NUTRIMAN

WP2: Collection and evaluation of innovative N, P nutrient recovery technologies and novel N, P fertiliser products, both by experts and by the potential end-users

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ZLTO

INSTITUT FÜR BAUSTOFF FORSCHUNG

FEhS

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Outline

Overview and general description of the work package

Prof. Dr. Erik Meers - UGENT

Collection of national innovative research results

Hongzhen Luo - UGENT

Practice oriented evaluation and revision of collected technologies and products

Martine Dellevoet-Groenewegen - ZLTO

Report on Farmers'/ growers' incentives and bottlenecks

Dr. Ana A. Robles Aguilar - UGENT

Priority list 25 selected best products and technologies

Dr. Ana A. Robles Aguilar - UGENT

WP2 objectives

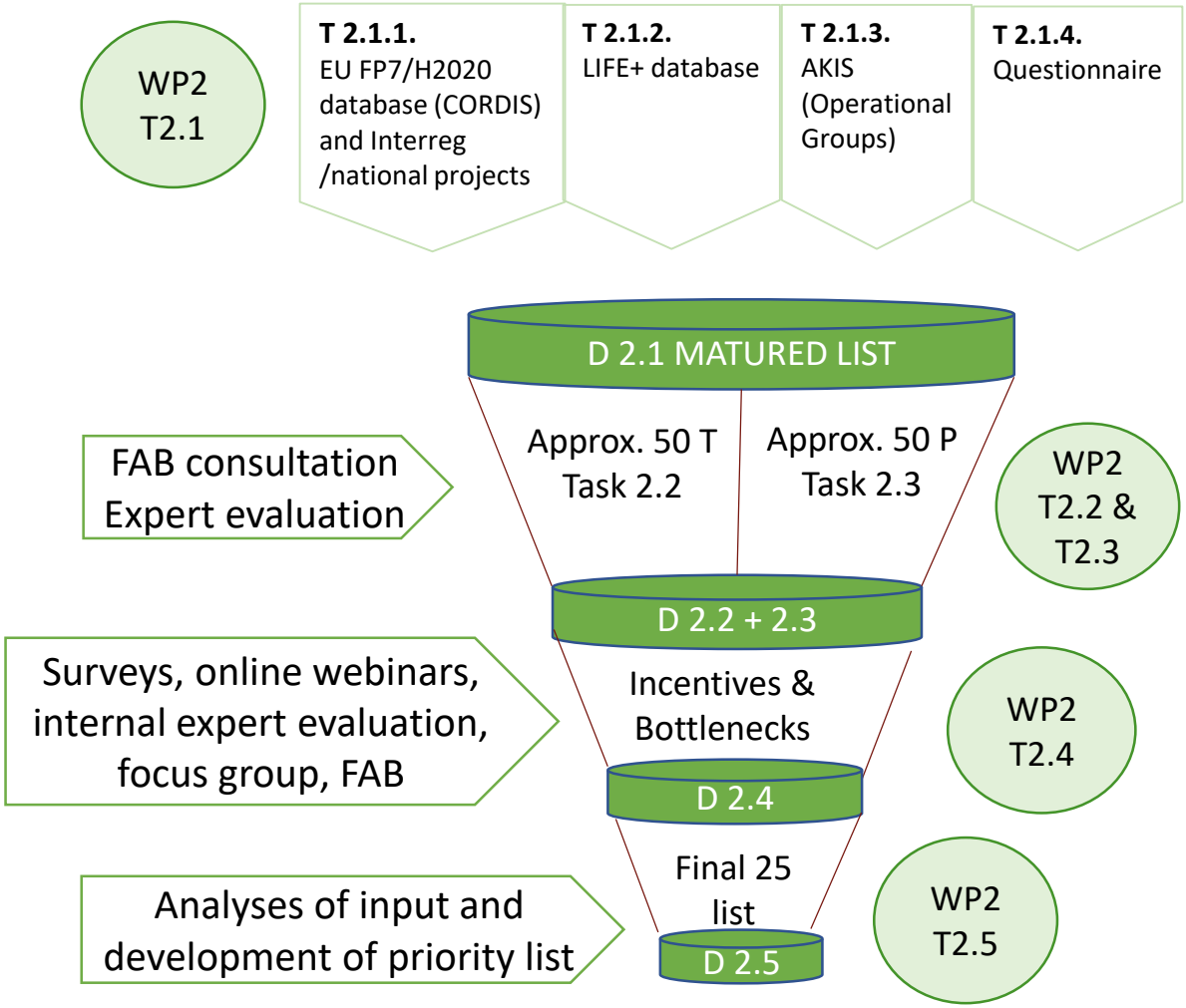
Inventory of "Close to market" technologies and products for N & P recovery

Evaluation of technologies, products and practices, both by experts and by the potential end-users.

Prioritization of demonstration needs with the 25 shortlist

Support to the implementation of the European Innovation Partnership for Agricultural Productivity and Sustainability through interactive linking with Operational Groups, Thematic Networks, Focus Groups, and related multi-actor Research and Innovation H2020 projects.

Methodology overview



Task 2.1 Collection of innovative research results from the field N&P recovery technologies and products

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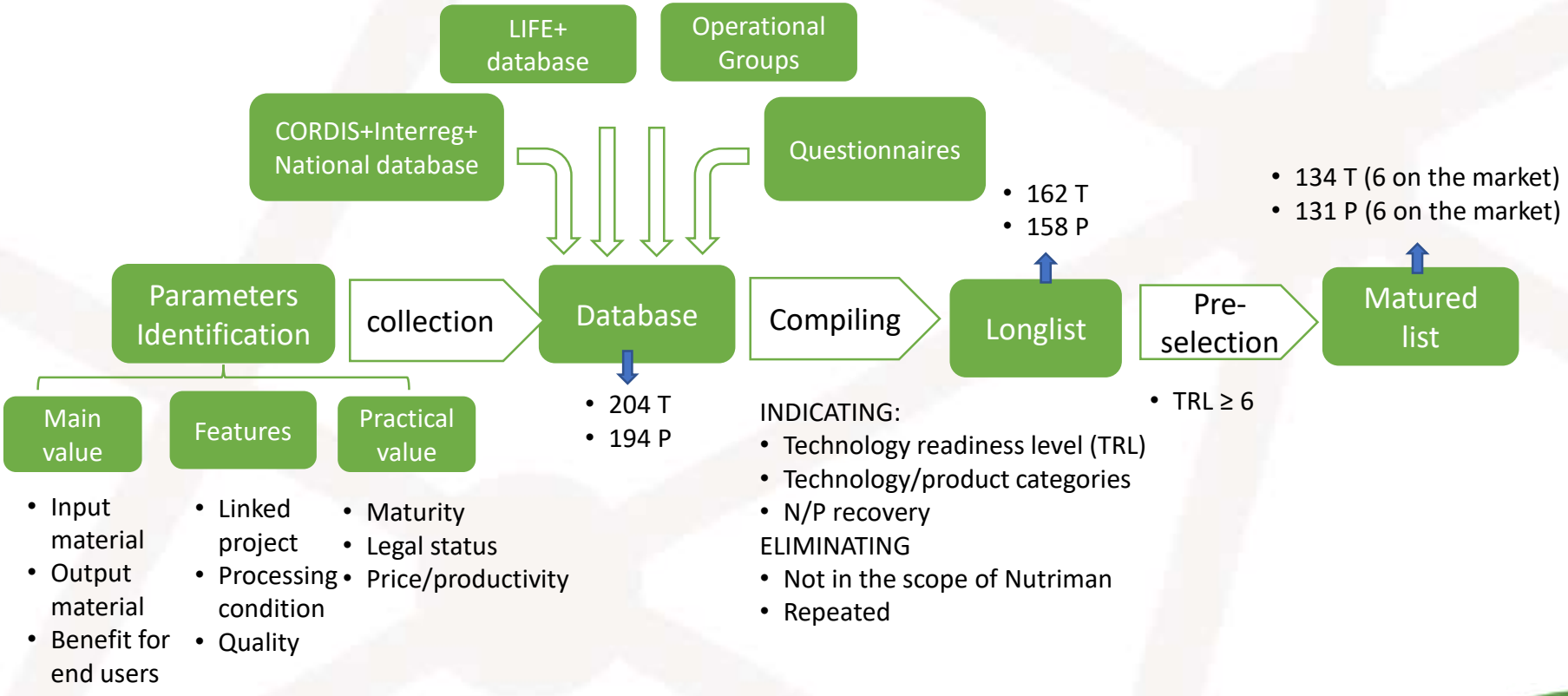
Hongzhen Luo
Ghent university

Collection of matured innovative research



Detailed Information obtained from the P/T

- Product/Technology Description
- Info on collection path and agreements signed
- Info related to the project and partner to contact
- Info related to WP3
- Info related to Farmer Platform

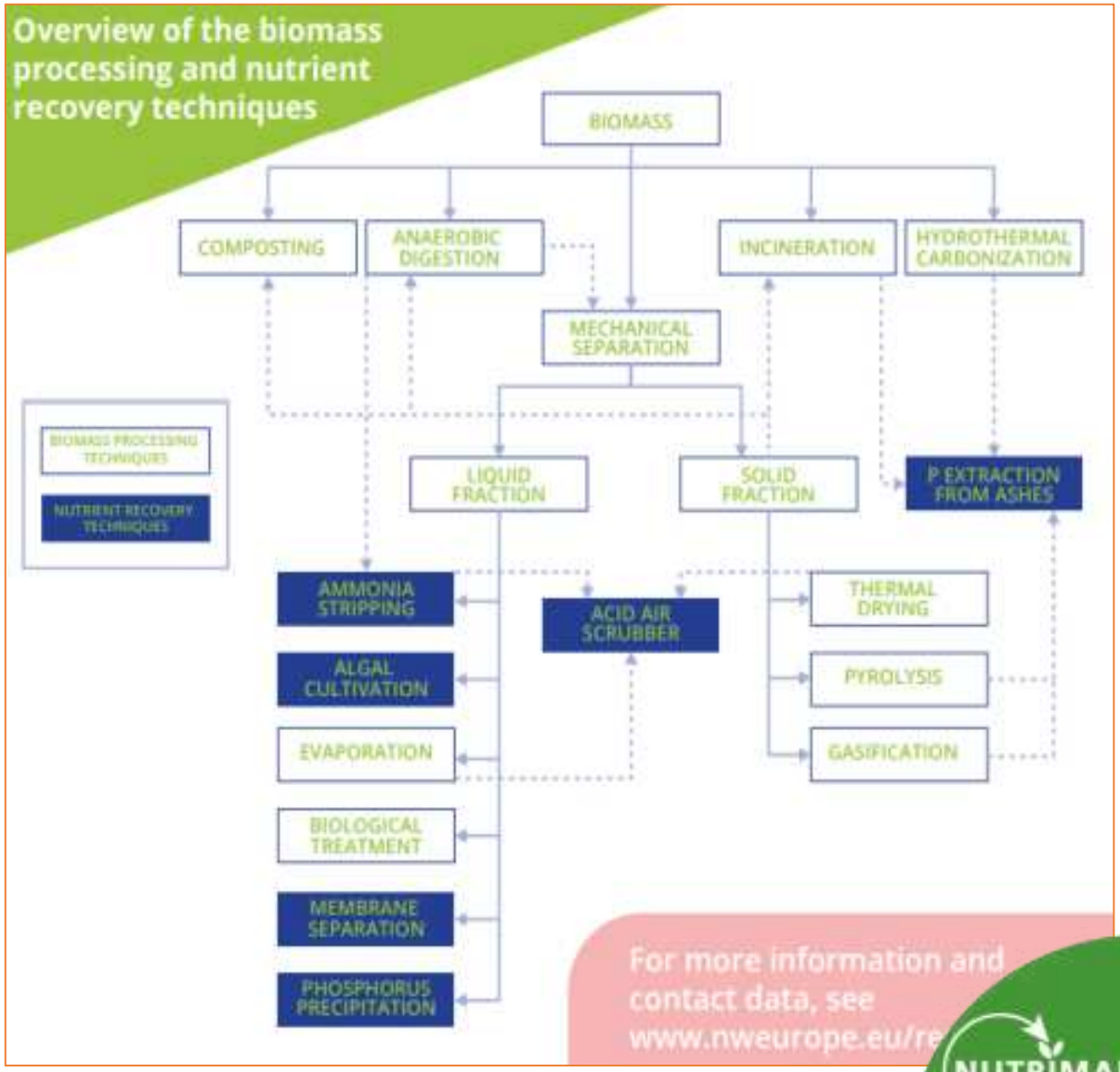
Problems during the data collection

- Real state-of-the-art?
- Contacted >1000 projects & vendors
- Reduced number of success stories:

True TRL appears below 6, despite earlier communication showing TRL 6 or higher.

The contact person of the T/P appears not to be the lawful owner and is not authorized to give all information.

Scientific research projects are publication driven research activities and not driven by higher maturity development of T/P that are expressively made for market uptake and application in operational environment.



Products subcategories

Product category as in the GA	Product sub-category
T2.3.1 Biochar & Bio-Phosphate	BioPhosphate
	Biochar
T2.3.2 Ash	Ash
T2.3.3 Struvite & other P-product	Struvite
	Precipitated Calcium Phosphate
	Phosphoric-acid
	Phosphorus precipitate
T2.3.4 Compost & Digestate (and biomass)	Compost
	Digestate
	Alternative biomass
T2.3.5 Scrubber water & mineral nitrogen concentrates	Scrubber water
	Ammonium nitrate/sulphate
	Mineral concentrate
	Solid manure
	Liquid manure

Technologies subcategories

Technology category as in the GA	Technology sub-category
T2.2.1 Thermochemical nutrient recovery	Reductive thermochemical P recovery
	Multi feed reductive thermochemical process
	Oxidative thermochemical P recovery
T2.2.2 P-precipitation from liquid manure, wastewater and drain water	Phosphorus precipitation from manure/digestate
	Phosphorus precipitation from multi organic wastes
	Phosphorus precipitation from wastewater/sludge
T2.2.3 Physic-chemical nitrogen recovery from manure, digestate and wastewaters: separation, stripping and membrane processes	Nitrogen recovery from air
	Chemical addition
	Membrane filtration
	Physical separation
	Stripping + Scrubbing
T2.2.4 Biological nutrient recovery: composting, anaerobic digestion, microalgae technology	Anaerobic digestion
	Composting
	Anaerobic digestion + composting
	Microalgae/duckweed/insect/enzyme technology

