FORENV

THE EU FORESIGHT SYSTEM FOR THE ENVIRONMENT

SYNTHESIS REPORT

Delivering a zero pollution ambition by 2050 – input towards strategic foresight

February 2022

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1 Introduction

This report presents a synthesis of the outputs from the third annual cycle (2020-21) of the EU Foresight System for the Environment (FORENV). FORENV is a structured horizon scanning and expert-led sense-making process, which each year identifies ten priority emerging issues for Europe and Europe's environment (see Box 1). In its third cycle FORENV focused on identifying emerging societal, economic and environmental issues (i.e. benefits, opportunities and threats) which will impact our ability to deliver a zero-pollution ambition for a toxic-free environment by 2050.

A scanning exercise identified more than 150 weak signals of change relevant to this topic. These were discussed in four workshops bringing together Commission officials and external experts which led to the identification of ten priority emerging issues. These issues were then characterised via desk research, including defining their key drivers and expected future development. Drivers and future changes include those that are societal (such as demographic changes and lifestyles), economic and technological (such as cellular agriculture), and environmental. The ten issues are listed and summarised in Annex 1.

Based on the ten priority issues, this synthesis presents and assesses five clusters of potentially disruptive changes associated with the emerging issues, implications for the zero pollution ambition and associated uncertainties (Section 2). Key policy questions are then defined (Section 3), which are intended to inform ongoing discussion about potential threats and opportunities to Europe's zero pollution ambitions.

1.1 Purpose of this synthesis assessment

As this report is based on a horizon scanning exercise the FORENV results presented here do not represent a comprehensive review of emerging trends. They are intended to raise some key questions and stimulate discussion on how emerging issues could change the societal, economic and environmental landscape for achieving zero pollution over the coming decades.

The synthesis assessment, uncertainties and key policy questions have the aim of providing input to further policy discussions. Furthermore, in the context of the proposed zero pollution monitoring and outlook framework, the results presented could provide a starting point in future for a wider strategic foresight exercise related to zero pollution.

Box 1: Horizon scanning as the basis of the EU Foresight System for the identification of emerging environmental issues and related opportunities and risks (FORENV)

The methodology used for FORENV is based on horizon scanning. Horizon scanning refers to the systematic identification and examination of potential future developments or drivers of change at the margins of current thinking and to explore the opportunities and threats to policy or society these may represent. As a process horizon scanning involves desk based and expert-led identification of weak signals of change that may challenge current assumptions or trends.

By making sense of such weak signals through its structured horizon scanning approach, FORENV identifies, characterises and communicates emerging issues to policy makers and risk managers so that they can decide what action needs to be taken. As FORENV is not embedded within a specific policy unit it is not intended to develop or assess policy options, however the outcomes are expected to be relevant for environmental policy.

More information on FORENV and the methodology used are available on the Commission website.

1.2 Pollution in Europe today

This section provides a brief overview of the main types of pollution in the EU as context for the clusters of emerging issues presented in this synthesis. More detailed information is provided through recent reports, in particular the EEA 2020 Signals Report: Towards Zero Pollution in Europe (EEA, 2020a).

The most polluting sectors in Europe are transport, agriculture, energy, housing, and waste management. Activity in these sectors cause pollution of the air, water, land and soil, as well as noise pollution. For example, unsustainable farming practices lead to pollution of soil, water, air and food, and can result in ecosystem degradation (EEA, 2020a). There are also many types of polluting substances, including plastics and hazardous chemicals.

The main sources of **air and noise pollution** are road transport, energy production and distribution, domestic heating, agriculture, and industry (EEA, 2020a, 2020c). Air and noise pollution remain an important concern in Europe despite reductions in emissions of many harmful pollutants such as PM10 (by 22% over the period 2009-2018), and nitrogen oxides (by 34%), (EEA, 2020b). In 2018,

exposure to particulate matter, Ozone (O3), Nitrous Dioxide (NO2) and Sulphur Dioxide (SO2) remained above EU standards in many urban areas (EEA, 2020b). Much of Europe is also adversely affected by noise pollution, with only 4% of Europe's territory considered to have a 'high potential' for quiet (EEA, 2016).

In relation to **water pollution**, only 44% of surface waters in the EU are assessed as having good or high ecological status (EEA, 2020a). The main sources of surface water pollution are chemical pollution from industry and nutrient runoff and leaching from agriculture. Urban waste water and digitalisation (through production and disposal of devices and generation of the energy they use) is also causing water pollution risks in Europe (EEA, 2020a; European Commission, 2021). In some European countries less than 80% of the population was connected to public urban wastewater treatment systems in 2017 (EEA, 2020a). Various sources, including synthetic chemicals and heavy metals originating from industry, pollute Europe's marine waters. Eutrophication and noise pollution from ships and other machinery also negatively affect marine life in European coastal waters (EEA, 2020a).

Land and soil pollution in the EU is mainly caused by agriculture. Pesticides, copper and cadmium are common pollutants of soil and land from agricultural activities. Municipal and industrial waste is responsible for more than one third of local contaminations, followed by industrial activities. Europe's growing urban areas are also responsible for land and soil pollution as concrete and asphalt surfaces seal the soil increasing run-off and pollution concentration. Poor waste management through waste dumps, illegal disposal and littering create further risks of soil pollution.

