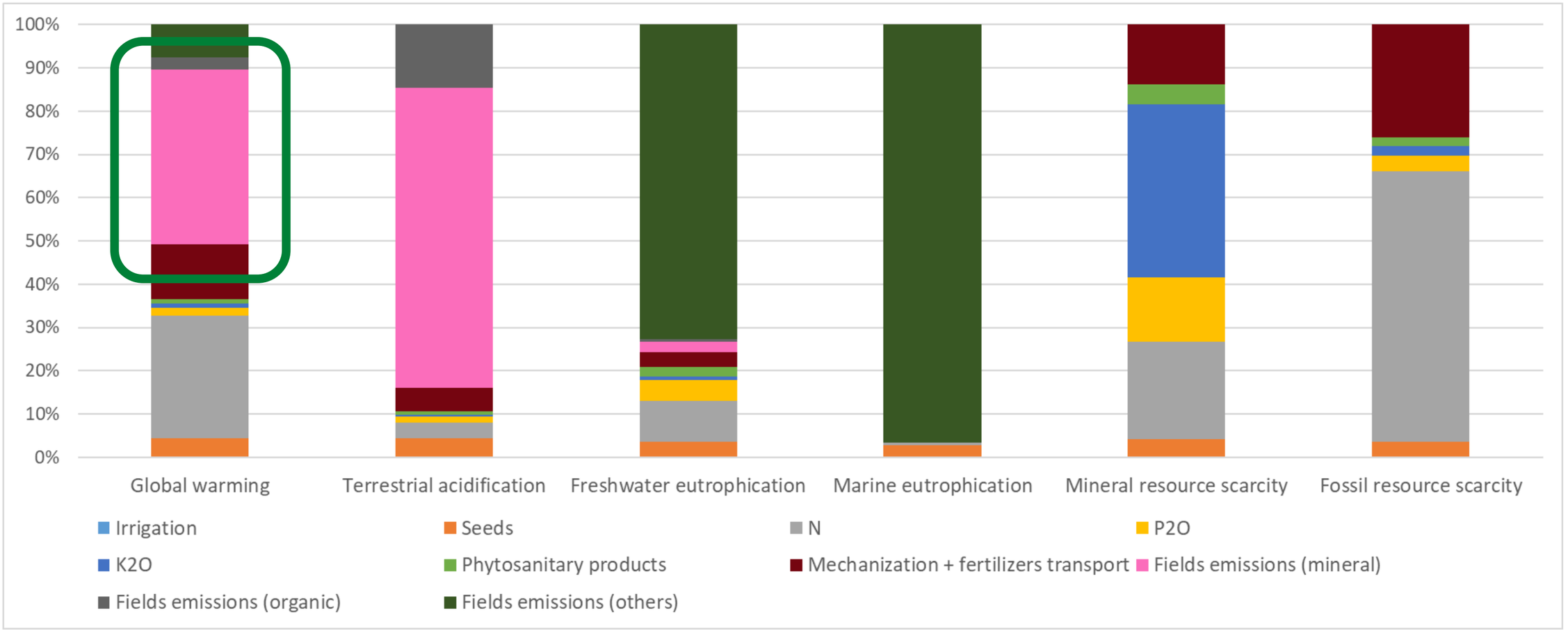
fertilizers europe

eco nvent



Field emissions

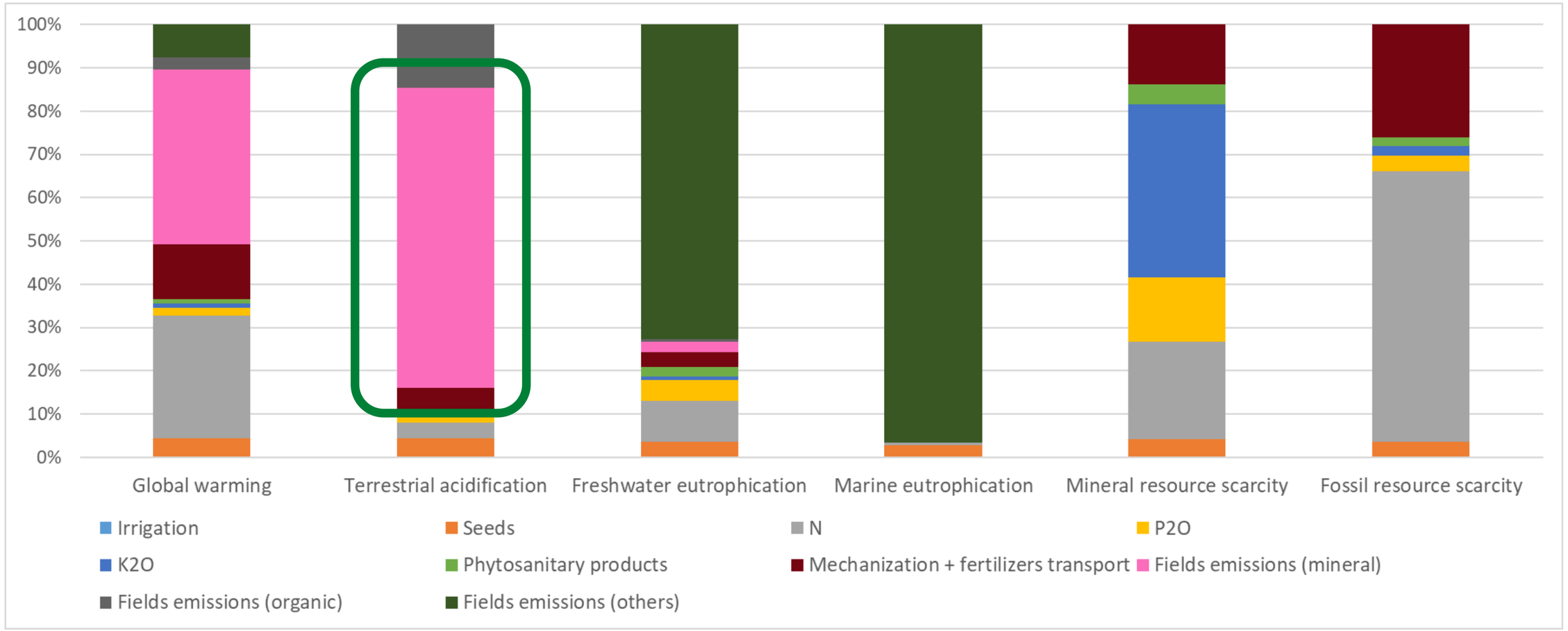
Conventional case: detailed analysis



ReCiPe, MidPoint (H), 1 kg of wheat

Nitrous oxides emissions (air)