Mature list

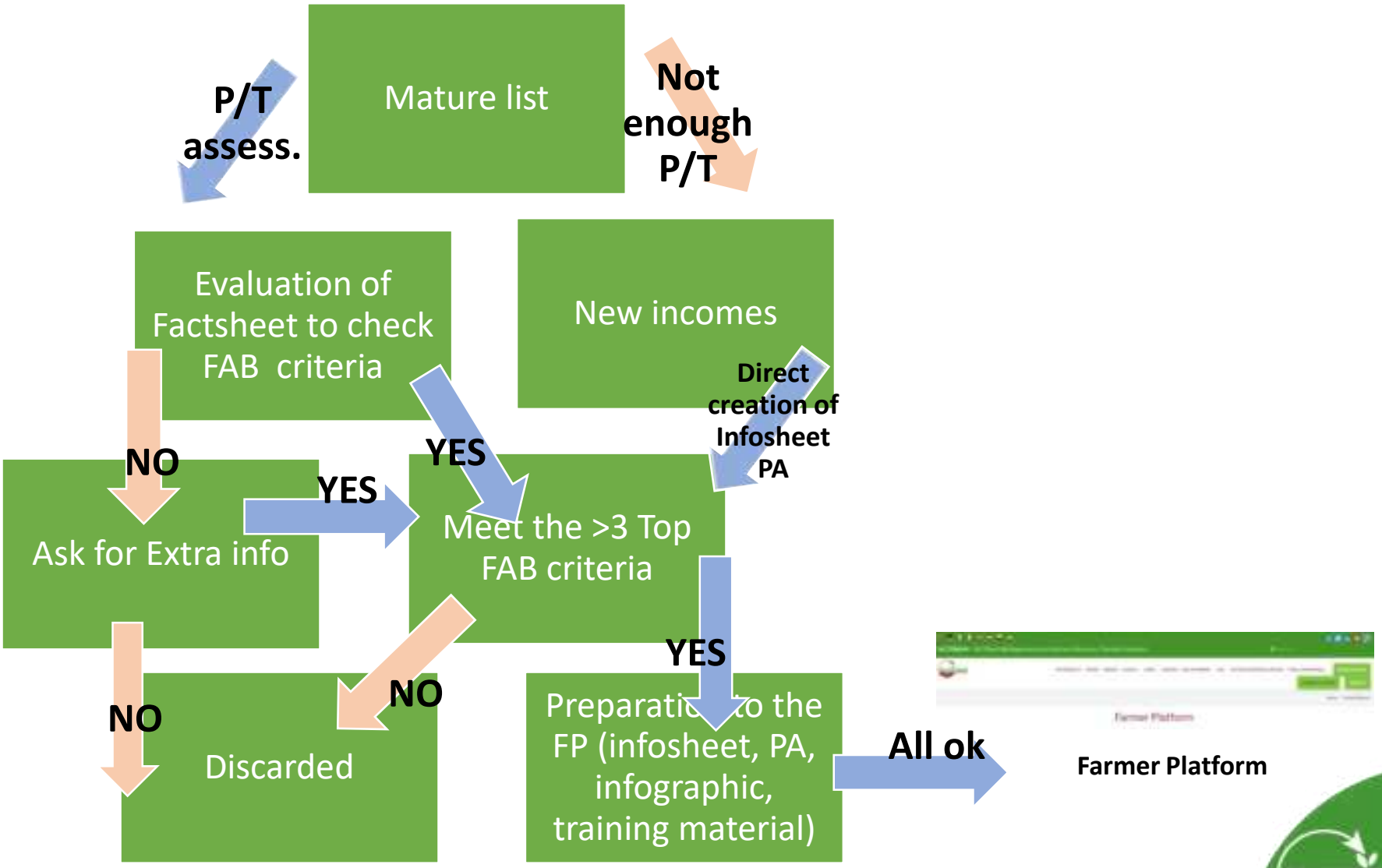
Product/ Tech No.	Categories	sub-categories	Title	TRL	Target nutrients	Project/Company	Source	Link
T144	T2.2.3	Nitrogen recovery from air	Technology for N recovery as liquid fertilizer starting from liquid manure or biogas digestate with plasma manure processing system	TRL7	N	N2 Applied, via Questionnaire	49-NO_QUESTIONNAIRE_N2 Applied	https://n2.no/
T145	T2.2.2	Phosphorus precipitation from wastewater /sludge	Technology for P recovery as P-rich precipitate from wastewater by ICS (Iron coated sand)	TRL 7-8	P	NuReDrain, Nutrient Removal and Recovery from Drainage Water, Interreg North Sea Region	50-BE_QUESTIONNAIRE_Nuredrain-1	http://northsearegion.eu/nuredrain/
T146	T2.2.3	Physical separation	Technology for N & P recovery as liquid and solid organic fertilizer from manure and digestate with decanter-disc stack centrifuge	on market	N & P	GEA Group, via Questionnaire	51-DE_QUESTIONNAIRE_GEA	https://www.gea.com/en/index.jsp
T147	T2.2.4	Anaerobic digestion + composting	Technology for N&P recovery as compost starting from manure and slurry with mobile cavitator combining anaerobic digestion and composting system	TRL8	N & P	LIFE DOP: DemonstrativemOdel of circular economy Process in a high quality dairy industry	55-IT_QUESTIONNAIRE_LIFEDOP	http://www.lifedop.eu
P1	T2.3.1	Bio-phosphate	High nutrient dense Bio-Phosphate products recovered from food grade animal bone grist with over 30% P2O5 content by "3R zero emission pyrolysis" process	TRL/IRL9	P	REFERTIL: Reducing mineral fertilisers and chemicals use in agriculture by recycling treated organic waste as compost and biochar products	1-HU_QUESTIONNAIRE_ABC-Bio-Phosphate	https://www.3ragrocarbon.com/project-reference
P2	T2.3.3	Rich Phosphorus precipitate	Bio-polyphosphate from canola seed press cake by "Value-PP" process	TRL / IRL 7	P	Value-PP: Valorisation of plant grist through phosphate depletion with coupled polyphosphate synthesis	2-DE_QUESTIONNAIRE_VALUE-PP	https://www.iamb.rwth-aachen.de/cms/iamb/Forschung/Blank-Lab/~pcmb/ValuePP/lidx/1/
P4	T2.3.4	Digestate	Pelletized digestate from pig manure by Ecoson process	TRL 7	P	arling Ingredients International – Ecoson BV, via Questionnaire	57-NL_QUESTIONNAIRE_Ecoson_manure	www.ecoson.nl

Task 2.2 & 2.3 Practice oriented evaluation and revision of the collected technology, products, and expert consultation

Martine Dellevoet-Groenewegen

ZLTO

Flowchart on the first selection methodology



FAB criteria

Results from First FAB consultation - Ranking of criteria by FAB members

Proposed criteria· Comments made by FAB members	Points	Times mentioned
Nutrient quality/efficiency, demonstrated in agricultural practice (proof of fertilizing value for agriculture) • Effectiveness in fields. • Once the cost of "fertilizer unit" is known, it is necessary to know the fertilizing value. • This criteria is the most important, far in front the others. • Best with experiments and recommendations of the Chamber of Agriculture.	15	9
Input material: (type of raw material) • Farmers clear information what's about. • The third most important parameter is to know the origin of nutrients. • Important to determinate applicable rules and potential product application. • May contain no pollutants (heavy metals, plastics). • Absence of contaminants, foreign substances, risk assessment. • How much raw materials are harmful to the environment and society. Highly rated should be disposal of environmentally hazardous waste and proceeding into usable product.	15	6
Product price: (€ / kg N; € / kg P2O5) • For many products today the cost of production is almost equal to the sales value of the products. The cost of nutrients is therefore the main parameter of choice. • The lower the nutrient density the lower the price. • Key factor. • First factor for decision. • Not No. 1 but important, must be in proportion to content and operation.	15	6
Legal status (national/EU): (allowed in which countries, allowed in new EU regulation) • It must have all approvals of all fertilizers possibly also for organic farms. • Products' environmental safety (N leaching, emissions, heavy metals, other contaminants,…)	9	4
Market potential input availability: (farm/local/national/international) • Formal availability (compatible with machinery). • At the fertilization times in the region. • The second issue is to what extent a given technology can be used in mass technology, i.e. whether it can be widespread and apply to a large mass of waste	8	4
Output material: (type of end product) • Grained or pilled spreadable goods. • Practical applicability, spreading, distribution, dosage. • Application method/form	8	3
Nutrient content N+P, other product benefits: (Total N+P2O5 density: Low (<5%) – Medium (5-10%) – High (>10%)) • Usual comparable measures. • Important: high concentration. • The higher the nutrient contents the more important is the throwing power. • Content in microorganism also very important. • Homogeneous quality.	7	5
Market potential product application: (farm/local/national/international) • Quantitative demand. • Farmers, machinery rings and contractors	3	

1st FAB Criteria for revision of longlist PRODUCTS

1. Nutrient quality/efficiency, demonstrated in agricultural practice (proof of fertilizing value for agriculture)
2. Input material
3. Product price EXW wholesale: euro/kg N; euro/kg P2O5
4. Legal status (MS national/EU)
5. Output material

1st FAB Criteria for revision of longlist TECHNOLOGIES

1. Technology maturity and readiness level from successfully completed TRL≥6.

2. Processing conditions proven effectiveness to convert crude input material into safe and high quality fertilizing products.

3. CAPEX and OPEX: production costs

4. Legal status (regional/national/EU)

5. Output material

Nutriman Expert assessment

*The assigned partners evaluated the collected data from task 2.1 based on the criteria developed by consulting the FAB. At that stage a **factsheet** had been made for all products by the expert partners. In this **factsheet** the availability and quality of the data has been assessed based on the criteria as suggested and ranked by the FAB.*

Technology categories and assigned expert partners	Product categories and assigned expert partners
1. Thermochemical nutrient recovery (P1 3R, Biochar and Bio-Phosphate) (P11 FehS, ash)	1.a. Biochar and Bio-Phosphate (>TRL7 industrial: P1 3R) (<TRL7 research: P6 INAGRO, P6.2 ILVO) 1.b. Ash (P11 FEhS)
2. P-precipitation from liquid manure, waste water and drain water (P13 DAM, P9 CARTIF, P6 INAGRO)	2. Struvite and other P-precipitates (P13 DAM, P9 CARTIF)
3. Physic-chemical nitrogen recovery from manure, digestate and wastewaters: separation, stripping and membrane processes (P5 UGent, P6 INAGRO, P9 CARTIF).	3. Scrubber waters & mineral nitrogen concentrates (P5 UGent, P6 INAGRO)
4. Biological nutrient recovery: composting, anaerobic digestion (P10 UNITO, P8 VLACO) (P12 IUNG)	4. Compost and Digestate (incl. derivatives) (P10 UNITO, P8 VLACO, P6 INAGRO) (P12 IUNG)

Shortlist of 47 Technologies

Evaluating the factsheets and the later coming info sheets or PA in EIP-AGRI format using the 3 most important FAB criteria lead to a selection of 52 suitable products and 47 technologies by the responsible experts.

Shortlist D2.2 Technologies

Tech No.	Technology categories	Technology sub-category	Technology title	TRL	recover y	Technolog y Factsheet (only INTERNAL use)	Selectio n next steps 3-2-1 top criteria
T1	T2.2.1 Thermochemical nutrient recovery	Reductive thermochemical P recovery	3R Recycle-Reuse-Reduce zero emission pyrolysis technology for phosphorus recovery from food grade animal bone grist for production of Bio-Phosphate products	TRL/IRL 9	P	yes	3
T4	T2.2.4 Biological nutrient recovery: composting, anaerobic digestion	Anaerobic digestion	Technology for P recovery as biophosphate stating from pig manure with Ecoson process	TRL7	P	yes	2
T6	T2.2.1 Thermochemical nutrient recovery	Multi feed reductive thermochemical P recovery	Technology for P recovery as biochar starting from biowaste with "INCOVER" hydrothermal carbonization process	TRL9	P	yes	2
T11	T2.2.1 Thermochemical nutrient recovery	Oxidative thermochemical P recovery	Technology for P recovery as PK fertilizer from the ash of poultry manure with "BMC Moerdijk" thermochemical process	TRL9	P	Yes	2

Shortlist of 52 Products

Evaluating the factsheets and the later coming info sheets or PA in EIP-AGRI format using the 3 most important FAB criteria lead to a selection of 52 suitable products and 47 technologies by the responsible experts.

Shortlist D2.3 Products

Product No.	Product categories	Subcategory	Product	TRL	recovery	Product Factsheet (only INTERNAL use)	Selection next steps 3-2-1 top criteria
P1	T2.3.1 Biochar & Bio-Phosphate	Bio-phosphate	High nutrient dense Bio-Phosphate products recovered from food grade animal bone grist with over 30% P2O5 content by "3R zero emission pyrolysis" process	TRL/ IRL9	P	Yes	**3**
P4	T2.3.4 Compost & Digestate (and biomass)	Digestate	Pelletized digestate from pig manure by Ecoson process	TRL 7	P	yes	**2**
P6	T2.3.1 Biochar & Bio-Phosphate	Biochar	Biochar from biowaste by INCOVER process	TRL9	P	Yes	**2**
P7	T2.3.1 Biochar & Bio-Phosphate	Biochar	Biochar from sewage sludge by 3R-BioPhosphate Ltd. Nova Ultra process	TRL8	P		3
P11	T2.3.2 Ash	Ash	PK fertilizer from the ash of poultry manure with "BMC Moerdijk" thermochemical process	TRL9	P	Yes	**2**

Specification and differentiation of Products of per region

recovery	Region origin	country	Product category	Product	numbers
	Mediterranean				**9**
			T.2.3.3 Struvite & other P-Products		**3**
P		Spain	Struvite	Struvite from wastewater by "Canal de Isabel II S.A." process	
			T 2.3.4 Compost and Digestate (incl. Derivates)		**6**
N & P		Italy	Compost	Compost from green waste and food wastes by "Biociclo" process	
N & P		Spain	Digestate	Digestate from the co-digestion of vegetable oils waste and pig manure by "VALUVOIL" process	
	Central Europe				**9**
			Task 2.3.1. Biochar and Bio-Phosphate		**3**
P		Hungary	Bio-phosphate	High nutrient dense Bio-Phosphate products recovered from food grade animal bone grist with over 30% P2O5 content by "3R zero emission pyrolysis" process	
P		Germany	Biochar	Biochar from biowaste by INCOVER process	

Specification and differentiation of Products of per type of agricultural praxis

Product ID on Farmer Platform	Product category Subcategory	Country	Focusing area	Farming system			Cultivation method		Recommended use						
				Conventional	low input	organic	open field	greenhouse	arable crops	grassland	vegetable	horticulture	arboriculture	fruits	others
	Task 2.3.1. Biochar and Bio-Phosphate														
192	Bio-phosphate	Hungary	EU	X	X	X	X				X			X	X
1571	Biochar	Hungary	EU	X	X	X	X	X			X		X	X	X
	T2.3.2 Ash														
321	Ash	France	regional	X	X	X	X	X	X	X	X				
397	Ash	Germany	EU	X			X	X	X		X	X		X	
401	Ash	Netherlands	EU	X			X		X	X	X				
	T.2.3.3 Struvite & other P-Products														
293	Struvite	Belgium	regional	X			X	X	X		X	X			
208	Struvite	Spain	regional	X	X	X	X		X	X					

T2.4 Evaluation of the reduced list of technologies and products by potential end-users: farmer consultation and identification of incentives and bottlenecks for adoption

