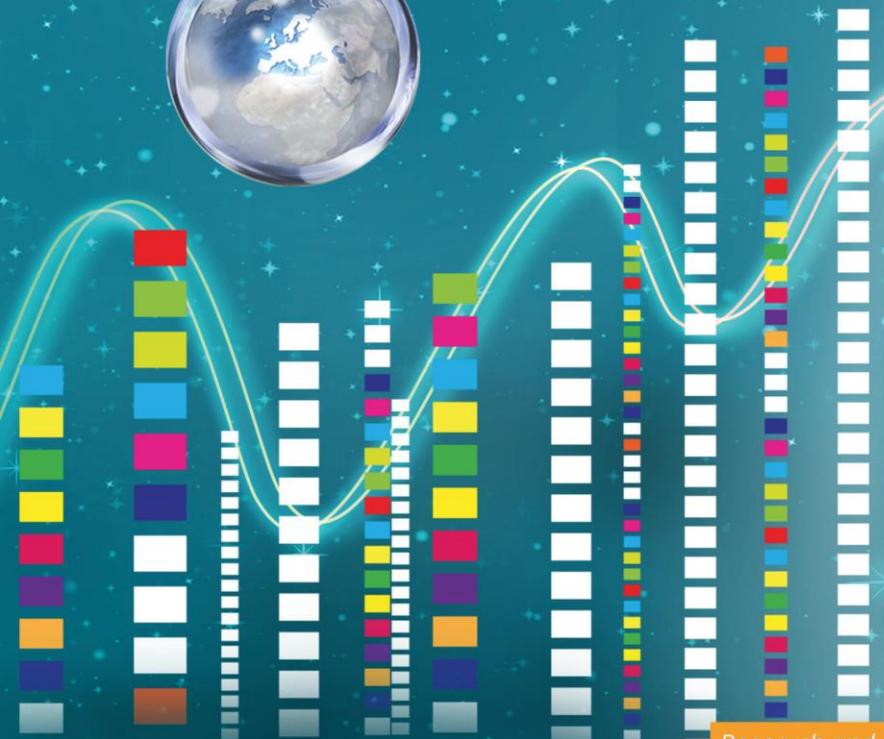




European  
Commission

# Horizon Projects Supporting the Zero Pollution Action Plan



Research and  
Innovation

## Horizon Projects Supporting the Zero Pollution Action Plan

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EUROPEAN COMMISSION

# Horizon Projects Supporting the Zero Pollution Action Plan



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## Executive summary



*Taking good care of our water, soil and air in a rapidly changing world is a serious challenge. Although much progress has been made, the European Union's fight against pollution needs to be more efficient and make better use of innovative solutions. This will help to prevent and remediate the pollution of land, water ecosystems and the atmosphere, to combat loss of biodiversity and to tackle increasing energy and water needs.*

*Scientific and technological achievements can significantly contribute to efforts to meet the 2030 targets of the Zero Pollution Action Plan (ZPAP) <sup>(1)</sup>, which include reducing:*

- *the number of premature deaths caused by air pollution by 55 %;*
- *the share of people chronically disturbed by transport noise by 30 %;*
- *air pollution threatening the biodiversity of the EU's ecosystems by 25 %;*
- *nutrient losses and the use of chemical pesticides by 50 %, to improve soil quality;*
- *waste, plastic litter at sea (by 50 %) and microplastics released into the environment (by 30 %);*
- *total waste generation significantly and residual municipal waste by 50 %.*

*To achieve these targets, the ZPAP sets out nine flagships. This report is structured around these. It offers an overview of research results from 27 recently completed or almost completed Horizon 2020 projects and 79 examples of recently started projects under Horizon 2020 and Horizon Europe that will deliver results in the years to come.*

*Research results are vital in implementing the preventive and protective actions set out in the ZPAP. They also contribute to several actions under other European Green Deal initiatives, including the Chemicals' Strategy for Sustainability. A deeper understanding of the links between environmental and human health and pollution will be crucial to finding the most efficient policies capable of improving our health and well-being and protecting our environment.*

*The project overviews in the chapters on the nine flagships are supported by a 'compass' of projects and partnerships enabling easy identification of relevant activities. This overview provides details on the duration of projects and the focus of partnerships to facilitate early engagement with and uptake of the projects' results.*

*The report concludes that while the projects described provide sufficient coverage of actions to improve water and air quality, soil quality actions are still underrepresented among the three main pollution action areas and research in this area could be strengthened. It recommends that interested parties reach out to relevant projects that are already under way, so that the new knowledge and results can help in solving the problems of citizens, authorities and the industry.*

*Horizon Europe partnerships and missions are invited to use this report in their future work to boost their contribution to the Zero Pollution Ambition under the Green Deal. This publication also seeks to contribute to the public debate on the next strategic agenda of Horizon Europe and to stimulate new research projects to aim to achieve the Zero Pollution Ambition.*

*The report encourages readers to dig deeper into the portfolio of projects and find those that could support them in their fight against pollution. The list of Horizon projects is by no means exhaustive, but it highlights the contribution that research projects can make to the goals forming the Zero Pollution Ambition. For more information on projects not covered here, please visit the Community Research and Development Information Service website ([www.cordis.eu](http://www.cordis.eu)).*

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(1) [https://environment.ec.europa.eu/strategy/zero-pollution-action-plan\\_en](https://environment.ec.europa.eu/strategy/zero-pollution-action-plan_en)

## 1. Introduction



*The Zero Pollution Action Plan (ZPAP) is one of three headline actions under the Zero Pollution Ambition of the Green Deal. Its implementation cannot be allowed to depend only on future research and innovation (R&I) activities; recently completed or soon-to-be completed Horizon 2020 projects can make major contributions here and now. Knowledge valorisation <sup>(2)</sup> – sharing results and best practices among actors and promoting their use in policy initiatives – will support the faster realisation of the ZPAP goals.*

*The ZPAP is accompanied by two staff working documents: (1) Towards a monitoring and outlook framework for the zero-pollution ambition and (2) Digital solutions for zero pollution. One of the key deliverables of the first staff working document for 2022 is the Zero Pollution Monitoring and Outlook Report, which will aim to determine whether actions at different levels are enough to close the gaps identified by the monitoring. It will also provide a synthesis of the findings of various data sources and thematic reports. The deliverables announced include other reports, such as the present report on key results of EU-funded pollution-related research projects.*

*This report is structured around the nine ZPAP flagships (Table 1). For each flagship, we have selected examples of Horizon 2020 projects with relevant results. In addition, a list of ongoing Horizon 2020 and Horizon Europe projects from which interesting results are expected in the near future is provided for each flagship. Links to the Horizon Europe missions (Table 2) and partnerships (see Table 5 in Chapter 12) are also outlined.*

**Table 1: The nine flagships of the ZPAP**

No	Name	Description
1	Reducing health inequalities through zero pollution	Regularly feed pollution monitoring and outlook data into the Cancer Inequalities Registry and the Atlas of Demography
2	Supporting urban zero pollution action	As part of the Year of Greener Cities, in cooperation with the Horizon Europe Mission for Climate-neutral and Smart Cities and the Covenant of Mayors, identify key urban greening and innovation needs to prevent pollution
3	Promoting zero pollution across regions	In cooperation with the Committee of the Regions, present a scoreboard of EU regions' green performance to measure, in particular, efforts to achieve pollution-relevant targets
4	Facilitating zero pollution choices	Encourage public and private sector operators to make 'zero pollution pledges' to promote best available near-zero waste and least-polluting options
5	Enforcing zero pollution together	Bring together environmental and other enforcement authorities to kick off an exchange of best practices and encourage Member States to devise cross-sectoral compliance actions towards zero tolerance for pollution at national level and transboundary level
6	Showcasing zero pollution solutions for buildings	Showcase, using results from the renovation wave strategy and New European Bauhaus initiative, how building projects and local digital twins can contribute to zero pollution objectives

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<sup>(2)</sup> <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2022%3A391%3AFIN&qid=1660055341349>

7	Living labs for green digital solutions and smart zero pollution	Launch Living Labs for green digital solutions and smart zero pollution to help develop local actions for green and digital transformation
8	Minimising the EU's external pollution footprint	Promote global zero pollution in all relevant international forums and work with the EU Member States and stakeholders on external pollution
9	Consolidating the EU's knowledge centres for zero pollution	Consolidate the roles of the European Environment Agency and the Joint Research Centre as the EU's Knowledge Centres of Excellence for Zero Pollution Monitoring and Outlook

**Table 2: Relation of Horizon Europe missions to ZPAP flagships**

<b>Key areas of the five EU missions relevant to pollution mitigation</b>	<b>Relevant ZPAP flagships</b>
<p><b>Adaptation to climate change, including societal transformation</b> Solutions are expected to build resilience to health risks caused by the effects of climate change. Challenges related to links between water and air pollution and human health (coal power and combustion engines in urban agglomerations) are to be addressed. Extreme weather events, covered by this mission, are also a source of pollution impacting citizens and the environment.</p>	1, 3, 5, 6, 7, 8, 9
<p><b>Cancer</b> Healthy living environments require the elimination of sources of pollution. Air, soil and other types of pollution are increasing, thus causing an increase in cancers. The annual burden of disease caused by indoor and outdoor air and noise pollution is a major concern in urban environments. Improper management of solid waste is also a key issue, especially in developing countries.</p>	1, 5, 7, 9
<p><b>Restore our ocean and waters</b> Pollution-free waters are critical for the health of both citizens and planet. Monitoring, assessment and implementation of prevention, elimination and remediation measures affecting the whole water system will make it possible to meet the EU's expectations in this regard. New transformative solutions will be piloted and tested, developing circular and carbon-neutral blue economy activities. Zero pollution offshore clean energy facilities and digital solutions are enablers of the mission.</p>	1, 2, 3, 4, 5, 7, 8, 9
<p><b>Climate-neutral and smart cities</b> Smart-city solutions and data sharing will be used in monitoring emission reductions in mobility, creating smart energy grids, improving the energy efficiency of buildings, monitoring air pollution, water, and waste management. Cities will be supported in applying circularity principles to building renovation to move towards zero air, water and noise pollution. EU-level, national and regional climate action and pollution policies will also help to energise local efforts.</p>	1, 2, 3, 4, 5, 6, 7, 9
<p><b>Soil health and food</b> With a focus on soil pollution and restoration, the mission will address problems related to the use of pesticides, nutrients and other agrochemicals, as well as pollution from industrial chemicals and contaminants, which have consequences also for water quality. Reducing pollution in soils and thus decreasing food contamination is a major step towards reducing cancer and other diseases. Societal (including legal), economic and cultural drivers will make it possible to co-develop and implement business cases, blended finance strategies, governance models and policies that proactively address soil pollution. The main goal of the mission is to establish 100 Living Labs and lighthouses.</p>	1, 2, 4, 5, 6, 7, 8, 9

*The results of and recommendations arising from the projects selected for inclusion in this report are also linked to the key cooperation areas between the European Commission and the United Nations*

Environment Programme (UNEP), as identified by the first policy dialogue on zero pollution <sup>(3)</sup> in December 2021. The policy dialogue was one of the measures set out in the global implementation plan 'Towards a Pollution-free Planet and Better Health' <sup>(4)</sup>. A collaborative approach will enable pollution reduction measures to be implemented in an integrated manner, as agreed in the policy dialogue. Selected key areas for cooperation are listed in Table 3.

