

Thematic Research Priorities 2024-2026

Key evidence and research needs required to
address policy and knowledge gaps



About the EPA Thematic Research Priorities 2024–2026

The EPA have identified 37 Thematic Research Priorities for 2024–2026, listed in Table 1, which will set the strategic direction for the EPA Research Programme over the next three years. The priorities reflect key evidence and research needs required to address policy and knowledge gaps in the medium and longer term (2026 and beyond). They have been identified through a review of global, European and national priorities, as well as extensive consultation and engagement with EPA Research stakeholders both nationally and internationally.

The Thematic Research Priorities support the implementation of the EPA’s research framework [EPA Research 2030](#), and will inform the development and implementation of targeted research actions over the three-year cycle 2024–2026, including our annual research calls, fast-track to policy funding and our national and international partnerships.

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Overview of Thematic Research Priorities 2024–2026

Table 1: The EPA Thematic Research Priorities 2024–2026 under each hub of the EPA Research 2030 framework

HUB	THEMATIC RESEARCH PRIORITY
<p>Climate Change Evidence Needs</p>	Developing Climate Neutral Pathways for Ireland
	Understanding Vulnerabilities and Identifying Risks to Inform Decision-Making at Local Level
	Social Science, Citizen Science and Behavioural Science for Climate Action
	Climate Action: Bringing Mitigation and Adaptation Together
	Deep Decarbonisation in Agriculture and Land Use
	Improving Cross-Sectoral Governance in Climate Adaptation
	Understanding the Impacts of Climate Change on the Water and Coastal Environments and Ecosystems
	Understanding the Impacts of Climate Change on the Agriculture, Forestry and Land-Use Sectors
	Understanding the Impacts of Climate Change on the Built Environment, Critical Infrastructure, Heritage, and Rural Communities
<p>Green and Circular Economy</p>	Integration of the Circular Economy, Climate and Biodiversity
	Enhancing the Assessment of Materials, Products and Value Chains in the Circular Economy in Ireland
	Supporting and Scaling up the Just Transition to the Circular Economy
	Developing Metrics and Indicators of Progress to Circularity
	Designing Innovative Sustainable Products, Value Chains and Managing Materials using Digital Technologies
<p>Delivering a Healthy Environment</p>	Material Flow Analysis to Support the Transition to a Circular Economy and Bioeconomy
	Towards Zero Pollution
	Disentangling Sources of Air Pollution & Exploring Integrated Solutions
	Further Understanding the Health Impacts of a Changing Environment
	Chemicals and Materials that are Safe and Sustainable by Design
	Establishing Links Between Hazardous Chemicals in the Environment and Health Impacts
	Strengthening the Environmental Dimension of One Health Action
Environmental Transmission of AMR & Targeted Interventions	
<p>Protecting and Restoring our Natural Environment</p>	Exploring the Health Impacts of Poor Water Quality
	Supporting Nature, Ecosystems and Biodiversity in our Waters
	Sustainable Management of our Water Resources – Water Quantity
	Sustainable Management of our Water Resources – Water Quality
	Knowledge and Evidence to Support Soil Monitoring for Nature, Ecosystems and Biodiversity
	Supporting the Transition to Sustainable Land-use Planning and Management
	Integrating Nature into Decision-Making
	Implementing Effective Protect and Restore Solutions
Understanding the Environmental Impacts of Plans and Policies	
<p>Cross-cutting Priorities</p>	Policy Implementation, Effective Regulation, and Innovative Governance Models
	Environmental and Social Inequities
	Data & Digitalisation Solutions to Support the Protection and Restoration of the Environment
	Societal Transformation to Support the Protection and Restoration of the Environment
	Social and Geopolitical Risks to the Environment
	Alternative Economic Paradigms for Sustainability

Why we need Thematic Research Priorities

The EPA’s vision is for us to live sustainably in a healthy environment that is valued and protected by all. Achieving this ambitious vision will require systemic transformation. Research and innovation will be a critical enabler of this transformation, providing the evidence to support the development and implementation of robust policy and effective regulation, as well as exploring new and innovative ideas.