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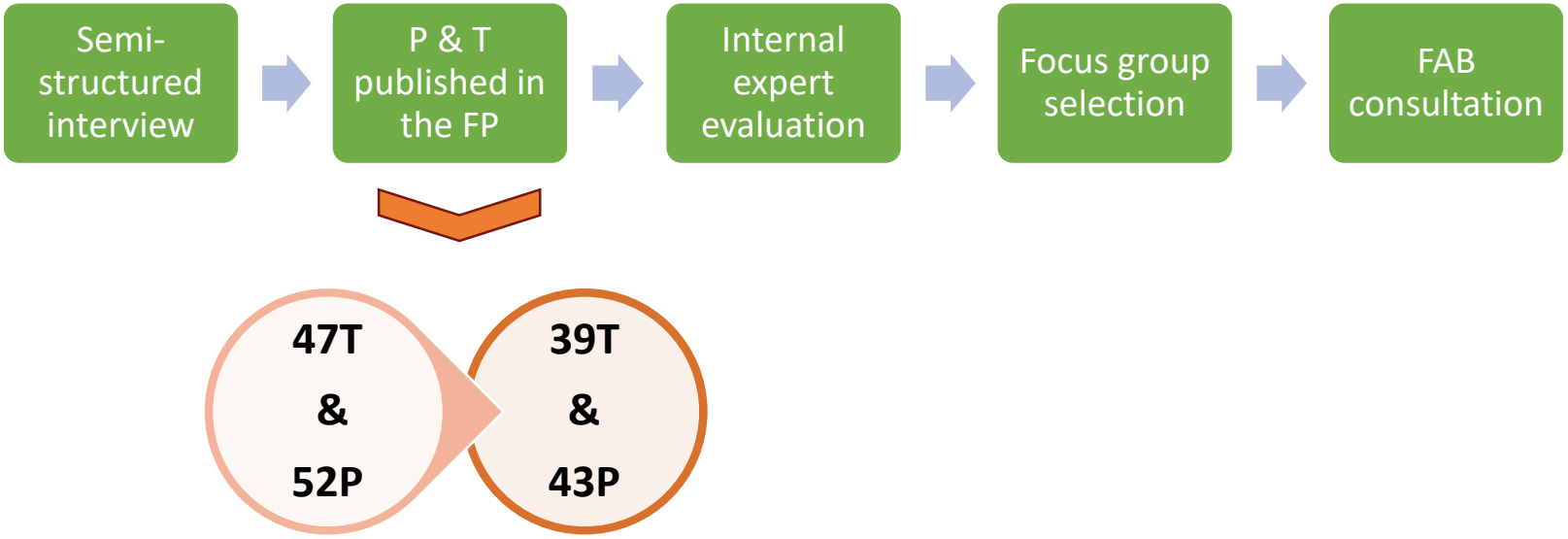
Dr. Ana A. Robles-Aguilar

UGent

Expert evaluation and selection of the shortlist P/T towards 25 selection



Farmers' incentives and bottlenecks

Evaluation of the reduced list of technologies and products by potential end-users: farmer consultation and identification of incentives and bottlenecks for adoption.

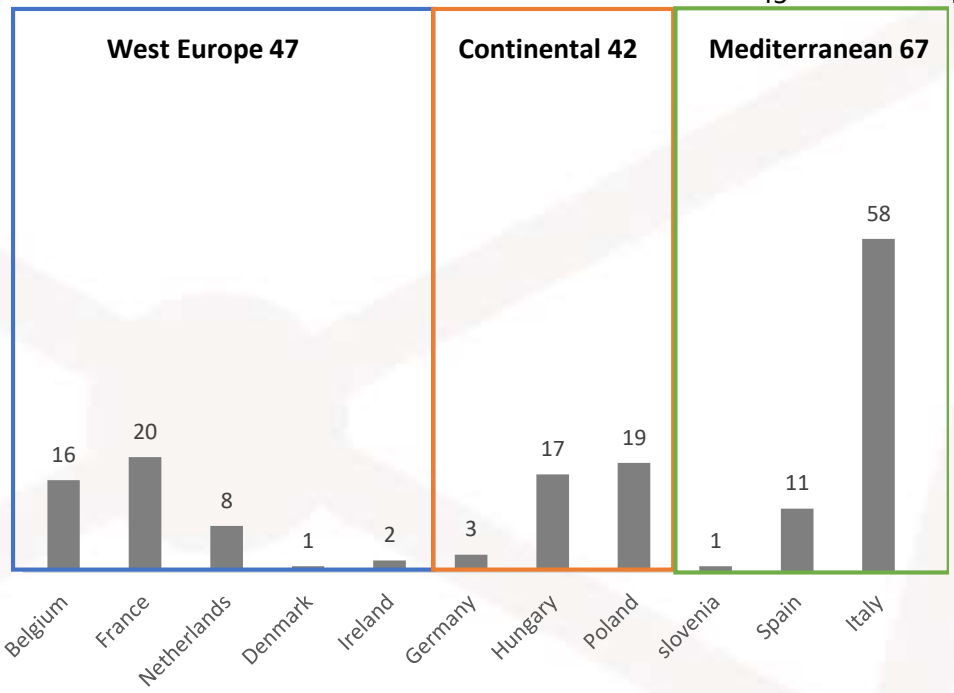
1. Conducting semi-structured interviews with end-users at the different regions and type of agricultural production. These interviews will provide insight into the farmers'/growers' willingness to adopt the practices/products from the shortlist

- Survey: general incentives and bottlenecks
- Mini-survey: willingness to adopt P/T from shortlist and why

General survey

- **156 received by 24 August 2021**

Cultivation	West Europe	Continental	Mediterranean	SUM
Arable cropping (vegetables, cereals, oilseeds and protein crops)	16	17	11	**44**
Orchards (vineyards, fruits, olives)	6	8	11	**25**
Greenhouse (including ornamental crops, flowers, fruits, vegetables)	4	3	8	**15**
Animal husbandry (dairy cows, beef cattle, pigs, poultry, sheep, …) : specify	3	8	1	**12**
Mixed crop-livestock: specify	2	5	1	**8**
Other: (floriculture in open ground or in field containers)	14	1	34	**49**
SUM	45	42	66	**153**