**Table 3: Selected areas for cooperation between the European Commission and UNEP resulting from the first policy dialogue in December 2021**

<b>Key areas for cooperation</b>	<b>Relevant ZPAP flagships</b>
Strengthening political support for reducing and capacities to reduce air, water and marine pollution, promoting the sound management of chemicals and waste, and addressing transboundary pollution	3, 5, 8
Spearheading a circular life-cycle approach in high-impact sectors and value chains such as transport, building and construction, food and agriculture, electronics, textiles, and plastics	2, 4, 6
Increasing cooperation on trade in potentially polluting products and waste, by promoting strategies including a 'safe and sustainable by design' approach, green chemistry, non-toxic circularity and integrated waste management	4, 8
Developing data and knowledge to provide policymakers with a solid scientific basis to track progress and address pollution, to improve the quality of our air, reduce sources of marine pollution, reduce health impacts and enhance opportunities for pollution-free economies	1, 7, 9

*The selection of projects reflects consultations with European Commission directorates-general (the Directorate-General for Research and Innovation and the Directorate-General for Environment) and EU executive agencies (the European Health and Digital Executive Agency, the European Research Executive Agency and the European Climate, Infrastructure and Environment Executive Agency). Flagship 9 has a special role relating to the Commission's activities on knowledge management. Therefore, it is less influenced by input from specific projects; rather, it relates to all research results.*

*There are undoubtedly other Horizon 2020 projects that are relevant for the implementation of the flagships, but, as this report has the simple aim of showcasing the wealth of available opportunities, we have decided not to include them all.*

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<sup>(3)</sup> [https://environment.ec.europa.eu/news/european-commission-and-un-environment-programme-step-cooperation-zero-pollution-future-2021-12-10\\_en](https://environment.ec.europa.eu/news/european-commission-and-un-environment-programme-step-cooperation-zero-pollution-future-2021-12-10_en)

<sup>(4)</sup> [https://wedocs.unep.org/bitstream/handle/20.500.11822/21213/Towards a pollution free planet advance%20version.pdf?sequence=2&isAllowed=y](https://wedocs.unep.org/bitstream/handle/20.500.11822/21213/Towards%20a%20pollution%20free%20planet%20advance%20version.pdf?sequence=2&isAllowed=y)

## 2. Reducing health inequalities through zero pollution



The aim of this flagship is to feed pollution monitoring and outlook data regularly into the Cancer Inequalities Registry <sup>(5)</sup> and the Atlas of Demography <sup>(6)</sup>. By 2024, an assessment will be carried out of the need to have an inequalities registry identifying trends, disparities and inequalities across the EU regions also for other pollution-related diseases, to help target interventions at EU, national and local levels. This registry would enable people to compare how much pollution affects their health across the different regions where they live, study and work.

The flagship is supported by the recently published briefing from the European Environment Agency on cancer and pollution <sup>(7)</sup>, which shows that pollution causes over 10 % of all cancer cases in Europe, which are therefore preventable.

The Commission–UNEP policy dialogue identified an urgent need for a shift from the generation, production and use of harmful chemicals that pose a risk to human health and the environment towards the sound management of chemicals in key sectors.

### 2.1. Projects' highlights

The following Horizon 2020 projects have been identified as having contributed to the abovementioned goals.

- **HBM4EU** <sup>(8)</sup> (the European Human Biomonitoring Initiative), co-funded by the European joint programme on rare diseases, provided harmonised monitoring data on the European population's exposure to chemicals and gathered evidence on health effects in by age group and gender, taking into account also other factors such as socioeconomic status, lifestyle, diet and environmental conditions. The work started within HBM4EU will be continued by the Partnership on Chemical Risk Assessment(PARC) <sup>(9)</sup>.
  - For the first time, harmonised and high-level quality-assured data on humans' internal exposure to chemicals across all European regions is available for the 18 substances and substance groups that were prioritised by policymakers at national and EU levels.
  - HBM4EU built up a network of national and European regulatory and scientific expertise. The groundwork for a sustainable, Europe-wide human biomonitoring platform has been laid and the results can be used as a baseline to evaluate the effectiveness of the chemicals regulation.
  - Significant parts of the European population, including the susceptible groups of children and women of childbearing age, are exposed to measurable levels of hazardous chemicals and the risk of adverse health effects cannot be ruled out.
  - HBM4EU data point to a need for political action to strengthen the chemicals regulation, more information for citizens and greater awareness of the European population about health risks arising from chemicals.
- **PROTECTED** <sup>(10)</sup> (PROTECTION against Endocrine Disruptors – detection, mixtures, health effects, risk assessment and communication) worked to increase expertise and develop protective strategies against endocrine disruptors. Endocrine disruptors and mixtures of them are a modern-day health concern; they lead to health problems such as obesity, cancer and infertility, as well as failing ecological systems and falling agricultural production. PROTECTED focused on emerging endocrine disruptors and real-life multiple substance exposure.

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<sup>(5)</sup> <https://cancer-inequalities.jrc.ec.europa.eu/>

<sup>(6)</sup> <https://migration-demography-tools.jrc.ec.europa.eu/atlas-demography/>

<sup>(7)</sup> <https://www.eea.europa.eu/highlights/pollution-and-cancer>

<sup>(8)</sup> <https://cordis.europa.eu/project/id/733032>

<sup>(9)</sup> <https://www.anses.fr/en/content/european-partnership-assessment-risks-chemicals-parc>

<sup>(10)</sup> <https://cordis.europa.eu/project/id/722634>

- PROTECTED informed the European scientific community and regulators about the risks of exposure to endocrine-disrupting chemicals for agricultural output and consumer food safety.
- The interdisciplinary approach of the PROTECTED network led to a new understanding of endocrine mixtures and their complex effects on human and environmental health. It also delivered new technologies for detection, analysis and prediction of the effects of endocrine disruptors.
- PROTECTED developed better strategies for communicating with the public about the risks by researching consumer knowledge on endocrine disruptors and subsequently developing public communication tools for key stakeholder groups, including scientists, business leaders, regulators and politicians.
- **EuroMix** <sup>(11)</sup> developed a verified, tiered test strategy for risk assessment of mixtures of chemicals originating from multiple sources, including food and water intake and dermal contact, as well as a novel risk-modelling approach. The test strategy makes it possible to generate the toxicity data needed to conduct future risk assessments. Three case studies were run (multiple pesticides, bisphenols and pyrethroids) linking exposure assessment to three adverse outcomes: liver steatosis, craniofacial malformation and harm to the endocrine system.
  - The EuroMix methodology, anchored in the adverse outcome pathway concept, entailed first-tier screening of chemicals for mixture testing based on literature data and *in silico* models. This methodology will serve as a basis for future research and development of risk assessment tools for mixtures, for example by the Organisation for Economic Co-operation and Development <sup>(12)</sup>, the European Food Safety Authority <sup>(13)</sup> and the Joint Research Centre <sup>(14)</sup>.
  - EuroMix provided practical guidance on the regulatory implementation of testing chemical mixtures using the new tests, on the use of test results for mixture risk assessment and on *in vitro* tests to generate hazard data and understand mixture effects.

## 2.2. In the innovation pipeline

The portfolio of projects contributing to this flagship may be expanded in future when the results of certain Horizon 2020 projects that are currently running are known, namely:

- EURION <sup>(15)</sup>, a cluster of eight projects (ATHENA, EDCMET, ENDpoiNTs, ERGO, FREIA, GOLIATH, OBERON, and SCREENED) focusing on improved identification of endocrine disruptors, which started in 2019;
- CUSP <sup>(16)</sup>, a cluster of five projects (AURORA, Imptox, Plasticheal, PlasticsFatE and POLYRISK) researching the impact of micro- and nanoplastics on human health, which started in 2021;
- ASPIS <sup>(17)</sup>, a cluster of three projects (RISK-HUNT3R, PrecisionTox, and ONTOX) working on animal-free safety assessment of chemicals, which started in 2021;

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<sup>(11)</sup> <https://cordis.europa.eu/project/id/633172>

<sup>(12)</sup> Organisation for Economic Co-operation and Development, *Considerations for assessing the risks of combined exposure to multiple chemicals, Series on Testing and Assessment*, No 296, OECD Environment Directorate, Environment, Health and Safety Division, 2018.

<sup>(13)</sup> European Food Safety Authority, 'Guidance on harmonised methodologies for human health, animal health and ecological risk assessment of combined exposure to multiple chemicals', *EFSA Journal*, Vol. 17, No 3, pp. 5634, 2019.

<sup>(14)</sup> S. Bopp, A. Kienzler, A. N. Richarz, S. van der Linden, A. Paini, N. Parissis and A. Worth, 'Regulatory assessment and risk management of chemical mixtures: challenges and ways forward', *Critical Reviews in Toxicology*, Vol. 49, No. 2, pp. 174–189, 2019. doi:10.1080/10408444.2019.1579169.

<sup>(15)</sup> <https://eurion-cluster.eu/>

<sup>(16)</sup> <https://cusp-research.eu/about/>

<sup>(17)</sup> <https://www.aspis-cluster.com/>

- EHEN <sup>(18)</sup>, a cluster of nine projects (Athlete, EPHOR, Equal-Life, Eximious, Expanse, HEAP, HEDIMED, LongITools, and Remedia) focusing on the exposome and addressing issues such as exposures to air quality, noise, chemicals, urbanisation, etc., and health impacts, which started in 2020;
- PROMISCES <sup>(19)</sup>, SCENARIOS <sup>(20)</sup>, and ZeroPM <sup>(21)</sup>, projects resulting from the ‘Zero pollution, toxic-free environment’ topic in the Horizon 2020 Green Deal call, addressing mobile and persistent chemicals and chemical mixtures, which started in 2021;
- TUBE <sup>(22)</sup> and ULTRHAS <sup>(23)</sup>, projects arising from the Horizon 2020 topic ‘Reducing the health impact of transport emissions’, addressing the impact of different transport modes, fuel technologies and the emission of ultrafine particles responsible for adverse health effects, which started in 2019 and 2021 respectively.

Moreover, new projects promoting the ‘safe and sustainable by design’ concept, funded under Horizon Europe, will target the ambition of making chemicals and materials safer and more sustainable, thus having a positive impact on both human health and the environment <sup>(24)</sup>.

### 3. Supporting urban zero pollution action



As part of this flagship, the Commission will, in synergy with the Horizon Europe Mission for Climate-neutral and Smart Cities, the Covenant of Mayors and the New European Bauhaus initiative, identify key urban greening and innovation needs to prevent pollution. By 2024, the Commission will reward the cities reporting the most progress over 2021–2023 in reducing air, water and soil pollution. This will help people to benefit from actions against pollution that are tailored to their immediate local surroundings.

One of the key actions identified in the Commission–UNEP policy dialogue on zero pollution is improving the quality of air globally, thus reducing the number of premature deaths caused by air pollution, by putting in place the enabling conditions to tackle key pollution sources and polluting sectors of the economy.

#### 3.1. Projects’ highlights

The following Horizon 2020 projects have been identified as having contributed to the abovementioned goals.