[EPA Research 2030](#) is the ten-year high-level framework for the EPA’s Research Programme. It sets out the broad structure and ambition for EPA research activity over the period 2021 to 2030 and is designed to be agile, responsive, and flexible. To support its implementation, the EPA carries out a consultative process to identify research priorities on a three-year cycle. Following on from our [previous 2021–2023 assessment](#), the EPA Thematic Research Priorities 2024–2026 have been identified to address policy and research needs in the medium and longer term (2026 and beyond).

EPA Research 2030 is structured around four research hubs, which span the primary policy areas of relevance to the EPA:

- Addressing Climate Change Evidence Needs
- Facilitating a Green and Circular Economy
- Delivering a Healthy Environment
- Protecting and Restoring our Natural Environment

This hub structure facilitates alignment of EPA research activities to relevant policy areas and is used to present the thematic priorities identified here. It is recognised, however, that the hubs are strongly interconnected and that there are critical cross-cutting issues – including social, behavioural and economic factors – that require a holistic approach, such that research at the nexus of these areas is becoming increasingly important.

The Thematic Research Priorities will set the strategic direction for the EPA Research Programme and will be used to inform research actions and partnerships over this period. As well as actions undertaken by the EPA over the period 2024–2026, the thematic research areas will also act as a signpost to researchers and others, facilitating better understanding of the most policy-relevant research questions for the EPA.

How we identified our Thematic Research Priorities

The Thematic Research Priorities have been identified through review, consultation and engagement with EPA Research stakeholders at national and international level, as shown in Figure 2. They are informed by priorities that have been identified at global, European and national levels, with sources including:

- Strategies, Work Programmes and Reports from the European Commission, the European Environment Agency and Horizon Europe;
- National plans and policies from relevant government departments and agencies;
- Public consultation initiatives, such as Creating Our Future.



Figure 1: EPA Research 2030 is structured around four Research Hubs

These national and international priorities were compiled into a long list that was subsequently refined through extensive consultation with national stakeholders, including a survey that received over 260 written responses, as well as bilateral engagements with relevant government departments and implementing agencies. This consultation informed the final list by highlighting additional knowledge gaps, amalgamation of research areas and refinement of the scope of some priorities.



Figure 2: Overview of review and consultation process to identify the Thematic Research Priorities

How the Thematic Research Priorities will inform our work

Over the period 2024–2026 the EPA Research Programme will seek to address the thematic research priorities through various research actions, such as the annual EPA Research Call, strategic partnerships and co-funding agreements with other organisations, international partnerships, PhD programmes, Research Fellowships and our Fast Track to Policy scheme. Research actions will be selected as appropriate to address particular thematic priorities and deliver the objectives in EPA Research 2030, as illustrated in Table 2. When implementing these actions, further engagement with stakeholders will be undertaken to further refine the thematic research priorities. EPA Research commenced actioning of the Thematic Research Priorities in 2024, through the inclusion of 13 of them in the annual EPA Research Call 2024.

Table 2: Primary objectives of research actions under EPA Research 2030.

Research Action	Typical Duration	Objectives					
		Addressing short-term policy priorities	Addressing medium- to long-term policy needs	Deepening engagement between research and policy	Supporting cross-sectoral partnership	Supporting research collaboration	Building environmental research capacity in Ireland
Annual Research Call (Thematic)	24-48 months		✓	✓		✓	✓
Annual Research Call (Targeted Topics)	12-48 months	✓		✓		✓	
Fast-track to Policy Funding	6-9 months	✓		✓			
EU Partnerships	36 months		✓		✓	✓	✓
National Partnerships	48 months		✓			✓	✓
Co-funding Partnerships	24-48 months		✓	✓	✓		
Framework Agreements	24 months	✓	✓	✓			
Fellowships	24 months	✓		✓			✓

The Thematic Research Priorities

The Thematic Research Priorities are presented in the following section by EPA Research Hub, firstly with their alignment to relevant EU and Irish plans and policies and secondly with high-level descriptions of key knowledge gaps and research needs. Only a small selection of plans and policies have been included for each research hub in order to illustrate the potential impact of research in these areas; these lists are not meant to be exhaustive. In addition, for all hubs and for many of the priorities identified, the same plans and policies at global and EU level are relevant. For this reason, we have omitted specific mention of, for example, the EU Green Deal in each of the tables, and instead point to the relevant plan or strategy under the Green Deal. A list of key publications that informed the Thematic Research Priorities is provided in Annex 1.