General survey

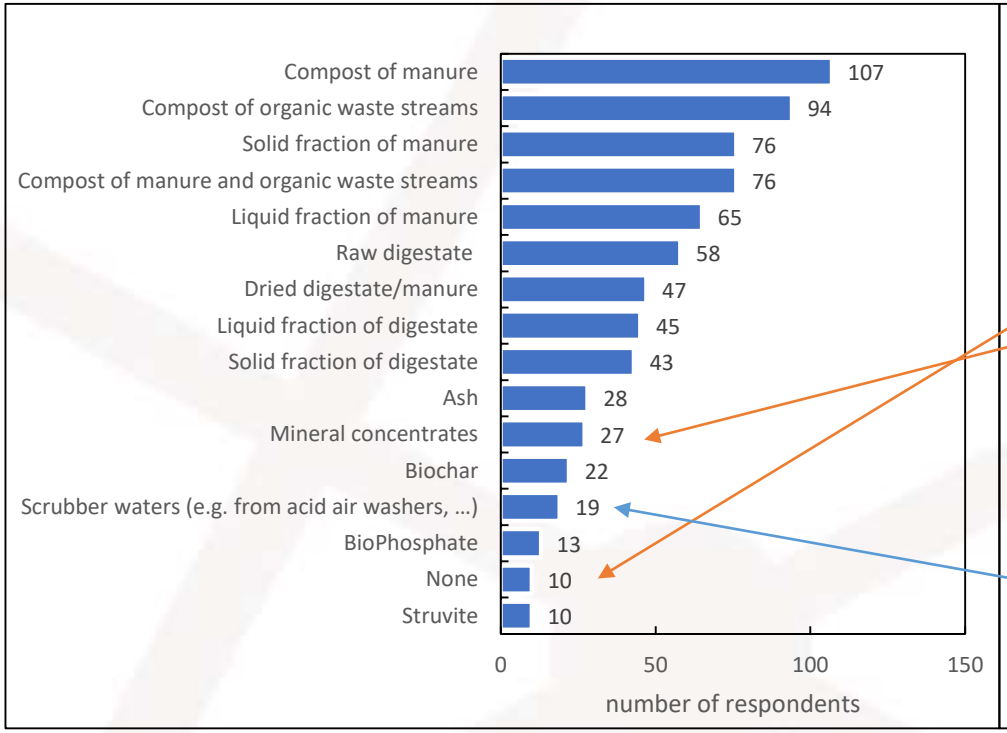
- **Product awareness**

Respondent: 156
Responses: 746

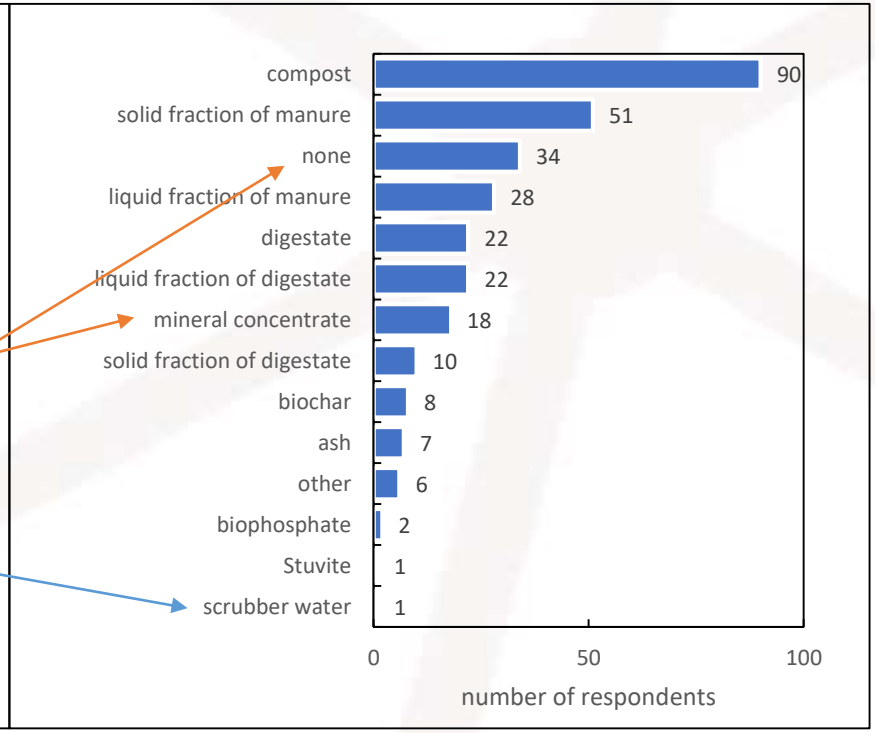
General survey

❑ Products awareness and in-use

products known

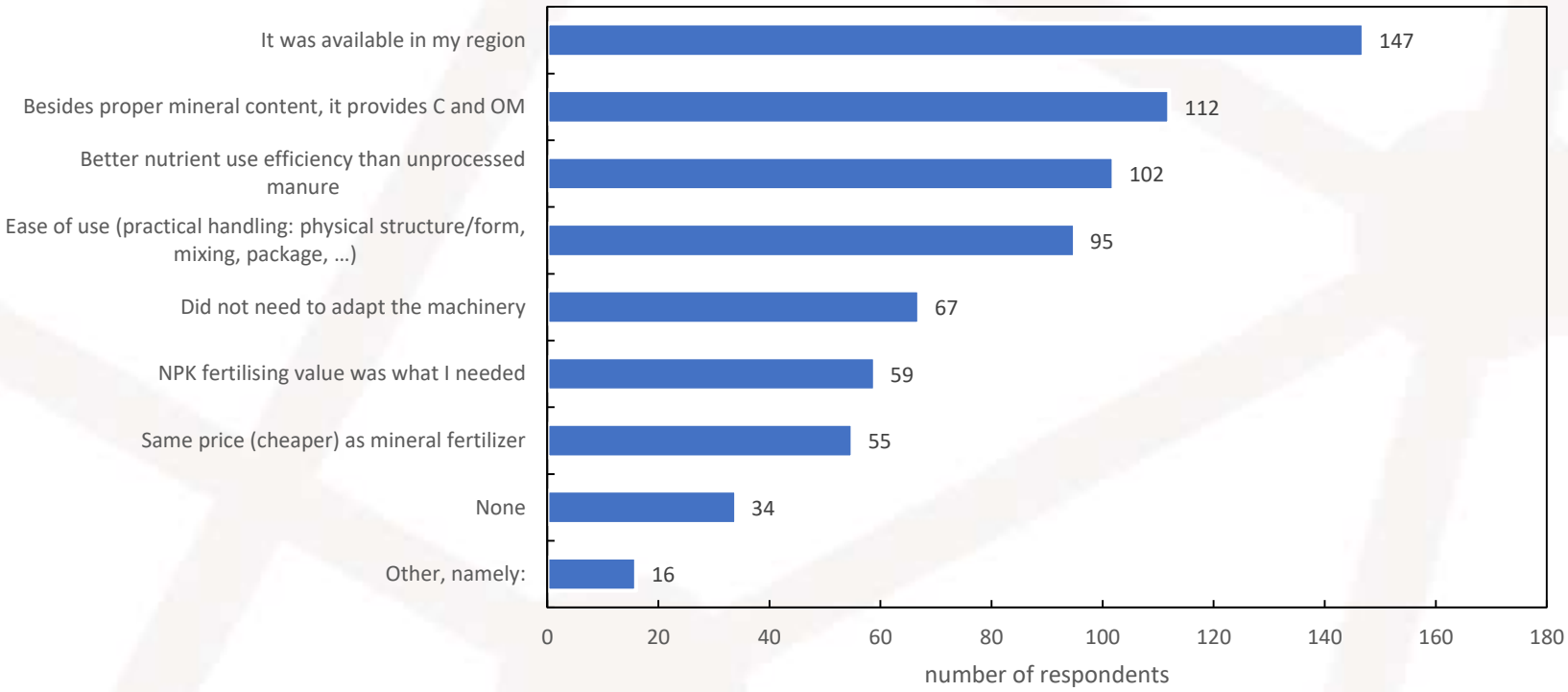


products in-use



General survey

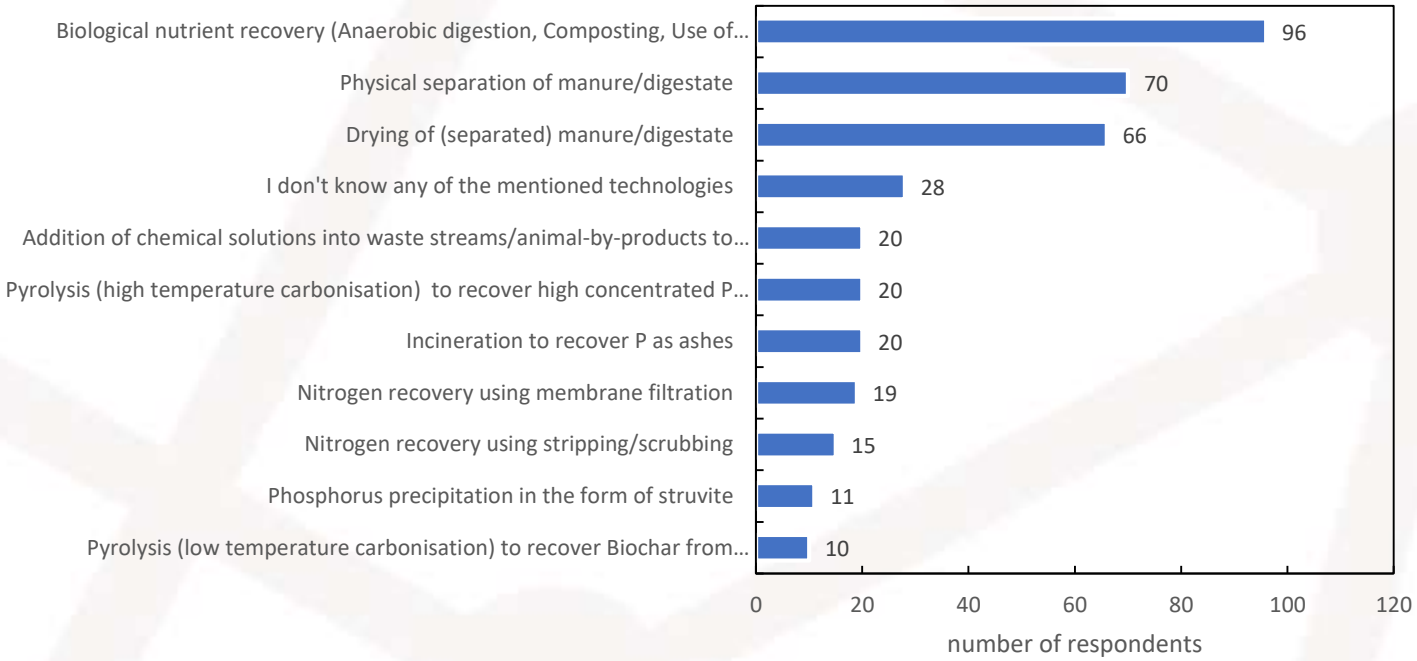
❑ Experience for product in-use



Respondent: 156
Responses: 687

General survey

❑ Technology awareness

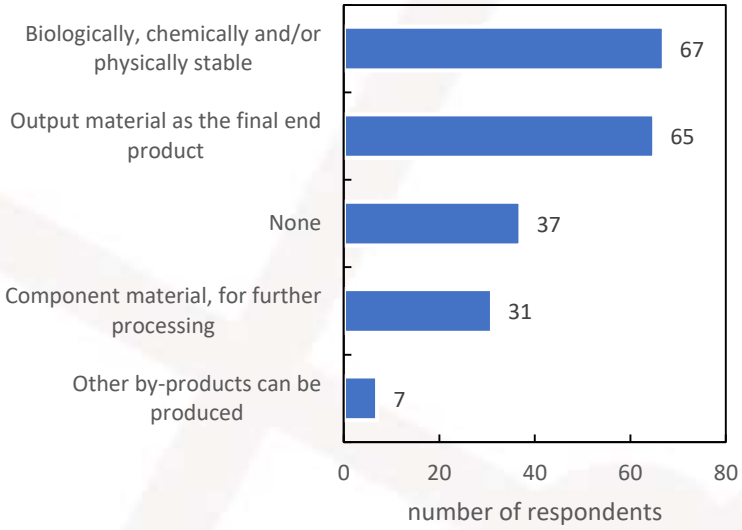


Respondent: 156
Responses: 375

General survey

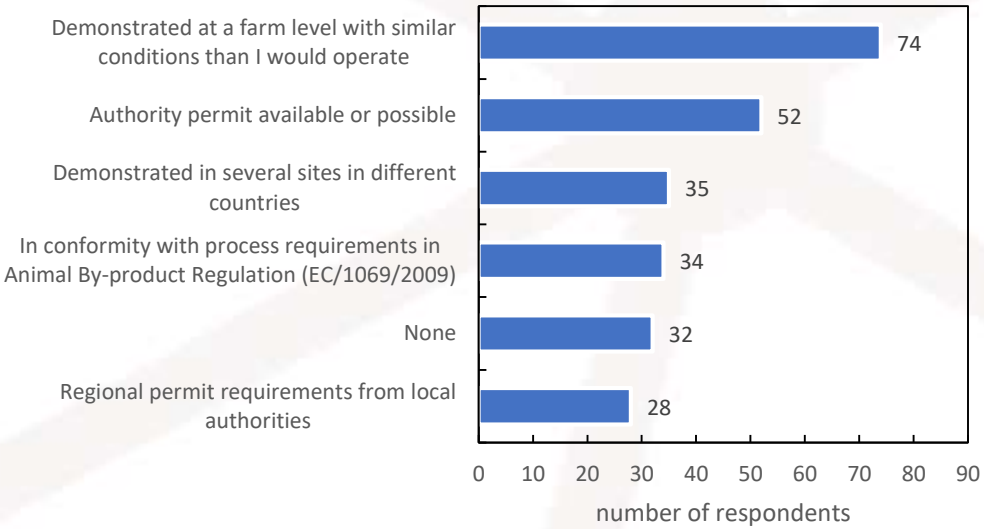
❑ Technology output and maturity

Important output quality



Respondent: 156
Responses: 207

Expected TRL



Respondent: 156
Responses: 255

General survey

❑ The most important information for product

User's opinion

- o Nutrient density and application dose/ha.
- o Nutrient efficiency demonstrated in agricultural practice
- o NPK fertilising value
- o Input material
- o The whole fertiliser composition (NPK + Ca, Mg, S, and micronutrients)
- o Product price based on N+P (or other nutrients) content
- o Advice on how to use the fertiliser (what rate, what crop, what period) and how it is stored (packaging, packaging size, …)
- o Ability to use the same machinery and machine tracks
- o Market potential (Availability to buy at fertiliser supplier/trader)
- o Extended Producer Responsibility Certification/ Legal status

Non-user's opinion

- o Nutrient density and application dose/ha.
- o Input material
- o Nutrient efficiency demonstrated in agricultural practice
- o Product price based on N+P (or other nutrients) content
- o NPK fertilising value
- o The whole fertiliser composition (NPK + Ca, Mg, S, and micronutrients)
- o Advice on how to use the fertiliser (what rate, what crop, what period) and how it is stored (packaging, packaging size, …)
- o Ability to use the same machinery and machine tracks
- o Extended Producer Responsibility Certification/ Legal status
- o Market potential (Availability to buy at fertiliser supplier/trader)

Most important

Less important

General survey

❑ The most important characteristics for product

User's opinion

- o High organic matter content
- o Contribute to reduced CO2 emission during the production compared to mineral fertilizer
- o Besides mineral nutrients, provides C to the soil
- o The nutrient ratio that fits with crop nutrient demand (no extra fertiliser run necessary on the field)
- o Reduce NH4 emission to the environment compared to untreated input
- o Fast/slow nutrient release speed
- o Ease of use (practical handling: physical structure/form, mixing, …)
- o Texture (granule, powder, liquid)
- o Acidic pH

Non-user's opinion

- o The nutrient ratio that fits with crop nutrient demand (no extra fertiliser run necessary on the field)
- o Contribute to reduced CO2 emission during the production compared to mineral fertilizer
- o High organic matter content
- o Besides mineral nutrients, provides C to the soil
- o Reduce NH4 emission to the environment compared to untreated input
- o Fast/slow nutrient release speed
- o Ease of use (practical handling: physical structure/form, mixing, …)
- o Acidic pH
- o Texture (granule, powder, liquid)

Most important

Less important

General survey

❑ The most important to be improved for product

User's opinion

- Physical structure/form (powder, liquid etc.)
- Nutrient content needs to be higher concentrated
- Lower application dose is preferred
- The nutrient ratio needs to be different, and mineralization dynamics need to be different to fit crop need
- It should also provide Organic Matter
- the release rate of nutrients
- Product is not homogenously mixed/Product composition is not homogenous over several applications
- Information on safety (purity, contaminants)
- Accessibility to the vendor
- Legislation/policy, namely:

Non-user's opinion

- Physical structure/form (powder, liquid etc.)
- Nutrient content needs to be higher concentrated
- Lower application dose is preferred
- The nutrient ratio needs to be different, and mineralization dynamics need to be different to fit crop need
- It should also provide Organic Matter
- the release rate of nutrients
- Product is not homogenously mixed/Product composition is not homogenous over several applications
- Legislation/policy, namely:
- Accessibility to the vendor
- Information on safety (purity, contaminants)

Most important

Less important

General survey

❑ Technology characteristics

12. WHAT ARE OR COULD BE REASONS TO INVEST IN N-P RECOVERING TECHNOLOGIES?

- o I want to improve the N-P uptake of organic nutrients by my crop
- o I want to reduce nutrient losses to the environment (soil, water, air)
- o I want to save on fertilising costs
- o I have a waste problem I need to solve (namely: …)
- o I want to recover nutrients that are currently not available for my crop (namely: …)
- o I want to separate different nutrients N-P to be able to apply them separately.
- o I want to reduce my CO2 footprint
- o My customers (or certification scheme) are requesting me to do so
- o Authorities are requesting me to do so
- o I want to have some financial remuneration

14. WHICH OF THE FOLLOWING CHARACTERISTICS OF THE RECOVERY TECHNOLOGIES DO YOU CONSIDER MORE IMPORTANT?

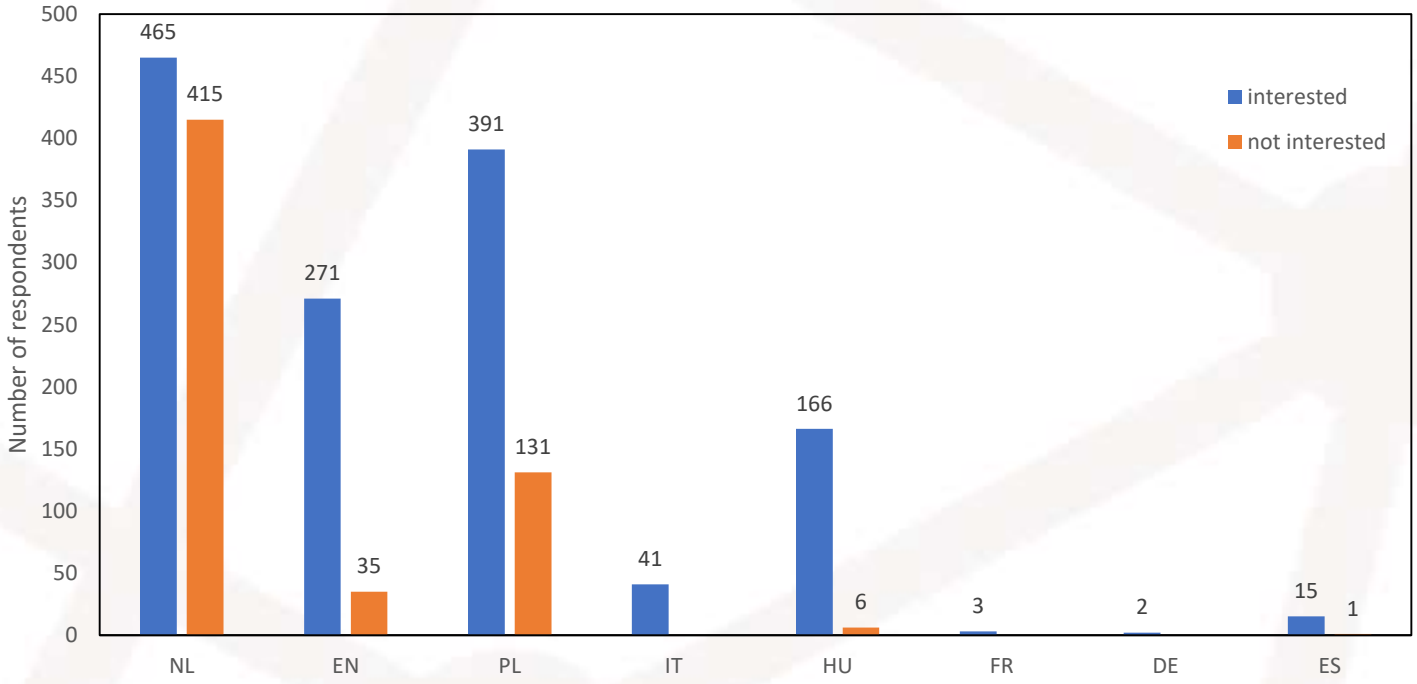
- o High quality of the output products
- o High processing efficiency: Best available technique listing status
- o Low operational, energy and maintenance cost.
- o less than <5 years payback on technology investment
- o The versatility of the input material: Feed flexibility.
- o The environmental and climate performance of the operations
- o Operational Authority permit availability
- o Risk assessment of bio-hazards, pathogens heavy metals, pollutants contaminants, foreign substances
- o Social acceptance New market niches, applications
- o Capacity to handle sufficient input volumes

17. WHICH CHARACTERISTICS DO YOU CONSIDER THE MOST CRUCIAL ISSUE HINDERING THE IMPLEMENTATION OF A SPECIFIC NUTRIENT RECOVERY TECHNOLOGIES THAT STILL REQUIRE IMPROVEMENTS?

- o The recovery process is not cost-effective due to high operational or investment costs
- o The quality of a recovered resource is not high enough to market easily.
- o Compared with conventional production systems, only small quantities of a resource can be recovered
- o Market value is not competitive to commercial products
- o The environmental advantages of using recovery technologies are unknown
- o The usefulness of recovered products might be unknown. New market niches, applications and partners have to be investigated
- o Recovered products are not used on-site, distribution and transport may be challenging due to geographical and temporal discrepancies between supply and demand
- o There are not adequate policies and legal frameworks. A lack of legislation, political will or economic incentives may hinder successful implementation
- o User acceptance may be low due to fears or misconceptions about the risks they pose
- o The use of the recovery process may entail risks to human health due to contaminants or may cause emissions and environmental problems.

Mini-survey

- **In total 1954 responses received by 24-08-2021**



- **Product mini survey** status by 24-08-2021:
- EN:221, DE:2, FR: 1, IT: 45, ES: 8, NL:5, PL:286, HU:129
- **Technology mini survey** status by 24-08-2021:
- EN:85, DE:0, FR:2, IT:8, ES:8, NL:4, PL:236, HU:43
- **BE-NL webinar of T5.3 (14th of January)**: 808 for the 6 presented products (ID 270-272-280-322-593-596) and 72 for the presented technology (ID 292)

Mini-survey

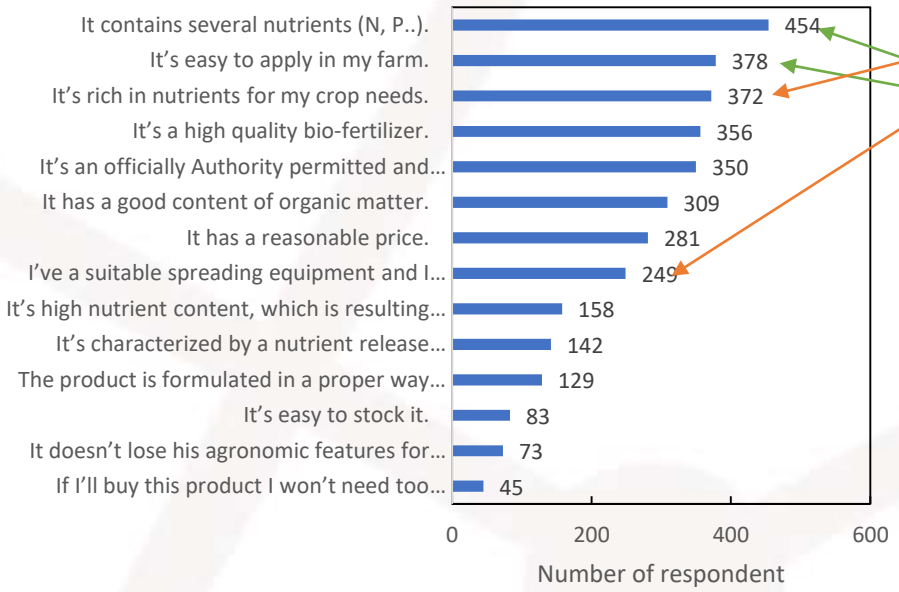
❑ mini survey: top 30 clicked

P/T	ID	NL	NL-BE webinar		FR		DE		PL		HU		IT		ES		EN		SUM	
		interested	interested	no interest	interested	no interest	interested	no interest	interested	no interest	interested	no interest	interested	no interest	interested	no interest	interested	no interest	**interested**	**no interest**
		9	465	415	3	0	2	0	391	131	166	6	41	12	15	1	271	35	**1363**	**591**
P	192						1		9	3	83	3	5			1	97	3	195	10
P	596		116	103						6			1					1	117	110
T	193								5	1	42	1	1		1		67		116	2
P	1571									5	41	2	2		1		72	1	116	8
P	593		93	80					3	4								1	96	85
P	322		72	64					4	4									76	68
P	272		62	57					11				1					1	74	58
P	280		46	45					9	1			1						56	46
T	292	2	38	34					6										46	34
P	270		38	32					5	1							1	1	44	34
P	210								10				3				7	1	20	1
T	207				1				6				3	1	4				14	1
P	208								4	3			5		4		1		14	3
T	257								7								3		10	0
P	264	2							6	1			1						9	1
P	250								4	3			3	1	1			1	8	5
T	253	1							6								1		8	0
T	258								6				2	1					8	1
P	260								7	1			1					2	8	3
P	267								7				1						8	0
P	451								7	1			1						8	1
T	592								7								1		8	0
P	594								8										8	0
P	595								8										8	0
T	1343								6								2		8	0
T	209								7										7	0
T	252								6								1		7	0
T	259								7									1	7	1
T	261				1				6										7	0
T	271								6								1		7	0

Mini-survey

❑ Opinions on specific product

I've already applied it or I'm interested to apply it



I'm not interested to apply it or I do not consider it a good bio-fertilizer.