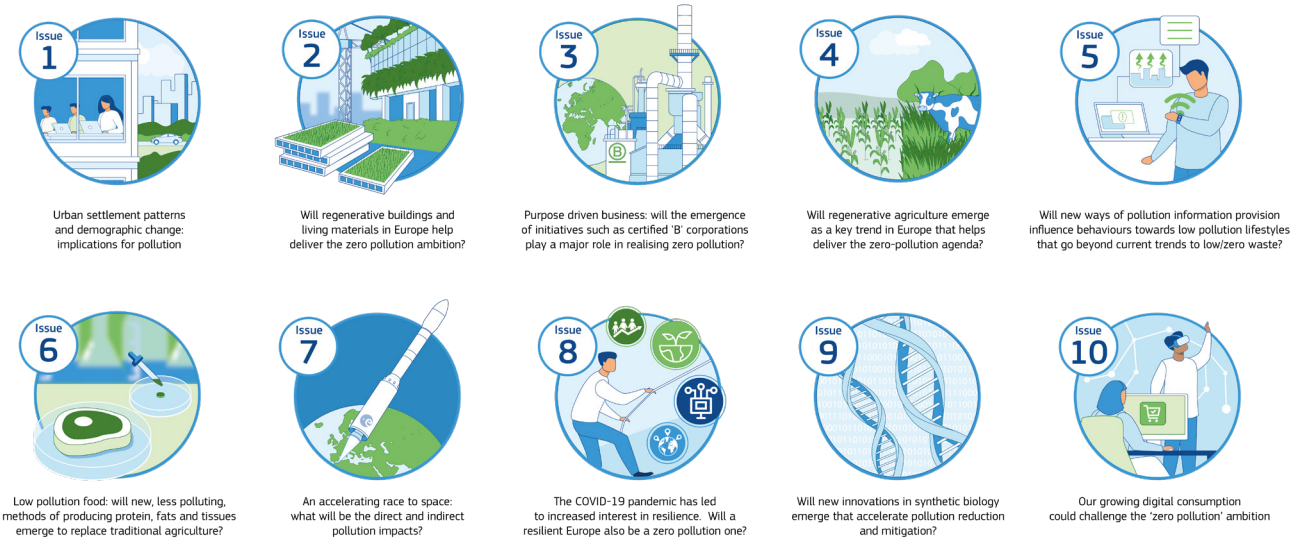
Chemical pollution contributes to the degradation of Europe's environment, though its true impact is not yet fully understood. There are approximately 100,000 substances containing synthetic chemicals on the EU market of which around 70,000 (70%) have very limited information on their hazards or exposures (EEA, 2019). Two thirds of the 300 million tonnes of chemicals consumed in the EU in 2018 were classified as hazardous. Approximately 3.5 million sites around Europe are contaminated by these hazardous substances, including very persistent substances (European Commission, 2020).

Plastic pollution and microplastics is a growing environmental issue with almost 26 million tonnes of plastic waste generated every year in the EU (European Commission, n.d.). Electronic waste is a key source for **other key pollutants** such as nanomaterials. Europe has the highest per capita generation of e-waste globally amounting to 16kg per person in 2019 (European Commission, 2021). There is no accurate estimate of the quantities of nanomaterials in different waste streams (Manžuch et al., 2021).

2 Synthesis assessment of emerging issues

Five clusters of disruptive changes arising from the ten priority emerging issues identified by FORENV are proposed. The first cluster relates to the emergence of *pervasive digital tools and lifestyles*, in which new digital tools and services increasingly emerge and affect all aspects of life. In turn, increasing digitalisation of life and work is a key driver in the second cluster on *transformations in where we live and work*. Digital tools and technological advances also provide a range of *new pollution monitoring and data methods*, which are explored in the third cluster. Technological advances, including cellular and synthetic biology are key drivers in the final two clusters which relate to the emergence of *living buildings and new materials* for construction, and the potential for *multi-faceted food system revolutions*.

Each cluster is presented below. The icons used in the cluster infographics correspond to one of the ten priority emerging issues (see figure below). Each of the ten issues is summarised in Annex 1.

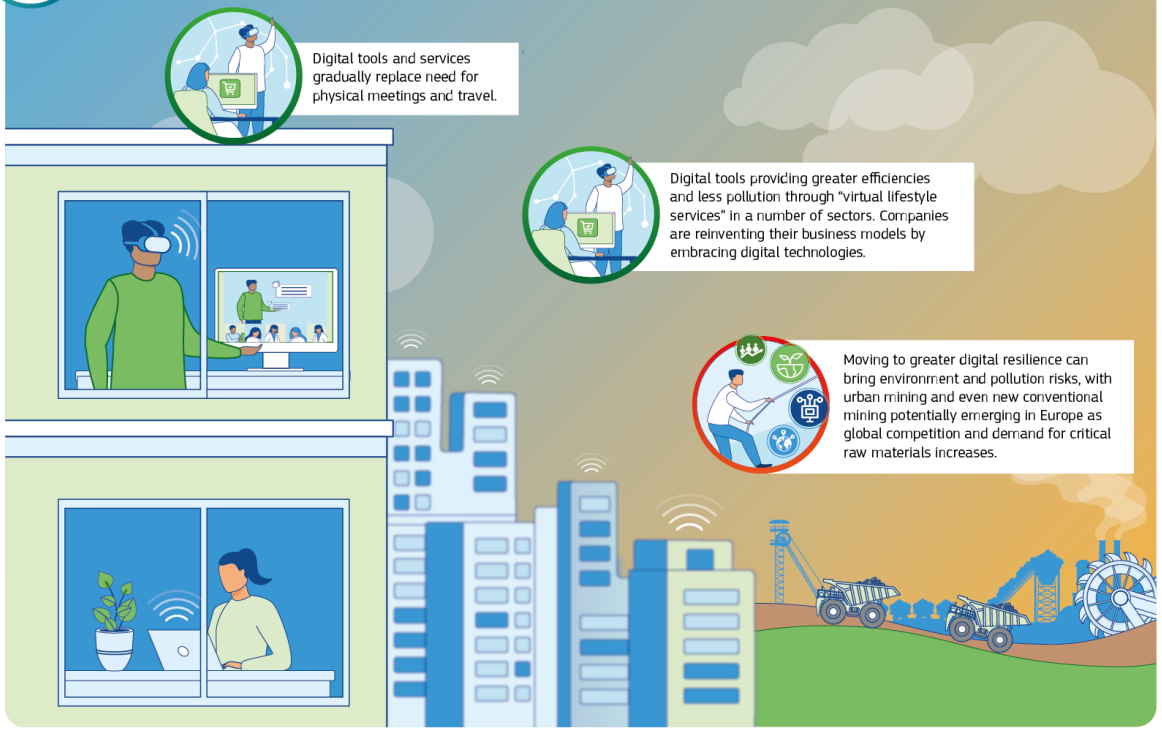


2.1 Cluster 1: Pervasive digital tools and lifestyles

CLUSTER 1

Pervasive digital tools and lifestyles

FORENV



Potential implications for the zero pollution ambition

If a society-wide move to more digital lifestyles is seen this could reduce the impact of some forms of physical consumption, improve efficiency in major economic sectors, as well as reduce the need for travel and associated pollution impacts.

Short 1-5 years | Medium 5-10 years

If ownership of digital devices becomes pervasive, then typically short product lifecyles are likely to create increasing pollution risks resulting from the growing quantity and diversity of products entering the waste electronic and electrical equipment stream.

Short 1-5 years | Medium 5-10 years

If digital lifestyles become pervasive this will require a range of materials and resources to support the required production of digital technologies and related infrastructure. Urban or conventional mining for these resources would lead to new pollution and health risks, with risks for soil, water and from chemicals.

Medium 5-10 years

New forms of digital consumption could have uncertain implications (e.g. reduced transport through virtual mobility vs. increased transport created by the desire to travel to places seen on the internet).