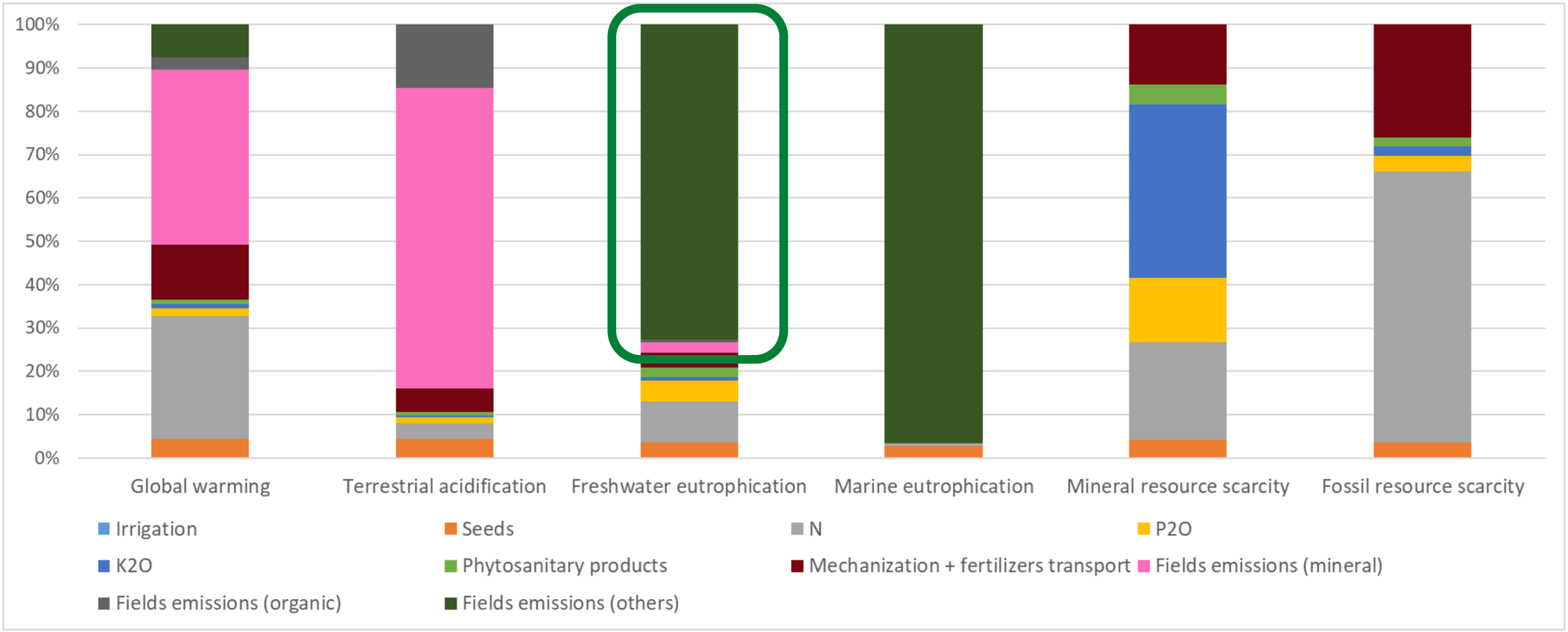
Conventional case: detailed analysis



Ammonia emissions (air)