- **iSCAPE** <sup>(25)</sup> (Improving the Smart Control of Air Pollution in Europe) integrated and advanced control of air quality and carbon emissions in European cities through the development of sustainable and passive air pollution remediation strategies, policy interventions and behavioural change initiatives. The project engaged citizens in alternative solutions to environmental problems.
  - iSCAPE deployed a network of low-cost air quality and meteorological sensors (stationary and mobile) that support sustainable urban development. Guidelines to facilitate decision-making were made available to city stakeholders: *Implementing Green Infrastructure for Air Pollution Abatement: General recommendations for management and plant species selection*.

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<sup>(18)</sup> <https://www.humanexposome.eu/>

<sup>(19)</sup> <https://cordis.europa.eu/project/id/101036449>

<sup>(20)</sup> <https://cordis.europa.eu/project/id/101037509>

<sup>(21)</sup> <https://cordis.europa.eu/project/id/101036756>

<sup>(22)</sup> <https://cordis.europa.eu/project/id/814978>

<sup>(23)</sup> <https://cordis.europa.eu/project/id/955390>

<sup>(24)</sup> [https://research-and-innovation.ec.europa.eu/research-area/industry/key-enabling-technologies/advanced-materials-and-chemicals\\_en](https://research-and-innovation.ec.europa.eu/research-area/industry/key-enabling-technologies/advanced-materials-and-chemicals_en)

<sup>(25)</sup> <https://cordis.europa.eu/project/id/689954>

- Four pollution abatement solutions were investigated: (1) green barriers to reduce the concentration of black carbon and various particulate matters, (2) low boundary walls to protect pedestrians from nearby traffic pollution, (3) trees lining roads to reduce pollutant concentration and mitigate the urban heat island effect and (4) photocatalytic coating to reduce pollutant NO<sub>x</sub> concentration. The performance of the solutions was evaluated at three scales: the street, the neighbourhood and the urban scale.
- A review of the influence of air pollution on climate change highlighted three climatological variables: surface temperature, precipitation and sea-level pressure. This led to the identification of large-scale trends in different distributions and concentrations of pollutants. The modification of global sea-level pressure patterns has consequences for the local circulation and distribution of air masses. Climate change induced by increased pollutant emissions will in turn increase pollutant concentration. Air quality is generally better in northern Europe: the presence of widespread basins or the influence of sea breezes mitigates the stagnation effect that leads to higher pollutant concentration in surrounded basin and industrial areas. Ozone concentration in the urban environment seems to be influenced by the distribution of its precursors (NO<sub>x</sub> and volatile organic compounds), but in general it is quite homogeneous at the city scale.
- **NOVELOG** <sup>(26)</sup> (New cooperative business models and guidance for sustainable city logistics, 2015–2018) enabled greater knowledge and understanding of pollution caused by freight distribution and service trips and provided guidance on implementing effective and sustainable policies and measures. This guidance, at the intersection of social and economic aspects of policymaking, supports the choice of optimal solutions for urban freight and service transport. These solutions will help to decrease the carbon footprint of vehicles used in cities and thus improve air quality.
  - The NOVELOG roadmap was created to increase understanding, facilitate planning and prioritisation, and offer guidance on better integration of urban freight transport. The project provided tools for guidance and evaluation <sup>(27)</sup>, intended to enable decision-makers to have a significant impact in terms of fleet improvements, reducing negative impact on environment. The added value provided by NOVELOG has been reported in case studies of 12 cities.
  - The project put forward *Guidelines on Electromobility*. Through diagnostic checks, and taking into account habitual behaviour and appropriate infrastructure needs, the project found that there is a need for standardisation of equipment and facilities solutions and for incentives (financial and technical) to convince end users to use electric vehicles.
- **MossTree** <sup>(28)</sup> (A new urban green infrastructure to actively reduce air pollution in urban hotspots) presented an urban green infrastructure (a combination of street furniture and a biofilter – a bench below, a moss-covered surface above and complex technology including a bio-algorithm inside) based on a patented combination of Internet of Things technology and biotechnology.
  - The project developed the world's first regenerative biofilter based on moss cultures, which can attract air pollution from their surroundings and convert it into biomass without leaving any residue. Using Internet of Things technology and machine learning to monitor the moss's status in real time and automatically supply it with the required nutrients and water, the CityTree can reach a filter efficiency of 82 %. It offers a fast, elegant and natural solution to combat the problem of air pollution.
  - MossTree products fit in perfectly to filter pollution locally where people are, thus avoiding having to clean the air of an entire city (the air volume would be too high). The added value that the moss biofilters bring consists in significant cooling performance, production of oxygen, moisturising capacity (a humidifying effect) and capturing in particular smaller particles such as black carbon (reducing these particles by up to 60 %); therefore, these filters can compete with the performance of industrial filters in a real urban environment.

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<sup>(26)</sup> <https://cordis.europa.eu/project/id/636626>

<sup>(27)</sup> <http://www.uct.imet.gr/Novelog-Tools/Toolkit>

<sup>(28)</sup> <https://cordis.europa.eu/project/id/847744>

- The biofilters can be installed in urban locations, in façades and on asphalt-covered ground, where trees and plants have not previously been able to grow, bringing nature back to these locations, which has a positive impact on people's well-being. MossTree will install hundreds of biofilters in various traffic and pollution hotspots in Europe by 2024.

### 3.2. In the innovation pipeline

The portfolio of projects contributing to this flagship may be expanded in future when the results of certain Horizon 2020 and Horizon Europe projects that are currently running are known, for example:

- the Urban Health Cluster <sup>(29)</sup>, made up of six Horizon 2020 projects (URBANOME, RECETAS, WELLBASED, eMOTIONAL Cities, ENLIGHTENme, and HEART), all of which started in 2021, intended to improve urban health and well-being, addressing environmental, climate and socioeconomic factors;
- EHEN <sup>(30)</sup>, a cluster of nine projects (Athlete, EPHOR, Equal-Life, Eximious, Expanse, HEAP, HEDIMED, LongITools, and Remedia) focusing on the exposome and addressing issues such as exposures to air quality, noise, chemicals, urbanisation, etc., and health impacts, which started in 2020;
- CARES <sup>(31)</sup> and NEMO <sup>(32)</sup>, projects working on enforcing legislation by measuring real-world vehicle emissions in urban environments, detecting, for instance, vehicles whose pollution and noise control systems have been tampered with, which started in 2019 and 2020 respectively;
- MODALES <sup>(33)</sup> and uCARE <sup>(34)</sup>, projects showing how driving behaviour affects emissions from different sources – engine, brakes and tyres – enabling cities to develop education and urbanistic programmes to reduce emissions, which started in 2019;
- six new projects (LEARN, SynAir-G, InChildHealth, INQUIRE, TwinAIR and K-HEALTHinAIR) starting in 2022 and funded under the Horizon Europe topic 'Indoor air quality and health' <sup>(35)</sup>.

## 4. Promoting zero pollution across regions



Under this flagship, the Commission, in cooperation with the Committee of the Regions, will present by 2024 a scoreboard of EU regions' green performance to measure the efforts of the regions to achieve the pollution-relevant targets set in the ZPAP and other strategies. Citizens will be able to check progress in the regions over time, and the scoreboard will create a race to zero pollution, offering new tourism and business opportunities.

The Commission–UNEP policy dialogue identified an urgent need to strengthen pollution prevention, to increase control capacities and to replicate, deploy and scale up successful, cost-effective measures. This also includes mapping existing efforts, policy frameworks and opportunities, including through regional ministerial forums, subregional platforms to beat pollution, regional interagency efforts, national joint initiatives and UN reform mechanisms, which can offer effective and efficient platforms for implementation.

<sup>(29)</sup> <https://www.urban-health.eu/>

<sup>(30)</sup> <https://www.humanexposome.eu/>

<sup>(31)</sup> <https://cordis.europa.eu/project/id/814966>

<sup>(32)</sup> <https://cordis.europa.eu/project/id/860441>

<sup>(33)</sup> <https://cordis.europa.eu/project/id/815189>

<sup>(34)</sup> <https://cordis.europa.eu/project/id/815002>

<sup>(35)</sup> [https://cordis.europa.eu/programme/id/HORIZON\\_HORIZON-HLTH-2021-ENVHLTH-02-02](https://cordis.europa.eu/programme/id/HORIZON_HORIZON-HLTH-2021-ENVHLTH-02-02)

## 4.1. Projects' highlights

While most project consortia are made up of partners from different regions and the core technology development activities are of interest to all countries across the EU, the integration of solutions into specific local and regional infrastructures is necessary to guarantee cross-regional success.

The following Horizon 2020 projects have been identified as having contributed to the abovementioned goals.

- **NextGen** <sup>(36)</sup> (Towards a next generation of water systems and services for the circular economy) provided innovative technological, business and governance solutions for water in the circular economy, namely, to reduce consumption of water, energy and materials and to prevent pollution of water ecosystems (rivers, lakes, coastal waters) and the environment (including through reduction of greenhouse gas emissions).
  - NextGen demonstrated the added value of a symbiotic approach, with sectors (e.g. agriculture, energy and industry) reusing resources recovered from other sectors.
  - NextGen resulted in 10 high-profile, large-scale demonstration cases across Europe, which can be transferred and scaled up; in particular, it demonstrated considerable potential for production of biogas from sludge treatment. Better alignment of regulations and directives on water, waste sludge and renewable energies is needed to optimise the potential of the new technologies explored.
  - The NextGen demonstration cases provided evidence on enabling framework conditions for the transition to a circular economy in the water sector, such as societal acceptability (e.g. of treated effluent reuse), circular value chains and business models (e.g. for recovered calcite), and supportive policies and regulations.
  - NextGen has launched a Water Europe online matchmaking marketplace for products and services that showcases circular water technologies, environmental and economic assessment tools, and best practices for implementing circular economy solutions.
- **MMAtwo** <sup>(37)</sup> (Second generation methyl methacrylate) aimed to contribute to the circular economy by recycling thermoplastic polymethyl methacrylate (PMMA), which is – due to its optical properties such as UV resistance and transparency – often used as lighter, shatter-resistant alternative to glass in everything from windows, aquariums and hockey rinks to electronic and medical products. MMAtwo focused on recycling of both production waste and end-of-life waste, with the aim of lowering CO<sub>2</sub> emissions from incineration and landfill disposal of PMMA and reducing the need for fossil fuels to create new PMMA products.
  - Currently, only about 10 % of annual PMMA production – mostly production scraps – is recycled to recover the monomers via depolymerisation. MMAtwo converted waste, including (contaminated) post-consumer and post-industrial PMMA waste, into high-quality raw material that could be used to produce new, virgin-quality PMMA.
  - The MMAtwo initiative engaged the whole value chain across Europe, addressing challenging aspects of collection, sorting and separation of PMMA from various waste streams. The project delivered industry guidelines to assist waste producers in dealing with PMMA waste effectively and maximising its value.
- **iCAREPLAST** <sup>(38)</sup> (Integrated catalytic recycling of plastic residues into added-value chemicals) addresses the cost- and energy-efficient recycling of a large fraction of today's non-recyclable plastics from urban waste. This is done via a multi-stage process that yields valuable chemicals (alkyl aromatics) as well as carbon char and pure CO<sub>2</sub> stream as products, with improved economic sustainability, operational flexibility and a reduced CO<sub>2</sub> footprint.