Opportunity | Risk | Uncertainty

Cluster summary

- Life and work is becoming progressively more digitalised as many services and activities move online.
- This is driven by technology, but also social factors like avoiding disease transmission and seeking quality of life, as seen during Covid-19.
- These changes will influence how we consume goods and where we choose to live.

- Emerging tools like virtual and augmented reality may accelerate changes to business practices already transformed through online meetings.
- This is coupled with the emergence of 'virtual lifestyle services' that are replacing traditional physical services.
- Associated reductions in travel, consumption and production of physical goods, could bring significant, though uncertain, pollution alleviation.

- Digital devices and infrastructure often have short life cycles and require rare minerals and metals, with pollution risks from urban or conventional mining.
- An increase in the ownership of multiple devices, and greater use of higher footprint services like video streaming, can also bring novel pollution risks.
- People's mental and physical health is also at risk due to less activity and social engagement.

Key uncertainties for policy

Non-energy impacts of digital technologies

Much of the focus on understanding the environmental and pollution impacts of digital technologies has been on energy efficiency and carbon. How can wider implications such as the use of resources, water consumption, land use, biodiversity and pollution be better understood and addressed?

Conventional vs urban mining

How should demand for critical raw materials be met, given Europe relies heavily on imports from third countries? Can the pollution impacts of new conventional mining be mitigated? What risks emerge from urban mining, if this becomes more prevalent? Are new policy and regulatory tools needed?

New regulations on digital products and lifestyles

As the proportion of an individual's environmental footprint associated with digital media consumption is small, there is little pressure to change. Will new regulation be needed to ensure improved transparency about the overall environmental and pollution footprint of digital products and lifestyles?

Twin digital and green transition

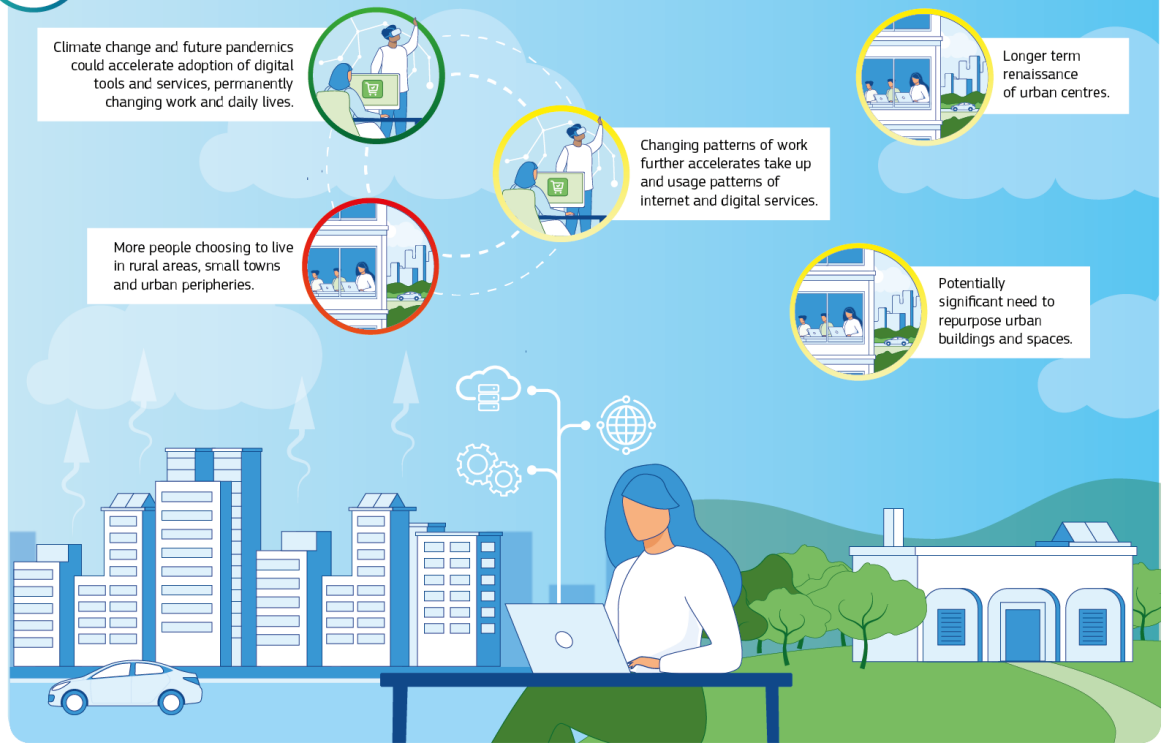
Combining the digital and green transition agendas could foster more integrated digital solutions, and create opportunities to better monitor and manage environmental impacts across the whole digital ecosystem, but to what extent can traditional policy silos and governance structures change to accommodate a more integrated approach?

2.2 Cluster 2: Transformations in where and how we live and work

CLUSTER 2

Transformations in where and how we live and work

FORENV



Potential implications for the zero pollution ambition

If a large proportion of city workers move away from urban areas, then commuting patterns will change. This is likely to reduce congestion, noise pollution and improve urban air quality due to less car traffic and reduced economic activity.

Short 1-5 years

If there is less commuting to urban areas and low levels of utilisation of buildings, public officials may need to rethink urban mobility and land use. Retrofitting urban building stock could bring pollution benefits but will require integrating climate, environmental and social agendas in cities to maximise co-benefits.

Short 1-5 years | Medium 5-10 years

If the repurposing of buildings and infrastructure, or building and land abandonment occurs on a large scale, the associated waste and material use could bring new pollution risks in urban areas.

Short 1-5 years | Medium 5-10 years

If wealthier residents leave urban areas for greener, more spacious suburbs, this could shift tax revenues out of inner cities and reduce investment in deprived areas, including for services such as urban waste management.

Medium 5-10 years

Where more dispersed settlements develop together with changes in mobility this could lead to greater integration of rural towns into wider urban areas. This would broaden the catchment area of cities and increase economic activities in rural areas, with associated pollution risks.

Medium 5-10 years | Long 10+ years

Opportunity | Risk | Uncertainty

Cluster summary

- The adoption of digital tools and internet-based systems and services may be sped up by future disasters (such as pandemics) and environmental change.
- This could result in more flexible work patterns and changes in how people live, as well as how they consume.

- Permanent flexible and home-based working may lead to an exodus of office workers from urban centres to urban peripheries, small towns and rural areas.
- Areas currently facing depopulation and its associated consequences may therefore be revitalised.
- Depopulated urban centres may lead to the need to repurpose or reconstruct offices, other buildings and infrastructure.