ReCiPe, MidPoint (H), 1 kg of wheat

Conventional case: detailed analysis

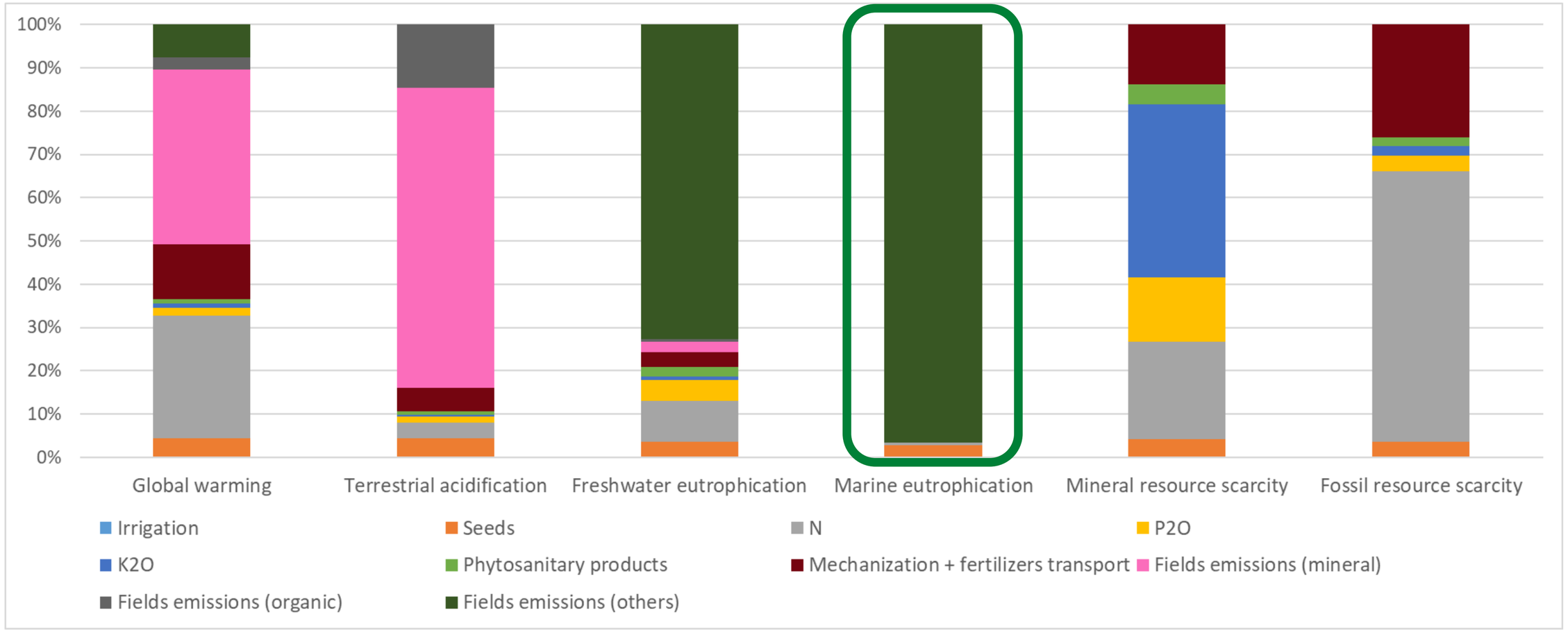


Phosphorus (79 %)/phosphates (21 %)

emissions (water)