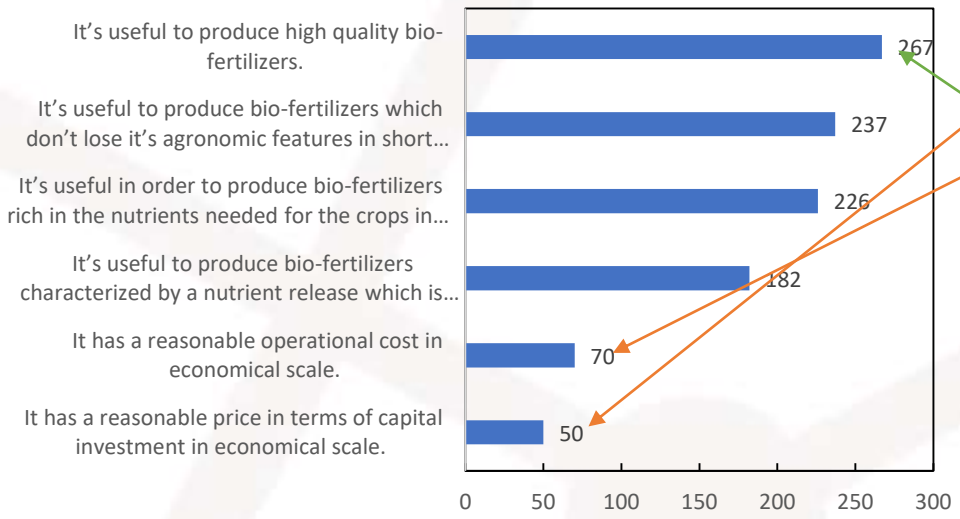
Respondents: 947
Responses: 3379

Respondents: 558
Responses: 1411

Mini-survey

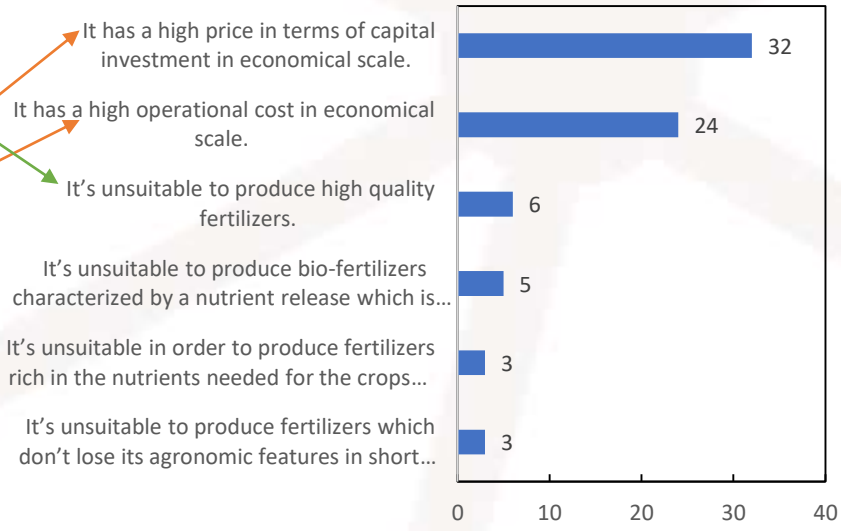
❑ Opinions on specific technology

In my opinion it's an interesting technology for the production of bio-fertilizers



Respondents: 416
Responses: 1032

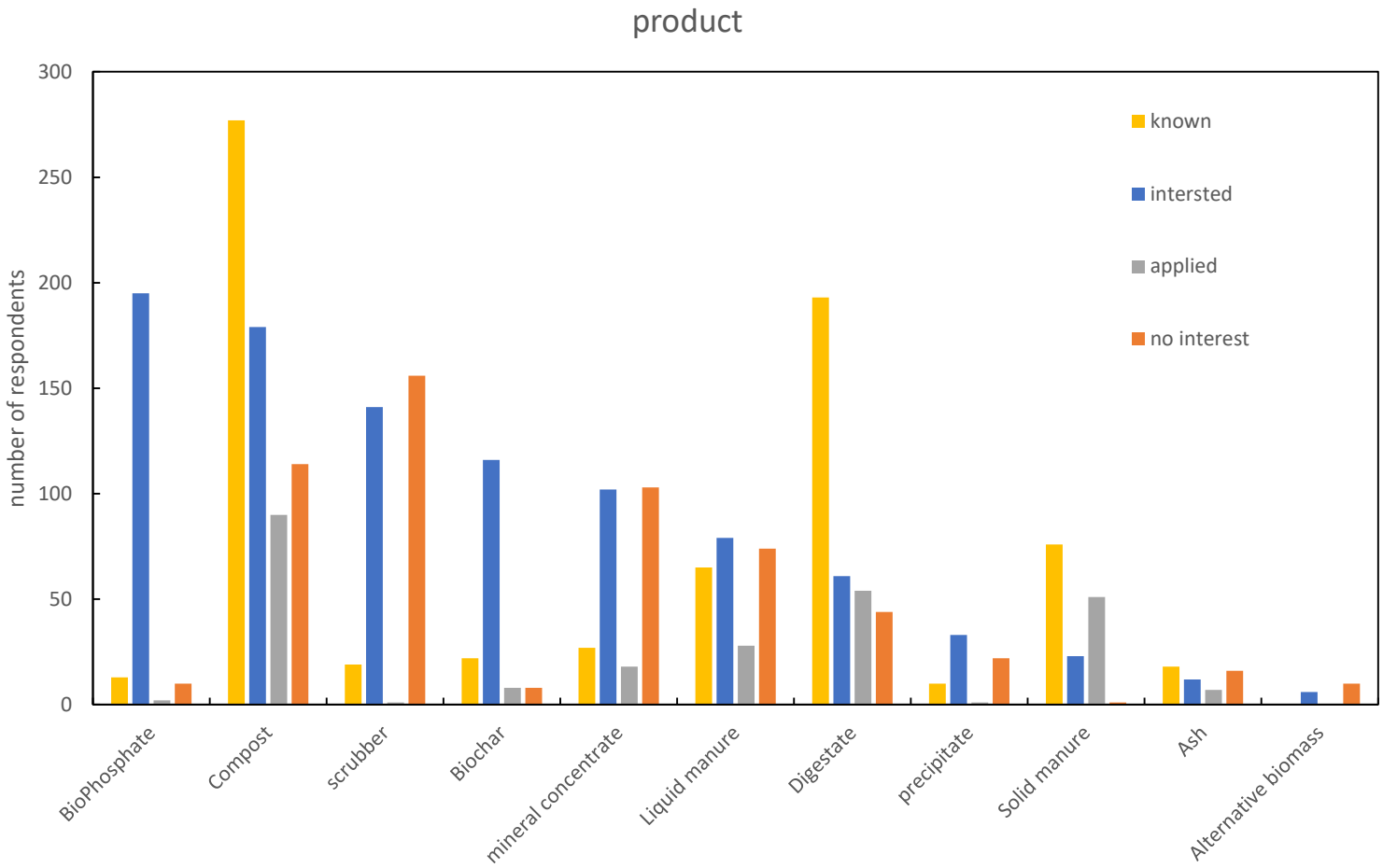
In my opinion it's not an interesting technology for the production of bio-fertilizers



Respondents: 42
Responses: 73

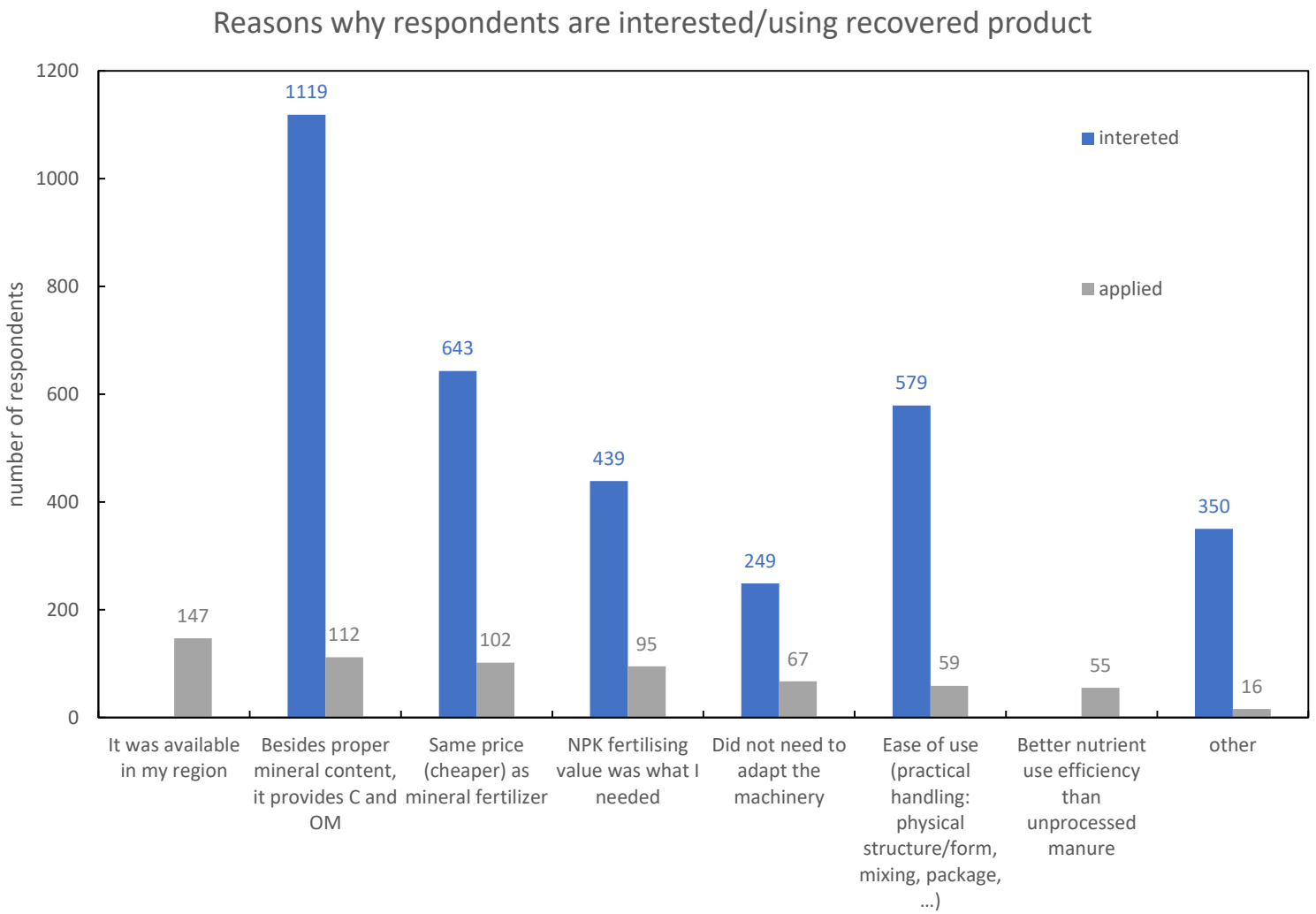
D2.4 Farmers' incentives and bottlenecks

- **Comparison between general and mini survey:**



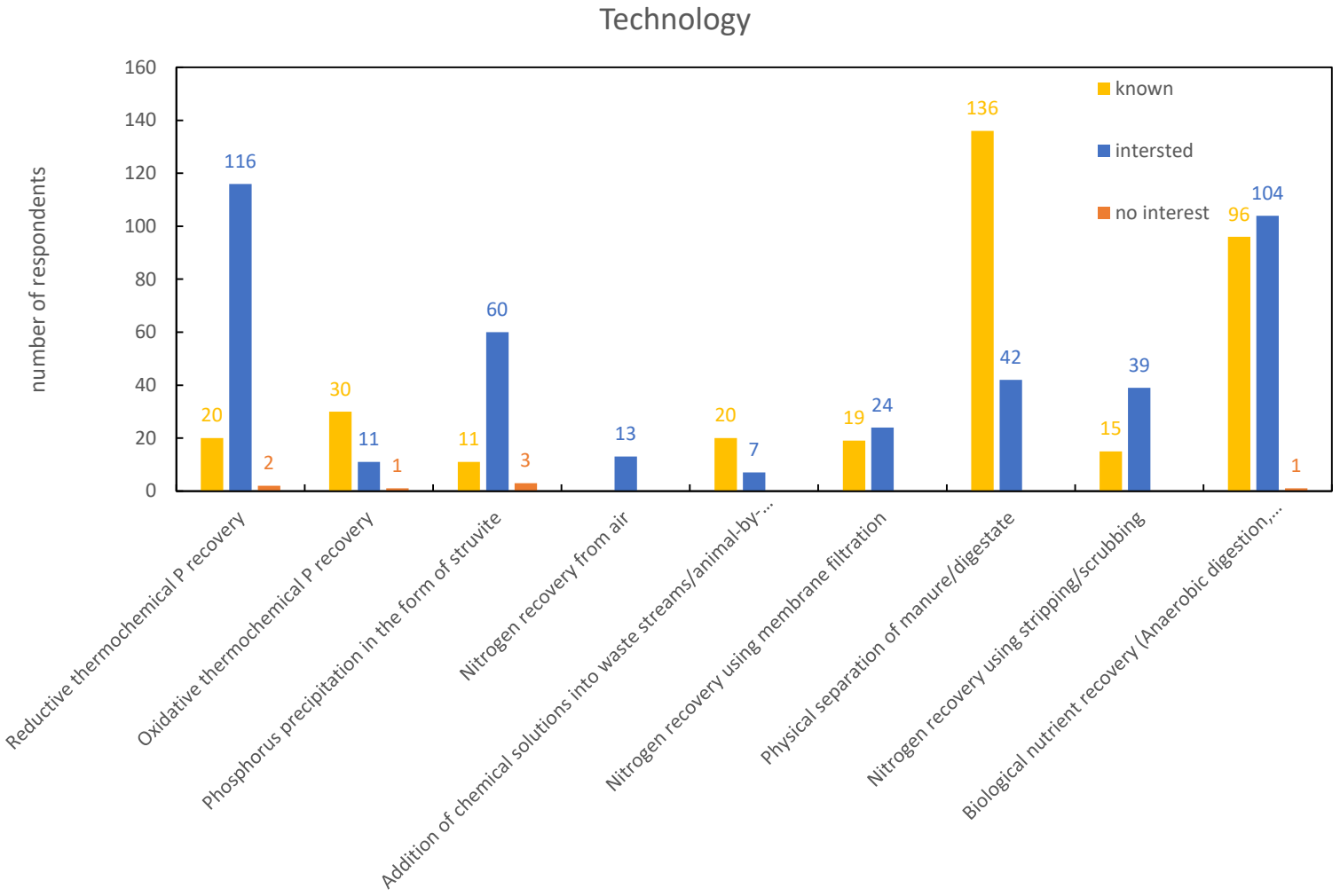
D2.4 Farmers' incentives and bottlenecks

- **Comparison between general and mini survey:**



Farmers' incentives and bottlenecks

- **Comparison between general and mini survey:**



Conclusions

The incentives of nitrogen/phosphorus recovery technologies:

1. It is useful to produce high quality bio-fertilisers rich in the nutrients needed for the crops in my region and which don't lose its agronomic features in short time.
2. It is helpful in improving the N-P uptake of organic nutrients by crop, reducing nutrient losses to the environment (soil, water, air) and reducing the fertilising costs.