- In the longer term, some city centres may experience a renaissance as they become more affordable for young, less affluent people.
- A widening demographic divide between urban and rural populations could, however, lead to increased social segmentation and segregation.
- Long-term decline and more derelict buildings in areas such as business districts could lead to pollution and other environmental and health risks.

Key uncertainties for policy

Mobility

Will urban settlement and working trends combine with wider mobility trends (e.g. electrification, automation) to significantly reduce the pollution burden of urban mobility and commuting?

Use of Buildings

Can we retrofit or reimagine urban buildings if they are underutilised or need repurposing to maximise opportunities to reduce pollution? (see Cluster 4)

Urban decay or revitalisation

Urban decay and abandonment will have pollution risks. Can cities be reimagined to maximise greenspace, liveability and environmental health?

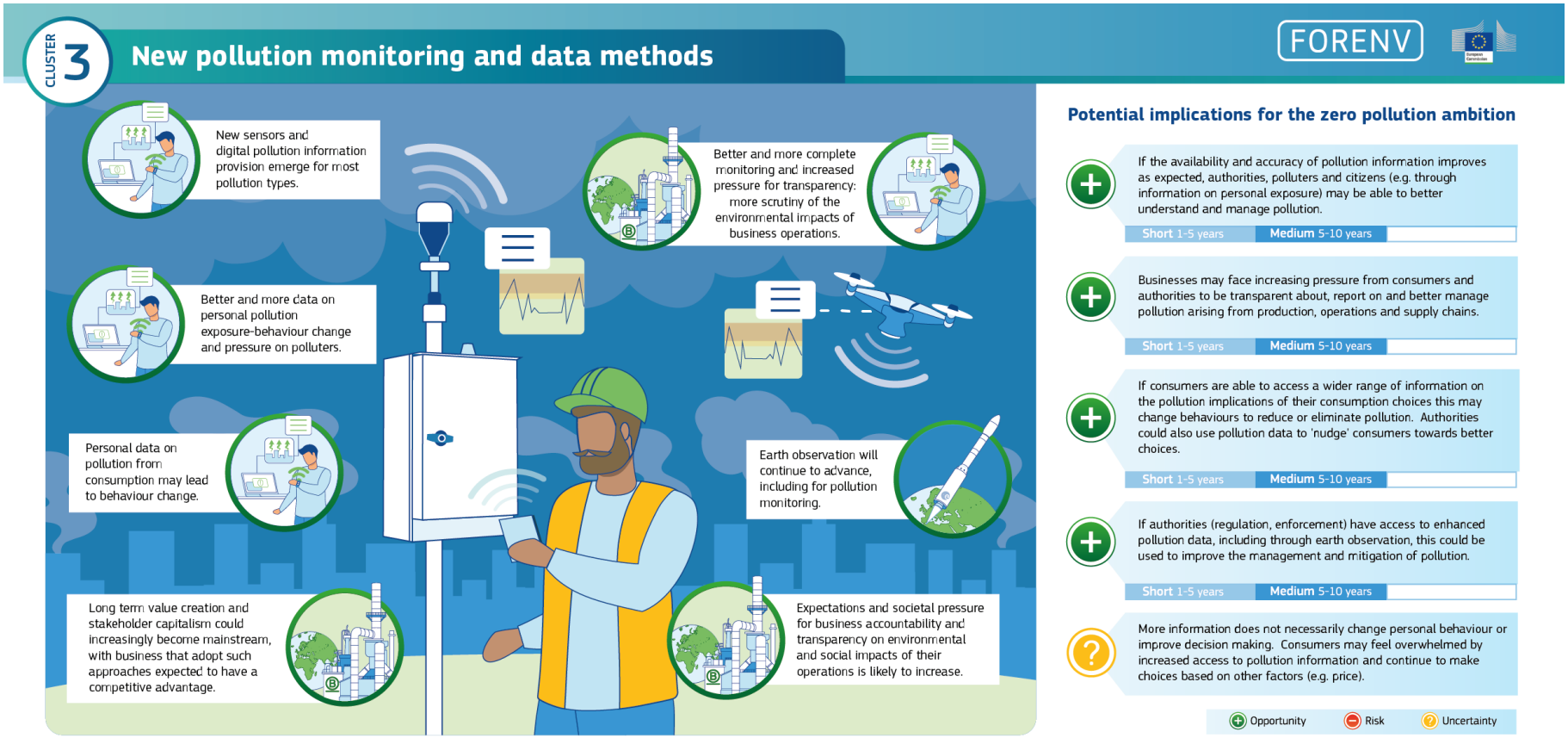
Urban-rural expansion

Will mobility transformation hollow out urban areas and transfer pollution impacts to rural or peri-urban areas? Will changes to mobility broaden urban catchment areas and increase noise and air pollution impacts?

New monitoring and data

How might new tools for monitoring and data on pollution (see Cluster 3) be used to understand these emerging pollution risks and enable preventative action to mitigate new risks?

2.3 Cluster 3: New pollution monitoring and data methods



Cluster summary

- Data and information on types and sources of pollution, along with our exposure to them, is becoming increasingly available.
- New sensing, monitoring and communication technologies, including satellite technology, are facilitating this new data.
- Developments in AI are helping us to understand the data better and inform our actions.

- Businesses are increasingly focused on reducing their environmental impacts.
- A greater availability of information on pollution sources could further stimulate businesses to address their own pollution emissions.

- Citizens could become more aware of their personal exposure to pollutants and of the pollution implications of their consumption choices.
- This may amplify pressure on authorities and polluters to address pollution, increase transparency and inform regulation
- New and increased data could also highlight inequalities in pollution exposure, supporting a more just social landscape.

Key uncertainties for policy

Understanding what is available

As new tools, sensors and technologies emerge rapidly and from a range of sources (e.g. public research, private sector) including in the commercial sphere, such as smartphone applications (apps), how can the zero pollution ambition keep on top of these developments and understand which tools can support progress?

New sources of data

Data collected by the private sector, citizen science and through academic research may become a more important source of intelligence for monitoring zero pollution in future, but there is a risk that it will be hard to collect and analyse. Will new approaches be needed to collect large amounts of disparate data?

Shifting consumption behaviours

As the volume of data on pollution grows, often reported in real-time, the opportunity to use this to stimulate behaviour change, such as through nudging mechanisms will grow. However, influencing individual consumption choices may prove contentious as ethical concerns around nudging behaviour exist. How can consumers be supported in reducing the pollution implications of consumption, and what role should they be expected to play?