ReCiPe, MidPoint (H), 1 kg of wheat

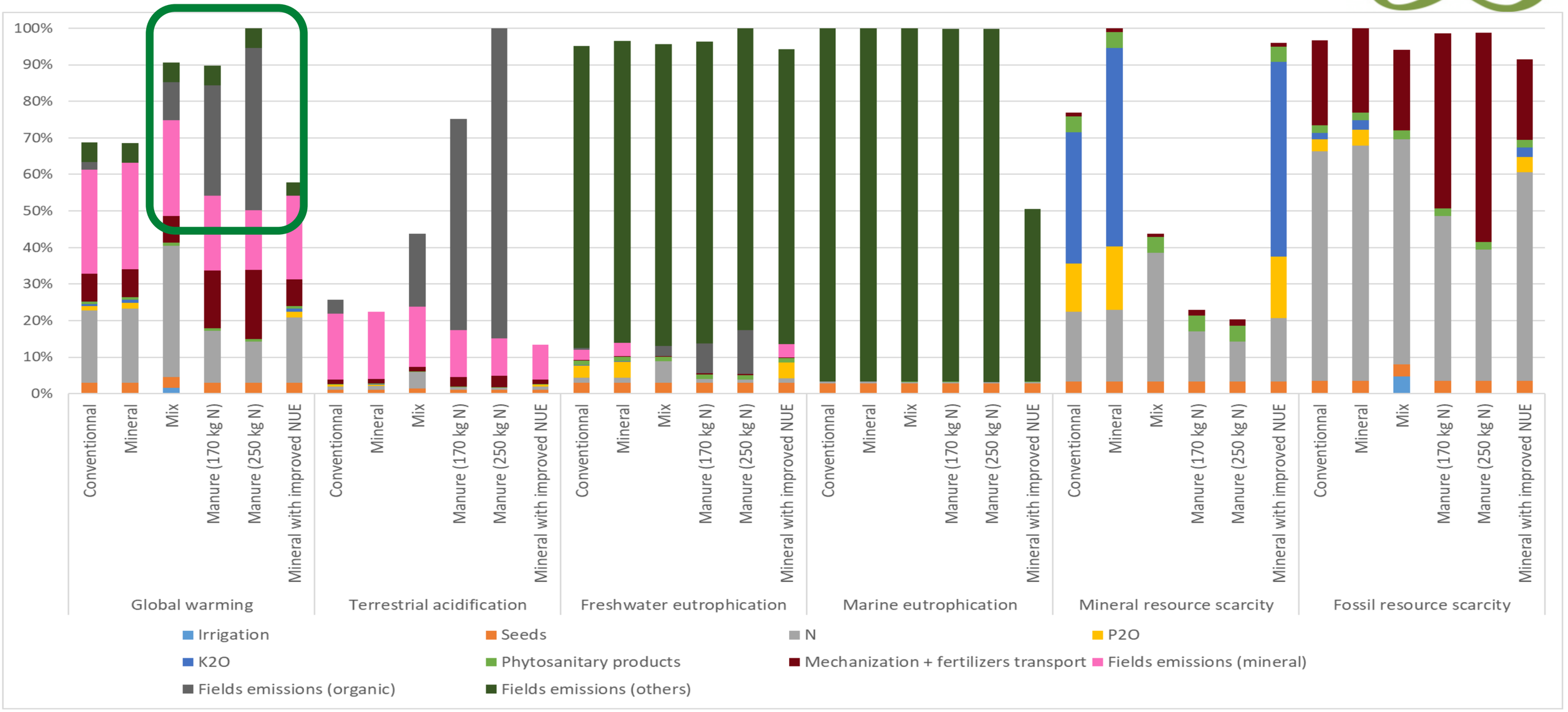
Conventional case: detailed analysis



Nitrates emissions (water)

