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D5.5 Report on results of actions for knowledge exchange and capacity building (4 focus groups) providing focus groups results

Closing the gap between fork and farm for circular nutrient flows

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D5.5 Report on results of actions for knowledge exchange and capacity building (4 focus groups) providing focus groups results

Executive Summary

This report presents the results of the focus groups assembled in the follower regions, namely Hungary, Italy and Greece, with the goal of supporting the development and adoption of P2GreeN's solutions. These focus groups aim to assist the feasibility study implementation in T5.2 - Conducting feasibility studies in 4 follower regions and identify the pain points of applying the P2GreeN solutions. The outputs from the focus group were further enhanced by an interview with the representatives from the City of Paris to document the experiences and lessons learned from the French case supporting the potential implementation of the P2GreeN technologies in the follower regions.

Structurally the report contains the methodology used to implement the focus group, the detailed replies received from participants, and a discussion of the main points. Overall, 33 experts from a range of relevant sectors took part in the 3 focus groups.

The discussions on technical and economic considerations underscored the positive outlook of experts towards innovative waste and fertiliser technologies, emphasizing their potential in various regions, despite challenges. Various, contexts were identified in which contexts the P2GreeN technologies might be appropriate in the follower regions. Economic obstacles, especially the cost-effective replacement of traditional technologies, and additional factors like follow-up treatment and transportation costs were acknowledged. Social aspects discussions revealed diverse perspectives, with considerations ranging from farmer acceptance based on affordability and quality to the need for extensive awareness campaigns for public acceptance. The case of Paris highlighted the importance of integrating infrastructure into new builds, while existing building renovations posed cost challenges.

Policy-related aspects emphasized the need for an extensive supportive policy framework at both EU and national levels. Regulatory adjustments, financial incentives, and proactive decision-making were deemed crucial for the effective scaling of these technologies. Challenges such as EU regulations, division of water management responsibilities, and the absence of a domestic sludge utilization strategy were acknowledged, calling for collaborative efforts between policymakers and industry stakeholders to shape upcoming policies.

1 Introduction

Focus groups have been assembled in the follower regions, namely Hungary, Italy and Greece with the goal of supporting the development and adoption of P2GreeN's solutions. These focus groups aim to assist the feasibility study implementation in *T5.2 - Conducting feasibility studies in 4 follower regions* and identify the pain points of applying the P2GreeN solutions.

In that manner, a group of experts representing relevant bodies (i.e. wastewater management, research and development companies, agricultural associations and cooperatives, fertiliser companies and more) has been selected in each region, considering that they will have the most insight and knowledge on the potential replication of these technologies in the follower regions.

For the case of the follower region in France, which presents a more advanced solution compared to the rest of the regions, an interview was conducted with representatives from the City of Paris and the technical and social aspects of the solution to be applied were thoroughly discussed. The benefit of doing this is that it allows us to document the experiences and lessons learned from the French case supporting the potential implementation of the P2GreeN technologies in the follower regions.

Apart from the aforementioned main goal, focus groups will additionally (a) act as the knowledge basis for the workshops to come in the next period where stakeholders of all types and not just experts will participate; and (b) provide interesting content for the P2GreeN communication and dissemination channels.

It was deemed appropriate to present in this report both the main outcomes of the focus groups in a summarised manner, but also the detailed replies received from the participants, in case the reader would like to further elaborate on the produced conclusions. Finally, it should be noted that the opinions and placements of the focus groups' participants as presented in this report do not necessarily reflect the opinions of the P2GreeN Consortium.

2 Methodology

In this section the general methodology that has been followed for each of the 3 focus group meetings that have been carried out in each of the follower regions is briefly presented. The methodology as well as the various questions for each focus group were initially developed and reviewed by all relevant Partners in the English language, but were later on translated in the follower regions' local languages. The outcomes/results obtained were then translated back into English in order for this report to be produced.

The questions were initially developed by CERTH and then reviewed by IRS and IRIDRA. Broadly the questions were divided into three sections focusing on technical potentials for each technology as well as social and policy aspects related to the potential implementation of these technologies in each follower region.

The focus group meetings were held either in-person or online and were facilitated by the relevant follower region P2GreeN Partner (Hungary: IRS, Italy: IRIDRA, Greece: CERTH). The main objective throughout the focus groups' meetings was to hold a detailed direct discussion with the participants in order to obtain qualitative information.

The proposed timeline suggested to the local Partners that were facilitating the meetings was the following:

- Greetings, participants' short self- and body representing introduction (10')
- General presentation of P2GreeN Project (5')
- Brief presentation of the 4 innovative technologies (20', 5' to 7' each)
- Main Session (70' - 100')
    - [Part 1] Innovative technologies evaluation
    - [Part 2] Social acceptance
    - [Part 3] Existing and future policies
- Critical views (15')
- End of session (Total Duration: approx. 2 to 2.5 hrs)

For the brief presentation of each technology a comprehensive video was requested by each relevant Partner/technology provider. Subtitles in the English language were generated with specific care in the terminology and then, the partner in charge for each follower region translated the subtitles in the local language in order to ensure the full comprehension of the content by the participating experts. The videos are uploaded on the P2GreeN YouTube channel.

Additional to the proposed timeline, the general guidelines for each meeting were the following:

- The meetings should not exceed the duration of 2.5 hrs so as to keep the members' interest and participation high. Each question should be briefly discussed in order to have enough time for all the questions.
- Each meeting should be held by at least two persons, a facilitator to run the meeting and a rapporteur to keep notes and assist the facilitator.
- It is proposed for the whole meeting to be recorded in order to simplify the debriefing process. A consent form will be required. The consent form can be paired with a P2GreeN newsletter subscription form.
- Pictures of the procedure should be taken. If there is consent for a video, then that too. In case of an online meeting, please ask the participants if they agree to record the session and then extract frames for WP6 (Communication and Dissemination) purposes.
- The *Main Session's* content regarding social acceptance is fairly based on the *Task 3.3 - Awareness raising & enhancing social acceptance* interviews for the pilot regions.
- A *Critical views* section is proposed to cover any additional, favourably member proposed issues. It can be skipped if deemed appropriate mostly due to time management issues.
- It would be interesting to match each specific reply or comment with the expert who answered/expressed it. This information will not directly reach the final deliverable due to privacy issues.
- At the end of the session the experts should be informed about the 1st P2GreeN Physical Workshop that will take place on May '24 in each follower region (the 2nd one will take place on November '25).
- At the end of each part the relevant answer sheet can be handed in. The facilitators can be as creative as they wish during the process to keep the members' participation high.

3 Focus groups' results

In this section the detailed results of each focus group meeting are presented per question and follower region in comprehensive tables. Meeting details and the composition of the members are also given. The results are thoroughly discussed in the Section 5 of this report.

3.1 Focus group in Hungary (HU)

Date: November 10th, 2023

Location: Territorial Committee of the Hungarian Academy of Sciences, Pécs, Hungary

Facilitators: Cecília Mezei, Ágnes Óvári, Viktor Varjú (IRS)

Participants: 23 experts divided in 3 groups, 1 group in-person, 2 groups online

Invited experts represented various relevant stakeholders, including technology development and provider companies, universities, agricultural enterprises, agricultural service providers, the Hungarian Chamber of Agriculture, a wastewater management company, a research institute, a waste-management company as well as central and local governmental bodies. More specifically:

Online focus group #2 member composition:

- Participant A - Technologist, Wastewater management company
- Participant B - Expert, Technology provider company
- Participant C - Expert, Research and development company
- Participant D - Expert, Technology provider company
- Participant E - Researcher, Agricultural research institute
- Participant F - Researcher, Agricultural research institute
- Participant G - Farmer, Agricultural enterprise

Online focus group #1 member composition:

- Participant H - Expert, Representative body for water supply and wastewater treatment
- Participant I - Expert, Investment company for water and wastewater, strategic and technical management
- Participant J - Researcher for community supported agriculture, Agricultural University
- Participant K - Eco-manager, City Hall of Pécs, Hungary

In-person focus group member composition:

- Participant L - Researcher, Expert on waste management
- Participant M - Engineer, Expert #1 of local waste management company
- Participant N - Engineer, Expert #2 of local waste management company
- Participant O - Expert from a NGO
- Participant P - Local farmer
- Participant Q - Representative of the regional green authority

3.2 Focus group in Italy (IT)

Date: December 14th, 2023

Location: Online

Facilitators: Anacleto Rizzo, Giulio Conte, Fabio Masi (IRIDRA)

Participants: 3 experts

Multiple experts from various relevant bodies were invited but were unable to attend. They expressed, however, interest in the Project in general and the focus groups' results in particular. Some of them express their willingness to attend the upcoming workshops. The participating experts' composition was the following:

- Participant A - Assistant Professor, Faculty of Engineering
- Participant B - Expert, Consultant on fertilisers
- Participant C - Expert, Responsible of Water economics in a research and consultancy company

3.3 Focus group in Greece (GR)

Date: December 18th, 2023

Location: Offices of the Centre for Research and Technology Hellas (CERTH) / Institute for Bio-economy and Agri-technology (iBO) in Athens, Greece

Facilitators: Balafoutis Athanasios, Bas Paris, Michas Dimitrios, Moraitis Michael (iBO/CERTH)

Participants: 7 experts

The experts invited were very interested in the Project thematic since the beginning of the communication and supported a very fruitful discussion throughout the meeting. The composition was the following:

- Participant A - Expert #1 on bio-based fertilisers

- Participant B - Expert, #2 on bio-based fertilisers
- Participant C - Researcher, Representing agricultural organisation
- Participant D - Expert, Water, wastewater and biological treatment solutions
- Participant E - Assistant Professor, Specialization in biorefineries
- Participant F - Expert, Local water supply and sewerage company
- Participant G - Expert, Researcher on soil science

3.4 Detailed Results

In this section the results of the focus groups' meetings are presented in a detailed manner. The pairing of the response/opinion with the participant that expressed it is also given where available, as it was deemed of interest to highlight the different perspectives depending on the body/area represented.

First are presented the results of the evaluation of the innovative technologies (part A), then the discussion on social acceptance (part B) and finally the questions regarding the policies (part C). Part A is divided into 3 sub-parts, as many as the technologies, each represented in a different colour for ease of reading. In some of the questions apart from the discussion a quantitative approach, on a scale of 1 to 10, was also requested by the participants and is given below.