The most important benefits of recycling-derived products are summarised as:

1. Besides proper mineral content, it provides C and OM
2. Same price (cheaper) as mineral fertilizer
3. Ease of use (practical handling: physical structure/form, mixing, package, …)
4. Did not need to adapt the machinery

The bottlenecks for farmers/growers are summarised as:

1. Low awareness of the innovative nutrient recovery technologies and the recycling-derived products
2. The capital investment and operation cost of technologies in economical scale are high.
3. The nutrient contents of the recovered products are relatively low.
4. The product is not formulated in a proper way or the release rate is not suitable for crop.

Task 2.4 Evaluation of P/T by end-users

Evaluation of the reduced list of technologies and products by potential end-users: farmer consultation and identification of incentives and bottlenecks for adoption.

2. Second, from opinions in the focus groups with farmers and experts per region and per type of agricultural production it will be prioritized between the practices/products from the shortlist. These focus groups need to take both the experts' opinion and the incentives and bottleneck identified in the interviews into account.

- New round of Farmers questions
- Internal NUTRIMAN Experts
- FAB consultation
- Focus group

Extra call for more response from Farmers

- **7** “Landwirtschaftskammern” of the German States were contacted by UGent, only **1** response received which was negative
- Call in German was sent out by FEhS to **53** contacts
- Call in French was sent out by CA17 newsletter to reach a target group of **6450** farmers
- An article published by APCA in the intranet of the French Chambers of Agriculture, OPERA

Sehr geehrter

Mein Name ist Hongzhen Luo. Ich bin Wissenschaftlerin an der Universität Gent und arbeite an dem EU H2020 Projekt NUTRIMAN. Im Rahmen von NUTRIMAN haben wir eine Bestandsaufnahme der aktuellen innovativen EU-Technologien für die Nährstoffrückgewinnung und damit hergestellte Recyclingprodukte vorgenommen. Unser Ziel ist es, landwirtschaftlichen Praktikern den Wissensstand zu den noch unzureichend genutzten innovativen Forschungsergebnissen mit Praxisreife zur N- und P-Rückgewinnung zu vermitteln.

Auf der NUTRIMAN Farmer-Plattform für Landwirte können Sie die 82 ausgewählten Technologien und Produkte finden.

Um den Wissensaustausch mit Landwirten zu verbessern, sammeln wir die Meinungen von Landwirten über ihre Bereitschaft, recycelte Düngemittel basierend auf der neuen EU-Düngeprodukteverordnung zu verwenden. Wir würden uns freuen, wenn Sie uns Ihr Feedback zu einem bestimmten Recycling-Produkt geben würden, indem Sie die Online-Umfrage ausfüllen, die nur 1 Minute dauert. Sie können ein oder mehrere Produkte auswählen, die Sie interessieren, indem Sie auf die ID auf der rechten Seite klicken.
Derzeit fehlen uns Rückmeldungen von deutschen Landwirten, was sehr wichtig ist, wenn man bedenkt, dass Deutschland einer der wichtigsten landwirtschaftlichen Produktionsstandorte in der EU ist. Wir würden es sehr begrüßen, **wenn Sie die Umfrage (https://nutriman.net/farmer-survey/product-mini-survey-categories-de) an Ihre Kontakte unter den Landwirten weiterleiten oder in Ihren sozialen Medien verbreiten könnten.**

Wir danken Ihnen im Voraus für Ihre freundliche Mitarbeit!

Im Auftrag des UGent Teams, mit freundlichen Grüßen,

Expert pre-selection

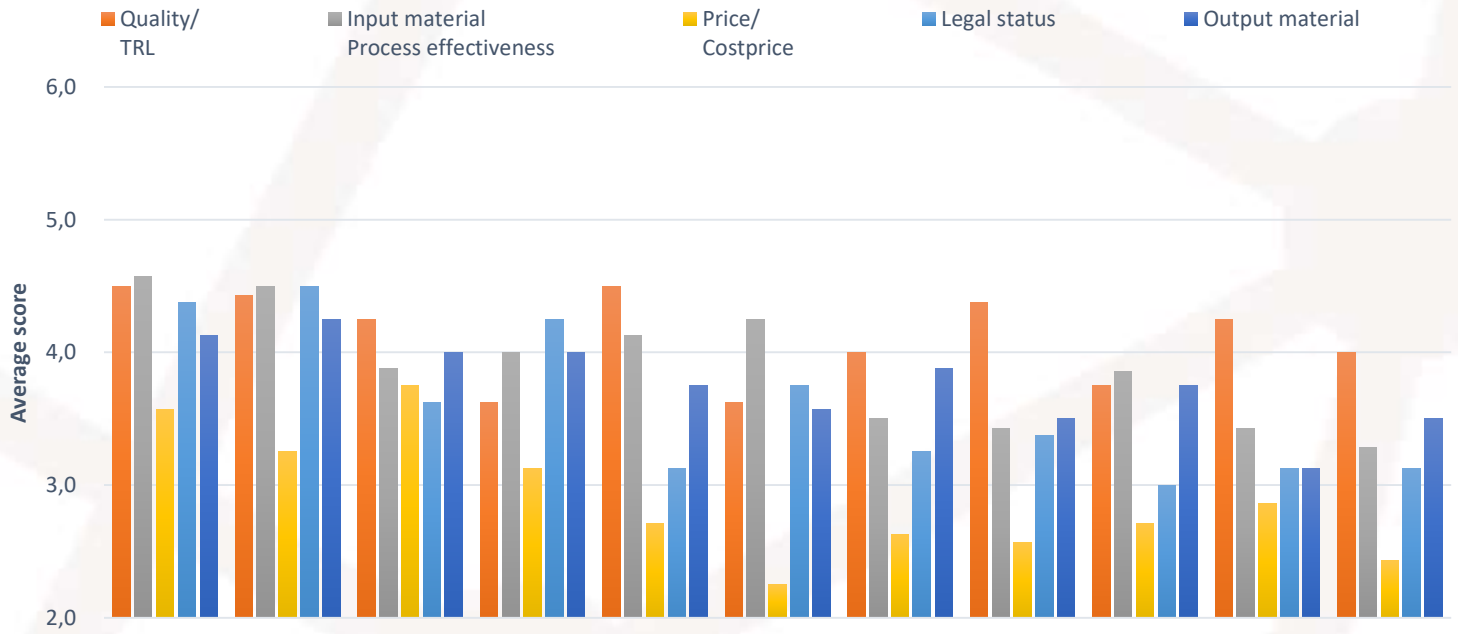
- Using the FAB 1st consultation criteria
- From opinions in the focus groups with experts per region

8 Mach Pre-selection N group	10 March Pre-selection P group	11 March Pre-selection C Group

Expert pre-selection

Expert pre-selection

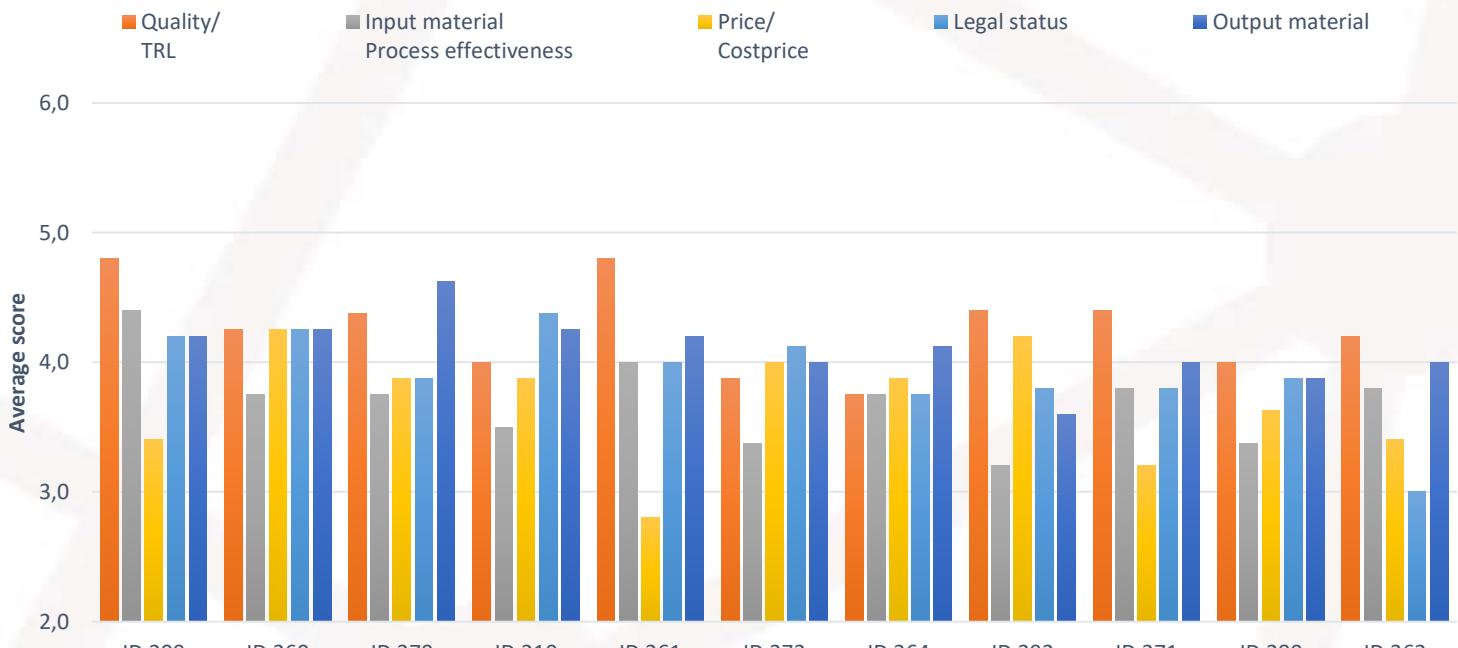
❑ Preselection by experts: Phosphorus group



	ID 193	ID 192	ID 293	ID 1571	ID 294	ID 401	ID 251	ID 399	ID 398	ID 449	ID 317
average	4,2	4,2	3,9	3,8	3,6	3,5	3,5	3,5	3,4	3,4	3,3

Expert pre-selection

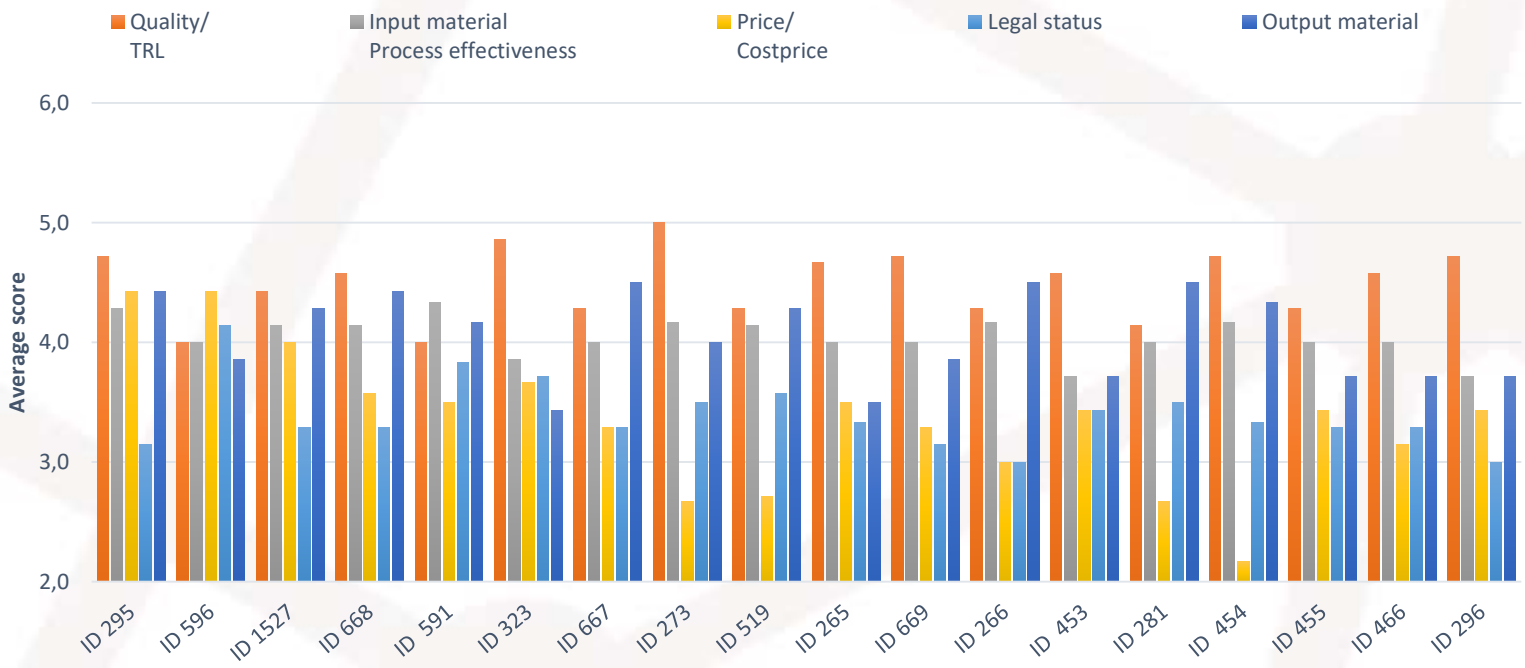
- **Preselection by experts: Compost + digestate group**