Addressing Climate Change Evidence Needs

Climate change is already having an impact in Ireland and strong mitigation and adaptation measures are urgently needed. Research under this hub is focussed on providing the evidence necessary to improve our knowledge systems and inform policy decisions that will advance our ambitions to be carbon neutral and resilient to climate disruption. Nine thematic research priorities have been identified under this hub, which are presented in Table 3 along with their relevance to selected national and international plans and policies.

Table 3: Alignment of Climate Change Hub Thematic Research Priorities with Selected Plans and Policies

Addressing Climate Change Evidence Needs	International			National					
	EU Fit for '55	EU 2030 Climate Target Plan	EU Climate Adaptation Strategy	Climate Action Plan	National Adaptation Framework	National Climate Risk Assessment	National Biodiversity Action Plan	Ag-Climate Roadmap	Draft Water Action Plan
Developing Climate Neutral Pathways for Ireland		✓		✓		✓		✓	
Understanding Vulnerabilities and Identifying Risks to Inform Decision-Making at Local Level			✓	✓	✓	✓			
Social Science, Citizen Science and Behavioural Science for Climate Action			✓	✓	✓	✓			
Climate action - bringing mitigation and adaptation together			✓	✓	✓				
Deep decarbonisation in agriculture and land use	✓			✓				✓	
Improving cross-sectoral governance in climate adaptation			✓	✓	✓	✓			
Understanding the impacts of climate change on the water and coastal environments and ecosystems			✓	✓					✓
Understanding the impacts of climate change on the Agriculture, Forestry and Land-Use sectors			✓	✓			✓	✓	
Understanding the impacts of climate change on the Built Environment, Critical Infrastructure, Heritage, and Rural Communities			✓	✓					

1. Developing Climate Neutral Pathways for Ireland

Achieving climate neutrality by mid-century requires a comprehensive and strategic approach that aligns with national, EU and international climate objectives and contributes to the broader goal of limiting global temperature rise to well below 2 degrees Celsius. Ireland's Climate Change Assessment highlighted a significant gap related to developing climate-neutral pathways in Ireland, with mitigation options explored to date not achieving net zero. Current knowledge gaps, especially in the Agriculture, Forestry and Land-Use (AFOLU) sector, make this more challenging. Research is needed to advance development of integrated and cross-sectoral net-zero pathways for Ireland.

2. Understanding Vulnerabilities and Identifying Risks to Inform Decision-Making at Local Level

Ireland's Climate Change Assessment highlighted an adaptation deficit in Ireland with a need to comprehensively understand the vulnerabilities and risks to the impacts of climate change so that decision-makers can prioritise mitigation and adaptation strategies. This includes furthering our knowledge of climate event attribution to understand the influence climate change is already having on weather events in Ireland and internationally. Research is needed to provide actionable insights and practical solutions for ensuring and enhancing 'just resilience', reducing vulnerabilities and improving decision-making processes at the local level in the face of various climate risks and uncertainties.

3. Social Science, Citizen Science and Behavioural Science for Climate Action

The EPA's Climate Change in the Irish Mind project shows that there is widespread agreement on many climate change attitudes and strong majority support for climate action amongst the Irish public. Social science, citizen science and behavioural science for climate action help us to further understand, to promote acceptance, and to influence human behaviour in the context of climate change mitigation and adaptation efforts. This thematic priority will focus on how citizen science, the social sciences and behavioural science can be effectively used to increase action on climate change in Ireland.

4. Climate Action: Bringing Mitigation and Adaptation Together

Mitigation efforts aimed at reducing greenhouse gas emissions are crucial for minimising the severity of climate impacts. However, certain climate impacts are already 'locked in' due to our past emissions and adaptation measures are equally critical for building resiliency and minimising vulnerability to climate-related risks in Ireland. An integrated approach to mitigation and adaptation strategies can help mainstream climate considerations into broader policy agendas, foster interdisciplinary collaboration and enhance Ireland's capacity to effectively respond to the complex and interconnected challenges posed by climate change. Research is needed to identify synergies, minimise trade-offs and optimise resource allocation, leading to more cost-effective and holistic approaches to climate action in Ireland.