3.4.1 Innovative technologies' evaluation

- Urine drying technology developed by SLU and Sanitation 360
- Urine and faeces technologies from Goldeimer & VunaNexus
- BioAzul technology for reclaimed water

Urine drying technology developed by SLU and Sanitation 360 (Swedish pilot region)	
1	What is, in your opinion, the degree of innovation of the technology presented?
HU	• On a scale of 1 (not very innovative) to 10 (very innovative): **7.65** *[Expert A]:* Hungary is currently at a stage in wastewater technology where efforts are being made to separate rainwater from wastewater, preventing them from entering the same system. This is a different system than the ones we are currently discussing but relevant to the discussion in terms of infrastructure development and exploring alternative approaches within current wastewater systems. *[Expert H]:* The presented technology is not so novel; it has been a long-standing objective in wastewater treatment. However, due to the influence of the chemical industry lobby,

	large-scale utilisation of sewage sludge in agriculture is currently unfeasible, with only a few exceptions. The Pécs wastewater plant has employed fluidized bed drying technology for approximately 15 years, producing pellets from dried sewage sludge for agricultural use. Unfortunately, the sale of this product and its acceptance in agriculture and society have faced significant challenges. Consequently, the technological innovation in this context is not particularly high; it essentially reiterates an existing concept. Rather, it is the dissemination of a new approach, e.g. sustainability or climate change, that innovation can be valuable (reinventing the old one).
IT	• On a scale of 1 (not very innovative) to 10 (very innovative): N/A All the experts agreed on considering the solution innovative for the Italian context.
GR	• On a scale of 1 (not very innovative) to 10 (very innovative): **6.57** Experts agreed that the technology is not so innovative, but this is not a negative thing. Given that it is financially viable, it is promising. Experts also agreed that innovation does not have to include, for example. novel physicochemical methods, but it can also be geographic, i.e. to bring in your region something that is already being implemented elsewhere. Also, innovation could be the combination of existing technologies and their application. In Greece this is something new for everyday people.
2	Which are the advantages/pros (technical, economic, environmental)?
HU	*[Expert C]:* From a technical perspective, it is advantageous that the technology provides a solution to the issue of festivals generating a large volume of concentrated urine. *[Expert D]:* The granular form of the product enhances the mobility of goods, as the technology produces a concentrate that results in lower transportation costs and demand. *[Expert F]:* This technological solution is environmentally friendly, contributing to reduced water pollution, which is highly beneficial. *[Expert E]:* Regarding fertilisers, it is generally crucial to enhance soil organic content, as it is unfortunately on a constant decline. Increasing organic content is essential for maintaining a healthy water balance and mitigating greenhouse gas emissions. Therefore, recycling organic content is necessary. *[Expert H]:* Urine, being a consistently available resource from sewage plants, can be obtained in substantial quantities. *[Expert M]:* It can be spread out as liquid manure (like natural fertiliser). *[Expert L]:* Drug residue decomposes faster than in sewage.
IT	Most advantages are environmental: reduce nutrients load to water bodies, ease the wastewater treatment process so that it becomes more effective, reduce energy use to produce artificial fertilisers Additionally, the pelletization of the fertiliser increases the ease of use by the farmers.
GR	Experts agreed on the environmental friendliness of the technology, combined with the efficient solution for places like mass exhibitions/festivals or other similar events.

3	Which are the disadvantages/cons (technical, economic, environmental)?
HU	*[Expert A]:* Simultaneously, the solution's applicability is challenged by the fact that the option for separate collection (due to large quantities) arises seasonally, potentially impeding the continuous operation of the technology. *[Expert C]:* The process of separate collection itself demands a substantial investment, prompting consideration of whether it makes sense to implement separate collection at all. The currently widely used technology differs significantly on a large scale. *[Expert C]:* The technology involves various resource and energy inputs that contribute to increased costs, such as pelleting and transportation. This could potentially disadvantage the idea compared to other solutions, such as conventional treatment. *[Expert D]:* While there is information suggesting low input requirements for the technology (not from the short film), high marketing costs associated with its introduction could pose a significant challenge. *[Expert B]:* A common barrier for all tested technologies is the apprehension among both farmers and consumers regarding these substances. *[Expert E]:* Currently, green manure serves as a competitor to sewage sludge. Despite considerable resistance to sludge, there is no corresponding opposition to green manure. *[Expert H]:* A separate consideration arises when discussing established utilities: What is the environmental footprint of the separate collection and transportation of urine in this manner, which we overlook to present a sufficiently innovative image of the technology? Traditional technology is already well-established, and common difficulties are faced. If these challenges can be addressed, then in areas where mobile applications are primarily needed, the presented technology stands as a good innovative solution. Other aspects primarily hinge on lobbying efforts. However, it's crucial to note that the success of these initiatives depends on the chemical industry lobby discontinuing activities that significantly influence social attitudes. A notable example is the situation in Germany, where labelling tomatoes as fertilised with human manure led to a decline in consumer purchases. So, if this practice can be "buttoned up" again with an awareness-raising and legislation changes accordingly, then the robustness of technology will not be an issue. *[Expert I]:* Technology designed for a very narrow area in terms of applicability. Currently, it is not relevant from the point of view of the population in Hungary, because they are not "disciplined" enough, rather this technology can be used at events. However, the sanitation conditions after such events are currently suboptimal. Special collection is a big burden, it can only be solved in large cities and large factories. The technology is not bad, but its dissemination is not easy in the current economic conditions. *[Expert L]*: Agriculture is price sensitive. They (farmers) won't pay more than for natural fertiliser. His experience is similar to the compost created from green waste composted by the local waste management company. It can be feasible (economically) in the long term. The high energy need is among the challenges. *[Expert N]*: It is important to see it as a whole, as a system. "Waste producers" have to

	contribute to the costs as well. *[Expert M]*: In case the beer company promotes the 'use of urine', it can have a negative effect. *[Expert N]:* There is a need for long-term monitoring.
IT	*[Expert B]:* The complex administrative process to allow the production and use of a new type of fertiliser is a major disadvantage at the moment. Also, the environmental and economic disadvantage of the transportation of the raw urine before drying up should be considered. *[Expert A]:* It is not clear from the presentation if the temperature used during the process allows for the complete removal of pathogens: this could be a disadvantage compared to conventional fertilisers. Similarly, the final destination of micropollutants and emerging pollutants is not clear. It would be interesting if P2GreeN could analyse in depth the paths of micropollutants after the application of the fertilisers, by trials in the field.
GR	*[Expert G]:* The presence of heavy metals is an issue in general, not only in the reused water. If the water is not heavy-metal free and irrigation or fertigation is applied with it, especially in leafy vegetables, these will most certainly reach the plant tissue. Environmentally speaking, the soil quality will be degraded. There are relevant thresholds but are heavily dependent on the depth. *[Expert D]:* The issue is that you isolate networks and you also remove nutrients from the treatment centre. If you remove the N from it, what are you going to treat? i.e. in a hotel there is a biological treatment plant with membranes that irrigates with the outlet of the treatment centre, if the nutrients are removed, there will be only grey water (water that already has been used domestically, commercially and industrially) left, what are you going to do with it? I believe that portable toilets are the best solution for technologies like this, to avoid using networks that implement biological treatment centres because there you need these nutrients (P, N, organic) because you have kitchen waste (any kind of rubbish produced during commercial kitchen activities) to a great extent and you need it to dilute this waste. Also if you remove the nutrients and you have only water again there is an issue. So if you apply one of these technologies you will need to redesign the whole biological treatment centre. This is feasible but it is not easy. Grey waters are very difficult to handle. The investment to create a new network is big, i.e. replacing one piping line with three. [Expert F]: But there are countries with water shortages that utilise 6 different pipeline networks. Let's not forget that desalination technologies also produce harmful by-products.

4	Which are the opportunities for (new) businesses/companies/public entities/farmers to adopt this technology, especially from a technical and economic perspective, in your region and within the EU? *Follow up question #1:* Are there specific conditions/contexts in specific areas that are particularly relevant for this technology? *Follow up question #2:* Which are the threats?
HU	*[Expert E]:* In the case of granules as a standalone product, transport distance becomes a crucial factor. Therefore, it would be most advantageous to develop it as a local product, promoting the recycling of local resources, which aligns well with a Circular Economy (CE) perspective. *[Expert C]:* This local utilisation has a longstanding tradition (such as the application of sewage sludge to the surrounding agricultural areas). This allows local characteristics to be integrated into the locally developed "product," resulting in a potentially varied composition of the final product at different locations. *[Expert D]:* Due to the fertilisers approved as a product, the exact composition of manure can be known by farmers. *[Expert G]:* A crucial economic aspect of the finished product is its cost-effectiveness, particularly when compared to traditional fertilisers and livestock manure. It is essential to carefully evaluate production and logistics costs. *[Expert I]:* The technology could potentially be installed in large office buildings. However, the question remains whether the cost of separately collecting it is justified in terms of value for money, which may not be profitable. Currently, this type of special collection is implemented on construction sites in metropolitan-large-scale environments. *[Expert J]:* There might be an issue with the farmers' approach, as they prioritise value for money considerations. *[Expert L]*: What is needed is quantity and/or high concentration of available materials. It means that to set-up a collection system for a factory can ensure the possibility of collecting enough.
IT	*[Expert B]:* Presently in Italy all N and P fertilisers are imported (mostly from North Africa), after the last national factory (IARA located in Ferrara) closed due to the low price of competitors abroad. Even in case of a heavy subsidy to produce P2Green fertilisers, the production price could be higher than average price of conventional fertlisers. Considering the administrative difficulties of opening new economic activities, and the heavy permitting burden (long and uncertain procedure to get health and environmental “nulla osta”), it is very unlikely that local companies would be interested in starting a novel fertiliser production. *[Expert A]:* As mentioned before, clear scientific evidence of the path of micropollutants into the soil and the crops showing that the process is absolutely safe would certainly ease the diffusion of P2GreeN solutions, if market conditions allow it. Probably field trials would be necessary to allow the production in Italy.

GR	*[Expert F]:* Regulations regarding the discharge of wastewater into the sea will in the near future tighten up. We will be forced to face this soon enough but consequently, it will provide new opportunities for such technologies.
5	How would you rate the robustness of the presented technology? *Follow up question:* How would you increase the TRL?
HU	● On a scale of 1 (not robust at all) to 10 (very robust): **6.35** *[Expert A]:* The technology could find application in places like large malls (high-traffic buildings with existing urinals) where separate collections could be more easily managed using the already installed urinals. *[Expert D]:* In general, technology change can be problematic because it is always cumbersome. *[Expert B]:* The widespread adoption of this technology is not anticipated in Hungary; it may only offer a solution in specific cases. *[Expert E]:* Certainly, addressing cleaning concerns for the finished manure is crucial. Additionally, farmers need guidance on proper usage (dosage, application, etc.). Therefore, the optimal solution might involve introducing combined, complex fertiliser products to the market, which are in high demand among farmers.
IT	● On a scale of 1 (not robust at all) to 10 (very robust): **varies** (5 to 8) There is some concern about the possible presence of micropollutants.
GR	● On a scale of 1 (not robust at all) to 10 (very robust): **5.86**
6	How willing are you to invest in the presented technology?
HU	● On a scale of 1 (not willing at all) to 10 (very willing): **4.96** *[Expert D]:* There is an innovative solution for separately collecting urine in Hungary, supported by a suitable device and service provider. However, as of now, its implementation is limited to the small scale.
IT	● On a scale of 1 (not robust at all) to 10 (very robust): **varies** (3 to 8) There are concerns about high production costs and availability to pay back on the market.
GR	● On a scale of 1 (not willing at all) to 10 (very willing): **4.71**
7	Do you consider the extracted fertilisers technically and economically viable for the

	farmers?
HU	*[Expert L]*: If there is enough material, it could work. The question is the quantity produced.
IT	*[Expert B]:* There are no specific technical advantages or disadvantages for the farmers since the P2GreeN fertiliser is similar to the one they normally use. They would however use it if the price was lower compared to the conventional one. If the price on the market increases significantly due to increase of energy costs for N fertiliser production or for decreased availability of P, the interest could grow, but this will happen over a long time period. Moreover, if the extraction of fossil P becomes significantly more expensive, P could be recovered by animal bones at a price that presently is too high to compete on the market; but will be most likely still much lower than the price of the P2GreeN production chain.
GR	*[Expert G]:* Organic farming will be increased in the near future, the yield should be secured. Farmers will be convinced to use such technologies if the agricultural yield is ensured. *[Expert F]:* A comment for all technologies, the logistics, meaning how to transfer the wastewater from one place to another, is a very important issue. In the new wastewater treatment centres around Athens there is a prediction regarding the reuse of water for irrigation purposes of non-food plants.