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<sup>(36)</sup> <https://cordis.europa.eu/project/id/776541>

<sup>(37)</sup> <https://cordis.europa.eu/project/id/820687>

<sup>(38)</sup> <https://cordis.europa.eu/project/id/820770>

- iCAREPLAST takes into account regional differences through the integration of models covering the technology aspects as well as the background system (infrastructure, climate, collection systems and electricity mixes), which enables the widespread and efficient scaling of the project.
- iCAREPLAST demonstrates the entire technological solution for plastic waste valorisation in a pilot plant able to process > 100 kg/h of plastic in an operational environment.
- The recycling process results in improved cost and energy efficiency and greater operational flexibility thanks to the sustainable energetic valorisation of gas by-products and the use of predictive control and real-time optimisation.

## 4.2. In the innovation pipeline

The portfolio of projects contributing to this flagship may be expanded in future when the results of certain projects that are currently running are known, for example, five new Horizon 2020 projects under the topic 'Green airports and ports as multimodal hubs for sustainable and smart mobility' <sup>(39)</sup> – MAGPIE, TULIPS, STARGATE, PIONEERS and OLGA – which support green tourism opportunities, and which started in 2021 and 2022.

## 5. Facilitating zero pollution choices



The Commission is encouraging public and private sector operators to make 'zero pollution pledges' to promote best available near-zero waste options and products and services that have been proven to be less polluting over their whole life cycle. The focus is on EU Ecolabel products and services, from tourist accommodation to less toxic chemicals and materials. This aim is to provide people with more access to and information on cleaner options.

The Commission–UNEP policy dialogue identified, among other requirements, the need to support the development of indicators and data, novel materials and products, substitution and elimination of hazardous substances based on a 'safe and sustainable by design' approach, circular business models, and new production and recycling technologies.

### 5.1. Projects' highlights

The following Horizon 2020 projects have been identified as having contributed to the abovementioned goals.

- **CREAToR** <sup>(40)</sup> (Removing toxic flame retardants supports recycling and reuse of materials, 2019–2023) aims to remove toxic flame retardants from waste materials in the building, construction, electrical and electronic equipment sectors.
  - Removal and reuse are key steps in promoting recycling in the circular economy. The project has established a complete workflow for recycling of products containing flame retardants. Using laser-induced breakdown spectroscopy, plastic waste containing brominated and bromine-free polymer parts are sorted. Through batch extraction with supercritical carbon dioxide and/or natural deep eutectic solvents, brominated polymers are purified in a cost-effective process using green chemical solutions. The recycled materials are then reused in 3D printing and other expanded-polystyrene-based products for automotive and aeronautical purposes.
  - CREAToR has developed a smart labelling system (using QR codes) indicating the components of the (purified) waste streams, showing the success of the purification process, and linking it with the new items' material properties.

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<sup>(39)</sup> [https://cordis.europa.eu/programme/id/H2020\\_LC-GD-5-1-2020](https://cordis.europa.eu/programme/id/H2020_LC-GD-5-1-2020)

<sup>(40)</sup> <https://cordis.europa.eu/project/id/820477>

- The project highlights the urgent need for harmonisation of the implementation of the Waste Framework Directive and the by-product criteria used by Member States to ensure consistent classification of materials and sufficient material streams for specific types of recycling processing. Sector-specific regulations on hazardous material content also need to be harmonised to enable the reuse of recycled material regardless of the sector in question, based solely on the material properties of the recycled product. The project aims to provide effective policy recommendations to overcome the current barriers to recycling and depolluting materials at cross-regional level and to increase the market for such materials.
- **NanoFASE** <sup>(41)</sup> (Nanomaterial fate and speciation in the environment) delivered an integrated Exposure Assessment Framework for nanomaterials <sup>(42)</sup>, to explore their transformation and transport processes in manufacture, use, waste streams and different environments (air, soil, and water/sediment), and their uptake and accumulation in biota. This framework includes methods, parameter values, model and guidance enabling stakeholders in industry to assess the full diversity of industrial nano-enabled products to a standard acceptable to regulatory registries.
  - NanoFASE developed methods to assess how use phases, waste streams and environmental compartments (air, soil, water biota) act as ‘reactors’ in modifying and transporting engineered nanomaterials (e.g. TiO<sub>2</sub>, Ag, ZnO, carbon black and Cu-based nanomaterials).
  - NanoFASE established inventories of nanomaterial release in different forms along the product value chain and identified links between the properties of engineered nanomaterials and their environmental fate.
- **PAPERCHAIN** <sup>(43)</sup> (New market niches for the pulp and paper industry waste based on circular economy approaches) deployed five novel circular economy models centred on the valorisation of the waste streams generated by the pulp and paper industry as secondary raw materials for resource-intensive sectors, namely construction, mining, and chemicals.
  - The project developed solutions based on circular economy models enabling sustainable reuse of waste. These were tested in large-scale trials in four EU countries (Spain, Portugal, Slovenia, and Sweden). The tests involved using ash produced when burning wastepaper as a binder in road construction works; using green liquor dregs and grits – pulp and paper mill residues – as aggregates for asphalt road layers; deinking paper ash and paper sludge composite for railway applications; and using fibre sludge waste generated by the pulp industry to produce bioethanol.
  - The circular models were implemented in compliance with all technical requirements set by the national authorities in each field of application. Each test investigated certification pathways by means of CE marking, European assessment documents and the EU’s environmental technical verification programme.
  - The project also fostered economic relationships among the stakeholders, leading to commercial or scientific agreements relating to the models tested and contributing to market uptake.

## 5.2. In the innovation pipeline

The following Horizon 2020 and Horizon Europe projects that are currently running or due to begin soon are highly relevant to this flagship:

- the ‘Safe-by-Design’ projects SABYDOMA, SbD4Nano, SAByNA and ASINA, which are focusing on metrics and main sectors <sup>(44)</sup>, and DIAGONAL, HARMLESS and SUNSHINE, which are focusing on multi-component nanomaterials <sup>(45)</sup>;

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<sup>(41)</sup> <https://cordis.europa.eu/project/id/646002>

<sup>(42)</sup> [http://www.nanofase.eu/news/1970\\_Exposure%20Assessment%20Framework](http://www.nanofase.eu/news/1970_Exposure%20Assessment%20Framework)

<sup>(43)</sup> <https://cordis.europa.eu/project/id/730305>

<sup>(44)</sup> [https://cordis.europa.eu/programme/id/H2020\\_NMBP-15-2019](https://cordis.europa.eu/programme/id/H2020_NMBP-15-2019)

<sup>(45)</sup> [https://cordis.europa.eu/programme/id/H2020\\_NMBP-16-2020](https://cordis.europa.eu/programme/id/H2020_NMBP-16-2020)

- other 'safe and sustainable by design' projects that are looking at sustainability criteria over the life cycle of products and processes <sup>(46)</sup>, metallic coatings and engineered surfaces <sup>(47)</sup>, polymeric materials <sup>(48)</sup>, and organic and hybrid coatings <sup>(49)</sup>;
- SOPLAS <sup>(50)</sup>, which aims to advance our knowledge of the sustainable use of plastics in European agriculture and study plastic pollution in agricultural soils.

## 6. Enforcing zero pollution together



Under this flagship, since 2022 the Commission has been bringing together environmental and other enforcement authorities (e.g. those in charge of EU transport, energy, agriculture and consumer protection legislation) to exchange best practices and encourage Member States to devise cross-sectoral compliance actions towards zero tolerance for pollution at national level and transboundary level. People will ultimately benefit from cleaner air, water and soil, and less noise, thanks to better enforcement of pollution-related legislation.

The Commission–UNEP policy dialogue on zero pollution identified the need to support opportunities for collaboration on ambitious international responses to major international pollution issues, namely marine litter and plastic pollution, wastewater, and nutrients. In addition, it will be important to align policies to achieve integrated approaches to land-based and coastal and marine pollution; the current approaches are considered suboptimal.

### 6.1. Projects' highlights

The following Horizon 2020 projects have been identified as having contributed to the abovementioned goals.

- **INTCATCH** <sup>(51)</sup> (Development and application of novel, integrated tools for monitoring and managing catchments) developed efficient, user-friendly water monitoring strategies and systems based on innovative technologies that provide real-time data on important parameters, moving towards smart rivers. This helps communities and authorities in detecting and tackling water pollution.
  - INTCATCH uses autonomous boats controlled by a handheld radio device to enable ordinary citizens to collect evidence themselves and find out just how healthy their local river is. Boats are equipped with innovative sensors (including for genomics, toxicity, and metal detection) that enable mobile, real-time water-quality monitoring and mapping. All the data collected are transmitted via the INTCATCH Water Quality Information System, where they are stored securely and can be processed using decision-support software to help communities and authorities make decisions.
  - The process was demonstrated in strategic water reservoirs in Germany, Greece, Spain and the United Kingdom. The INTCATCH combined sewer outfall system, based on flexible single or combined treatment using a dynamic rotating filtration unit, rapid adsorption or UV open channel lamps, has been successfully used as an example in guidelines on treatment of combined sewer outfall.
- **ECORISK2050** <sup>(52)</sup> (Effects of global change on the emission, fate, effects and risks of chemicals in aquatic ecosystems) focuses on future conditions that will affect emissions, environmental transport

<sup>(46)</sup> [https://cordis.europa.eu/programme/id/HORIZON\\_HORIZON-CL4-2021-RESILIENCE-01-08](https://cordis.europa.eu/programme/id/HORIZON_HORIZON-CL4-2021-RESILIENCE-01-08)

<sup>(47)</sup> [https://cordis.europa.eu/programme/id/HORIZON\\_HORIZON-CL4-2021-RESILIENCE-01-12](https://cordis.europa.eu/programme/id/HORIZON_HORIZON-CL4-2021-RESILIENCE-01-12)

<sup>(48)</sup> [https://cordis.europa.eu/programme/id/HORIZON\\_HORIZON-CL4-2021-RESILIENCE-01-11](https://cordis.europa.eu/programme/id/HORIZON_HORIZON-CL4-2021-RESILIENCE-01-11)

<sup>(49)</sup> [https://cordis.europa.eu/programme/id/HORIZON\\_HORIZON-CL4-2022-RESILIENCE-01-23](https://cordis.europa.eu/programme/id/HORIZON_HORIZON-CL4-2022-RESILIENCE-01-23)

<sup>(50)</sup> <https://cordis.europa.eu/project/id/955334>

<sup>(51)</sup> <https://cordis.europa.eu/project/id/689341>

<sup>(52)</sup> <https://cordis.europa.eu/project/id/813124>

pathways and the environmental fate of chemicals, and thus affect the exposure of the natural environment to chemicals. It aims to assess how the transport and fate of chemicals will change, identify potential adaptation and mitigation strategies, and develop tools for industry and policymakers.