ReCiPe, MidPoint (H), 1 kg of wheat

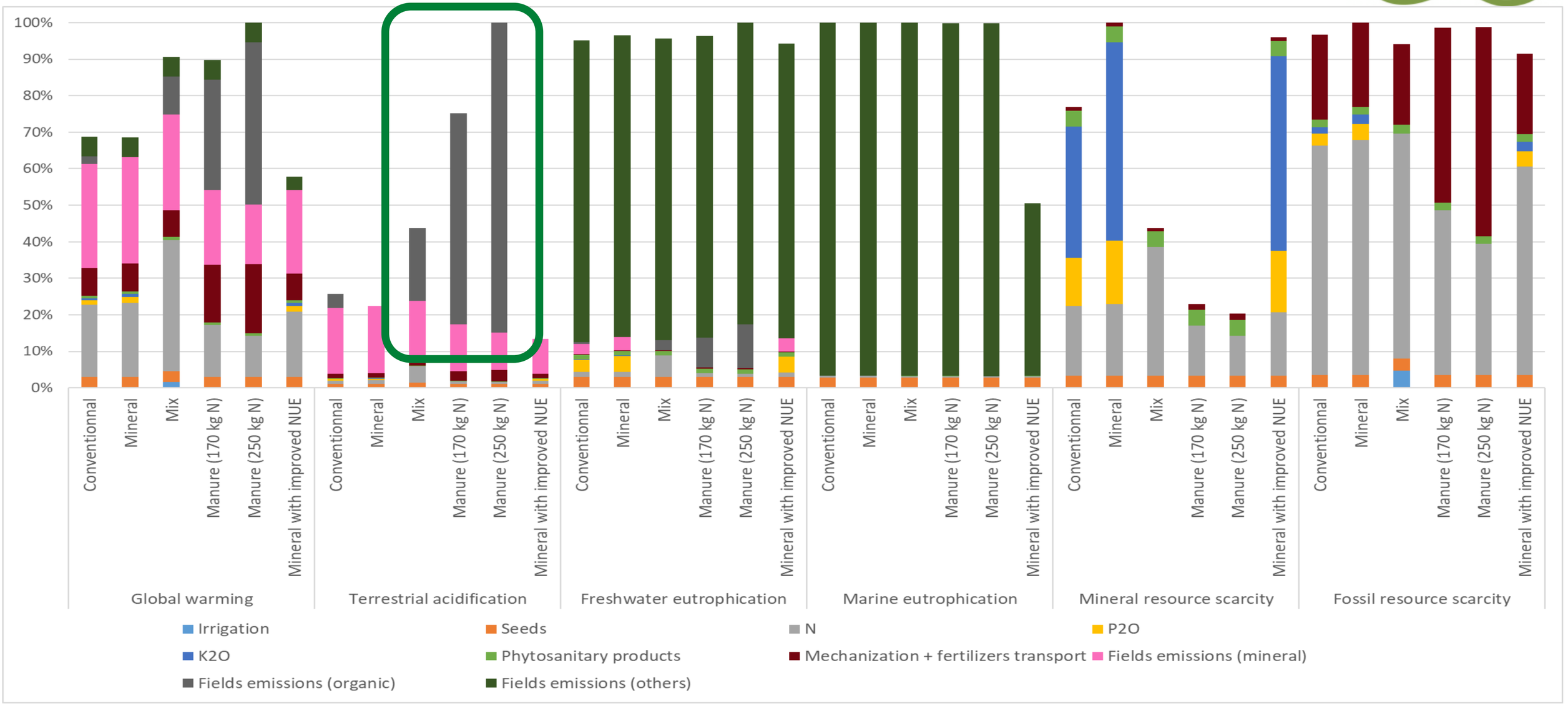
Comparison – 1 kg of wheat



N_2O emissions (air)