Urine and faeces technologies from Goldeimer & VunaNexus (German pilot region)	
1	What is, in your opinion, the degree of innovation of the technology presented?
HU	• On a scale of 1 (not very innovative) to 10 (very innovative): **7.61** *[Expert D]:* Container toilets also work at festivals, in principle solid toilets could be an installable solution. *[Expert H]:* The EVH system is highly innovative as it introduces a new approach. *[Expert L]:* The solution has a system thinking approach, touching all the phases of the nutrition circle.

IT	• On a scale of 1 (not very innovative) to 10 (very innovative): Goldeimer: **5,** VunaNexus: **8.5** Experts agreed that the Goldeimer solution is based on the quite well-known technology of composting: the innovation is in the source of materials to be composted and in the business model, rather than in the technology. *[Expert A]:* The composting technology is a "bio-container", not very innovative. What is more interesting in the VunaNexus technology is the removal of micropollutants.
GR	• On a scale of 1 (not very innovative) to 10 (very innovative): Goldeimer: **5.57**, VunaNexus: **5.43**
2	Which are the advantages/pros (technical, economic, environmental)?
HU	*[Expert F]:* It is a technological solution that minimises water pollution, which is highly beneficial. *[Expert E]:* Regarding fertilisers, it is generally crucial to enhance soil organic content, as it is unfortunately on a constant decline. Increasing organic content is essential for maintaining a healthy water balance and mitigating greenhouse gas emissions. Therefore, recycling organic content is necessary.
IT	According to the experts, the advantages are the same as for the case of Sanitation360.
GR	*[Expert F]:* This technology could be applied in hotels rather than single houses, meaning that it would make more sense in a more organised setting. Also it would be very positive to see this applied in remote areas.
3	Which are the disadvantages/cons (technical, economic, environmental)?
HU	*[Expert A]:* The technology can offer a localised solution to a specific problem, but it remains only a partial solution since separate collection cannot be addressed on a national scale. *[Expert B]:* A common challenge for all the tested technologies is the apprehension among both farmers and consumers regarding these substances. *[Expert E]:* In the present context, green manure serves as a competitor to sewage sludge. Despite substantial resistance to sludge, there is no corresponding opposition to green manure. *[Expert H]:* In my opinion, the EVH system is not economically viable, as it necessitates installing a fivefold network and a new type of toilet bowl. While it may be applicable for newly built houses, there is no solution for existing real estate. *[Expert N]:* There is a need for long-term monitoring. *[Expert L]*: There is a need for high quantities for economic functioning and this is not the case at the moment. At least it seems to be that there is not at the moment.

IT	Experts agreed that the disadvantages are again similar to the technology of Sanitation360 (high costs, transportation of raw materials, etc.). The group made a rough cost analysis based on the cost of Aurin (18€ litre) and the content of N (5%). According to *[Expert B]* knowledge about N fertilisers the cost for 1 N Kg of Aurin is roughly 2 orders of magnitude higher than 1 N Kg of conventional fertiliser. None in the group has information regarding the production costs of the organic soil improver by Goldeimer technology, so no comment was made on this technology.
GR	Experts unanimously emphasised the fact that the process of producing chemical fertilisers is very harmful for the environment, which is worse? In the end further research has to be done, is it more advantageous to renovate / build a new building with i.e. three different pipeline networks?
4	Which are the opportunities for (new) businesses/companies/public entities/farmers to adopt this technology, especially from a technical and economic perspective, in your region and within the EU? *Follow up question #1:* Are there specific conditions/contexts in specific areas that are particularly relevant for this technology? *Follow up question #2:* Which are the threats?
HU	*[Expert B]:* In Hungary, aside from nutrient deficiencies, common problems also include soil structure issues and water scarcity that need to be addressed. *[Expert A]:* Before applying sewage sludge in agriculture, obtaining a permit for agricultural land, and creating a plan is a costly process that is often abandoned by farmers. *[Expert B]:* In certain areas (bioeconomy, Natura 2000) sludge cannot be applied at all. *[Expert A]:* For sludge, applying it to energy crops could be a viable solution, especially considering the significant public apprehension. While concerns about heavy metals are realistic, small municipal wastewater plants typically do not have heavy metal content above the limit value. *[Expert G]:* An important economic consideration for the finished product is cost-effectiveness, particularly when compared to traditional fertilisers and livestock manure. Production and logistics costs are crucial factors that need careful examination.
IT	Based on the rough cost analysis done, the Aurin could not be competitive on the ordinary fertiliser market. However, it could be sold to specific market niche with high availability to pay (very environmentally aware clients) or the technology could be used in closed loop facilities (such as sport or tourism facilities, airports, big shopping centres, etc.). Similarly, organic soil improver produced by Goldeimer technology could be sold through an appropriate green branding strategy. Facilitators asked the group if the liquid formulation of Aurin could be interesting for some kind of crop production and according to *[Expert B]* the liquid use is technically feasible,

	but considering the 5% concentration of Aurin, it is unlikely that it could consist an affordable solution for farmers, compared to conventional fertilising practices. Indeed the liquid phase of the fertilisers does not seem a particular issue in terms of capability of farmers to use it, since Italian farmers are already acquainted with the use of liquid amendments (e.g. pesticides); rather, the problem would be the low % of N per volume of the liquid, probably making it unrealistic to spread it on the field, in terms of volume, rather than using conventional solid fertilisers.
GR	Experts discussed this question in comparison with the rest in the open discussion section.
5	How would you rate the robustness of the presented technology? *Follow up question:* How would you increase the TRL?
HU	• On a scale of 1 (not robust at all) to 10 (very robust): **6.70** *[Expert B]:* The widespread adoption of this technology is not anticipated in Hungary; it may only offer a solution in specific cases. *[Expert E]:* Certainly, addressing cleaning concerns for the finished manure is crucial. Additionally, farmers need guidance on proper usage (dosage, application, etc.). Therefore, the optimal solution might involve introducing combined, complex fertiliser products to the market, which are in high demand among producers. *[Expert H]:* From the perspective of a technology expert, the EVH system appears to be a peculiar detour. Building a system for urine separation to produce a product called Aurine, and then applying it mixed with composted faecal matter seems like an unnecessary detour. There is a very narrow group of actors who can finance this and build a positive image of the product. Innovation potential could be increased by applying the technology in places where sewage networks are not yet established, such as ranches, mountainous areas of cities, construction sites, and events (where there is no sewage network or it is not worth building).
IT	• On a scale of 1 (not robust at all) to 10 (very robust): Goldeimer: **varies** (2 to 8)**,** VunaNexus: **7**
GR	• On a scale of 1 (not robust at all) to 10 (very robust): Goldeimer: **6.86,** VunaNexus: **5.57**
6	How willing are you to invest in the presented technology?
HU	• On a scale of 1 (not willing at all) to 10 (very willing): **5.52** *[Expert D]:* The German solution utilises a Swiss innovation, and considering its application in Hungary could be worthwhile for developers to explore.

IT	• On a scale of 1 (not willing at all) to 10 (very willing): Goldeimer: **varies** (2 to 7)**,** VunaNexus: **varies** (6 to 9)
GR	• On a scale of 1 (not willing at all) to 10 (very willing): Goldeimer: **5.57,** VunaNexus: **4.29**
7	Do you consider the extracted fertilisers technically and economically viable for the farmers?
HU	*[Expert L]*: If there is enough material, it could work. The question is the quantity.
IT	Already discussed in Question No 4.
GR	*[Expert D]:* A comment for all technologies, there are pilots that use the outlet of the biological treatment for irrigation. How are you going to convince someone to use that water instead of the wastewater? Is there a higher yield potential?

BioAzul technology for reclaimed water (Spanish pilot region)	
1	What is, in your opinion, the degree of innovation of the technology presented?
HU	• On a scale of 1 (not very innovative) to 10 (very innovative): **6.52** *[Expert A]:* The feasibility of the technology could be explored for existing wastewater plants. Considering the prevalence of small sewage plants in Hungary, it could also be viable for them, especially as agricultural land often surrounds these sites. *[Expert I]:* Among the presented technologies, this one appears to be the most plausible in Hungarian conditions. The agro-economic and technical approach to greywater utilisation has been a longstanding concern in Hungary, particularly in terms of covering water demand and nutrient supply for irrigation systems, especially in drier areas.
IT	• On a scale of 1 (not very innovative) to 10 (very innovative): **varies** (2 to 6) *[Expert B]:* It would be very helpful to create a table showcasing for each technology presented the amount of N and P per unit of fertilising product. *[Expert A]:* The innovative part is limited to the smart system to dose the amount of fertilisers, that is quite interesting. According to our studies, in fact, very rarely nutrient concentration in treated wastewater fits the needs of the irrigated crops that change significantly from crop to crop in different climates and vegetative periods. The N/P ratio is also rarely the correct one to satisfy the plants needs. A system allowing to correct fertilisers' concentration (either by dosing conventional fertilisers or by dilution with water

	from other sources) in treated wastewater could be interesting for farmers.
GR	• On a scale of 1 (not very innovative) to 10 (very innovative): **5.29**
2	Which are the advantages/pros (technical, economic, environmental)?
HU	*[Expert E]:* The technology incorporates a clever dosing solution, which is a positive aspect. However, it is crucial for end-users to be familiar with dosage guidelines. *[Expert B]:* A notable advantage of this technology is its ability to bring water to the area, providing an additional benefit. *[Expert F]:* This technological solution has the advantage of minimising water pollution, which is highly beneficial. *[Expert E]:* Regarding fertilisers, it is generally important for the soil to increase organic content, as it is unfortunately constantly decreasing. Enhancing organic content is crucial for maintaining a healthy water balance and mitigating greenhouse gas emissions. Therefore, recycling organic content is necessary. *[Expert I*]: If the Spanish example proves successful, the potential extension of the technology in Hungary becomes evident. The use of smart devices should not be a problem among Hungarian farmers, as technological coverage and Wi-Fi use are adequate. Several smaller greenhouse growers already use such equipment, such as precision nutrient delivery systems, suggesting that this can work on a larger scale. *[Expert J]:* Smart devices are already widely used in traditional nutrient applications in Hungary. *[Expert L]:* No need for further technological development. The current technology (in the city of Pécs) can be a very good base for that. It can be feasible (economically) in the short term. *[Expert M]:* Reclaimed water will have a much higher importance in the future, not only in Spain, but in other regions as well.
IT	Freshwater and conventional fertilisers saving, as well as continuous availability of water and fertilisers (the wastewater is produced on a daily and continuous basis as soon as the size of the wastewater treatment plant becomes significant, i.e. from thousands of inhabitants onward. *[Expert A]:* Nutrients dissolved in water are fully available for plant uptake and the smart irrigation system would avoid risk of groundwater contamination with nitrates.
GR	Experts unanimously agreed on the importance of utilising smart monitoring techniques.
3	Which are the disadvantages/cons (technical, economic, environmental)?
HU	*[Expert B]:* Utilising compost (from sludge) on the area instead of water could also enhance soil structure. However, a common challenge for all the tested technologies is