- ECORISK2050 has developed models to predict exposure (covering more than 700 active pharmaceutical ingredients) and the probability of risk levels about pesticides. This will facilitate the communication of risk estimates and help to manage uncertainty. Empirical emission models for 2050 have been developed for ibuprofen and diclofenac (pharmaceuticals) and for terbuthylazine (a pesticide). Information on chemical pollution in multiple cities has been gathered and analysed to identify which chemicals are likely to be most toxic to human health and the environment.
- Experiments have been conducted to investigate the absorption of pharmaceuticals by microplastics and the transformation of all components in soils. A risk assessment of the impact of industrial chemicals on microorganisms commonly used for waste-water treatments has been carried out.
- ECORISK2050 has developed a transportable temperature and heatwave control engine (TENTACLE) to manipulate and record temperature simultaneously in indoor and outdoor aquatic micro- and mesocosms.
- **SOILCARE** <sup>(53)</sup> (soil care for profitable and sustainable crop production in Europe) evaluated the benefits and drawbacks of a new generation of soil-improving cropping systems (SICS), considering all relevant biophysical, socioeconomic, and political considerations.
  - The SOILCARE project proposes options for keeping European agriculture competitive while reducing its environmental impact. To this end, it developed a novel methodology for identifying the best possible crop and land use combinations for each climate and socioeconomic system in Europe based on a new SICS concept.
  - As each country has its own climate-related and socioeconomic specificities, the project team selected 16 study sites across Europe to identify promising SICS. These SICS incorporated methods already in use such as soil-improving crops, fertilisation, tillage management and solutions preventing soil compaction. The results from these study sites have been scaled up to European level to draw general lessons about the potential applicability of the SICS and related profitability and sustainability impacts.
  - The project developed four scenarios that capture various possible pathways for European agriculture between now and 2050 to support the development of future-proof policies. The findings include analysis of sustainability impacts (soil degradation and emissions of pollutants to the environment) and yield impacts by type of region. Despite public awareness of the need to improve agriculture, policy support will be essential to drive change.
  - SOILCARE conducted a thorough analysis of the impact of policies on SICS adoption and implementation and presented the results using an interactive tool allowing stakeholders to identify the best possible SICS for their needs. It also formulated a set of policy briefs and overarching recommendations for actions to facilitate the wider uptake of SICS across Europe.
- **SOPHIE** <sup>(54)</sup> (Seas, oceans, and public health in Europe: a strategic research agenda for Europe and beyond) delivered a clear, evidence-informed oceans and human health strategic research agenda <sup>(55)</sup> addressing the need to understand the complex interactions between the marine environment and human health and well-being. While the ocean can benefit human health and boost well-being through recreation and relaxation, it can also pose risks to human health, for example through flooding and pollution.

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<sup>(53)</sup> <https://cordis.europa.eu/project/id/677407>

<sup>(54)</sup> <https://cordis.europa.eu/project/id/774567>

<sup>(55)</sup> <https://sophie2020.eu/strategic-research-agenda/>

- The SOPHIE strategic research agenda provides valuable advice to policymakers regarding the need for additional data collection and monitoring of both marine and health parameters to support understanding of abovementioned interactions.
- The agenda advocates for promoting and supporting the development of a ‘health in all policies’ approach to marine and maritime policies and their implementation.
- Moreover, there is a need to increase support for oceans and human health as a core component of the Planetary Health and One Health frameworks through research and sectoral and regional cooperation programmes.
- Three main target actions identified in the SOPHIE strategic research agenda relate to areas also highlighted in the EU Mission ‘Restore our Ocean and Waters’, the UN sustainable development goals and the UN Ocean Decade initiative: (1) sustainable seafood and healthy people, (2) blue spaces, tourism, and well-being, and (3) marine biodiversity, biotechnology and medicine.

## 6.2. In the innovation pipeline

The portfolio of projects contributing to this flagship may be expanded in future when the results of certain Horizon 2020 projects that are currently running are known, namely:

- RI-URBANS <sup>(56)</sup>, which aims to close knowledge and data gaps on ultrafine particles by developing measurement systems and protocols for monitoring stations to enable the integration of these particles and other unregulated pollutants into future air-quality legislation while providing data for epidemiological studies, and which started in 2021;
- AVIATOR <sup>(57)</sup>, which is developing a proof-of-concept low-cost sensor network for the monitoring of ultrafine particles and gaseous species such as NO<sub>x</sub> and SO<sub>x</sub> in airports and the surrounding communities, and which started in 2019;
- SCIPPER <sup>(58)</sup>, which deals with the implementation of available and innovative techniques for monitoring the compliance of individual ships with existing sulphur and future NO<sub>x</sub> and particulate matter air pollution regulations, and which started in 2019;
- PREP4BLUE <sup>(59)</sup>, which aims to develop the co-creation and co-implementation R&I modalities required to achieve the objectives of the EU Mission ‘Restore our Ocean and Waters’ and to prepare the ground for inspiring and engaging citizens and stakeholders, and which started in 2022;
- LENS <sup>(60)</sup>, which aims to assist enforcement authorities, cities and regulators to reduce the contribution made by L-category vehicles such as mopeds, motorcycles, tricycles and quadrimobles to noise and air pollution, and which started in 2022.

## 7. Showcasing zero pollution solutions for buildings



Under this flagship, the Commission will showcase how building projects can contribute to zero pollution objectives by applying the concept of ‘beautiful, sustainable, together’, based on the Renovation Wave Strategy <sup>(61)</sup>, the New European Bauhaus initiative <sup>(62)</sup> and the use of local digital twins <sup>(63)</sup>. These results

<sup>(56)</sup> <https://cordis.europa.eu/project/id/101036245>

<sup>(57)</sup> <https://cordis.europa.eu/project/id/814801>

<sup>(58)</sup> <https://cordis.europa.eu/project/id/814893>

<sup>(59)</sup> <https://cordis.europa.eu/project/id/101056957>

<sup>(60)</sup> <https://cordis.europa.eu/project/id/101056777>

<sup>(61)</sup> [https://ec.europa.eu/energy/sites/ener/files/eu\\_renovation\\_wave\\_strategy.pdf](https://ec.europa.eu/energy/sites/ener/files/eu_renovation_wave_strategy.pdf)

<sup>(62)</sup> [https://new-european-bauhaus.europa.eu/index\\_en](https://new-european-bauhaus.europa.eu/index_en)

<sup>(63)</sup> <https://digital-strategy.ec.europa.eu/en/library/local-digital-twins-forging-cities-tomorrow>

will also contribute to the implementation of the energy efficiency directive <sup>(64)</sup>, resulting in improved housing and less pollution from, in and around buildings, as well as cost savings.

The Commission–UNEP policy dialogue identified an urgent need to promote minimised use and release into the environment of chemicals of concern in key industries and sectors, including building and construction, mainly through investment in ‘safe and sustainable by design’ approaches, green chemistry, life-cycle assessment and increased uptake of cost-effective policies such as the Globally Harmonised System of Classification and Labelling of Chemicals.

## 7.1. Projects’ highlights

The following Horizon 2020 projects have been identified as having contributed to the abovementioned goals.

- **Build-in-Wood** <sup>(65)</sup> (Sustainable wood value chains for construction of low-carbon multi-storey buildings from renewable sources) seeks to examine ways of minimising harmful emissions in the construction sector by optimising the use of environmentally conscious construction resources. The project proposes a sustainable and innovative wood value chain for the construction of multi-storey wood buildings.
  - Build-in-Wood has established a network of seven early adopter cities from different regions of Europe for open exchange and co-design activities to draw up new policies, uptake strategies and action plans for multi-storey wood construction practices.
  - Each of the cities has developed its own specific path to support further development through wood construction, tackling the challenges of (1) increased urbanisation, population growth and the resulting growing demand for new buildings, (2) an increased regulatory focus on sustainable construction and decreasing the greenhouse gas emissions of the construction sector, (3) the trend to build more vertically, (4) ensuring a competent, trainable workforce, and (5) the availability of wood resources and wood-processing industries and encouraging other positive trends in construction and/or forestry such as increased wages, higher employment rates, lower staff turnover, more personnel and more companies.
  - Each pathway considers not only the policy framework but also the context of the city (i.e. spatial, social, economic and administrative data), which is key to achieving the desired transferability and replicability of wood construction.
- **BAMB** <sup>(66)</sup> (Buildings as material banks: integrating materials passports with reversible building design to optimise circular industrial value chains) sought to prevent construction and demolition waste and thus reduce virgin resource consumption. Two complementary value-adding frameworks, (1) materials passports and (2) reversible building design, were integrated to enable progress.
  - The BAMB project worked on ways to drive a systemic shift towards sustainable buildings and foster a paradigm shift whereby materials, components and buildings are conceived and evaluated based on effective circularity requirements.
  - A reversible building design protocol was developed that enables stakeholders in the construction value chain to implement reversible design strategies in construction and refurbishment.
  - The materials passports developed by BAMB act as a one-stop shop for information on materials supporting circular decision-making. The materials passport framework <sup>(67)</sup> drawn up by BAMB has inspired and guided the development of various product data initiatives such as the product circularity data sheet initiative developed by the Luxembourg Ministry of the Economy.

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<sup>(64)</sup> [https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficiency-targets-directive-and-rules/energy-efficiency-directive\\_en](https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficiency-targets-directive-and-rules/energy-efficiency-directive_en)

<sup>(65)</sup> <https://cordis.europa.eu/project/id/862820>

<sup>(66)</sup> <https://cordis.europa.eu/project/id/642384>

<sup>(67)</sup> <https://www.bamb2020.eu/wp-content/uploads/2018/01/Framework-for-Materials-Passports-for-the-webb.pdf>

- A prototype circular building assessment tool was also delivered. The decision-making tool is built on a methodology for assessing new and existing buildings' resource productivity, based on material selection and design decisions.
- Six real-scale construction pilots were implemented: Green Transformable Building Lab (the Netherlands), Reversible Experience Modules (various locations), Circular Retrofit Lab (Belgium), Build Reversible in Conception (Belgium), New Office Building (Germany) and Green Design Centre (Bosnia and Herzegovina). They revealed that the approach and tools developed by BAMB can reduce construction and demolition waste by 75 %, or even 95 %.
- **ISOBIO** <sup>(68)</sup> (Development and demonstration of highly insulating, construction materials from bio-derived aggregates) developed a new approach to insulating materials through the novel combination of existing bio-derived aggregates having low embodied carbon with innovative binders to produce durable composite construction materials.
  - Through the combination of different eco-friendly materials, ISOBIO developed external and internal retrofit panels with improved properties (e.g. 20 % insulation improvement) compared with competing products and at lower overall cost (15 % less than regular products).
  - In a house, over a 60-year period, ISOBIO panels can achieve a reduction in global warming potential of 21.8 tonnes CO<sub>2</sub> equivalent and help to improve human health and safety (taking into account moisture buffering, fire resistance, etc.).
  - The ISOBIO panels have been successfully produced on an industrial scale using a continuous production line.

## 7.2. In the innovation pipeline

The portfolio of projects contributing to this flagship may be expanded in future when the results of certain Horizon 2020 projects that are currently running are known, namely:

- BASAJAUN <sup>(69)</sup>, which demonstrates how wood construction chains can be optimised to support rural development and urban transformation and to foster connections with sustainable forest management in Europe;
- HOUSEFUL <sup>(70)</sup>, which is developing solutions to increase resource efficiency throughout the life cycle of a building, based on an integrated circular approach that considers energy, materials, waste and water.