ReCiPe, MidPoint (H), 1 kg of wheat

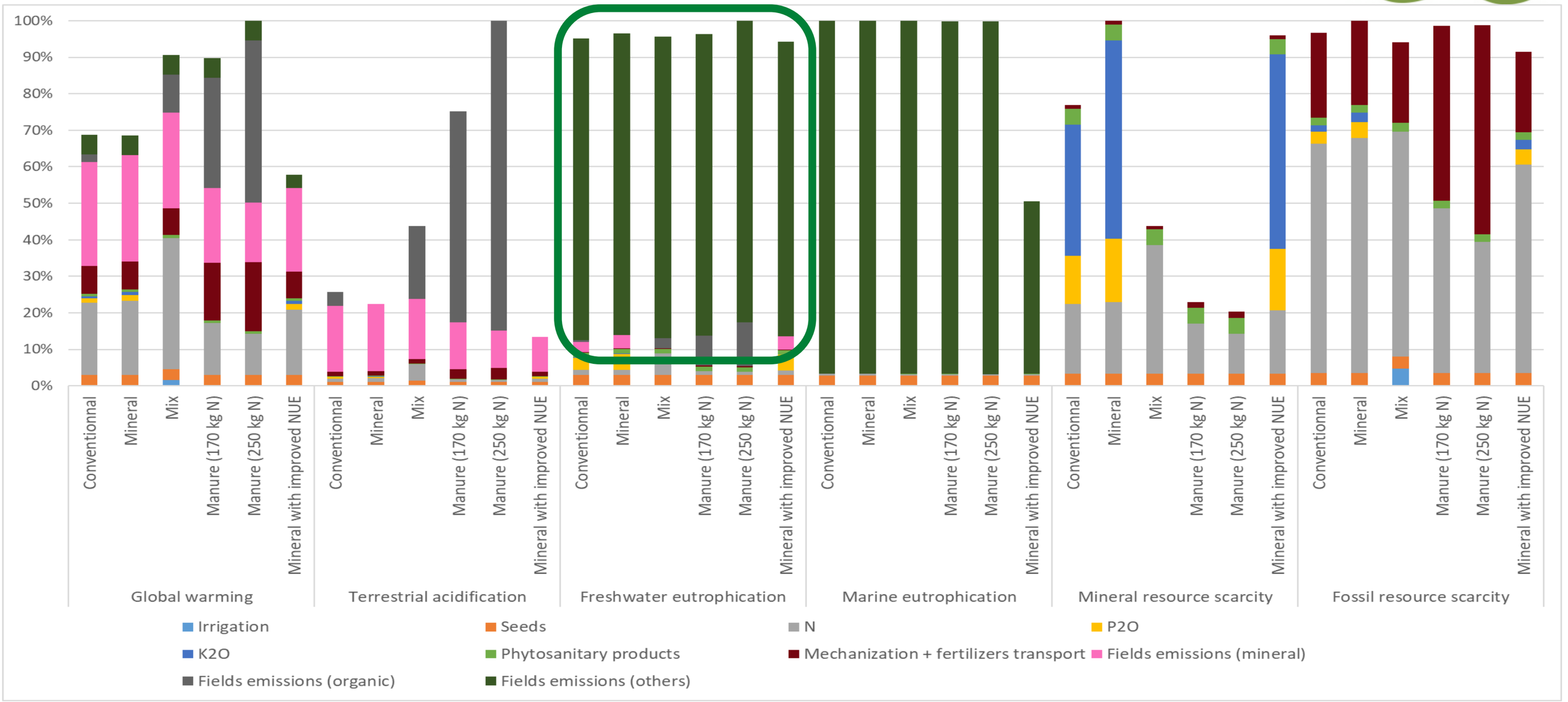
Comparison – 1 kg of wheat



Ammonia emissions (air)