	the fear among both farmers and consumers regarding these substances. *[Expert E]:* Currently, green manure serves as a competitor to sewage sludge. Despite significant resistance to sludge, there is no corresponding opposition to green manure. *[Expert H]:* The operation of wastewater plants is a finely tuned system, operating based on water input and output limits. If introduced elsewhere, technological discipline might not be ensured, and the cost implications of this are questionable in light of the benefits of using nutrient-rich water. *[Expert N]:* There is a need for long-term monitoring. *[Expert L]:* Sooner or later releasing the remaining water (into the sea) will be a luxury.
IT	Beside the possible critical points (rather than disadvantages) mentioned in Question No. 1, a possible disadvantage of any direct wastewater reuse depends on the location of the source and the possibility to convey the wastewater (treated or to be treated) to the irrigation plots. *[Expert A]:* In our studies we are also considering a possible disadvantage of wastewater reuse that is not always taken into account: having wastewater with a higher salinity compared to freshwater, and some crops are more sensitive to water conductivity and that can negatively affect their growth. This issue should be always considered in reuse projects.
GR	*[Expert G]:* There are concerns about how to apply, i.e. the reused water while controlling the soil degradation. It is very important to reuse the water but the specific agricultural practices should be further investigated.
4	Which are the opportunities for (new) businesses/companies/public entities/farmers to adopt this technology, especially from a technical and economic perspective, in your region and within the EU? *Follow up question #1:* Are there specific conditions/contexts in specific areas that are particularly relevant for this technology? *Follow up question #2:* Which are the threats?
HU	*[Expert C]:* Concerns associated with treated wastewater must be addressed through appropriate knowledge transfer, where only the properties of the product should be emphasised. *[Expert G]:* An essential economic aspect of the final product is its cost-effectiveness, particularly when compared to traditional fertilisers and livestock manure. Production and logistics costs play a crucial role and need careful consideration. *[Expert I]:* In Hungary, this technology could be rational, but legislative changes are necessary for its implementation. It is the most straightforward technology to introduce and adapt for both farmers and wastewater treatment plants. Regarding spatial placement, plantations near Homokhátság and Kiskunság (geographical regions of Hungary) can be considered, which are similar to the Spanish pilot area. Currently, it can complement irrigation from underground wells in these regions, helping to mitigate the

	anticipated water management challenges from an agro-economic perspective. However, this issue did not come to the forefront as long as the legislative environment allowed unrestricted water usage without regulating water abstraction. With the new Water Framework Directive, water use and exploration permits have not been issued for several areas, making this the opportune moment to consider such a solution in collaboration with agriculture and regulatory authorities at the societal and governmental levels. *[Expert H]:* Hungary possesses a supply of irrigation water. In arid regions, it might be economically more viable to source irrigation water from surface water using currently nonexistent water retention technologies, rather than transporting subsequently purified water to these areas. An emerging consideration is that instead of purified water, utilising more nutrient-rich water extracted from an earlier stage of the wastewater treatment process in agriculture could be more economical from an agro-economic standpoint. This approach has more potential to replace the use of traditional fertilisers. *[Expert L]:* In the business model, there is a need to involve insurance companies as there is a need for calculation with drought damage.
IT	Should wastewater reuse take over as expected, the smart system is potentially of great interest.
GR	Experts discussed this question in comparison with the rest in the open discussion section.
5	How would you rate the robustness of the presented technology? *Follow up question:* How would you increase the TRL?
HU	• On a scale of 1 (not robust at all) to 10 (very robust): **5.61** *[Expert A]:* Wastewater is collected at existing treatment plants where nitrification - denitrification processes take place sequentially. Exploring the potential outcomes by halting the process after nitrification and studying how the resulting water could be beneficially used in the neighbouring agricultural areas is a viable topic for investigation. *[Expert C]:* It is noteworthy to consider non-sewered areas as well. In addition to existing infrastructure systems, developing the possibility of a micro-regional sewage sludge utilisation system could address the challenges of non-sewered settlements. A potential innovation involves the concept of a plant sanatorium. In this novel technology, culminating with a plant sanatorium, wastewater is collected in pools. Locally, an apparatus drains the water, leaving purified water behind for utilisation after filtration. The transported component is the dry matter content, which is directed to a compost site. The installed plants in the plant sanatorium are then nourished with compost, and these plants can subsequently be transplanted and utilised in urban spaces and public parks. *[Expert E]:* Certainly, addressing the cleaning aspect is crucial for finished manure. However, farmers also need guidance on how to use this manure, including dosing and application methods. Therefore, the optimal solution would be to introduce combined,

	complex fertiliser products to the market, as these are in high demand among producers.
IT	• On a scale of 1 (not robust at all) to 10 (very robust): **varies** (2 to 9)
GR	• On a scale of 1 (not robust at all) to 10 (very robust): **7.29**
6	How willing are you to invest in the presented technology?
HU	• On a scale of 1 (not willing at all) to 10 (very willing): **5.13** *[Expert E]:* During discussions with irrigation communities at an event, it was highlighted that the amount of water recoverable from wastewater in the country is only a fraction of the irrigation water demand. Therefore, only local solutions may be feasible. *[Expert L]*: The biggest problem of the whole waste management sector is the underfinancing and the so-called Hungarian household overhead cuts (maximised price for public services), that resulted in the decreasing budget of the service providers (incl. waste water treatment companies). It means that there is a lack of innovation or technological changes.
IT	• On a scale of 1 (not willing at all) to 10 (very willing): **varies** (2 to 7)
GR	• On a scale of 1 (not willing at all) to 10 (very willing): **6.29**
7	Do you consider the extracted fertilisers technically and economically viable for the farmers?
HU	*[Expert F]:* There was an attempt to introduce a technology similar to the Spanish one in Hungary, but the areas that could have been considered for utilisation were too distant from the settlements, leading to the plans being unrealized. *[Expert A]:* Similar requests for wastewater plants also arise in Hungary, but the viability of these projects is contingent on the required investment and the volume of irrigation water needed. In the case of small plants, there might not be sufficient potential for purified water to justify the investment. If implemented, continuous monitoring of the water composition would be necessary. Additionally, the possibility of water enriched with phosphorus (P) and nitrogen (N) content leaving the plants has not been thoroughly studied, which could provide new insights into the matter. *[Expert H]:* The critical question is who bears the cost of this follow-up treatment. The technology primarily ensures water replenishment, as the nutrient content of the treated wastewater effluent is reduced to a qualified limit. Therefore, if the treated water must be transported to areas further from the treatment facility, it is economically justifiable only if water scarcity exists in the given area. *[Expert P]:* Actually, they have already used fertiliser made from sewage sludge. It was

	good. However, each year, after the harvesting, regional food security authorities investigated/monitored the residues in the fruits. Actually, the use of the fertiliser made from human extraction was a constraint as natural fertiliser (from animal manure) was not available on the market due to the decrease of livestock in the region. Based on his experience, farmers are more and more open (as there are more and more younger farmers). What matters is only the price. If artificial fertiliser is cheaper, they will use it.
IT	Already addressed above.
GR	*[Expert G]:* As in all the technologies above, it is crucial to know what the final product contains. In organic materials it is typical for their contents to vary. If we can stabilise them then there won't be a problem and maybe they will also be cheaper. Products with stable properties paired with a reasonable cost will appeal to farmers as soon as they see the same results. Times have changed and farmers are more receptive to new technologies/products. All these have to be combined with a parallel development of smart agriculture. Monitoring of the whole process and precise application of the i.e. fertilisers is required.

Open discussion	
	Which technology will work better in which context according to your opinion?
HU	*[Experts A, E & F]:* Consideration should be given to the potential applications of the end products derived from the technology. There may be various barriers to food production, so exploring alternative uses such as energy plantations, public parks, public spaces, landfill covering, and recultivation areas could be worthwhile. *[Expert E]:* Alternative fertilisers are not widely embraced in Hungary, indicating a limited market. Therefore, emphasis should be placed on their utilisation in non-food production areas. *[Expert E]:* It is essential to consider the entire value chain. Each technology caters to a distinct customer base within the value chain, such as residential parks, festivals, and environmentally conscious residents. The development of a given technology should align well with the specific value chain. *[Expert B]:* In organic farming and Natura 2000 sites, substantial subsidies are provided, but the application of wastewater and sludge is prohibited. The only viable solution is the spreading of rotted composted material. For instance, dehydrated sewage sludge mixed with straw can be utilised. *[Expert H]:* Among the technologies, the Spanish one appears to be the most feasible innovation. However, questions arise regarding the installation of tertiary treatment technology at the sewage plant. While the treated effluent can be purified to drinking water

	quality, the critical question remains: who bears the cost of this process? *[Expert L]:* Using any of the technologies (especially the second and the third one with more liquid in) can be important in the second part of the century, due to climate change, in forests or in energy plantations, where pharmaceutical residues do not have a large impact. *[Expert P]:* From the technological point of view, the best solution (for at least for a peach producer) is the liquid fertiliser. It is because, nowadays, it is impossible to grow fruits without water. Creating an irrigation well can take one and a half, or more, due to the long administrative process. However, the first solution can also work. Although the energy input in that case is big, the cost of the transportation and the burden are smaller.
IT	N/A
GR	Experts unanimously agreed that a table showcasing the performance of each technology or some lab results would be really helpful to help them better judge them. *[Expert F]:* These technologies are not yet mature so it would be hard to have those. Apart from BioAzul's which is operational. Monitoring is very important. *[Expert A]:* A market has to be developed. Apart from the environmental benefit, there is a business opportunity. Financial incentive is required, unfortunately. *[Expert G]:* Low innovation in all cases, but if place, combinations etc. are taken into account then it's higher. A long term trial with the final products of the technologies is required. Are the nutrients directly available to the plant? Phosphorus will one day run out, we need to find ways to retrieve it and make it more available, especially in Greek soils which are in their biggest part alkaline and there is an issue in P absorption. To that is added the low organic matter, so solving the P issue in that way makes sense. I don't think that converting buildings is feasible. *[Expert F]:* As soon as they grow and we have all the data, there is potential for these technologies and issues to solve. Regulations also encourage the P retrieval. They are pretty much worth investigating. *[Expert C]:* It's all about P. This will be the main motive. We will be forced to find new ways to retrieve/reuse it. All technologies seem to be very promising, but VunaNexus and Goldeimer would be easier applied in Greek conditions. *[Expert A]:* P needs can't be covered in that way, chemical fertilisation products in the market contain 60 units of P, while organic 2 to 4, there is a huge difference. Farmers will be afraid to use them. Promotion from big entities in the field is required. *[Expert D]:* As a general comment, it seems that such technologies are still in their infancy, the cost for their adoption is high and someone has to undertake that extra cost. A probable solution would be the industry, in the name of social responsibility.