## 8. Living Labs for green digital solutions and smart zero pollution



Under this flagship, the Commission, together with partners, is creating Living Labs for green digital solutions and smart zero pollution to engage with regional and local authorities and other stakeholders (e.g. the Living-in.eu <sup>(71)</sup> community) to help develop local actions for green and digital transformation that contribute to the European Digital Green Coalition <sup>(72)</sup> and the European Climate Pact <sup>(73)</sup>.

By 2023, the Living Lab members will develop recommendations for climate- and environment-friendly use of digital solutions to accelerate zero pollution efforts, with a particular focus on citizen engagement.

<sup>(68)</sup> <https://cordis.europa.eu/project/id/636835>

<sup>(69)</sup> <https://cordis.europa.eu/project/id/862942>

<sup>(70)</sup> <https://cordis.europa.eu/project/id/776708>

<sup>(71)</sup> <https://living-in.eu/>

<sup>(72)</sup> <https://digital-strategy.ec.europa.eu/en/policies/european-green-digital-coalition>

<sup>(73)</sup> [https://climate-pact.europa.eu/index\\_en](https://climate-pact.europa.eu/index_en)

The Commission–UNEP policy dialogue identified an urgent need to strengthen global and regional actions and national capacities at the science–policy interface to address issues relating to chemicals, waste and pollution. The activities agreed on also include creating effective and efficient platforms for implementation, such as the Living Labs.

## 8.1. Projects' highlights

The following Horizon 2020 projects have been identified as having contributed to the abovementioned goals.

- **PEAKapp** <sup>(74)</sup> (Personal Energy Administration Kiosk application: an ICT ecosystem for energy savings through behavioural change, flexible tariffs and fun) proposed an ICT-to-human ecosystem to trigger lasting energy savings through behavioural change and continuous engagement and to boost the efficacy of smart home building energy management systems.
  - The PEAKapp ecosystem enables increased consumption of clean and low-priced electricity from the spot market by household customers. It connects consumers to social networks and motivates them through serious gaming.
  - To encourage European households to participate in the energy transition and improve their consumption, PEAKapp developed smart meters, to be installed in homes with zero investment by households. Using a free smartphone or tablet application for end-user energy management and savings, consumption can be monitored in real time, and this feedback motivates consumers to adjust their habits to increase energy efficiency and thus save money.
  - More than 6 000 households from four countries – Estonia, Latvia, Austria and Sweden – assessed the efficacy of the system during the project. Almost 3 000 of them offered the project team access to their smart-metered load profiles for detailed scientific analysis. After 69 weeks of field testing, 40 % of users had paid more attention to energy use, 14 % had replaced energy-inefficient appliances and 22 % had changed their behaviour. Active users had succeeded in decreasing their daily electricity consumption by 7 % on average.
- **Project Ô** <sup>(75)</sup> (Demonstration of planning and technology tools for a circular, integrated and symbiotic use of water) developed sustainable, cost-effective and customisable water management and treatment technologies. The project considered the needs of various users and waste-water producers, involving regulators, service providers, civil society, industry and agriculture.
  - Project Ô demonstrated solutions for reducing water and energy consumption by enabling the use/reuse of water, maximising water and energy efficiency, and tailoring treatment to end users' needs. This resulted in improved water quality (for urban, agricultural and industrial use) and reduced water footprints.
  - Project Ô created new economic and social opportunities by better distributing water resources through co-creative water management systems, with consultative, inclusive planning involving stakeholders and citizens.
  - Project Ô proposed integrating the key requirements of the circular economy action plan <sup>(76)</sup> into efforts to facilitate the transition to water circularity and the implementation of water reuse. The proposal also includes new water loop schemes, taking into account water and land concerns and ensuring horizontal consistency across related policies and strategies.
- **ICARUS** <sup>(77)</sup> (Integrated Climate forcing and Air pollution Reduction in Urban Systems) developed innovative tools for urban impact assessment to support air quality and climate change governance in the EU, putting forward strategies for improving air quality and reducing carbon footprints in

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<sup>(74)</sup> <https://cordis.europa.eu/project/id/695945>

<sup>(75)</sup> <https://cordis.europa.eu/project/id/776816>

<sup>(76)</sup> [https://environment.ec.europa.eu/strategy/circular-economy-action-plan\\_en](https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en)

<sup>(77)</sup> <https://cordis.europa.eu/project/id/690105>

European cities. The project also considered social and cultural factors, socioeconomic status and societal dynamics to assess overall policy impact.

- The technologies developed and the recommendations for improvement made by the ICARUS project were tested in nine European cities. The project assessed a total of 45 policies in cooperation with local authorities. It also carried out cost–benefit and cost-effectiveness analyses for each of them.
- ICARUS optimised existing models and computational techniques to reduce uncertainty, developed wearable sensors allowing citizens to assess their exposure and estimated health impact based on the uptake of pollutants instead of concentration in ambient air. The key motivation is to inform citizens and advise them on more environmentally conscious behaviour, while also capturing societal interactions to assess the impact of policy.
- ICARUS developed a mobile app called RQuality to track air-quality data and individual exposure to airborne chemicals in real time, promoting wellness and environmental awareness. The app tracks consumption patterns and lifestyle choices, estimating their carbon footprints, and even reports incidents affecting air quality in the local area.
- The project’s decision-support system will help authorities to improve air quality and assess climate change governance based on a fully integrated assessment of both predefined policies and new policy scenarios. They will be able to estimate impacts in terms of changes in air pollution and population exposure and conduct full cost–benefit analyses. This supports the realisation of green cities within the next 50 years.

## 8.2. In the innovation pipeline

The portfolio of projects contributing to this flagship may be expanded in future when the results of certain Horizon Europe projects that started in 2022 are known, namely:

- NOVAFERT <sup>(78)</sup>, which maps existing alternative fertilising products across Europe, aims to develop an atlas of nutrient-oriented Living Labs and will support the development of sustainable local value chains;
- FER-PLAY <sup>(79)</sup> develops a comprehensive approach to gather, harmonise, select and complement knowledge on alternative fertiliser value chains and to promote the wide-scale production and application of alternative fertilisers with best environmental, social and economic performance, as well as technical and regulatory viability.

## 9. Minimising the EU’s external pollution footprint



Under this flagship, the Commission promotes global zero pollution in all relevant international forums and works with the EU Member States and stakeholders to significantly reduce the EU’s external pollution footprint. This includes a proposal, in line with the EU’s international commitments, to restrict the export of certain products that are no longer allowed on the EU market and of waste that has harmful environmental impacts in non-EU countries. This will ultimately reduce the EU’s global pollution footprint and benefit non-EU citizens’ health and the environment.

The Commission and UNEP agreed during their first policy dialogue to strengthen integrated approaches to the implementation of the external dimension of the EU ZPAP and of UNEP’s implementation plan *Towards a Pollution-free Planet*, with a focus on key regions such as Africa. They further agreed on aligning regional and national transboundary cooperation within the context of the sustainable development goals, in support of:

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<sup>(78)</sup> <https://cordis.europa.eu/project/id/101060835>

<sup>(79)</sup> <https://cordis.europa.eu/project/id/101060426>

- waste shipment policies that reduce the global footprint;
- enhanced programmatic collaboration on source-to-sea pollution action;
- uptake of best practices on traceability and management of transboundary waste in developing countries;
- identification and progressive closing of dump sites worldwide;
- promotion of ambitious global responses to major international pollution issues, including lead and other harmful chemicals and waste, as part of the 'beyond 2020' process, and a stronger science–policy interface on chemicals, waste and pollution.

## 9.1. Projects' highlights

The following Horizon 2020 projects have been identified as having contributed to the abovementioned goals.

- **IC4WATER** <sup>(80)</sup> (Tackling water challenges in the international context) supported agencies to step up international cooperation to address global water challenges, through the sharing of best practices, networking, closer coordination of existing activities and the establishment of new relationships to facilitate multidisciplinary networking on water challenges at a larger scale.
  - IC4WATER mapped the existing research cooperation models and identified barriers to and challenges for transnational collaboration. The project formulated mechanisms for successful and efficient collaboration beyond the traditional bilateral approach.
  - The new structured strategy and models for international R&I cooperation developed by IC4WATER address global water challenges and target European initiatives, governmental institutions, researchers, economic sectors and international funding partners.

The International Water Joint Programming Initiative Knowledge Hub <sup>(81)</sup> was launched to strengthen scientific outreach and science–policy interactions. Long-term R&I cooperation has been established to address global water challenges with European key players (joint programming initiatives <sup>(82)</sup>, Article 185 initiatives <sup>(83)</sup>, the Joint Research Centre and Euraqua <sup>(84)</sup>) and international institutions (the Belmont Forum, the United Nations Educational, Scientific and Cultural Organization, the Global Water Research Coalition) and the Beyond Europe countries (Horizon 2020 associated countries and non-EU countries).

- **IMPRESSIVE** <sup>(85)</sup> (Integrated Marine Pollution Risk assessment and Emergency management Support Service In ports and coastal enVironmEnts) developed a universal relocatable platform for real-time management of marine pollution events in EU harbours and their vicinities, easy to manipulate and use from the harbour control post.
  - The IMPRESSIVE project developed a brand-new solution specifically for monitoring marine pollution caused by illegal tanker discharges, combining Earth observation satellites with hydrodynamic modelling and remote-controlled monitoring vehicles.
  - Synthetic-aperture radar images were used to monitor open ocean waters, wastewater and oil spills and combined with optical images from Earth observation satellites such as the Copernicus Sentinels. With remotely operated vehicles that can be used in multiple marine environments,

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<sup>(80)</sup> <https://cordis.europa.eu/project/id/730264>

<sup>(81)</sup> <http://www.waterjpi.eu/implementation/thematic-activities/water-jpi-knowledge-hub-1>

<sup>(82)</sup> [https://research-and-innovation.ec.europa.eu/research-area/health/joint-programming-initiatives\\_en](https://research-and-innovation.ec.europa.eu/research-area/health/joint-programming-initiatives_en)

<sup>(83)</sup> <https://www.era-learn.eu/partnerships-in-a-nutshell/type-of-networks/partnerships-under-horizon-2020/article-185-initiatives>

<sup>(84)</sup> <https://www.euraqua.com/>

<sup>(85)</sup> <https://cordis.europa.eu/project/id/821922>

IMPRESSIVE has provided port authorities, competent administrations and the maritime industry with technology that can be used for constant monitoring and control around ports.

- IMPRESSIVE is also a platform that gathers and fuses data acquired from multiple Earth observation satellites and air and sea-level sensors, as well as using a full set of downscaled hydrodynamic models based on Copernicus Marine Environment Monitoring Service products. It provides maps, statistics, geanalytics and alerts on the monitored area. Three pilots demonstrated the technology in Greece, Spain and Italy before it was released to the global market.
- **CLAIM** <sup>(86)</sup> (Cleaning Litter by developing and Applying Innovative Methods in European seas) focuses on the development of innovative cleaning technologies, targeting the prevention and *in situ* management of visible (macroplastics > 5 mm) and invisible (microplastics < 5 mm) marine litter at their point of introduction to the marine environment (river estuaries and waste-water treatment plants) in the Mediterranean and Baltic Seas.
  - CLAIM developed and demonstrated technologies that retain and collect 96 % of floating litter in rivers and retain 99 % of microplastics up to 50 µm in waste-water treatment plants. The collected microplastics, which are difficult to recycle, can produce energy in small-scale thermal treatment devices (pyrolysers), whereas microplastics are effectively dissolved in photocatalytic reactors, where active radicals attack the polymeric chains, breaking them down into innocuous simple compounds.
  - CLAIM identified a need for new policy targets for macro- and microplastics to ensure that both existing and new marine-litter-related targets are monitored and met.