5. Deep Decarbonisation in Agriculture and Land Use

The land-use sector can act as both a sink and a source for greenhouse gas emissions, and thus it is imperative that we fully understand the complex links between land-use and climate. Sustainable food production while increasing the AFOLU sector's carbon dioxide removal capacity will also require a better understanding of the multidimensional land-climate-biodiversity-food-health nexus. Research is needed to further our understanding of this nexus and explore the feasibility and impacts of the agricultural sector adopting sustainable farming practices, increasing the potential for sequestration of carbon in soils and other 'carbon farming' practices.

6. Improving Cross-Sectoral Governance in Climate Adaptation

Climate change in Ireland impacts all aspects of society and climate-related challenges, such as increased flooding, coastal destruction, land-use change, urban pressures and agricultural impacts require multi-sectoral planning and response. To achieve this more effectively it is crucial to have an effective and responsive cross-sectoral governance strategy to manage the move towards a climate-resilient Ireland. Research is needed to fully consider barriers to adaptation across sectors and indeed opportunities that might arise, which could be highlighted by the development of adaptation ‘storylines’ to convey how adaptation can work across sectors in Ireland.

7. Understanding the Impacts of Climate Change on the Water and Coastal Environments and Ecosystems

Ireland’s extensive coastline makes it vulnerable to climate change threats such as rising sea levels, increased frequency of extreme weather events and shifts in ocean currents and temperatures. These changes can lead to coastal erosion, flooding and habitat loss, which in turn can affect biodiversity, aquaculture and tourism. Furthermore, alterations in freshwater availability and quality can impact agriculture, drinking water supplies and overall public health. Research to develop seasonal hydrological forecasting, sea-level rise projections and understanding the impact on marine food webs will be crucial to mitigating the worst impacts of climate change on these environments.

8. Understanding the Impacts of Climate Change on the Agriculture, Forestry and Land-Use Sectors

The importance of agriculture and the land-use sector in Ireland’s economy and society cannot be overestimated. Climate change poses significant risks to this sector, including altered weather patterns, water availability and frequency and intensity of extreme weather events. Land-use practices are integral to maintaining soil health, water quality, and ecosystem diversity, all of which are susceptible to climate-induced changes. Research is needed to update climate impact assessments for the AFOLU sectors in Ireland, to develop new projections to understand pressures, improve land-use decision making and increase understanding of land-use interactions.

9. Understanding the Impacts of Climate Change on the Built Environment, Critical Infrastructure, Heritage, and Rural Communities

Climate change, increased frequency of extreme weather events and sea-level rise is exposing our built environment, critical infrastructure, cultural heritage, and rural communities to new risks. Research is needed to develop, for example, land-use scenarios for urban development, stress testing critical infrastructure, and assessing vulnerabilities of tangible and intangible assets for different climatic events using a risk-based approach.

Facilitating a Green and Circular Economy

Environmental and sustainability challenges are inextricably linked to economic activities and lifestyles. Research under this hub is focussed on mainstreaming sustainable management of natural resources and waste, unlocking the potential of the circular and bio-economies, and boosting competitiveness, through resource efficiency and deployment of innovative technologies and solutions. Six thematic research priorities have been identified under this hub, which are presented in Table 4 along with their relevance to selected national and international plans and policies.

Table 4: Alignment of Green and Circular Economy Hub Thematic Research Priorities with Selected Plans and Policies

Facilitating a Green and Circular Economy	International			National						
	EU Farm to Fork Strategy	EU Climate Adaptation Strategy	EU Circular Economy Action Plan	Bioeconomy Action Plan	Whole of Government Circular Economy Strategy	National Hazardous Waste Plan	Food Vision 2030	A Waste Action Plan for a Circular Economy Strategy	National Food Waste Prevention Roadmap	Green Public Procurement Strategy and Action Plans
Integration of the circular economy, climate and biodiversity	✓	✓	✓	✓	✓			✓		
Enhancing the assessment of materials, products and value chains in the Circular Economy in Ireland	✓		✓	✓	✓	✓	✓	✓	✓	✓
Supporting and Scaling Up the Just Transition to the Circular Economy	✓		✓	✓	✓			✓		✓
Developing metrics and indicators of progress to circularity	✓		✓	✓	✓		✓	✓	✓	✓
Designing innovative sustainable products, value chains and managing materials using digital technologies	✓		✓	✓	✓			✓	✓	✓
Material flow analysis to support the transition to a Circular Economy and Bioeconomy	✓		✓	✓	✓	✓		✓		