3.4.2 Social acceptance

General questions regarding the social acceptance	
1	How open do you think that people in your country are to new ideas and innovations in general?
HU	• On a scale of 1 (not open at all) to 10 (very open): **5.79** *[Expert A]:* In rural areas, the population tends to be conservative and resistant to change, often adhering to established habits. Introducing new concepts and opportunities, even if the necessary infrastructure is in place, can be challenging. It's possible that a similar situation may be encountered in urban areas as well. *[Expert H]:* In today's world, successful adoption hinges on effective marketing. If the economic potential of sustainability is emphasised, it has the potential to transform society. However, social responsibility can sway in both directions, as there is currently no prevalent societal value system in Hungary that fosters awareness in this area. *[Expert J]:* Rejection is more likely, as the population may not be receptive to this kind of product. Strong marketing efforts would likely be required to increase openness, as a sustainable approach is not yet deeply ingrained. *[Expert K]:* Openness to new ideas is often generational, with younger people being more receptive while older individuals tend to be more dismissive. In marketing, understanding the target audience is crucial. *[Expert I]:* As a participant of the older but open generation, I perceive society as relatively closed.
IT	• On a scale of 1 (not open at all) to 10 (very open): **varies** (2 to 5) *[Expert A]:* Potentially open, in this case it would be easier if fertilisers were to be used in nonfood crops.
GR	• On a scale of 1 (not open at all) to 10 (very open): **4.71** *[Expert E]:* People in Greece are not receptive at all. They need to be informed and educated. i.e. for brown bins (food waste) that are to be used by households in Greece, in the municipalities that proper communication took place people were receptive and they are now using them in the correct way. Where no proper campaign took place they are used wrong or not at all. *[Expert B]:* A low score here, but the problem is not the people, but the briefing. In my experience people are very receptive if you explain to them the use and the benefits. *[Expert D]:* As mentioned, I think people are receptive if they are given the proper example and they are properly convinced.
2	According to your opinion, how would people in your country react if they knew that the local farms were using bio-fertilizers made from human excreta (dry toilet contents / reclaimed water from municipal wastewater) instead of artificial fertilisers?

HU	*[Expert D]:* Initial utilisation of this technology is likely to occur in niche markets, with micro-regions being particularly capable of adopting it. The technology's gradual development, along with the market, allows for a social cascading acceptance to progress. *[Expert E]:* The supply side is also a critical factor, considering who will provide the raw materials (e.g., green hotels, building blocks, smart house technologies). This aspect is also evolving in Hungary. *[Expert H]:* Despite distorted information about drug residues and heavy metal contamination from the mineral water manufacturer's side, the public has embraced this marketing. *[Expert L]:* People are usually not interested in the treatment of vegetables in Hungary, they are rather focusing only on the origin. If it is Hungarian, that is OK. *[Expert O]*: It is not entirely true. There are more and more people who are committed to organic and sustainability products. What is important is how we present these products. Media should take a major role in that. *[Expert P]*: Agreed that the presentation is important. *[Expert L]*: That is true, but most people do not care. Anyhow, labelling these products as "circular products" can be a good solution for raising awareness.
IT	At the moment no labelling on the source of fertilisers is required on any food product, it is only required to showcase if the product is organically grown or not. Experts agreed that, most likely, should the source form human excreta be declared, some opposition would emerge. *[Expert B]:* The term bio-fertilizer is not correct and could be misleading. Even though the raw material from which the fertiliser is extracted (human urine) is "organic", the fertiliser could not be recognised as "bio" and used in certified organic farming. Only organic ammonium is accepted for this purpose: the stabilisation process and the final product made of pure urea make the fertiliser not compatible with organic farming criteria.
GR	*[Expert F]:* Some consumers would pay more if the products were labelled as more environmentally friendly. *[Expert G]:* Even if products were cheaper, if they mention in the label that they are irrigated/fertilised by biological treatment plants' outlets or human excreta, I am not sure that consumers would prefer them. *[Expert F]:* Manure fertilisation is very similar but it is connected with small farming, it appeals to the emotion of the consumer.
3	In your opinion, how likely is it that local farmers would utilise such fertilisers for their crops?
HU	● On a scale of 1 (not likely at all) to 10 (very likely): **5.89** *[Expert B]:* The acceptance of the product hinges on its naming. If it's labelled as a fertiliser, acceptance is likely, but tying it to wastewater may render it unusable.

	[Expert C]: Acceptance exists in villages, where nutrient-improving products are available in shops and are purchased by the residents. Even if these products come from sludge, there is no issue with their use. The key determinant in rural areas is the price. If such products receive a product licence, they are likely to be accepted. The usability of solid and liquid products may vary, but the overall situation remains the same. *[Expert P]*: Actually, he would dare to display that during the production he could use fertiliser from human extraction.
IT	• On a scale of 1 (not likely at all) to 10 (very likely): **8** *[Expert B]:* The most important problem for farmers is the cost. Should the fertiliser be less expensive than conventional ones, it will certainly be used. *[Expert C]:* From the point of view of urban wastewater management it has to be noticed that presently we find it very difficult to reuse wastewater for irrigation. Firstly, it is considered of lower value than conventional water and secondly, the cost of fresh water for agriculture is too low (probably it still doesn't respect the "full cost recovery" principle) and there's no incentive to promote wastewater reuse. Probably we can expect a similar approach for P2GreeN fertilisers coming from diverted urine and faeces.
GR	• On a scale of 1 (not likely at all) to 10 (very likely): **4.14** *[Expert D]:* Raising awareness is the key. If the first pilot/example is a success then the farmers will be interested in it, if not, they will hardly be convinced. *[Expert B]:* It all sums up to the cost. If the increase in the cost was to be small and there were other benefits, i.e. a green label, then farmers would use them.
4	How would local farmers be more convinced to use such fertilisers for their crops? (e.g. promotional campaigns, incentives) *Follow up question:* Which are the threats?
HU	*[Expert B]:* The end user primarily considers the financial aspects, with the economy being paramount. Cost-effectiveness is a key factor in their decision-making. *[Expert J]:* Farmers can be persuaded through good practice and education. If a neighbouring farmer has had success with a particular approach, others are more likely to accept it. Emphasising cost-effectiveness is crucial in convincing them, as farmers are generally more interested in economic considerations than in sustainable thinking. While some small farms and horticulture operations may be exceptions, sustainability is not the primary consideration on a large scale.
IT	Experts agreed that incentives are expected to be needed if the products are not competitive in terms of cost.
GR	*[Expert G]:* More data needs to be provided to the farmer. Compost and inorganic fertilisers are being researched for 30-40 years with fruit analysis and foliar diagnostics. Farmers will end up using a product if their yield is ensured.

5	How likely is it that **people in your region** would buy a product which would mention in its label that it is not fertilised in the traditional way, but with nutrients made from human excreta (dry toilet contents / reclaimed water from municipal wastewater)?
HU	• On a scale of 1 (not likely at all) to 10 (very likely): **4.84** *[Expert B]:* The number of people concerned about the state of our environment is increasing every year, but it is still very low. There is not much enthusiasm yet in this direction. If it's on the label, it can scare away everybody. *[Expert E]:* There is an increasing number of environmentally friendly households who can be target audiences (see markets for organic and eco products). *[Expert I]:* Because of the misinformation, I think that if the population saw this on products in addition to the [E] numbers, they would definitely refuse to consume it. *[Expert J]:* The public could be persuaded through education, adequate information and good practices. *[Expert H]:* In terms of volume, industrial fertiliser is among the largest divisions in the chemical industry. Going against this can be done with very strong marketing. *[Expert M]:* These solutions should be promoted as there is no long term sustainable alternative to natural fertilisers and our needs for fertilisers in the agricultural sector are very high.
IT	• On a scale of 1 (not likely at all) to 10 (very likely): **varies** (2 to 7)
GR	• On a scale of 1 (not likely at all) to 10 (very likely): **3.43**
6	How likely is it that **you** would buy a product which would mention in its label that it is not fertilised in the traditional way, but with nutrients made from urine / dry toilet contents / reclaimed water from municipal wastewater?
HU	• On a scale of 1 (not likely at all) to 10 (very likely): **6.05** *[Expert K]:* I would make it dependent on its price, otherwise I don't shy away from it. In my opinion, the food chain in Europe is well controlled, so I am confident that what ends up on the shelf can be consumed, so I would buy it with the same confidence as other products. Sales in markets may be less controlled. *[Expert J]:* I am more sceptical. In addition to striving for self-preservation, I think fertiliser residues also appear on products in certain quantities. I prefer health risks in German technology, for example, where 65 Celsius degrees is not enough to kill bacteria. If there were a test run for a few years, a market launch, during which if no problems were detected and they could keep the right values, I would buy such products. *[Expert H]:* With regard to the opinion before me, I think marketing is about building that trust. If there is time to wait and build trust, then the introduction can work, but is there

	time to wait for consumption to ramp up this way? Since it is currently not written on the products that are fertilised with horse manure, for example, the customer does not think about it, but if it were written on it now, people may not buy these products. So, if the chemical lobby doesn't act as counter-propaganda against new fertilisers, it may not surface. Good value for money will continue to be decisive, which can currently be ensured by fertilisation up to and including the customer base. Additionally, enforcement of regulations on how new types of fertilisers are applied is also important to strengthen confidence. *[Expert I]:* Currently, nutrients from human sources cannot be transferred to plants suitable for primary human consumption in Hungary. They shall be applicable only to crops grown for animal feed. This already ensures that we will not see products (e.g., salad) in stores that have been irrigated with wastewater. But this does not mean that vegetables from the territory of the EU that are treated with the float slurry method do not enter domestic grocery stores. So, we still don't know if we already consume such products. All such products were also used earlier in peasant farms. This knowledge must be applied.
IT	• On a scale of 1 (not likely at all) to 10 (very likely): **varies** (5 to 9)
GR	• On a scale of 1 (not likely at all) to 10 (very likely): **8.29**
7	Would **people in your region** be willing to modify their house/building to apply new sanitation user interfaces for excreta collection and treatment (dry toilets or urine-separating WCs with additional tubing/collection tanks)?
HU	• On a scale of 1 (not willing at all) to 10 (very willing): **3.95** *[Expert D]*: Campaigns are needed for adoption. Currently, there is no decision point for residents (you can choose one technology e.g., during your own construction), but all this can open up a new point, as you could choose. *[Expert D]*: The calculation of return on investment in a single-family home will not yield demonstrable results. *[Expert C]:* If we approach it from only an economic perspective, it may not be useful (pricing eco-services), it is also a known fact that wastewater technology burdens our waters, so this can also be a decisive communication direction. *[Expert H]:* No. The technologies presented in the Swedish and German models produce minimal results and require strange (farming) practices on the part of farmers and the public. The expansion of the network is such a cost that the conscious part of society is also thinking about taking on such a cost. The public utility provider is currently unable to finance this either because the system is already outdated, and in many places the pipelines are no longer suitable for ensuring the proper level of public service. *[Expert J]:* No.

	[Expert I]: No. They will not bear the additional costs, and from the point of view of the population, the type of toilet they use and the way they treat wastewater are multitude of problems, among other existential problems. *[Expert K]:* No. Our society is not mature enough for this. They refuse to change their habits. Perhaps it could be mandatory for newly built houses and apartments, then perhaps it would be implemented. At present, the country is not there to address this issue.
IT	● On a scale of 1 (not willing at all) to 10 (very willing): **varies** (2 to 5) Experts underlined the big difference between retrofitting an existing building or initially designing the system for a new building.
GR	● On a scale of 1 (not likely at all) to 10 (very likely): **2.43**
8	Would **you** be willing to modify your house/building to apply new sanitation user interfaces for excreta collection and treatment?
HU	● On a scale of 1 (not willing at all) to 10 (very willing): **5.63** *[Expert H]:* No. *[Expert J]:* Yes. I'm already trying to live sustainably. I have also thought about using dry toilets, as I could use them in my self-sufficient farming. *[Expert I]:* No, because this is not the most important issue for me in everyday life, I do not think about replacing the functioning system. If I were to build a new one, I would apply the technology, but this is not expected. *[Expert K]:* No. But if I had the financial comfort to build my own house someday, I would consider it.
IT	● On a scale of 1 (not willing at all) to 10 (very willing): **varies** (2 to 5)
GR	● On a scale of 1 (not willing at all) to 10 (very willing): **6.29**

3.4.3 Existing and future policies

Policies related questions	
1	Are you aware of any currently active national or regional policies that forbid or hinder the adoption of such technologies in your region?