ReCiPe, MidPoint (H), 1 kg of wheat

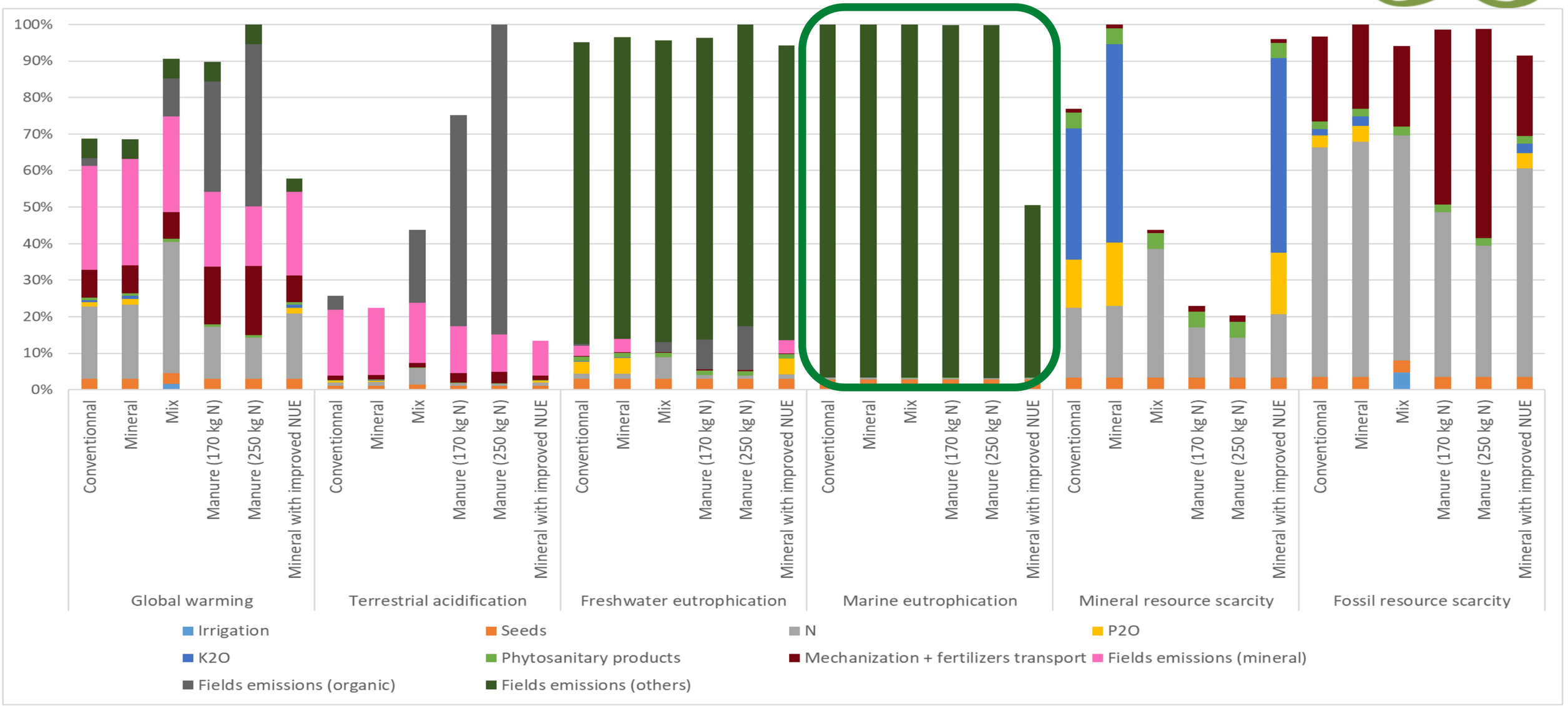
Comparison – 1 kg of wheat



Phosphorus emissions (water)