Business and finance

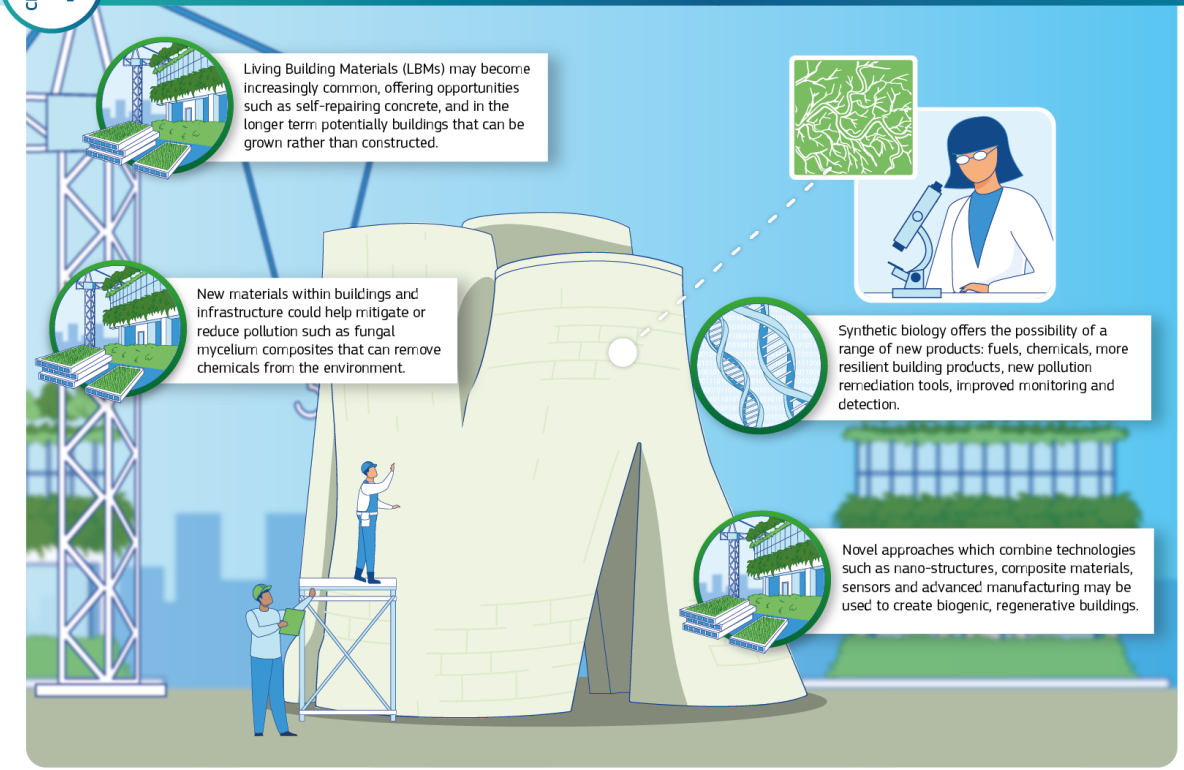
Could much greater availability of data on pollution from businesses, including in supply chains be used to encourage the inclusion of long-term pollution risks in investment decisions, similar to as being seen in relation to climate risks? Is the sustainable finance taxonomy an appropriate mechanism for this?

2.4 Cluster 4: Living buildings and new materials

CLUSTER 4

Living buildings and new materials

FORENV



Potential implications for the zero pollution ambition

- If a range of new building materials (e.g. living, biogenic, composites etc.) become more prevalent, this could reduce the environmental and pollution impacts of the extraction, production, use and disposal of traditional materials. — **Medium** 5-10 years
- Living Building Materials and potentially the growing of whole buildings could transform construction, by reducing the need for traditional construction activity, potentially alleviating air, dust, noise, soil and water pollution on sites. — **Long** 10+ years
- If used at scale, new building materials such as those incorporating living elements, or nano-structures could help mitigate some forms of pollution, including air and water, for example absorbing air pollution or chemicals. — **Long** 10+ years
- If there is an acceleration in the development and uptake of new, regenerative materials this could hasten the demolition and refurbishment of buildings, leading to an increase in waste and associated pollution. — **Medium** 5-10 years
- A focus on resource efficiency and material performance may lead to unanticipated or downplayed risks to the environment (including new forms of pollution) and human health from the lifecycle of new materials. This could include nanotoxicity or new chemical mixes. — **Long** 10+ years

Opportunity | Risk | Uncertainty

Cluster summary

- The extraction, production, transportation, use and disposal of building materials causes significant environmental harm and pollution.
- Research into new construction materials and approaches aims to reduce this by utilising regenerative, living materials.
- Nanotechnology, synthetic biology, novel composites and sensors could all soon be deployed in the construction sector.

- Traditional biobased materials like wood or bamboo will likely be used alongside new regenerative materials, including living building materials.
- Through the use of these materials buildings could potentially self-repair, provide a source of food and combat air or chemical pollution through absorption.

- In future buildings and materials used in them could interact more with their environment and nature.
- Some research suggests that via directed stimuli, buildings could even be grown rather than constructed.
- This would mitigate against air, noise, soil and water pollution on building sites.

Key uncertainties for policy

The construction industry is traditionally slow to adapt to change

How can the industry be encouraged to take up new, novel materials offering the highest environmental benefits, and who are the key partners in this?

Using new materials in retrofitting buildings

Much of the focus has been on the design and construction of new regenerative buildings. Yet 90% of buildings in Europe were built before 1990. How can the use of new and living materials be encouraged in retrofitting and refurbishing older buildings?