HU	*[Expert B]:* Domestic policy is good, harmonised with the EU, regulators are arranged. *[Expert B]:* Local organisations do not have the authority to review superior rules. *[Expert D]:* If there is a licensed finished product, then the risk can be excluded, it can be traded, and the technology can also be disseminated. *[Expert H]:* Among technologies, Spanish is the most feasible innovation. Even now, farmers have the option to take sewage sludge from municipal wastewater plants in a diluted form for injection, but these currently have very limited legal frameworks that place an excessive extra burden on users. Thus, the widespread application of current practice is technologically solved but not fully legally ensured. Current legislation with the designation of protection zones, administrative burdens, and monitoring wells places too much burden on farmers, while they can only farm in small areas. Because of this, they are completely discouraged from such practices. *[Expert Q]:* There is policy and legislation. What is missing from the whole system is the money.
IT	The group is unaware of such policies. For wastewater reuse, some food label regulation requires “pure fresh water irrigation”, that hinders the use of wastewater reuse for crops to be marketed under that label. *[Expert B]:* With limited knowledge on food production regulations, however, the first legal barrier is the authorization of a new fertiliser, that is a very complex procedure, both at national and EU scale. To authorise the P2GreeN fertilisers, rather than try to force the recognition of the products into existing Component Material Categories (CMC, presently there are 15 ones authorised), through an appropriate lobbying action at European Commission Fertilisers Workgroup, a new CMC could be created, as they did, for example, for Struvite. The process to authorise a new fertiliser in Italy could take between 2 and 7 years: then it would probably smoothen the EU authorization that implies that the product is authorised in all EU countries. However, given that Aurin is already marketable in Austria, the “mutual recognition” principle can be used, at least to allow the product to be sold in Italy.
GR	*[Expert B]:* I am not aware of such policies, but in the context of a multi-actor approach the policy makers and the industry should get together. It is certain that in the future organic and inorganic fertilisers will coexist, but at what percentage each? Yield performance and environmental impact have to be both taken into account. *[Expert D]:* I am not aware, but there is the legislative framework for safety that could potentially hinder their adoption.
2	Are you aware of any financing incentives that promote the adoption/promotion of such technologies in your region?
HU	*[Expert E]:* Under EU support policy (CAP), the use of sewage sludge for agriculture is prohibited in agri-environmental management target programs, especially in Natura 2000 and other high nature value areas. It would be good to change this incentive policy. *[Expert B]:* Currently, the incentive acts against the introduction of technologies. Sludge

	cannot be used for food production. *[Expert B]:* Local incentives could be developed. *[Expert E]:* Domestic incentives could be guessed (e.g., for areas extracted).
IT	All the River Basin Management Plans and the Regional Water Plans strongly promote wastewater reuse, but still the economic barrier is not clearly addressed (as also mentioned in part B, Question No. 3)
GR	Experts were not aware of such incentives but highlighted the fact that these technologies will affect the fertilisers' market and expressed their concern regarding who will undertake the extra cost. Will it be the industry or the farmer? Farmers would definitely need to be supported by incentives. Incentives can be both indirect, i.e. by formulating information campaigns, or direct, for the adoption of such technologies.
3	In your opinion, how important is the development of such incentives in the adoption of such solutions?
HU	• On a scale of 1 (not important) to 10 (very important): **8.63** *[Expert B]:* Hungarian agriculture does not live on products, but on subsidies. *[Expert H]:* If sustainability and circular farming become important as a social need, the means will be created. At present, this is not an important goal. If the incentive legislation appears, then the subsidies will also appear. The conflict of interest arising from the chemical industry lobby remains a significant aspect of this. *[Expert I]:* Until this issue is settled at social level, marketing cannot be built on it, and at present it would be much more important to strengthen the current service provider network system, which has become extremely outdated because there has been no development in the sector in the past 20 years. Only innovative technologies can then be integrated into the system. *[Expert L]:* Financial incentives would be essential for supporting technological change. At the source of the “raw materials”, there would be a need to support the selective collection (urine and faeces). Transformation, transportation as well as fertilisation phase should be incentivized. No big regional wastewater treatment investments have to be supported, but smaller alternative solutions.
IT	• On a scale of 1 (not important) to 10 (very important): **7**
GR	• On a scale of 1 (not important) to 10 (very important): **9.43** Experts agreed that as previously discussed, the development of such incentives is crucial for the adoption of such solutions as the extra cost should somehow be managed.
4	What new policies would you propose for your region in order to help the adoption of such technologies?

HU	*[Expert E]:* When talking about circular economy, solutions should be developed that would bring together the various actors along the value chain or manage the complex product. *[Expert F]:* The technology could be used in the recultivation areas, energy plantations could be planted and irrigated here. There are huge areas for reclamation purposes in the country. *[Expert A]:* Sewage sludge is already used for recultivation purposes in Hungary, compost is made from it and used for this purpose, the compost mixture can also be used in old mining areas and abandoned landfills. *[Expert E]:* For example, the domestic sludge utilisation strategy did not appear in the CAP strategy, while in several countries in the EU there are attempts to incorporate it. *[Expert H]:* Farmers are unanimous in their opinion regarding the use of biofertilizers from wastewater sources that it is necessary to change the legislation so that the use of these products does not impose an additional administrative burden for them and must be economically valuable for them. The technological background is still in place, but currently the wastewater plant pays a landfill fee for the waste treatment of sewage sludge, but if instead it gave the nutrient-rich material to farmers for free, they would accept it. Treatment plants are currently ready to hand over this material to farmers, but due to the regulatory environment, this entails administrative and other burdens for farmers. Behind the current practice is also the advocacy activities of the fertiliser lobby. It is also important in what context the population encounters the crops produced in this way. If you appear on the leaflet as being treated with human faecal matter, you will reject it, but if you see that it is nutrient-rich humus and a product for the circular economy, then the technology may spread, but this will require legislative changes. *[Expert I]:* As long as water management in Hungary is divided into three different ministries, there is no chance that complex issues (e.g. circularity in wastewater treatment and organic farming) can be handled uniformly. Different ministries are currently addressing the issue of water along different interests and in different regulatory systems. Partial developments do not make sense, uniform management would be needed under a complex agricultural and water management. *[Expert Q]*: What would be important is the promotion and availability of alternative use. Where there is a sewage system, it is compulsory to join to the sewage system (or at least very-very difficult to set-up an alternative waste water system facility). *[Expert P]:* Also, there is a need for EU regulation and policy for the filtering or treatment of heavy metals from the fertilisers.
IT	N/A
GR	*[Expert A]:* The process of authorization of such products (end products, fertilisers) could be facilitated in a manner that would require the same period of time as other fertilisers. That could span to a period of a few years, but it is reasonable as many tests have to be made.

	Experts also highlighted the potential of a tax incentive.

4 Paris follower region results

The interview with the Paris follower region was conducted on Tuesday 12th of December, 2023. Representatives from the City of Paris were interviewed by CERTH over the course of a two-hour long interview.

- Technical and implementation
- Social impact

Technical and implementation	
1	Briefly describe the wastewater technology/system you are applying to the Saint-Vincent de-Paul (SVP) neighbourhood. At what stage of the construction/implementation are you?
	Separate collection of urine via separate water toilets (Save! Model from Laufen) will be made, which will then be transported via a specific collection network to a local treatment plant located on the ground floor of the boiler house. The rest of the wastewater (household water and faecal matter) will be handled in the conventional way, through the main sewer network and the treatment plant. Rainwater, on the other hand, will be managed on site, in particular by means of ditches in the public spaces. Part of the rainwater will be recovered and reused to supply the sanitary facilities and water the green spaces, while some will be returned to nature through infiltration/evapotranspiration. The SVP district, which will include 600 homes, as well as public and private facilities and shops, is currently under construction. Work began in 2021 and should be completed in 2027. The wastewater transport networks, and in particular that for urine, were built in 2021/2022. The buildings in the various lots will be constructed progressively from 2024. The urine treatment plant should be built in 2025.
2	What are the main differences with the previous wastewater system that you were using?
	Before the new district was built, SVP's buildings were connected to the main sewage collection system, and wastewater was sent to a centralised treatment plant.
3	Why did the city of Paris decide to undertake this transition?

	In 2015/2016, elected officials from the City of Paris, namely deputies for sanitation and planning, were made aware of the issue of urine source separation and the associated challenges (preservation of aquatic environments/use of urine as fertiliser) by a well known researcher from the OCAPI team. They then looked for an area under redevelopment where they could experiment with such a system. The SVP re-development operation appeared to these elected officials as a favourable context for experimenting with urine-diverting management. It is in fact a development project that aims to achieve environmental excellence, develop the circular economy and experiment with new urban practices. The creation of an innovative separate sewage system based on urine collection could fit in with these objectives. Furthermore, in terms of timetable, the overall project was still in its early stages and it was therefore possible to consider integrating such a system. At the beginning of 2018, the deputy mayor of Paris asked the public developer P&MA to study the feasibility of a urine-diverting project at SVP.
4	Were any feasibility studies carried out prior to implementation? If so, in what year were these carried out?
	An initial feasibility study was commissioned in June 2018 to the Evoloop design office, which specialises in in situ recycling systems. The feasibility study, carried out during the summer of 2018, considered three scenarios for urine collection on different scales (from a single building to all the lots in the area). It proposed to treat and transform the urine on site via a nitrification-distillation process, in order to reduce the volumes to be removed from the site and subsequently transported for recovery. The study highlighted the fact that investment costs would be more easily amortised in a large-scale scenario. The results of this study were presented in October 2018 by P&MA to the SVP steering committee (COPIL), bringing together elected representatives and managers from the various departments involved in the City of Paris. The COPIL expressed its interest in the subject at the end of 2018, but also highlighted the need to explore it further. In June 2019 the developer P&MA submitted a call for tenders for a contract aimed at assisting it in “defining and operating a urine separation management strategy within the SVP area”. In September 2019 a consortium of four companies with a wide range of skills was selected: Tilia, a company which supports public and private actors in the technical set-up of projects linked to energy, water and sanitation; Symchowicz & Weissberg, a law firm specialising in public and private business law; Evoloop, a company specialising in the circular economy; and Louise Raguet, an independent designer specialising in ecological sanitation and supporting users in this area. In 2020, P&MA and its consultant developed a “master plan” for urine management at SVP, again studying 4 urine collection scenarios on different scales (from a single lot to ten lots in the area), with different technical possibilities. Ultimately, one of the two most ambitious scenarios (urine collection over the entire area, with a predominantly gravity network supplemented by a pressure network) obtained the preference of the different actors within the City of Paris and was validated in October 2020. The preference for this scenario was motivated by a number of criteria: the City's ambition to test a separate urine