1. Integration of the Circular Economy, Climate and Biodiversity

Half of greenhouse gas (GHG) emissions and 90% of biodiversity loss are due to resource extraction and processing. Decoupling economic growth from resource use and transitioning to a circular economy and bioeconomy is key to achieving net-zero GHG emissions by 2050 and restoring biodiversity. There are challenges associated with the implementation of an integrated approach to addressing climate change, biodiversity loss and the transition to the circular economy, and research is required to assess the role of the circular economy and bioeconomy in the mitigation of climate impacts and biodiversity loss in Ireland, and to better understand trade-offs and synergies between sectors and policy areas.

2. Enhancing the Assessment of Materials, Products and Value Chains in the Circular Economy in Ireland

Consideration of the whole life cycle – from design, extraction, importation, production, consumption, recovery and end of life – is required to develop sustainable products, services and business models. Assessment of materials, products and by-products in key product value chains (textiles; food, water and nutrients; plastics; packaging; electronics; construction and buildings; and batteries and vehicles) is necessary to capture the flow materials and to assess their environmental impacts (intended and unintended). Research is needed to move beyond traditional assessments, to analyse how circular materials, products and systems can go beyond the net zero goal of doing no harm and can have positive ecological, economic, and social impacts.

3. Supporting and Scaling up the Just Transition to the Circular Economy

As we transition to a sustainable society, we must ensure that this is done in a just and equitable way as this pertains to job creation, elimination and substitution, industrial transformation, and ensuring equity in accessing and benefitting from the opportunity of this transition. Research is needed to identify mechanisms and initiatives to accelerate the transition to the circular economy, to enable knowledge transfer and capacity building, while also considering the potential socio-economic impacts and gender vulnerabilities of the transition at local and regional level and in rural and urban areas.

4. Developing Metrics and Indicators of Progress to Circularity

Ireland currently collates and reports various statistics under the EU Circular Economy Monitoring Framework, but significant sectoral, material and economic data gaps still exist. As Ireland's circular economy and bioeconomy continues to mature, further development of sectoral and material metrics and indicators is required to measure and monitor the impact (intended and unintended) of circular economy policies and instruments during Ireland's just transition to circularity.

5. Designing Innovative Sustainable Products, Value Chains and Managing Materials using Digital Technologies

Digital technologies can help to develop innovative products, circular business and collaborative consumption models to accelerate circularity and dematerialisation and the use of virgin raw materials. Sustainable products that are more durable, more efficient and easier to repair and recycle will become the norm in the EU. Further research is required to explore how digital technologies can enable the development of sustainable products through innovative eco-designs, sustainable value chains and industrial symbiosis. Research is also needed to consider how initiatives such as the digital product passports, tagging and watermarks, will facilitate traceability, market surveillance and material management along the key product value chains (textiles; food, water and nutrients; plastics; packaging; electronics; construction and buildings; and batteries and vehicles).

6. Material Flow Analysis to Support the Transition to a Circular Economy and Bioeconomy

It is essential that the flow of materials in our economy is captured to support the transition to a circular economy and sustainable bioeconomy and improve self-sufficiency. In-depth research is required on material flow analysis to identify potential supply and demand gaps in key material flows and product value chains, during the transition from virgin raw materials use (e.g. fossil fuel-based carbon) to secondary raw materials (e.g. sustainable carbon) use, reuse and repair.

Delivering a Healthy Environment

A clean, vibrant and safe environment is a prerequisite for good health and wellbeing. Environmental degradation, pollution, as well as known and emerging substances of concern threaten our health and that of our supporting ecosystems. Research under this hub is focussed on understanding the risks and benefits, and to identifying appropriate policy and behavioural responses. Eight thematic research priorities have been identified under this hub, which are presented in Table 5 along with their relevance to selected national and international plans and policies.