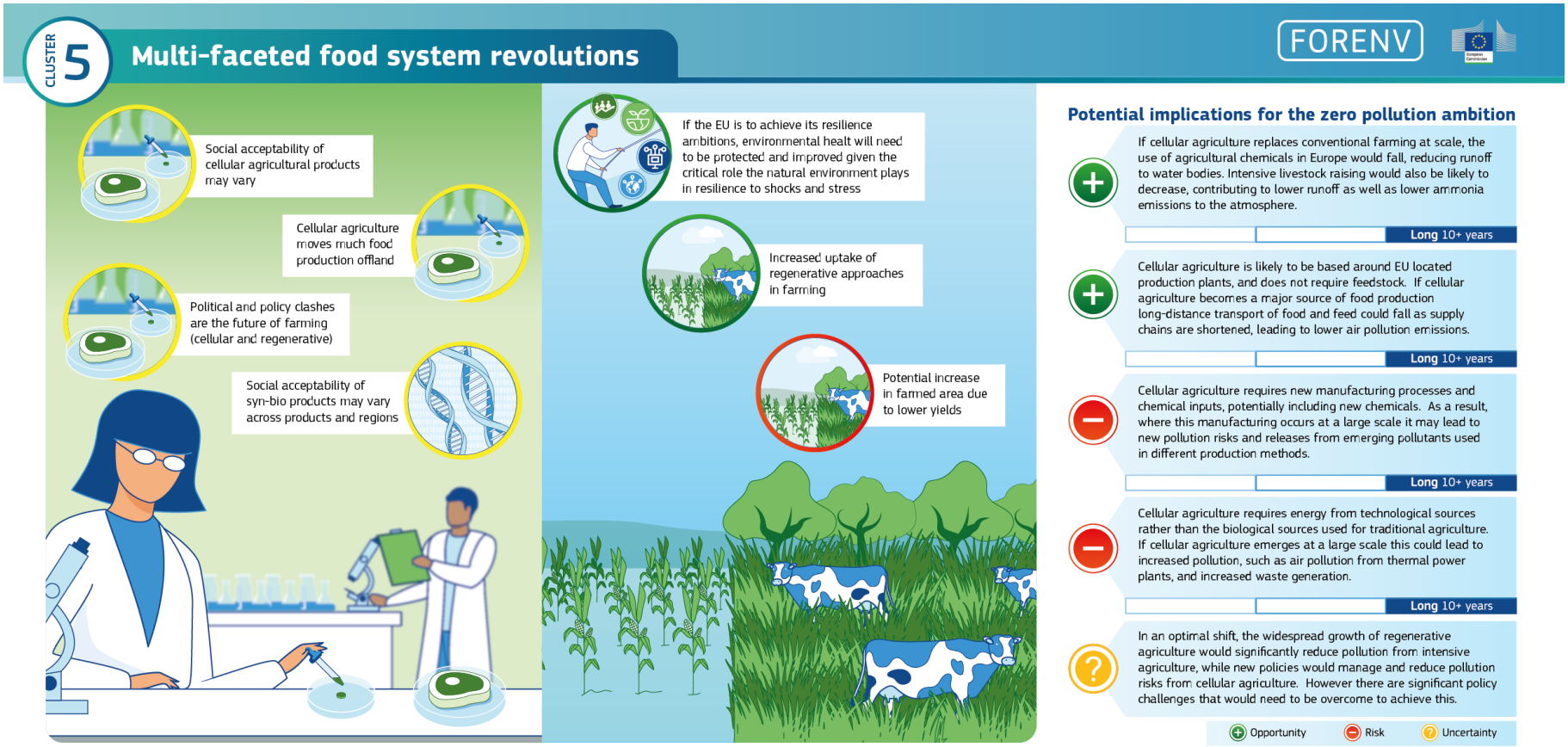
Cost and inequality

New buildings or those retrofitted with new materials may be more expensive. Who will be able to afford to live and work in these new buildings, and who will remain living in older, sub-standard building stock? Will such developments exacerbate inequalities?

Unexpected environmental and health risks

To what extent should Europe embrace the possibilities of new materials and to what extent is care needed to reduce the risk of unintended effects? Is existing risk and pollution monitoring and management sufficient or are new forms of assessments or measurements needed?

2.5 Cluster 5: Multi-faceted food system revolutions



Cluster summary

- The pollution impacts of the agriculture sector, and livestock especially, is of increasing concern.
- Synthetic biology and cellular agriculture may offer a 'greener' way of producing meat, dairy and other foods.
- As the required technologies advance, cellular agriculture facilities may soon become prevalent in Europe.
- There may also be an increased uptake of regenerative approaches to agriculture.
- European farmers may become 'land-stewards', with a focus on high-quality agricultural products.
- Farmers could also be responsible for public goods such as carbon sequestration, biodiversity and watershed management.
- However, these changes could face resistance from farming communities and consumers due impacts on regional employment and cultures.
- Synthetic and cellular foods may also be seen as 'unnatural'; and food from regenerative agriculture may be too expensive.
- The EU's trading partners may also resist import restrictions on their cheaper intensively farmed food products.
- A careful balance will have to be struck between satisfying citizens and reducing pollution from food systems, whilst ensuring resilience to potential shocks to supply.

Key uncertainties for policy

Emerging pollutants
Will cellular agriculture reduce the use of existing agricultural chemicals but lead to point-source releases of new chemicals?

Energy use
Will growth in cellular agriculture lead to growing energy demand (cellular meat and other products will use human energy systems rather than solar energy transformed by plants)?

Food transport
Will changes in agriculture reduce the transport of agricultural products (making supply chains shorter) and thus reduce associated pollution?

Clean water
To what extent can regenerative agriculture reduce agricultural leaching and runoff and help to protect watersheds, leading to cleaner water bodies and stronger ecosystems?

Human health
will cellular agriculture production methods lead to new risks for human health?

Systemic change
will the emergence of cellular agriculture undermine potential for a more systemic change in the food system and eating habits towards more sustainable consumption (e.g. less meat)? Will new food production approaches propagate existing behaviours?

3 Policy questions

The five clusters of disruptive developments presented in Section 2 point to a range of potentially important changes that individually and collectively suggest the emergence of new drivers and sources of pollution alongside opportunities to reduce the pollution burden of some sectors. By considering these changes a series of possible future (short, medium and longer term) implications for pollution are defined, and some key uncertainties. These implications and uncertainties represent areas where it may be important to improve understanding and consider how policy could respond to mitigate possible risks and maximise opportunities.

By looking across these implications and uncertainties, themes or cross-cutting topics can be observed. For example, the role of new technologies and information in a number of areas have the potential to reduce pollution, but also create new and in some cases uncertain risks. By considering such themes, some key questions for zero pollution policy are identified. These are intended to help guide potential future policy discussions and identify opportunities but also where preventative action may be needed to manage future risks.

3.1 Pollution risks from territorial shifts

Trends in urban settlement patterns (Cluster 2) and digitalisation (Cluster 1) suggest that pollution pressures in and around cities are likely to change. Currently, key pollution sources outside urban areas are from industry, energy production, transport, farming and agriculture. However, the nature of pollution drivers may change as more people move to live and work in rural areas and urban peripheries. The centres of cities may be 'hollowed out', and their peripheries and wider rural areas may emerge as the focus of economic activity, especially if digitalisation opens up opportunities for more dispersed working patterns and the replacement of physical with digital / online services. These settlement and demographic changes will lead to the more traffic and economic activity, but infrastructure (e.g. mobility, waste management) may not be there to support these changes, creating future pollution pressures.