	ID 209	ID 260	ID 270	ID 210	ID 261	ID 272	ID 264	ID 292	ID 271	ID 280	ID 262
average	4,2	4,2	4,1	4,0	4,0	3,9	3,9	3,8	3,8	3,8	3,7

Expert pre-selection

- **Preselection by experts: Nitrogen group**



average	4,2	4,1	4,0	4,0	4,0	3,9	3,9	3,9	3,8	3,8	3,8	3,8	3,8	3,8	3,8	3,7	3,7	3,7

Expert pre-selection

❑ Preselected list by experts

Nitrogen	
P/T	**PRODUCT/TECHNOLOGY ID**
P	NH3-water from pig manure or digestate with VP-Hobe Manure Valorisation system (ID:1527)
P	Liquid ammonia sulphate or ammonia nitrate from digestate or slurries stripped and scrubbed with H2SO4 or HNO3 by "Circular Values"process (ID:266)
P	Ammonia sulphate/nitrate from poultry manure by "Poul-AR®" technology (ID:281)
P	Ammonium nitrate from liquid fraction of manure, digestate or other waste stream by "Detricon" process (ID:295)
P	Ammonium nitrate/sulphate from raw digestate with "AMFER" stripping process (ID 454)
P	Ammonium sulphate from pig manure by on-farm scrubbing the air from the stables (ID:596)
P	Ammonium sulphate from co-digestion of corn silage, chicken manure and other biowaste by BENAS process (ID:667)
P	Urine from calves manure by "Geamix" separation at source (ID: 591)
T	N recovery as dried digestate and ammonia sulphate from solid fraction digestate with "Biogas Bree" air scrubbing process (ID:273)
T	N&P recovery as solid manure and mineral concentrate from pig and cattle slurry by belt press sieve and reverse osmosis (ID:519)
T	N Recovery as liquid ammonium sulphate or ammonium nitrate from separated liquid slurry with "Circular Values" stripping and scrubbing proces (ID:265)
T	N recovery as inorganic fertilizer from liquid fraction of manure, digestate or other waste streams with "Detricon" stripping and scrubbing (ID:296)
T	N recovery as ammonia nitrate/sulphate from raw digestate with "AMFER" stripping process (ID:455)
T	N recovery as ammonium sulphate from co-digestion of corn silage, chicken manure and other biowaste by BENAS process (ID:668)
T	N recovery as mineral concentrate, ammonia water and ammonium sulphate from manure/digestate by VP-Hobe manure and digestate valorisation (ID:669)
T	N recovery as urine from pig manure with "VeDoWS" adapted stable construction system (ID:323)
T	N recovery as ammonium sulphate from recovered ammonia sulphate solutions by "TerraSaline S (ASL)" water extraction (ID 453)
T	N&P recovery as ammonia sulphate solution and P-concentrated sludge from digestate, manure and wastewater by TerraOrganic FFT&HEF system (ID:466)

Phosphorous	
P/T	**PRODUCT/TECHNOLOGY ID**
P	PK fertilizer from the ash of poultry manure with "BMC Moerdijk" thermochemical process (ID 401)
P	Struvite from waste water by "Canal de Isabel II S.A." process (ID:251)
P	Struvite from digested sludge and wastewater by "NuReSys" process (ID:293)
P	Terra-Preta biochar product recovered from wood chips and processed by "3R" high temperature pyrolysis process. (ID: 1571)
P	High nutrient dense Bio-Phosphate products recovered from food grade animal bone grist content by "3R zero emission pyrolysis" process (ID:192)
T	P recovery as pelletized struvite starting from digested sludge and wastewater with "NuReSys" crystallisation process (ID:294)
T	P recovery as calcium-phosphate starting from sewage sludge ashes with "Ash2Phos" process (ID:317)
T	P recovery as phosphate salts from drinking water and waste water by the Crystalactor® water treatment process (ID:449)
T	3R Recycle-Reuse-Reduce zero emission pyrolysis technology for phosphorus recovery from food grade animal bone grist for Bio-Phosphate product(ID:193)
T	P recovery as biomass ashes from low plant available phosphorus compounds with "AshDec®" thermochemical process (ID:308)
T	P recovery as PK fertilizer from the ash of poultry manure with "BMC Moerdijk" thermochemical process (ID:309)

Compost-Digestate	
P/T	**PRODUCT/TECHNOLOGY ID**
P	Compost from green waste and digested mixed-waste by "ACEA Pinerolese" process (ID:210)
P	Compost from green waste and food wastes by "Biociclo" process (ID:260)
P	Compost from green waste and pre-digested vegetable, fruit and garden wastes by "IOK Afvalbeheer" process (ID:272)
P	Green compost from green waste by "SMOG" process (ID:290)
P	Liquid and solid (dried) fraction digestate from manure and energy maize by "Agrogas" process (ID:264)
P	High NP pelletized digestate from animal manure and organic waste digestate by "Arbio and NPirriK-project" process (ID:270)
T	N&P recovery as solid digestate starting from manure and slurry combining mobile cavitator and anaerobic digestion (ID:262)
T	N&P recovery as compost starting from green waste and food residues with "BIOCICLO" aerobic digestion process (ID:261)
T	N&P recovery as compost starting from organic waste with farm composting process (ID: 292)
T	N&P recovery as compost starting from green waste and pre-digested mixed-waste with "ACEA Pinerolese" anaerobic digestion and composting process (ID:209)
T	N&P recovery as compost starting from vegetable, fruit and garden wastes with "IOK Afvalbeheer" anaerobic digestion and composting process (ID:271)

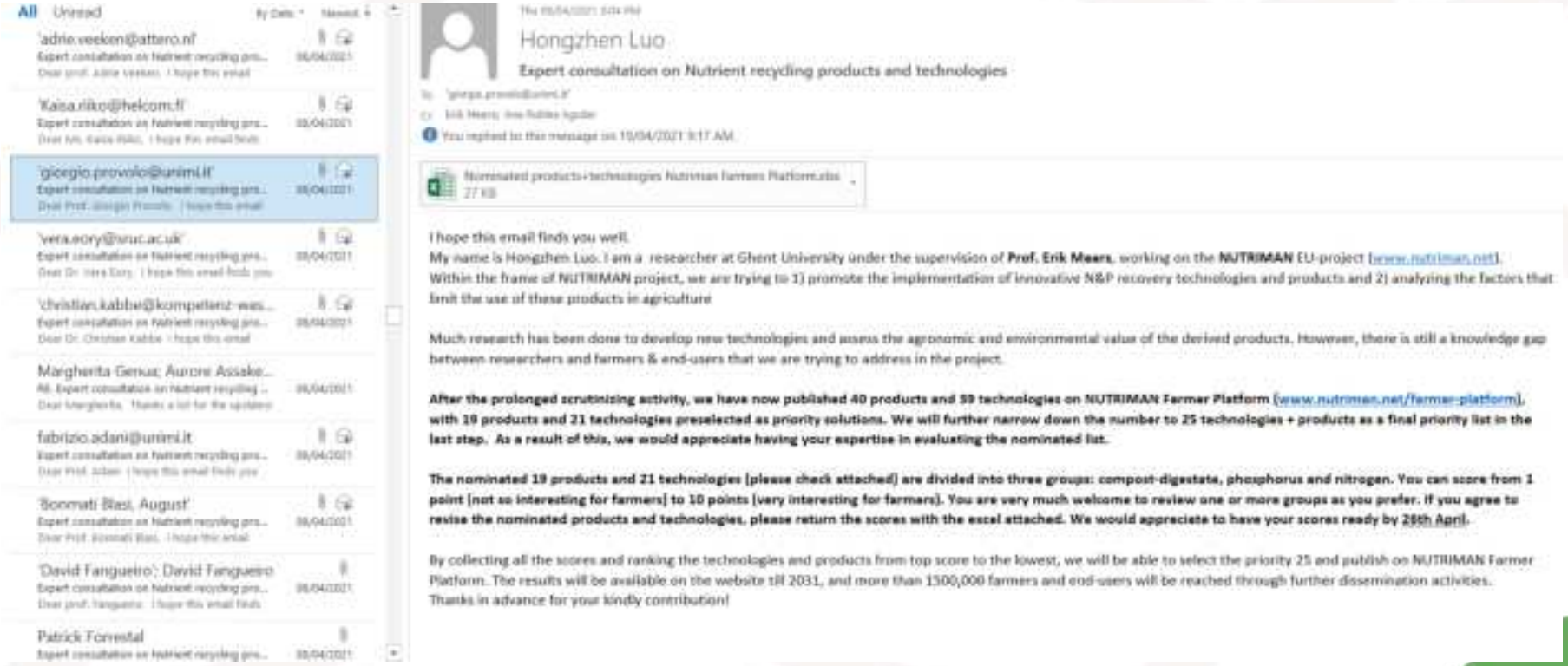
2nd FAB consultation –webinars

2nd FAB consultation

P/T	subcategory	Title	ID	Score	n
Technology	Phosphorus precipitation from wastewater/sludge	P recovery as calcium-phosphate starting from sewage sludge ashes with "Ash2Phos" process (ID:317)	ID 317	8,0	2
Product	Struvite	Struvite from digested sludge and wastewater by "NuReSys" process (ID:293)	ID 293	7,7	3
Product	Bio-phosphate	High nutrient dense Bio-Phosphate products recovered from food grade animal bone grist content by "3R zero emission pyrolysis" process (ID:192)	ID 192	7,7	3
Product	Struvite	Struvite from waste water by "Canal de Isabel II S.A." process (ID:251)	ID 251	7,3	3
Product	Biochar	Terra-Preta biochar product recovered from wood chips and processed by "3R" high temperature pyrolysis process. (ID: 1571)	ID 1571	7,3	3
Technology	Oxidative thermochemical Phosphorus recovery	P recovery as biomass ashes from low plant available phosphorus compounds with "AshDec®" thermochemical process (ID:398)	ID 398	7,0	2
Product	Ash	PK fertilizer from the ash of poultry manure with "BMC Moerdijk" thermochemical process (ID 401)	ID 401	6,7	3
Technology	Phosphorus precipitation from wastewater/sludge	P recovery as phosphate salts from drinking water and waste water by the Crystalactor® water treatment process (ID:449)	ID 449	6,5	2
Technology	Reductive thermochemical Phosphorus recovery	3R Recycle-Reuse-Reduce zero emission pyrolysis technology for phosphorus recovery from food grade animal bone grist for Bio-Phosphate product(ID:193)	ID 193	6,5	2
Technology	Phosphorus precipitation from multi organic wastes	P recovery as pelletized struvite starting from digested sludge and wastewater with "NuReSys" crystallisation process (ID:294)	ID 294	6,0	2
Technology	Oxidative thermochemical Phosphorus recovery	P recovery as PK fertilizer from the ash of poultry manure with "BMC Moerdijk" thermochemical process (ID:399)	ID 399	6,0	2
Product	Digestate	High NP pelletized digestate from animal manure and organic waste digestate by "Arbio and NPirriK-project" process (ID:270)	ID 270	8,7	3
Technology	Composting	N&P recovery as compost starting from green waste and food residues with "BIOCICLO" aerobic digestion process (ID:261)	ID 261	8,0	3
Technology	Anaerobic digestion + composting	N&P recovery as compost starting from green waste and pre-digested mixed-waste with "ACEA Pinerolese" anaerobic digestion and composting process (ID:209)	ID 209	8,0	3
Product	Compost	Compost from green waste and food wastes by "Biociclo" process (ID:260)	ID 260	7,7	3
Product	Digestate	Liquid and solid (dried) fraction digestate from manure and energy maize by "Agrogas" process (ID:264)	ID 264	7,7	3
Product	Compost	Compost from green waste and pre-digested vegetable, fruit and garden wastes by "IOK Afvalbeheer" process (ID:272)	ID 272	7,3	3
Technology	Composting	N&P recovery as compost starting from organic waste with farm composting process (ID: 292)	ID 292	7,3	3
Technology	Anaerobic digestion + composting	N&P recovery as compost starting from vegetable, fruit and garden wastes with "IOK Afvalbeheer" anaerobic digestion and composting process (ID:271)	ID 271	7,3	3
Product	Compost	Green compost from green waste by "IMOG" process (ID:280)	ID 280	7,0	3
Technology	Anaerobic digestion	N&P recovery as solid digestate starting from manure and slurry combining mobile cavitator and anaerobic digestion (ID:262)	ID 262	7,0	3
Product	Compost	Compost from green waste and digested mixed-waste by "ACEA Pinerolese" process (ID:210)	ID 210	6,7	3
Technology	Physical separation	N recovery as urine from pig manure with "VeDoWS" adapted stable construction system (ID:323)	ID 323	8,5	2
Product	Ammonium nitrate/sulphate	Ammonium sulphate from pig manure by on-farm scrubbing the air from the stables (ID:596)	ID 596	8,0	3
Technology	Nitrogen recovery from air	N recovery as dried digestate and ammonia sulphate from solid fraction digestate with "Biogas Bree" air scrubbing process (ID:273)	ID 273	8,0	2
Technology	Stripping + Scrubbing	N recovery as inorganic fertilizer from liquid fraction of manure, digestate or other waste streams with "Detricon" stripping and scrubbing (ID:296)	ID 296	8,0	2
Technology	Stripping + Scrubbing	N recovery as ammonium sulphate from co-digestion of corn silage, chicken manure and other biowaste by BENAS process (ID:668)	ID 668	8,0	2
Product	Ammonium nitrate/sulphate	Ammonium nitrate from liquid fraction of manure, digestate or other waste stream by "Detricon" process (ID:295)	ID 295	7,7	3
Technology	Stripping + Scrubbing	N recovery as ammonia nitrate/sulphate from raw digestate with "AMFER" stripping process (ID:455)	ID 455	7,5	2
Technology	Physical separation	N recovery as ammonium sulphate from recovered ammonia sulphate solutions by "TerraSaline S (ASL)" water extraction (ID 453)	ID 453	7,5	2
Product	Ammonium nitrate/sulphate	Ammonia sulphate/nitrate from poultry manure by "Poul-AR®" technology (ID:281)	ID 281	7,3	3
Product	Ammonium nitrate/sulphate	Ammonium nitrate/sulphate from raw digestate with "AMFER" stripping process (ID 454)	ID 454	7,0	3
Product	Ammonium nitrate/sulphate	Ammonium sulphate from co-digestion of corn silage, chicken manure and other biowaste by BENAS process (ID:667)	ID 667	7,0	3
Technology	Membrane filtration	N&P recovery as solid manure and mineral concentrate from pig and cattle slurry by belt press sieve and reverse osmosis (ID:519)	ID 519	6,5	2
Technology	Stripping + Scrubbing	N Recovery as liquid ammonium sulphate or ammonium nitrate from separated liquid slurry with "Circular Values" stripping and scrubbing proces (ID:265)	ID 265	6,5	2
Technology	Physical separation	N&P recovery as ammonia sulphate solution and P-concentrated sludge from digestate, manure and wastewater by TerraOrganic FFT&HEF system (ID:466)	ID 466	6,5	2
Technology	Stripping + Scrubbing	N recovery as mineral concentrate, ammonia water and ammonium sulphate from manure/digestate by VP-Hobe manure and digestate valorisation (ID:669)	ID 669	6,0	2
Product	Ammonium nitrate/sulphate	Liquid ammonia sulphate or ammonia nitrate from digestate or slurries stripped and scrubbed with H2SO4 or HNO3 by "Circular Values"process (ID:266)	ID 266	5,7	3
Product	Liquid manure	Urine from calves manure by "Geamix" separation at source (ID: 591)	ID 591	5,3	3
Product	Scrubber water	NH3-water from pig manure or digestate with VP-Hobe Manure Valorisation system (ID:1527)	ID 1527	4,3	3

Focus Group consultation by email

- **13** Experts from Focus Group **Nutrient recycling** were contacted
- **5** answers received: **1** rejected to score; **1** returned comments and scores for three products; **3** returned scores for each preselected T&P in the three groups



All Unread

'adrie.veeken@attero.nl'

'Kaisa.riiko@hekom.fi'

'giorgio.provolo@unimi.it'

'vera.eory@sruc.ac.uk'

'christian.kabbe@kompetenz-was...