ReCiPe, MidPoint (H), 1 kg of wheat

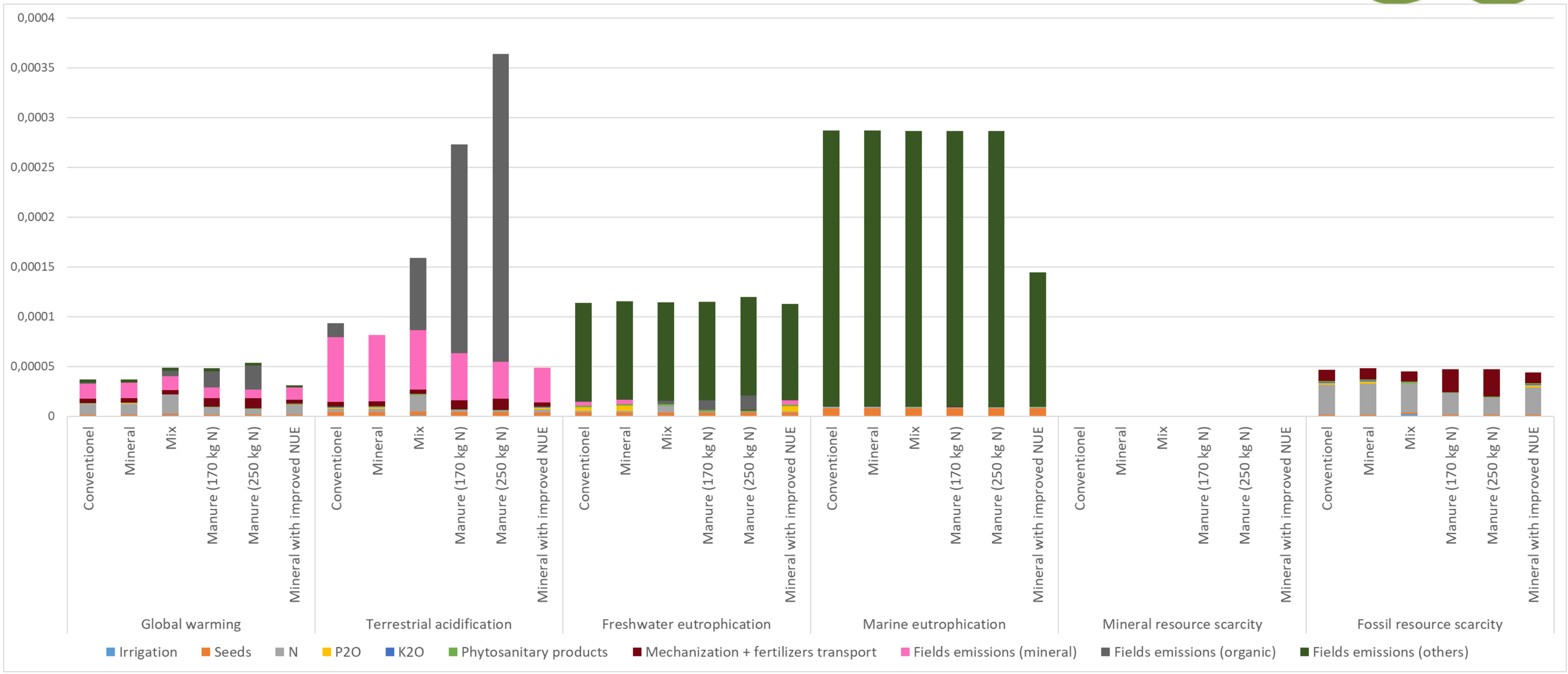
Comparison – 1 kg of wheat



Nitrate emissions (water)

ReCiPe, MidPoint (H), 1 kg of wheat

Comparison with normalization - 1 kg of wheat



ReCiPe, MidPoint (H) Normalization (world 2010), 1 kg of wheat

Conclusion

Organic vs conventional ?

Only the nutrient supply !

Efficient use of nutrient reduce the environmental impact

Advantages of the use of mineral fertilizers for climate change and acidification but disadvantages in resources use

Improved NUE: better thanks to higher yield and smaller emissions ➔ Achieve to European Farm to Fork objectives

France has high yield and efficient use of fertilizers, the study should be performed for other locations

Impact of organic fertilizers: processing or allocation of a part of the farm impact?

Influence of crop rotation?

Coming soon: a publication

Take home message

An efficient utilization of mineral fertilizers and the use of measures the improve the nitrogen use efficiency could help to reduce the impact of agriculture