- Will 'urbanised' hubs emerge in areas outside cities, and how can the pollution risks from these be managed? How can the EU support non-urban areas to become more resilient in the face of possible future demographic developments and pollution trends?

3.2 Data informs or misinforms citizen behaviour

New technologies and tools are offering a range of new forms of monitoring (e.g. new types of sensor,

personal pollution monitoring), and potentially a wealth of new pollution data that could be used by citizens, authorities and businesses (Cluster 3). The development of tools for sharing information and collaborating online is creating greater public awareness of environmental and pollution issues, increasing involvement in environmental monitoring and action. However, the Covid-19 pandemic combined with increasingly digital lives (Cluster 1), have illustrated the risks of misinformation and the power of internet-linked social movements to undermine the efficacy and legitimacy of policy interventions. New forms of environmental pollution monitoring data, especially if personalised, could lead to a 'cacophony' of different narratives around pollution and risks to people. This may undermine policy interventions or lead to a disproportionate focus on issues that in practice have relatively low health or environmental impacts. On the other hand, access to more and new forms of data could be used by policy makers and authorities to 'nudge' people to lower pollution lifestyles, for example through changes in consumption and mobility choices.

- How can policy and stakeholder actions promote digital developments that increase public awareness of pollution, address the misrepresentation of information online (e.g. social media) and encourage people towards lower-pollution lifestyles?

3.3 Scaling up new technologies

As advances in nanotechnology and synthetic biology continue to accelerate, they can bring new construction materials such as living building materials (Cluster 4) as well as cellular agriculture products (Cluster 5) that reduce many drivers of pollution (for example agri-chemicals and land-use associated with traditional agriculture or the extraction and processing of traditional building materials). However new materials and production methods can create new risks to health and the environment. This is most evident when they are scaled up, for example large cellular agriculture production facilities could present a new source of chemical and other forms of pollution, and new building materials could lead to uncertain and unintended long-term pollution and human health risks.

- How can the EU stimulate innovation with new technologies while identifying and managing possible pollution risks as these are scaled up?

3.4 International cooperation for zero pollution

The clusters are focused predominantly on possible emerging trends in the EU, but some clusters reflect trends that have international dimensions that will affect Europe. For example, advances in synthetic biology and cellular agriculture (Cluster 5) in other parts of the world are likely to influence food production and

consumption in Europe. Similarly, digital tools and lifestyles (Cluster 1) in the EU will be influenced by digital products developed elsewhere. For an issue not included in the clusters, the Race to Space (see Annex 1), private and public investment in the development of space technology and launches outside the EU are crucial drivers.

- How can the EU, including public bodies and stakeholders, strengthen interregional and international cooperation on emerging risks (e.g. pollution from increased launches, new forms of pollution in space) and opportunities (e.g. from experiments in space, improved earth observation) that will affect the achievement of our zero pollution ambition?

4 Concluding reflections: towards strategic foresight for zero pollution

In September 2020 the Commission published the first Strategic Foresight Report – *Charting the course towards a more resilient Europe*[1]. This was followed in September 2021 by the second of these annual reports which explored a range of global trends affecting the *EU's capacity and freedom to act*[2]. The 2021 report identified 10 strategic areas where the EU may need to strengthen its strategic autonomy. The Commission's focus on strategic foresight recognises that the nature and pace of change in areas such as climate, digital technologies and geopolitics means a stronger culture of preparedness and anticipatory policy making is needed. This is especially true in the context of the EU's ambitions to transition to a green, digital and fair Europe.

Themes relevant to a green, digital and fair Europe emerge through this FORENV cycle, and realising the zero pollution ambition is an important aspect of Europe's wider environmental and social ambitions, including for a more resilient future. While the FORENV outputs presented in the synthesis assessment are inevitably selective, the clusters, implications and policy questions identified should inform ongoing reflection. Initially this includes in the first half of 2022 through the zero pollution stakeholder platform, and as input to the forthcoming zero pollution monitoring and outlook framework (foreseen second half of 2022). These discussions can also reflect on the wider issues and challenges presented in the EU's strategic foresight reports, linking these with the focussed foresight activity in FORENV. As part of these reflections, the need for a more comprehensive strategic foresight for zero pollution could be considered, to build on the work of FORENV and connect more concretely to future policy development.

1 https://ec.europa.eu/info/strategy/strategic-planning/strategic-foresight/2020-strategic-foresight-report_en
2 https://ec.europa.eu/info/strategy/strategic-planning/strategic-foresight/2021-strategic-foresight-report_en

Annex 1: Summary of the ten priority issues

Urban settlement patterns and demographic change: implications for pollution

The Covid-19 pandemic has influenced the way people live and behave in cities and towns. Changing working patterns and consumption habits may challenge long-term trends in urban settlement and demography with a range of environmental, social and economic implications.

- Changing working and consumption patterns (e-commerce, food etc. delivery) driven by changing preferences and digitalisation (link to Issue 10) may lead to shifting settlement patterns, with more people choosing to live in rural areas and urban peripheries as well as smaller towns (offering better quality of life).

- This shift in working patterns (more teleworking, flexible working) accelerated by the pandemic could drive a decline in some urban areas, perhaps particularly in larger cities, with economic stagnation (with implications for tax revenues in cities) and the need for repurposing or reconstruction of (e.g. office) buildings and other aspects of urban infrastructure. This may lead to European Cities changing their vision on urban function by reimagining their mobility and green space networks and existing housing stock.

- In the longer-term city centres may become more affordable and could lead to a renaissance as younger, less affluent people move back into cities. This could widen demographic divides between urban and rural/sub-urban communities.

Will regenerative buildings and living materials in Europe help deliver the zero pollution ambition?

Scientific and technological advances, including collaborative research across disciplines, are leading to advances in regenerative buildings and construction materials. These materials intend to limit or avoid environmental harm while enhancing social and environmental outcomes.

- Novel approaches which combine technologies such as nano-structures, composite materials, sensors and advanced manufacturing may be used to create biogenic, regenerative buildings.
- Living Building Materials (LBMs) may become increasingly common, offering opportunities such as self-repairing concrete, and in the longer term potentially the opportunity for buildings that can be grown rather than constructed.
- New materials within buildings and infrastructure could also help mitigate or reduce pollution such as fungal mycelium composites that can also remove chemicals from the environment or panels incorporating algae that improve air quality while creating edible proteins.

Purpose driven business: will the emergence of initiatives such as certified 'B' corporations play a major role in realising zero pollution?