Margherita Genuc Aurore Assake...

fabrizio.adani@unimi.it

'Bonmati Blasi, August'

'David Fangueiro'; David Fangueiro

Patrick Forestal

Hongzhen Luo

Expert consultation on Nutrient recycling products and technologies

You replied to this message on 19/04/2021 9:17 AM.

Nominated products+technologies Nutriman Farmers Platform.xlsx
27 KB

I hope this email finds you well.
My name is Hongzhen Luo. I am a researcher at Ghent University under the supervision of **Prof. Erik Meers**, working on the **NUTRIMAN** EU-project (www.nutriman.net).
Within the frame of NUTRIMAN project, we are trying to 1) promote the implementation of innovative N&P recovery technologies and products and 2) analyzing the factors that limit the use of these products in agriculture

Much research has been done to develop new technologies and assess the agronomic and environmental value of the derived products. However, there is still a knowledge gap between researchers and farmers & end-users that we are trying to address in the project.

After the prolonged scrutinizing activity, we have now published 40 products and 39 technologies on NUTRIMAN Farmer Platform (www.nutriman.net/farmer-platform), with 19 products and 21 technologies preselected as priority solutions. We will further narrow down the number to 25 technologies + products as a final priority list in the last step. As a result of this, we would appreciate having your expertise in evaluating the nominated list.

The nominated 19 products and 21 technologies (please check attached) are divided into three groups: compost-digestate, phosphorus and nitrogen. You can score from 1 point (not so interesting for farmers) to 10 points (very interesting for farmers). You are very much welcome to review one or more groups as you prefer. If you agree to revise the nominated products and technologies, please return the scores with the excel attached. We would appreciate to have your scores ready by 28th April.

By collecting all the scores and ranking the technologies and products from top score to the lowest, we will be able to select the priority 25 and publish on NUTRIMAN Farmer Platform. The results will be available on the website till 2031, and more than 1500,000 farmers and end-users will be reached through further dissemination activities.
Thanks in advance for your kindly contribution!

Focus group consultation

P/T	subcategory	Title	Score	n
Product	Struvite	Struvite from digested sludge and wastewater by "NuReSys" process (ID:293)	6,5	4
Product	Ash	PK fertilizer from the ash of poultry manure with "BMC Moerdijk" thermochemical process (ID 401)	6,3	4
Product	Struvite	Struvite from waste water by "Canal de Isabel II S.A." process (ID:251)	6,3	4
Product	Biochar	Terra-Preta biochar product recovered from wood chips and processed by “3R” high temperature pyrolysis process. (ID: 1571)	5,8	4
Product	Bio-phosphate	High nutrient dense Bio-Phosphate products recovered from food grade animal bone grist content by "3R zero emission pyrolysis" process (ID:192)	5,3	4
Technology	Oxidative thermochemical Phosphorus recovery	P recovery as biomass ashes from low plant available phosphorus compounds with "AshDec®" thermochemical process (ID:398)	5,3	4
Technology	Oxidative thermochemical Phosphorus recovery	P recovery as PK fertilizer from the ash of poultry manure with "BMC Moerdijk" thermochemical process (ID:399)	5,0	4
Technology	Phosphorus precipitation from wastewater/sludge	P recovery as calcium-phosphate starting from sewage sludge ashes with "Ash2Phos" process (ID:317)	4,8	4
Technology	Phosphorus precipitation from multi organic wastes	P recovery as pelletized struvite starting from digested sludge and wastewater with "NuReSys" crystallisation process (ID:294)	4,5	4
Technology	Phosphorus precipitation from wastewater/sludge	P recovery as phosphate salts from drinking water and waste water by the Crystalactor® water treatment process (ID:449)	4,5	4
Technology	Reductive thermochemical Phosphorus recovery	3R Recycle-Reuse-Reduce zero emission pyrolysis technology for phosphorus recovery from food grade animal bone grist for Bio-Phosphate product(ID:193)	4,5	4

Product	Digestate	High NP pelletized digestate from animal manure and organic waste digestate by "Arbio and NPirriK-project" process (ID:270)	7,2	5
Technology	Composting	N&P recovery as compost starting from organic waste with farm composting process (ID: 292)	6,3	4
Technology	Anaerobic digestion + composting	N&P recovery as compost starting from vegetable, fruit and garden wastes with "IOK Afvalbeheer" anaerobic digestion and composting process (ID:271)	6,3	4
Product	Digestate	Liquid and solid (dried) fraction digestate from manure and energy maize by "Agrogas" process (ID:264)	6,1	5
Product	Compost	Compost from green waste and digested mixed-waste by "ACEA Pinerolese" process (ID:210)	6,0	4
Product	Compost	Compost from green waste and food wastes by "Biociclo" process (ID:260)	6,0	4
Technology	Composting	N&P recovery as compost starting from green waste and food residues with "BIOCICLO" aerobic digestion process (ID:261)	6,0	4
Technology	Anaerobic digestion + composting	N&P recovery as compost starting from green waste and pre-digested mixed-waste with "ACEA Pinerolese" anaerobic digestion and composting process (ID:209)	6,0	4
Product	Compost	Compost from green waste and pre-digested vegetable, fruit and garden wastes by "IOK Afvalbeheer" process (ID:272)	5,5	4
Product	Compost	Green compost from green waste by "IMOG" process (ID:280)	5,5	4
Technology	Anaerobic digestion	N&P recovery as solid digestate starting from manure and slurry combining mobile cavitator and anaerobic digestion (ID:262)	5,3	4

Product	Ammonium nitrate/sulphate	Ammonia sulphate/nitrate from poultry manure by "Poul-AR®" technology (ID:281)	7,3	4
Product	Ammonium nitrate/sulphate	Ammonium nitrate/sulphate from raw digestate with "AMFER" stripping process (ID 454)	7,3	4
Product	Ammonium nitrate/sulphate	Liquid ammonia sulphate or ammonia nitrate from digestate or slurries stripped and scrubbed with H2SO4 or HNO3 by "Circular Values"process (ID:266)	7,0	4
Product	Ammonium nitrate/sulphate	Ammonium nitrate from liquid fraction of manure, digestate or other waste stream by "Detricon" process (ID:295)	7,0	4
Product	Ammonium nitrate/sulphate	Ammonium sulphate from pig manure by on-farm scrubbing the air from the stables (ID:596)	6,8	4
Product	Scrubber water	NH3-water from pig manure or digestate with VP-Hobe Manure Valorisation system (ID:1527)	5,8	4
Product	Ammonium nitrate/sulphate	Ammonium sulphate from co-digestion of corn silage, chicken manure and other biowaste by BENAS process (ID:667)	5,8	4
Technology	Stripping + Scrubbing	N recovery as mineral concentrate, ammonia water and ammonium sulphate from manure/digestate by VP-Hobe manure and digestate valorisation (ID:669)	5,8	4
Technology	Membrane filtration	N&P recovery as solid manure and mineral concentrate from pig and cattle slurry by belt press sieve and reverse osmosis (ID:519)	5,5	4
Technology	Stripping + Scrubbing	N Recovery as liquid ammonium sulphate or ammonium nitrate from separated liquid slurry with "Circular Values" stripping and scrubbing proces (ID:265)	5,5	4
Technology	Stripping + Scrubbing	N recovery as inorganic fertilizer from liquid fraction of manure, digestate or other waste streams with "Detricon" stripping and scrubbing (ID:296)	5,5	4
Technology	Stripping + Scrubbing	N recovery as ammonia nitrate/sulphate from raw digestate with "AMFER" stripping process (ID:455)	5,5	4
Technology	Physical separation	N&P recovery as ammonia sulphate solution and P-concentrated sludge from digestate, manure and wastewater by TerraOrganic FFT&HEF system (ID:466)	5,5	4
Technology	Stripping + Scrubbing	N recovery as ammonium sulphate from co-digestion of corn silage, chicken manure and other biowaste by BENAS process (ID:668)	5,3	4
Technology	Nitrogen recovery from air	N recovery as dried digestate and ammonia sulphate from solid fraction digestate with "Biogas Bree" air scrubbing process (ID:273)	5,0	4
Technology	Physical separation	N recovery as ammonium sulphate from recovered ammonia sulphate solutions by “TerraSaline S (ASL)” water extraction (ID 453)	4,8	4
Product	Liquid manure	Urine from calves manure by “Geamix” separation at source (ID: 591)	4,3	4
Technology	Physical separation	N recovery as urine from pig manure with "VeDoWS" adapted stable construction system (ID:323)	4,3	4

T2.5 Development of priority list

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Summary of FAB + Focus group selection

Technology category as in the GA	Technology sub-category	SUM	Expert preselection	FAB + Focus group
T2.2.1 Thermochemical nutrient recovery	Reductive thermochemical P recovery	1	1	
	Multi feed reductive thermochemical process	0		
	Oxidative thermochemical P recovery	2	2	0
T2.2.2 P precipitation from liquid manure, waste water and drain water	Phosphorus precipitation from manure/digestate	2	0	
	Phosphorus precipitation from multi organic wastes	2	1	
	Phosphorus precipitation from wastewater/sludge	4	2	0
T2.2.3 Physic-chemical nitrogen recovery from manure, digestate and wastewaters: separation, stripping and membrane processes	Nitrogen recovery from air	2	1	
	Chemical addition	1	0	
	Membrane filtration	4	1	
	Physical separation	6	3	
	Stripping + Scrubbing	6	5	3
T2.2.4 Biological nutrient recovery: composting, anaerobic digestion	Anaerobic digestion	2	1	
	Composting	4	2	
	Anaerobic digestion + composting	2	2	
	Microalgae/duckweed/insect/ enzyme technology	1	0	5
		39	21	8

Product category as in the GA	Product sub-category	SUM	Expert preselection	FAB + Focus group
T2.3.1 Biochar & Bio-Phosphate	BioPhosphate	1	1	
	Biochar	1	1	1
T2.3.2 Ash	Ash	3	1	1
T2.3.3 Struvite & other P-product	Struvite	4	2	
	Precipitated Calcium Phosphate	1	0	
	Phosphoric-acid	0		
	Phosphorus precipitate	0		3
T2.3.4 Compost & Digestate (and biomass)	Compost	7	4	
	Digestate	4	2	
	Alternative biomass	1	0	6
T2.3.5 Scrubber water & mineral nitrogen concentrates	Scrubber water	1	1	
	Ammonium nitrate/sulphate	8	6	
	Mineral concentrate	4	0	
	Solid manure	3	0	
	Liquid manure	2	1	6
		40	19	17

T2.5 final priority list of 25

P/T	Sub-categories	Title	ID	score	votes
Product	Digestate	High NP pelletized digestate from animal manure and organic waste digestate by "Arbio and NPirriK-project" process (ID:270)	ID 270	7.75	8
Product	Ammonium nitrate/sulphate	Ammonia sulphate/nitrate from poultry manure by "Poul-AR®" technology (ID:281)	ID 281	7.29	7
Product	Ammonium nitrate/sulphate	Ammonium nitrate from liquid fraction of manure, digestate or other waste stream by "Detricon" process (ID:295)	ID 295	7.29	7
Product	Ammonium nitrate/sulphate	Ammonium sulphate from pig manure by on-farm scrubbing the air from the stables (ID:596)	ID 596	7.29	7
Product	Ammonium nitrate/sulphate	Ammonium nitrate/sulphate from raw digestate with "AMFER" stripping process (ID 454)	ID 454	7.14	7
Product	Struvite	Struvite from digested sludge and wastewater by "NuReSys" process (ID:293)	ID 293	7.00	7
Technology	Composting	N&P recovery as compost starting from green waste and food residues with "BIOCICLO" aerobic digestion process (ID:261)	ID 261	6.86	7
Technology	Anaerobic digestion + composting	N&P recovery as compost starting from green waste and pre-digested mixed-waste with "ACEA Pinerolese" anaerobic digestion and composting process (ID:209)	ID 209	6.86	7
Product	Struvite	Struvite from waste water by "Canal de Isabel II S.A." process (ID:251)	ID 251	6.71	7
Product	Compost	Compost from green waste and food wastes by "Biociclo" process (ID:260)	ID 260	6.71	7
Technology	Composting	N&P recovery as compost starting from organic waste with farm composting process (ID: 292)	ID 292	6.71	7
Technology	Anaerobic digestion + composting	N&P recovery as compost starting from vegetable, fruit and garden wastes with "IOK Afvalbeheer" anaerobic digestion and composting process (ID:271)	ID 271	6.71	7
Product	Digestate	Liquid and solid (dried) fraction digestate from manure and energy maize by "Agrogas" process (ID:264)	ID 264	6.69	8
Product	Ash	PK fertilizer from the ash of poultry manure with "BMC Moerdijk" thermochemical process (ID 401)	ID 401	6.43	7
Product	Biochar	Terra-Preta biochar product recovered from wood chips and processed by “3R” high temperature pyrolysis process. (ID: 1571)	ID 1571	6.43	7
Product	Ammonium nitrate/sulphate	Liquid ammonia sulphate or ammonia nitrate from digestate or slurries stripped and scrubbed with H2SO4 or HNO3 by "Circular Values"process (ID:266)	ID 266	6.43	7
Technology	Stripping + Scrubbing	N recovery as inorganic fertilizer from liquid fraction of manure, digestate or other waste streams with "Detricon" stripping and scrubbing (ID:296)	ID 296	6.33	6
Product	Bio-phosphate	High nutrient dense Bio-Phosphate products recovered from food grade animal bone grist content by "3R zero emission pyrolysis" process (ID:192)	ID 192	6.29	7
Product	Compost	Compost from green waste and digested mixed-waste by "ACEA Pinerolese" process (ID:210)	ID 210	6.29	7
Product	Compost	Compost from green waste and pre-digested vegetable, fruit and garden wastes by "IOK Afvalbeheer" process (ID:272)	ID 272	6.29	7
Product	Ammonium nitrate/sulphate	Ammonium sulphate from co-digestion of corn silage, chicken manure and other biowaste by BENAS process (ID:667)	ID 667	6.29	7
Technology	Stripping + Scrubbing	N recovery as ammonia nitrate/sulphate from raw digestate with "AMFER" stripping process (ID:455)	ID 455	6.17	6
Technology	Stripping + Scrubbing	N recovery as ammonium sulphate from co-digestion of corn silage, chicken manure and other biowaste by BENAS process (ID:668)	ID 668	6.17	6
Product	Compost	Green compost from green waste by "IMOG" process (ID:280)	ID 280	6.14	7
Technology	Anaerobic digestion	N&P recovery as solid digestate starting from manure and slurry combining mobile cavitator and anaerobic digestion (ID:262)	ID 262	6.00	7

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