	management system on a neighbourhood scale, the desire to experiment with different technical possibilities (collection of urine by gravity and under pressure), issues related to the functionality and management of the system put in place and finally, a concern for economic viability.
5	What are the benefits of switching to such a wastewater and fertiliser system in your view?
	The benefits of the system that will be implemented in SVP must be understood on a larger scale than that of the district itself. Such a system contributes to the protection of water resources and aquatic environments. In fact, it avoids discharges from the nutrient treatment plant into the Seine. It should be noted in this regard that since 2005, the Île-de-France Region has been classified as an area sensitive to eutrophication. The protection of water resources is therefore a matter of major concern. Separate collection of urine also makes it possible to produce a natural and renewable fertiliser, unlike mineral and synthetic fertilisers, the manufacture of which utilises fossil resources that are in the process of being exhausted, and are massively imported. Such a system therefore also contributes to agricultural and food safety issues, by making it possible to recreate a circular economy of nutrient flows.
6	Are there drawbacks? Have there been any unforeseen challenges so far?
	The urine collection system at SVP is an innovative project, involving a change in practices and new skills, and raising the question of the sharing of roles and responsibilities between the various actors concerned. One of the main challenges during the design phase of the project (2018-2020) was to succeed in involving and aligning the different operational actors from the different Departments concerned within the City of Paris (DPE (Hygiene and Water Department) and DEVE (Green Spaces and Environment Department) in particular). They were, in fact, able to welcome the project, but with certain reservations and questions. It took two years of discussion and consultation to be able to get on board all the stakeholders concerned and to validate a scenario accepted by everyone (October 2020). We are currently in the construction phase of the urine collection and recovery system, which began in 2021. A challenge during this phase is to properly supervise the companies which will build an unusual system which has a number of specific features. For the moment, only the public urine collection network has been built. There were no problems during the construction phase. The actors found themselves confronted with certain specific technical questions (i.e. manholes to be installed to enable the monitoring and maintenance of a network which cannot be visited, to guarantee a form of airtightness and avoid odour problems, slopes of the network to be respected in order to avoid problems of urine stagnation and precipitation), but solutions were found and the network

	was built without difficulty. We are now entering the construction phase for the buildings and the internal urine collection networks.
7	Can you provide us with some technical details about the capacity of the system, how many litres per day do you expect to handle and how much fertiliser will be created?
	Processing capacity of 1,900 L of urine per day, corresponding to a production capacity of 47,000 L of fertiliser per year. DEVE sites consume between 150,000 and 200,000 L of fertiliser per year, i.e. quantities between 3 and 4 times greater than those that will be produced at SVP.
8	Which and what type of actors are involved in implementing and managing the system?
	The developer of the SVP area, on behalf of the City of Paris, is the public institution P&MA. This is the project manager for the development of the entire area, and therefore who supervises the construction of the urine collection and recovery system. The City of Paris will own the public urine collection network, as well as the treatment plant and will manage the system with two of its Departments directly involved: the DPE and the DEVE). The operation of the network and the plant will initially be delegated to one or more service provider companies, before possibly re-internalising their management at a later stage. The design of the urine collection project was the subject of joint work between P&MA and the City of Paris, with ongoing exchanges between the two organisations.
9	Were there economic reasons that motivated you to make this transition?
	It was not economic reasons that led the City of Paris to aim to set up the urine collection and recovery system at SVP. Nevertheless, the sharp rise in the prices of nitrogen fertilisers, partly due to the war between Russia and Ukraine, has highlighted the need to find alternative solutions to synthetic fertilisers both from an economic point of view and in order to meet food safety requirements. The project represents an additional initial investment, which the City and other stakeholders (developers and landlords) would not necessarily have made if there had not been subsidies from the government (AESN (the Seine basin authority), 80% of investment costs for public actors, 40% for private actors). The investment costs before the subsidies were estimated in 2021 as follows for the public part of the urine collection and recovery system: network (330,000 €), plant (500,000 €), purchase of the boiler room where the plant will be located (170,000 €), fertiliser spreading equipment for DEVE: between 10,000 and 20,000 €. Concerning the operating costs of the system, the studies carried out showed that an economic balance on exploitation was possible if the DPE resold the urine fertiliser

	produced at a purchase cost comparable to that currently paid by DEVE for liquid fertilisers.
10	Were there environmental reasons that motivated you to make this transition?
	These environmental reasons have already been addressed in Question No.5. Environmental issues (protection of water and aquatic environments, and the production/use of a natural and renewable fertiliser) and agricultural and food safety issues are the reasons behind the desire to experiment with such a system. There is also the issue of adapting to climate change, alongside that of protecting water resources. Indeed, climate change and the resulting drop in the flow of the Seine, combined with projected population growth across the Paris metropolitan area are causing a "scissor effect": more effluent to treat and less water to dilute it. A deterioration in the ecological state of the Seine will be inevitable in the medium term, unless we amplify the number of treatments aimed at reducing nitrogen and phosphorus in wastewater treatment plants, which are very costly and have environmental side effects. An alternative solution consists of diverting nutrient flows away from wastewater treatment plants, in cases where they are treated on site, as at SVP, to be used as fertiliser. The City of Paris thought it would be worthwhile to test the feasibility and effectiveness of a system for collecting and recycling urine, given the challenges mentioned.
11	Based on your experiences so far, how do you see the future of this technology? Is there considerable potential for scaling in other areas in Paris and beyond? Could it be financially viable?
	It is difficult to say at this stage. The objective of the pilot project set up at SVP is precisely to test its feasibility and operation, and then to see whether such a system can be reproduced and disseminated on a larger scale throughout Paris. But if the SVP project is a success, the City would like to be able to replicate it elsewhere. It is also difficult to comment on the financial viability of such a project, since developments in the regulatory and economic context could change the situation on this subject: potential issuance of a Marketing Authorization for Aurin fertiliser, which would enable it to be sold; new tensions and increases in the prices of nitrogen fertilisers, which would make Aurin more and more economically attractive, stricter regulations on the protection of aquatic environments which would force actors to put in place new safety measures, etc. Based on our experiences and the results of the feasibility studies it seems that economically it might be justified to implement such a system in a new build area. In all cases, developing projects on a larger scale allows for economies of scale, and possibly the pooling of equipment (treatment plants, collection lorries, etc.).

Social impact	
1	How open are citizens to your initial proposals to implement this system?
	The “citizens” directly affected by the SVP project are the future residents of the 600 housing units, as well as the future users of the district’s facilities. In fact, most residents are not yet known, and therefore not aware of the urine collection system that will be put in place at SVP. Only the future residents of the participative housing of the “Lepage” lot (around thirty houses) and two panels of future residents, one in social housing the other in open-access housing, representing around sixty people, are already known. They have been informed of the urine collection and recovering project, and of the fact that separate water toilets will be installed in their homes for this purpose. On the whole, the project seems to be received with interest and enthusiasm, although sometimes with certain questions and fears of malfunction.
2	You mentioned that in case the system doesn’t work you can always revert back to the old system easily; in your view, was this mechanism necessary in order to convince residents?
	As mentioned above, most of the residents of SVP are not yet known and aware about the project. The fact that the system put in place can be reversed was an important aspect within the City of Paris in daring to embark on such a project. If there is an issue, we can always switch to main sewerage. This may reassure residents in the same way.
3	Did you have a social engagement strategy in place to ‘convince’ residents (and other actors)?
	P&MA and the City of Paris have effectively planned awareness-raising actions aimed at future residents/users, to make them aware of the issues associated with the collection and recycling of urine, and of the good practices to adopt for this purpose with regard to the toilets. P&MA organised two workshops in 2023 with panels of future residents from social landlords, aiming to raise their awareness of the topic and seeking to identify their needs for support in using separate toilets. Flyers and an awareness video were also produced. A support system is currently being considered. The City of Paris is also conducting, in conjunction with the Ocapi team (https://www.leesu.fr/ocapi/presentation/ocapi-program/), a survey among the panel of future residents. The area will also have a dedicated neighbourhood manager whose purpose it is to inform residents of the functioning of the system and to respond to any questions residents may have.
4	Did you face any opposition from residents (or other actors)? If so, What steps did you

	undertake to assure them? Did you involve different actors in this process?
	For the moment, no, there is no obvious opposition to the urine collection and recycling project. But it is only under construction, not yet in service, and few people are informed about this project.
5	Did you face any serious/considerable bureaucratic/planning problems during this transition? If so, how did you overcome them?
	No specific problem for the urine collection and recovery project have been encountered so far. This must, however, be integrated into the schedule and rhythm of the SVP development project. This could sometimes lead to having to make decisions at key moments (e.g. a scenario had to be validated at the end of 2020, so that the urine collection project could be pursued). The appeals against the SVP project lead to a delay in its construction, which in turn delays the commissioning of the urine collection system.
6	Did you face any serious/considerable legal problems during this transition? If so, how did you overcome them?
	Note in this regard that P&MA's AMO Urine includes a law firm. Indeed, the collection/recovery of urine is an innovative project which is currently part of a vague and unsuitable legal framework. We mentioned the fact that there is currently no Marketing Authorization for this type of fertiliser in France. The inability to sell the product is one of the reasons which led the City of Paris to choose to test and use urine fertiliser internally on DEVE sites. Even internally, the conditions of use of the urine fertiliser must be the subject of discussion and authorization from the Regional Health Agency (ARS).
7	Do you think that citizens outside the neighbourhood would be willing to adopt this new innovative technology from the urine separation toilet system?
	This is a difficult question to be answered. The future SVP district will make it possible to test the acceptability and appropriation of separative water toilets among varied audiences with different profiles: tenants in social housing, homeowners on freehold property, users of public and private facilities, schools, emergency accommodation centres, etc. If the SVP project works, it will show that it is accepted and appropriate for different groups of people (considering expected socio-economic diversity of the residents), and therefore replicable in different contexts.

	It should be noted that the technical system adopted with the construction of a double network is not adaptable to old buildings which constitute almost the entire Parisian territory.
8	Would residents be able to opt out of the system?
	This issue has not really been addressed. In fact, there is no contractual obligation for residents to have separate collection toilets in their homes. If some people want to change it, what should they do? This issue remains to be addressed.
9	Were there any concerns about creating fertiliser from urine and using it in local parks? How do you think residents would react if you told them that it would be used for agriculture?
	For the moment, it is planned to use the fertiliser at the Horticultural Production Center (CPH) in Rungis. It is therefore not intended to be used on lawns and gardens for the time being. The challenge is, therefore, to raise awareness and train the agents who will use the fertiliser at the CPH. The issues seem to be more logistical and agronomic than those of acceptability of the staff. Concerning the acceptance by citizens of using urine fertilisers to fertilise lawns or for agricultural purposes, a real survey should be carried out on this subject, with people from a wide range of backgrounds. The responses of the ten or so future residents of SVP interviewed on this subject show that there may be questions regarding the use of urine fertilisers for agriculture, but that people are in fact open to the idea, as long as we provide them with answers to the questions they ask (i.e. about drug residues and health issues in particular).
10	How successful do you believe is this business model, and what in your opinion would improve this success level?
	In fact, the economic models that will be put in place will depend on regulatory and economic developments (issuance or not of MA for fertilisers derived from urine), recent developments in global issues, both environmental and geopolitical, regarding access to and the price of fertilisers and other resources needed to produce them (energy, transport costs, etc.). Nevertheless, the issuance of certification for Aurin in Switzerland in 2018, then of an authorization for its marketing in Austria in 2022, as well as the issuance of the authorization in France and in 5 other European countries for the biostimulant produced urine base by Toopi Organics show that a market is emerging. The rapid development of the company Toopi Organics, which has raised nearly 20 million euros over the last two years to develop its activity, shows that there is real interest in this type of fertiliser.