Environmental, societal and investor pressures are leading to increased interest in 'purpose' driven businesses. Some consumers are increasingly demanding (and purchasing goods and services) that businesses reflect their values and demonstrate positive contributions to society and the environment.

- Long-term value creation and stakeholder capitalism could increasingly become mainstream, with businesses which adopt such approaches expected to have a competitive advantage.
- Expectations and societal pressure for business accountability and transparency on environmental and social impacts of their operations is also likely to increase (link to Issue 5 on new forms of information provision).
- These changes may accelerate in the medium-term as younger generations become economically more dominant: millennials and Gen-Z appear to have higher expectations that businesses will prioritise the environment and society.

Will regenerative agriculture emerge as a key trend in Europe that helps deliver the zero-pollution agenda?

Although not a new concept, recent years have seen increasing interest in Europe and globally in adopting regenerative agricultural approaches, with outlooks suggesting around 10% of agricultural land could be under regenerative management by 2030.

- Widespread adoption of regenerative approaches in EU agriculture could help reduce agri-chemical use (pesticides, fertilisers etc.) and pollution associated with intensive farming practices (plastics, run-off etc.).
- Impacts on yields are uncertain (some research suggests they could increase for some crops but fall for others, depending on context), but where they are reduced this could lead to increased land-use for agriculture (extensification), or greater reliance on imported food from third countries.
- Regenerative practices could emerge alongside other food system developments, such as cellular agriculture (Issue 6) and synthetic biology (Issue 8) with far-reaching implications for traditional agriculture in the EU.

Will new ways of pollution information provision influence behaviours towards low pollution lifestyles that go beyond current trends to low/zero waste?

New technologies and tools are creating or facilitating possibilities for environmental monitoring and analysis, and increasing interest in monitoring and data by and for individual citizens. This could include personal pollution exposure monitoring, and access to a wider range of environmental data through networks of micro-sensors and smart devices.

- Already quite established in air pollution, new types of sensors and digital information provision (especially through smartphone apps) may increasingly emerge for other pollution types including noise, industrial, water, soil and chemicals.
- Better access to data about pollution, or the ability to monitor real-time personal pollution exposure (e.g. air, chemicals) may lead to changes in behaviour and increased pressure on polluters (and authorities) to address pollution.
- Personal tracking and monitoring technologies could also increasingly emerge that provide citizens with detailed information about the pollution (or other) impacts of their consumption choices (these already exist for carbon and plastics).

Low pollution food: will new, less polluting, methods of producing protein, fats and tissues emerge to replace traditional agriculture?

Scientific advances are bringing cellular agriculture closer to commercial production: start-ups in the US, UK, Asia and also the EU are seeking to bring factory-grown meat, seafood, milk and other animal products such as leather to the market.

- Cellular agriculture could lead to a new agricultural revolution, moving the production of many products off the land itself.
- While cellular agriculture proponents predict that it will provide solutions to growing global food demand, agricultural pollution and animal welfare concerns (as well as pandemics arising from close human/animal interactions), social acceptability of the products is uncertain – though acceptability may vary across different types of products and in different regions of the world.
- The advanced technology approach of cellular agriculture may interact with trends for regenerative agriculture (link to Issue 4): this could lead to political and policy clashes, and possibly to a future where growing food production comes from cellular agriculture and farming moves towards land stewardship.
- It is in the scaling up of cellular agricultural units that real risks may emerge – including pollution risks.

An accelerating race to space: what will be the direct and indirect pollution impacts?

The space economy is expected to boom over the next decades with the increase of commercial launches and space activities including satellite constellations for communications and Earth observation, space tourism, near-zero gravity manufacturing and, in a longer term, deep space exploration, extra-terrestrial mining and potentially huge orbiting solar panels for terrestrial and space-based energy systems.

- Space launches are expected to increase rapidly around the world (though in the EU mainly in northern regions and in overseas territories), along with expanding terrestrial manufacturing for rockets and fuels as well as their payloads.
- Earth observation will continue to advance, including for pollution monitoring.

The COVID-19 pandemic has led to increased interest in resilience. Will a resilient Europe also be a zero pollution one?

There has been an increased focus on resilience in Europe in recent years, and this is likely to continue, with an EU strategic goal of increased resilience (reflected in the first EU Strategic Foresight Report) across four related dimensions: social and economic, green, digital and geopolitical.

- If the EU is to achieve its resilience ambitions, environmental health will need to be protected and improved in the short and longer term given the critical role the natural environment (including healthy ecosystems and biodiversity) plays in resilience to shocks and stresses.
- Although an initial focus on 'building back better' from the Covid-19 pandemic was seen throughout Europe, there remains a key risk that Europe's short and longer-term response to the pandemic could lead to serious environmental harm (e.g. around waste production and management).
- Moving to greater digital resilience can bring environment and pollution risks, with urban mining and even new conventional mining potentially emerging in Europe as global competition and demand for critical raw materials (needed in a range of digital technologies) increases.

Will new innovations in synthetic biology emerge that accelerate pollution reduction and mitigation?

Rapid advances in synthetic biology, supported by growing use of AI, could bring a range of new products and production methods in a broad range of sectors, from chemicals to construction to agriculture.

- Possible products range from bio-based fuels and chemical feedstocks to more resilient building products (e.g., self-healing concrete), new tools for remediating pollution and new methods for pollution detection and monitoring
- Social acceptability may vary across different types of products and production methods, and may also be different in different regions of the world.
- Synthetic biology-based products could lead to severe unintended environmental consequences (such as invasive species or disruption of food webs) in case of accidental releases or inappropriate testing and risk assessments.

- Synthetic biology is closely linked to other issues explored in this cycle, including cellular agriculture (link to Issue 6).

Our growing digital consumption could challenge the zero pollution ambition

By 2025 and beyond, there could be more people working from home, more social interactions and entertainment occurring on virtual platforms as the role of digital technologies become more prominent in industries such as education, health, tourism and retail.

- Digital tools and services (e.g. augmented and virtual reality) could improve human interactions and gradually replace the need for physical meetings, travel.
- Future pandemics or climate disasters could speed up the adoption of digital tools and services and trigger more permanent changes to our work and daily lives (link to Issue 1 on urban settlement patterns); e.g. flexible work patterns and work places may become permanent, changing where people choose to live and community structures.
- A more permanent home-based work culture could increase the use of internet and internet-based services, systems and networks, with significant changes in our individual (and collective) usage patterns and usage.
- Digital tools are providing greater efficiencies and less pollution through 'virtual lifestyle services' in a number of sectors. Increasingly, consumers are looking to access more products and services via the internet, and companies are reinventing their business models by embracing digital technologies to meet this demand.

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