## 9.2. In the innovation pipeline

The portfolio of projects contributing to this flagship may be expanded in future when the results of the following Horizon 2020 projects that started in 2021 are known.

- CIRCULAR FOAM <sup>(87)</sup> is developing a systemic solution to increase the circularity of high-performance plastics such as rigid polyurethane foams, used as insulation in refrigerators and in construction. The project aims to prevent toxic polyurethane going to landfill.
- EcoeFISHent <sup>(88)</sup> targets sustainable and efficient exploitation of fish-processing side streams by obtaining bioactives and gelatine for high value-added food supplements and skincare products and to produce biodegradable and compostable barrier layers for food packaging. Moreover, other fishing industry by-products will be converted into soil fertilisers, oil for biodiesel and chitin for cosmetic applications.
- Agro2Circular <sup>(89)</sup> focuses on the upcycling of residues from the agrifood sector (fruit and vegetables and plastic multilayers) into high added-value products, powered by a digital tool and following a systemic approach with high replicable/scalable potential.

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<sup>(86)</sup> <https://cordis.europa.eu/project/id/774586>

<sup>(87)</sup> <https://cordis.europa.eu/project/id/101036854>

<sup>(88)</sup> <https://cordis.europa.eu/project/id/101036428>

<sup>(89)</sup> <https://cordis.europa.eu/project/id/101036838>

## 10. Consolidating the EU's knowledge centres for zero pollution



Under this flagship, the Commission works to consolidate the roles of the European Environment Agency and the Commission's Joint Research Centre as the EU's Knowledge Centres of Excellence for Zero Pollution Monitoring and Outlook, and brings together relevant players in the Zero Pollution Stakeholder Platform to exchange best available data and inform the public through the upcoming Air Quality Index App.

The Commission–UNEP policy dialogue flagged up the importance of jointly strengthening the science–policy interface on pollution and chemicals through the creation of a digital platform and cooperation on zero pollution monitoring and outlook.

### 10.1. Projects' highlights

The following Horizon 2020 projects have been identified as having contributed to the abovementioned goals.

- **HERA** <sup>(90)</sup> (Integrating environment and health research: a vision for the EU) created the EU research agenda for the environment, climate and health 2021–2030 <sup>(91)</sup>. HERA also addressed research needs relating to the links between the COVID-19 pandemic and the environment, climate and health. HERA identified six major research goals, namely:
  - climate change and biodiversity loss – reduce effects on health and the environment;
  - cities and communities – promote healthy lives in sustainable and inclusive societies;
  - chemicals and physical stressors – prevent and eliminate chemical exposures harmful to health;
  - improve health impact assessment of environmental factors and promote implementation research;
  - develop infrastructures, technologies and human resources for sustainable research on the environment, climate change and health;
  - promote research on transformational change in the environment, climate change and health.
- **INHERIT** <sup>(92)</sup> (INter-sectoral Health and Environment Research for InnovaTion) investigated effective intersectoral policies, interventions and innovations that can enable and empower citizens to behave in ways that simultaneously improve the environment and human health and contribute to reducing health inequalities. INHERIT covered the areas of living (green space, energy efficient housing), moving (active transport) and consuming (food). A series of recommendations resulted from the project.
  - Policies and interventions are more likely to address needs and be supported and sustained over time if they involve a wide range of people and sectors in their design, implementation and evaluation.
  - Policies across sectors should support and not undermine one another.
  - Policies may have consequences for the broader ecosystem, the health of those living in poorer countries and future generations. Therefore, INHERIT developed a model to screen policies for these potential unintended consequences.

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<sup>(90)</sup> <https://cordis.europa.eu/project/id/825417>

<sup>(91)</sup> <https://www.heraresearch.eu/hera-2030-agenda>

<sup>(92)</sup> <https://cordis.europa.eu/project/id/667364>

- Ensuring economically viable green jobs and upskilling workers – as well as supporting the development of accessible, affordable green spaces for all, co-created with local communities – can foster health, equity, and environmental and economic benefits.
- People – as individuals and as professionals – need to be encouraged to make sustainable, positive changes, by implementing effective policies and identifying and tackling barriers. Invest in bringing together and building trust across a range of stakeholders to identify joint solutions.
- Design laws to help achieve difficult changes. Use legislative measures to ensure intersectoral collaboration and involve target communities early on through a sustained and well-conceived process.
- Ensure the sustainability of policies by embedding them in school curricula through legislative and regulatory measures and guidelines. Ensure that these policies build the capacities of the adults involved.

## **10.2. In the innovation pipeline**

To further this flagship, EU knowledge hubs should consider how the results of currently running projects and new European partnerships can contribute to achieving zero pollution. It will also be important to establish close links with the European Institute of Innovation and Technology (EIT) and its knowledge and innovation communities<sup>(93)</sup>. Table 5 provides information on the relevant partnerships and communities.

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<sup>(93)</sup> <https://eit.europa.eu/our-communities>

## 11. Conclusions



This report highlights the significant role of R&I in providing solutions to support the ZPAP. It describes how the R&I results of selected projects funded under the Horizon 2020 framework programme (2014–2020) work towards the goals of the nine flagships of the ZPAP. The projects selected are by no means the only ones making such contributions – there are many others that could equally well have been mentioned here.

The report also identifies projects that are in the pipeline that seem likely to make contributions in this regard and explains how the missions and partnerships launched under the Horizon Europe framework programme (2021–2027) support the flagships.

To increase the efficiency of cooperation, interested parties should reach out to projects during their lifetime, so that new knowledge and results can more quickly become part of the solutions that citizens, authorities and industry are searching for.

The analysis of the project portfolio has shown that, while water and air quality are sufficiently covered by the projects described, soil quality actions are still under-represented. This trend was visible already during the selection of 27 projects for this report from 71 project candidates, which were identified by colleagues from European Commission directorates-general (the Directorate-General for Research and Innovation and the Directorate-General for Environment) and EU executive agencies (the European Health and Digital Executive Agency, the European Research Executive Agency and the European Climate, Infrastructure and Environment Executive Agency). Only 3 of these 71 pre-selected projects (SOILCARE, NanoFASE and ECORISK2050) focused directly on soil pollution. Several projects, however, deal indirectly with soil pollution by considering, for instance, the monitoring of environmental pollution effects on human health, or by reducing landfill waste through the development of new circular approaches to the manufacture of various products (e.g. plastic, paper or construction materials).

A similar observation can also be made on studying the pool of 79 projects in the innovation pipeline. Here, only two of them (EcoeFISHent and SOPLAS) directly involve R&I activities intended to minimise soil pollution. Accordingly, the focus on soil pollution prevention and remediation of soils could be further strengthened for more equal coverage of the three main pollution areas.

It is obvious that the five missions will have an impact across the flagships, with some involving direct action on pollution (e.g. those tackling soil pollution, water pollution and air quality) and others dealing with pollution through indirect outputs (e.g. those addressing cancer risks). Likewise, the European partnerships will contribute to the flagships. Some partnerships address actions relevant to several ZPAP flagships, but most of them target more specific concerns (e.g. water quality, urban transportation) strongly linked to a single flagship. A key challenge will be keeping track of the outputs of all partnerships, in particular those cutting across several flagships. Establishing direct contact between the flagship owners and relevant partnerships would be a good step forward.

## 12. 'Compass' of projects and partnerships

This chapter provides an overview of the Horizon 2020 projects selected for inclusion in the report (Table 4). This list of projects is followed by examples of Horizon Europe partnerships that will contribute to the ZPAP flagships (Table 5). The partnerships are grouped by Horizon Europe cluster.

**Table 4: Examples of Horizon 2020 projects contributing to the implementation of the ZPAP flagships**

Flagship	Project	Type of pollution targeted (water, air, soil, all)	Project start and end dates	Project website	Type of project results
					Potential user of the results
1. Reducing health inequalities through zero pollution	HBM4EU	All	1 January 2017 30 June 2022	<a href="https://www.hbm4eu.eu/about-hbm4eu/">https://www.hbm4eu.eu/about-hbm4eu/</a>	Scientific data and recommendations Authorities and regulators
	PROTECTED	All	1 January 2017 30 June 2021	<a href="https://www.qub.ac.uk/sites/protected.eu/">https://www.qub.ac.uk/sites/protected.eu/</a>	New technologies Scientists and regulators
	EuroMix	All	15 May 2015 14 May 2019	<a href="https://www.euromixproject.eu/">https://www.euromixproject.eu/</a>	New methodology Authorities and regulators
2. Supporting urban zero pollution action	iSCAPE	Air	1 September 2016 30 November 2019	<a href="https://www.iscapeproject.eu/">https://www.iscapeproject.eu/</a>	New technology Policymakers and authorities
	NOVELOG	Air	1 June 2015 31 May 2018	<a href="https://civitas.eu/projects/novelog">https://civitas.eu/projects/novelog</a>	Business models and guidelines Policymakers and authorities including cities

	MossTree	Air	1 April 2019 30 September 2020	<a href="https://greencitysolutions.de/en/">https://greencitysolutions.de/en/</a>	New product Authorities including cities
3. Promoting zero pollution across regions	NextGen	Water	1 July 2018 30 November 2022	<a href="https://nextgenwater.eu/">https://nextgenwater.eu/</a>	New technology Policymakers, regulators and industry
	MMAtwo	All	1 October 2018 30 September 2022	<a href="https://www.mmatwo.eu/">https://www.mmatwo.eu/</a>	New technology and guidelines Industry and cities
	iCAREPLAST	All	15 October 2018 14 October 2022	<a href="https://www.icareplast.eu/">https://www.icareplast.eu/</a>	New technology Industry and cities
4. Facilitating zero pollution choices	CREAToR	All	1 June 2019 31 May 2023	<a href="https://creatorproject.eu/">https://creatorproject.eu/</a>	New technology and recommendations Regulators and industry
	NanoFASE	All	1 September 2015 30 September 2019	<a href="http://www.nanofase.eu/">http://www.nanofase.eu/</a>	New methodology Regulators and industry
	PAPERCHAIN	All	1 June 2017 31 August 2021	<a href="https://www.paperchain.eu/">https://www.paperchain.eu/</a>	New technology Industry
5. Enforcing zero pollution together	INTCATCH	Water	1 June 2016 31 January 2020	<a href="https://intcatch.eu/">https://intcatch.eu/</a>	New methodology and technology Authorities including cities
	ECORISK2050		10 October 2018	<a href="https://ecorisk2050.eu/">https://ecorisk2050.eu/</a>	New methodology