5 Discussion

The conclusions discussed in this Section are divided in 3 main parts: (a) technical and economic considerations regarding the adoption of such technologies; (b) social aspects regarding their adoption as a user of the technology, as a farmer which utilises the final product for fertiliser and as a consumer of the produced food; and (c) considerations on existing or future policies.

Technical and economic considerations

Generally, experts were positive about all technologies, and highlighted that if their pilots continue to show promise then there is potential for each of these technologies, despite perceived barriers, in each of the follower regions.

The Hungarian focus group members proposed that separate urine and dry matter collection could constitute a solution for large temporary events, construction sites, and sizable buildings such as malls, office buildings, and factory structures where urinals are already installed. The feasibility of the BioAzul technology could be considered in the context of small wastewater treatment plants in Hungary. However, it is debatable whether the extracted irrigation water would be sufficient to offset the substantial investment costs. Given the limited acceptance of wastewater derivatives, the primary application area for alternative fertilisers could be energy plantations, fodder crop areas, recultivation areas, public parks, and other public spaces. There is a strong consensus that these technologies can offer solutions on a local or regional scale. This approach would facilitate local resource utilisation, as well as the retention and recycling of nutrients and water.

The most significant obstacle to the practical application of the presented technologies lies in the cost-effective replacement of already established traditional technologies. However, additional cost factors, such as follow-up treatment, destruction and transportation, as well as warrant examination; as they contribute to increased cost levels. The potential advantage of the BioAzul technology may be its applicability to already installed wastewater treatment solutions. Nevertheless, even in such cases, the installation costs may not be fully recouped. The end products of these technologies can be utilised in agricultural areas to a limited extent, excluding food production and areas designated for Natura 2000 and organic farming. Agricultural lands require nutrients and soil improvers, while arid regions need a water supply. Therefore, the extraction and application of nutrients and irrigation water to the soil represent a viable solution; we simply need to identify optimal areas of use. It holds true for all technologies that they can contribute to reducing pollution in freshwater environments, which is a positive and noteworthy feature.

According to the Italian experts, the innovative solutions of Sanitation360 and VunaNexus, despite their acknowledged robustness, appear to have high production costs and are therefore believed not to be competitive with conventional fertilisers in that aspect. Nevertheless, specific marketing strategies could enhance their adoption, provided that they are implemented in “closed loop” establishments like sport facilities or hotels. In that way, urine could be collected, processed and reused for its main volume inside the specific facility. Part of it could also be traded but only through “green” marketing strategies, so as to both convince the end customer for its quality as well as balance the high production costs. Goldeimer technology was considered quite reliable by the Italian experts. A depiction of the production costs could further assist them to compare the produced compost with conventional products. As for the BioAzul technology, the main technical/economic barrier to wastewater reuse is the additive costs of treatment and to transfer the water to the location that it will be utilised. If this barrier is somehow overcome, the smart reuse concept appears to be both technically feasible and potentially interesting for farmers. In all cases, the modification of existing sanitation systems would be challenging in both private houses and public buildings. However, experts were positive for their initial installation in new or renovated public buildings.

Greek focus group members agreed that even if in early stages, all the proposed technologies are promising. Even if not presenting a great novelty, their overall application constitutes one and they are worth further investigation. VunaNexus and Goldeimer solutions, as well as the monitoring system of BioAzul appealed more to them in terms of being adopted in Greece. In all cases, a financial incentive seems to be necessary. Adding to the latter that they foresee a relevant market emerging, as apart from the environmental benefit, there is business opportunity. A long term trial with the final products of the technologies is required in an agricultural perspective if these products are to be used in fertilising for food production, and in any case, monitoring needs to be applied in all stages. Smart agriculture should assist, apart from the monitoring, in the precise application as well.

This discussion highlights that economic considerations regarding all technologies were a major theme in all focus groups. A major barrier, highlighted by the experts, to the implementation and scaling of these technologies is the associated investment cost of setting up and running these systems at scale. In addition, the innovativeness and newness of these systems mean that it is likely to be challenging to secure access to finance, especially from the private sector. It is likely that innovative financing mechanisms should be pursued in the follower regions to overcome these challenges. This may involve exploring public-private partnerships, leveraging existing infrastructure support programs, or establishing dedicated funds specifically tailored to incentivize and support the adoption of innovative waste and fertiliser technologies. Furthermore, fostering collaboration between research institutions, industry stakeholders, and financial institutions can play a crucial role in developing financial models that align with the unique needs and circumstances of each region. The further implementation of these technologies in the pilot regions as well as the planned feasibility studies in each follower

region will allow for a more concrete understanding of the economics in each context allowing for the development for financing solutions

The case of Paris is illustrative of this where the initial investment costs were, largely, covered (subsidised) by the City of Paris. The conducted interview suggested that if the produced fertiliser could be sold (pending legislation) then the business case could potentially be viable (in specific contexts and based on rough calculations). The case of Paris also suggested that this is likely to work in new build areas where the required infrastructure can be directly integrated into the building plans at the start of the project. By contrast renovations of older and existing buildings and their systems is likely to be cost-prohibitive.

Social aspects

The highlighted social aspects in the focus groups can be broadly split into several groups: related to the implementation and acceptance of the innovative systems and the use and acceptance of the fertiliser products and associated agricultural products.

In the Hungarian case, it is known that farmers currently utilise animal manure in production and for them, beside costs, regulations would also be a decisive factor. Presently, the disposal of wastewater derivatives is both costly and administratively burdensome, with restrictions on placement in specific areas (not intended for food production, Natura 2000, and organic farming zones). The potential rejection from end-users could serve as a deterrent to the adoption of alternative fertilisers in production. It is crucial to consider the entire value chain, as each technology caters to a distinct customer base within the chain, including residential parks, festivals, and environmentally conscious residents. The development of a given technology should align well with the specific requirements of the value chain. Farmers can be persuaded through good practice and education. Attitudes toward adoption are also influenced by generational factors, with older farmers facing greater challenges in adapting to change. As for the consumers of the food produced by utilising these fertilisers, the majority of the experts expressed their disbelief when asked if the everyday people would accept them.

Italian experts are convinced that the solutions that the P2GreeN Project examines will find some opposition by local residents, but this is not surprising as they are novel approaches. If necessary, ways to be adopted can be found. Especially for the farmers, who would not have any opposition to use human excreta derived fertilisers or soil improvers, as long as the products are affordable and competitive compared to the conventional ones they are currently using. It is understood that years of testing must precede.

The perspective of the sum of the focus group members was clearly in favour of the view that if a proper awareness campaign is developed, the vast majority of the people can be convinced and will gladly adopt a solution that will benefit the common good. As for the industry/companies to adopt such technologies in their facilities, the motive necessarily has to be financial; except if social responsibility is somehow brought into the equation.

Greek experts also agreed that farmers do not have any reason to object to using such fertilisers if their quality - and thus the yield - is ensured and the cost is, if not lower, reasonably higher and followed by some certification that could be utilised to justify the higher value of their end-products. They expressed the opinion that in any case, more agricultural research has to be carried out in that direction.

The discussions with potential residents in the French case illustrated that potential residents appeared positive of the new system and open to using it. Again, a system that informs residents through a series of events and material of the benefits system appears to be very supportive of successful adoption. In addition, the establishment of a dedicated 'neighbourhood manager' that provides residents with information on the proposed systems is likely to support social acceptance of the technologies considerable.

Policy related aspects

The discussion among experts highlighted varying degrees of awareness regarding national and regional policies related to the adoption of innovative waste and fertiliser technologies.

The national policy adheres to EU regulations, permitting the use of wastewater derivatives in specific areas. In these approved zones, such as recultivation and non-food production areas, the application of sewage sludge is widespread across the country. However, for these derivatives to be applicable in the food industry, regulatory changes are necessary. An additional challenge lies in the small settlements across the country that lack wastewater treatment facilities. In these areas, any alternative technology compliant with EU regulations could be embraced. The primary obstacle to the implementation of such technologies in these locations is the financial aspect.

Under the EU support policy (CAP), the utilisation of sewage sludge for agriculture is prohibited in agri-environmental management target programs, particularly in Natura 2000 and other high nature value areas. It could be beneficial to consider changing this incentive policy. Farmers unanimously agree on the need for legislation change concerning the use of biofertilizers derived from wastewater sources. They argue that such changes should eliminate additional administrative burdens and ensure economic viability. The division of water management in Hungary among three different ministries poses a significant challenge. This division hinders the uniform handling of complex issues, such as circularity in wastewater treatment and organic farming. A unified management approach is essential for addressing these complex intersections of agricultural and water management. The domestic sludge utilisation strategy is absent from the CAP strategy. In contrast, several EU countries are actively exploring ways to incorporate it into their policies.

The Italian focus group stated that the, the "mutual recognition" principle could potentially be utilised to allow such fertilisers to be traded in Italy. Regarding upcoming policies, it is known that all the River Basin Management Plans and the Regional Water Plans strongly

promote wastewater reuse, but the economic barrier or the incentives are not yet clearly addressed.

Greek focus group members were not aware of specific policies that hinder the adoption of such technologies, apart from the general legislative framework for safety. They agreed that policy makers and industry should get together and commonly decide on upcoming policies, taking for granted that political support is essential for such advances. Regarding the authorisation of fertilisers produced by such technologies, they found the admittedly long time that the authorisation of such products could take reasonable, as a number of tests needs to be taken before being released in the market, exactly like the authorisation process of common fertilisers.

The policy related discussions highlighted, that despite a number of supportive policies, these technologies and the use of their products require the development of an overall extensive supportive policy framework on both an EU and national level in order to effectively scale these technologies. This framework should encompass regulatory adjustments, financial incentives, and proactive decision-making to effectively scale these technologies and promote the production of fertilizers derived from human urine and faeces.

6 Conclusions

This report presents the results of the focus groups assembled in the follower regions, namely Hungary, Italy and Greece, with the goal of supporting the development and adoption of P2GreeN's solutions. These focus groups aim to assist the feasibility study implementation in T5.2 - Conducting feasibility studies in 4 follower regions and identify the pain points of applying the P2GreeN solutions. The outputs from the focus group were further enhanced by an interview with the representatives from the City of Paris to document the experiences and lessons learned from the French case supporting the potential implementation of the P2GreeN technologies in the follower regions.

The discussions on technical and economic considerations underscored the positive outlook of experts towards innovative waste and fertiliser technologies, emphasizing their potential in various regions, despite challenges. Economic obstacles, especially the cost-effective replacement of traditional technologies, and additional factors like follow-up treatment and transportation costs were acknowledged. Social aspects discussions revealed diverse perspectives, with considerations ranging from farmer acceptance based on affordability and quality to the need for extensive awareness campaigns for public acceptance. The case of Paris highlighted the importance of integrating infrastructure into new builds, while existing building renovations posed cost challenges.

Policy-related aspects emphasized the need for an extensive supportive policy framework at both EU and national levels. Regulatory adjustments, financial incentives, and

proactive decision-making were deemed crucial for the effective scaling of these technologies. Challenges such as EU regulations, division of water management responsibilities, and the absence of a domestic sludge utilization strategy were acknowledged, calling for collaborative efforts between policymakers and industry stakeholders to shape upcoming policies.

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