		Water and soil	9 April 2023		Industry and authorities including cities
	SOILCARE	Soil	1 March 2016 31 August 2021	<a href="https://www.soilcare-project.eu/">https://www.soilcare-project.eu/</a>	New methodology Policymakers and the agricultural sector
	SOPHIE	Water	1 December 2017 31 May 2020	<a href="https://sophie2020.eu/">https://sophie2020.eu/</a>	Strategic research and innovation agenda Policymakers
6. Showcasing zero pollution solutions for buildings	Build-in-Wood	Air	1 September 2019 31 August 2023	<a href="https://www.build-in-wood.eu/">https://www.build-in-wood.eu/</a>	New policies and strategies Policymakers and industry
	BAMB	All	1 September 2015 28 February 2019	<a href="https://www.bamb2020.eu/">https://www.bamb2020.eu/</a>	New methodology Policymakers and industry
	ISOBIO	Air	1 February 2015 31 January 2019	<a href="http://isobioproject.com/">http://isobioproject.com/</a>	New technology Industry
7. Living labs for green digital solutions and smart zero pollution	PEAKapp	Air	1 March 2016 30 June 2019	<a href="http://www.peakapp.eu/">http://www.peakapp.eu/</a>	New product Civil society (households)
	Project Ô	Water	1 June 2018 30 November 2022	<a href="https://www.eu-project-o.eu/">https://www.eu-project-o.eu/</a>	New technology Regulators, civil society and industry
	ICARUS	Air	1 May 2016	<a href="https://icarus2020.eu/">https://icarus2020.eu/</a>	New technology and strategy

			31 October 2020		Civil society, policymakers and authorities
8. Minimising the EU's external pollution footprint	IC4WATER	Water	1 January 2017 30 June 2022	<a href="https://supporting-projects/csa-ic4water">supporting-projects/csa-ic4water</a>	New strategy Policymakers and authorities
	IMPRESSIVE	Water	1 December 2018 30 November 2021	<a href="https://impressive-project.eu/">https://impressive-project.eu/</a>	New product Authorities
	CLAIM	Water	1 November 2017 30 April 2022	<a href="https://www.claim-h2020project.eu/">https://www.claim-h2020project.eu/</a>	New technology Policymakers and authorities
9. Consolidating the EU's knowledge centres for zero pollution	HERA	All	1 January 2019 31 March 2022	<a href="https://www.heraresearcheu.eu/">https://www.heraresearcheu.eu/</a>	Strategic research and innovation agenda Policymakers and authorities
	INHERIT	All	1 January 2016 31 December 2019	<a href="https://inherit.eu/">https://inherit.eu/</a>	Policy monitoring Policymakers and authorities

**Table 5: Relation of European partnerships to ZPAP flagships**

<i>Examples of European partnerships that will contribute to the flagships</i>	<i>Relevant ZPAP flagships</i>
<b><i>Health cluster</i></b>	
<p><b>The European Partnership on Chemical Risk Assessment</b> started in 2022 and will contribute to innovating risk assessment to better protect human and environmental health in line with the Green Deal’s zero pollution ambition for a toxic-free environment. It will be an enabler of the EU chemicals strategy for sustainability. The partnership will support EU and national chemical risk assessment and risk management bodies with new data, knowledge, methods, networks and skills to address current, emerging and novel chemical safety challenges.</p>	1, 4, 9
<p><b>The One Health AMR Partnership</b> aims to bring together the many aspects of antimicrobial resistance (AMR) research to overcome the fragmentation of the AMR research landscape and integrate the various fields (human and animal health, food safety and the environment). It will contribute to the EU One Health action plan against AMR. To improve knowledge of the occurrence and spread of antimicrobials in the environment, the partnership will use EU information platforms to access relevant monitoring data.</p>	4, 9
<p><b>The EIT Health Partnership</b> is a dynamic, integrated network of public, private, academic and innovation partners, combining their strengths and engaging their assets to address the health challenges of an ageing population. Various EU institutions, such as the European Investment Fund and the Joint Research Centre, by building bridges and collaborating, will ensure that the partnership’s strategy and objectives are in line with those supported by the EU.</p>	1, 9
<b><i>Digital, industry and space cluster</i></b>	
<p><b>The Smart Networks and Services Partnership</b> enables the infrastructure basis for the deployment of next-generation internet services used by citizens and for smart services required by vertical sectors such as transport, energy, manufacturing, health and the media.</p>	7
<p><b>The Made in Europe Partnership</b> promotes a competitive discrete manufacturing industry with a world-leading reduction of the environmental footprint while guaranteeing the highest level of well-being for workers, consumers and society.</p>	2, 4
<p><b>The Processes4Planet Partnership</b> aims to transform European process industries to achieve circularity and overall climate neutrality at EU level by 2050 while enhancing their global competitiveness. The partnership aims to achieve three general objectives: developing and deploying climate-neutral solutions by bringing technological and non-technological innovations to readiness for subsequent deployment; closing the energy and feedstock loops through technological and non-technological innovations, cross-sectoral collaboration and engagement with the local ecosystem; and achieving global leadership in climate-neutral and circular solutions, accelerating innovation, and unlocking public and private investment.</p>	4, 8
<b><i>Climate, energy and mobility cluster</i></b>	
<p><b>The Partnership for Transforming Europe’s Rail System</b> aims to accelerate the development and deployment of innovative technologies (especially digital and automation technologies) and to deliver on European Green Deal objectives with regard to the availability of these technologies. It will develop solutions with broad support across the EU, aiming for up to 75 % market uptake by 2030, thus improving the competitiveness of rail and supporting European technological leadership in rail.</p>	2

<b>The Integrated Air Traffic Management Partnership</b> promotes digital transformation of air traffic management that will make the European airspace the most efficient and environmentally friendly in the world. This will support the competitiveness and recovery of the European aviation sector in a post-COVID-19 crisis Europe. Key areas include improving connectivity, air-ground integration and automation, increased flexibility and scalability of airspace management and safe integration of drones.	2
<b>The European Partnership for Clean Aviation</b> will develop disruptive new aircraft technologies to deliver net greenhouse gas reductions of no less than 30 %, compared with the 2020 state of the art, and will consider noise regulations as well. It will enable net CO <sub>2</sub> reductions of up to 90 % when combined with the effect of sustainable 'drop-in' fuels, or zero CO <sub>2</sub> emissions in flight when using hydrogen as an energy source.	2, 5, 8
<b>The Clean Hydrogen Partnership</b> will accelerate the market entry of hydrogen-based technologies with near-zero greenhouse gas emissions across energy, transport and industrial end users, covering the full value chain for competitive hydrogen and fuel cell technologies, ensuring that Europe is in pole position to realise the potential of hydrogen technologies at scale.	3, 4
<b>The European Partnership for a People-centric Sustainable Built Environment</b> (Built4People) aims to achieve high-quality, low-carbon, energy- and resource-efficient built environments that drive the transition towards sustainability.	6
<b>The European Partnership towards Zero-emission Road Transport</b> (2ZERO) aims to accelerate the development of zero-emission transport in Europe, reducing CO <sub>2</sub> emissions and improving air quality. It will deliver a multistakeholder roadmap for a climate-neutral and clean road transport system.	2, 5
<b>The European Partnership on Zero-emission Waterborne Transport</b> will provide zero-emission solutions for all main ship types and services before 2030, which will enable zero-emission waterborne transport before 2050. It will develop and demonstrate deployable technological solutions for decarbonisation and the elimination of other harmful emissions for main ship types and services.	5, 7, 8
<b>The European Partnership on Driving Urban Transitions to a Sustainable Future</b> will engage and enable the whole spectrum of urban stakeholders to co-create innovative, systemic and people-centric approaches, tools, methods and services in support of urban transformative transitions leading to more efficient and decarbonised use of energy, sustainable and people-friendly mobility systems, and circular and environmentally friendly use of resources, for the well-being of citizens and the preservation of biodiversity.	2, 9
<b>The EIT Urban Mobility Partnership</b> will deliver solutions to develop greener, more inclusive, safer and smarter urban transport systems.	2, 9

### *Food, bioeconomy, natural resources, agriculture and environment cluster*

<b>The European Partnership for Accelerating Farming Systems Transition</b> will focus on agroecology Living Labs and research infrastructures. The partnership aims to accelerate the transition towards sustainable, climate- and ecosystem-friendly farming practices. To do so, it will (1) enable a better comprehension of agroecological processes from farm to landscape levels, (2) boost place-based innovation in co-creative environments and (3) improve the flow and uptake of knowledge and innovations on agroecology. It pursues a vision of teaming up to unlock the transition to agroecology so that farming systems are resilient, prosperous, place-sensitive, and climate-, biodiversity- and people-friendly by 2050.	7
<b>The European Partnership for Animal Health and Welfare</b> started in 2022 and aims to create sustainable and innovative solutions to tackle infectious animal diseases, including those transmitted between animals and humans (zoonoses) and to contribute to the fight against AMR, implementing the One Health concept.	1
<b>The Environmental Observations for a Sustainable EU Agriculture Partnership</b> (Agriculture of Data) has the objective of supporting the delivery of a sustainable common	7

agricultural policy by improving agricultural practices and farm profitability and using the possibilities of current digital/data technologies in the field. New services and applications will be developed for the EU's farming sector, enabling more efficient, environmentally friendly and profitable production systems.	
<b>The European Partnership for a Climate-neutral, Sustainable and Productive Blue Economy</b> aims to sustainably unlock, demonstrate and harvest the full potential of Europe's oceans and seas through a well-structured, sustained and simplified joint effort in this borderless domain. The aim is to support the transition to a strong, climate-neutral and sustainable blue economy by 2050.	3, 4, 8
<b>The European Partnership for a Circular Bio-based Europe</b> aims to develop and expand the sustainable sourcing and conversion of biomass into bio-based products focusing on multi-scale biorefinery processing and to apply circular economy approaches such as utilisation of biological waste from agriculture, industry and municipal waste processing.	4
<b>The Partnership for Water Security for the Planet</b> (Water4All) aims to secure all water demands in terms of quality and quantity, protecting both economic and natural systems, as well as people, from water-related hazards.	3, 8

### Cross-cutting cluster

<b>The EIT Manufacturing Partnership</b> will deliver solutions to transform today's industrial forms of production towards more knowledge-intensive, sustainable, low-emission, trans-sectoral manufacturing and processing technologies, to realise innovative products, processes and services.	4
<b>The European Science Cloud Partnership</b> (EOSC) is aimed at facilitating EOSC implementation activities in the project's second phase. After 2020, the EOSC will become more stakeholder driven, with a permanent governance structure in place. EOSC providers cover many domains, including air and water pollution, and have developed some virtual labs, such as <a href="#">the Blue-Cloud initiative</a> .	7
<b>The EIT Climate Partnership</b> is a network of universities, businesses and research organisations delivering solutions to mitigate or adapt to climate change and accelerate the deployment of new solutions to market.	9

## **Acknowledgement**

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This report provides a brief overview of the contribution of selected Horizon 2020 projects to the nine flagships of the zero pollution action plan. It identifies new projects and Horizon Europe partnerships in the pipeline and raises awareness about the five EU missions and their contribution to achieving the zero pollution ambition. The report highlights the importance of making research findings accessible to a wider audience to inform policymakers, citizens and other stakeholders, thus creating more value and better solutions from knowledge.

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