Table 5: Alignment of Healthy Environment Hub Thematic Research Priorities with Selected Plans and Policies

Delivering a Healthy Environment	International					National				
	EU Zero Pollution Action Plan	EU Chemicals Strategy for Sustainability	EU Drinking Water Directive	EU Farm to Fork Strategy	EU Sewage Sludge Directive	National Radon Control Strategy	National Clean Air Strategy	Chemicals Act	Persistent Organic Pollutants Reg.	One Health Action Plan on Antimicrobial Resistance
Towards Zero Pollution	✓		✓	✓	✓		✓	✓	✓	✓
Disentangling Sources of Air Pollution & Exploring Integrated Solutions	✓						✓			
Further Understanding the Health Impacts of a Changing Environment	✓	✓			✓	✓		✓	✓	
Chemicals and Materials that are Safe and Sustainable by Design	✓	✓		✓	✓			✓	✓	
Establishing links between hazardous chemicals in the environment and health impacts	✓	✓	✓		✓			✓	✓	
Strengthening the Environmental Dimension of One Health Action				✓				✓		✓
Environmental Transmission of AMR & Targeted Interventions	✓			✓						✓
Exploring the Health Impacts of Poor Water Quality	✓		✓		✓					✓

1. Towards Zero Pollution

To achieve targets set out in the EU Zero Pollution Action Plan, there is a need for more progress in reducing transport noise, excess nutrients and persistent chemicals in freshwater and marine ecosystems and waste, as well as needing to address key emerging issues including hazardous chemicals and soil pollution. Intensified monitoring, measuring, mapping and modelling is required in Ireland to prioritise pollution risks, to identify and enact solutions and to measure their impact. Research is needed to resolve, quantify, and prioritise the impacts of known and emerging pollutants and to explore potential solutions.

2. Disentangling Sources of Air Pollution & Exploring Integrated Solutions

In order to meet and go beyond the World Health Organisation's Air Quality Guidelines, research is needed to further investigate known and emerging sources of air pollution in Ireland such as backyard burning, aviation, shipping, agriculture/ammonia, black carbon, ultra-fine pollutants, indoor air, electric vehicles/hybrids as well as exploring opportunities and challenges to gathering long-term data and using low-cost sensors. Research is also needed to inform solutions and action, from meaningful engagement and co-design to influence behavioural change, and to exploring the co-benefits of solutions.

3. Further Understanding the Health Impacts of a Changing Environment

Changes to our air, water, soil and biota resulting from climate change, extreme weather events, and increased exposure to environmental pollution (for example, noise, hazardous chemicals, microplastics, artificial light, infectious disease, radon and radiation) will have impacts on our health that could be debilitating and life threatening. Exposure and vulnerability to environmental health hazards are not equal across society with regional differences and social vulnerabilities across Europe. Further work is needed at a national level to link environmental and health data, including support for the development of an Environmental Health Atlas for Ireland and the European Human Exposome Network.

4. Chemicals and Materials that are Safe and Sustainable by Design

The full extent of the occurrence/use of hazardous chemicals is not fully understood, particularly in industry, products, and waste. The EU Chemicals Strategy for Sustainability promotes the use of safer and more sustainable chemicals and materials through the Safe and Sustainable by Design (SSbD) framework. Research is needed to identify the challenges and opportunities in Ireland of moving to chemicals that are SSbD, to assess the effectiveness of existing regulatory frameworks for controlling hazardous chemicals and to explore innovative and co-ordinated regulatory approaches to support and promote the use of chemicals that are SSbD.

5. Establishing Links Between Hazardous Chemicals in the Environment and Health Impacts

Research is needed to further explore the risks posed from hazardous chemicals in an Irish context. This includes the health impacts resulting from the short- and long-term exposure to hazardous chemicals in the environment; human health and wellbeing in workplaces, homes and communities; the cumulative and synergistic effects of exposure to multiple chemicals; as well as routes and biomarkers of exposure and social determinants. Research is also needed to explore the effectiveness of existing regulation for protecting humans and the environment from hazardous chemicals.

6. Strengthening the Environmental Dimension of One Health Action

One Health is a holistic approach to addressing threats to health and well-being, including climate change and the spread of infectious disease, by recognising the interdependence of people, animals, plants and the environment. The environment is often the least studied aspect of the One Health and research is needed to explore the benefits and challenges of strengthening the environmental dimension of One Health action in Ireland and opportunities for linking environmental and human and animal health data to inform action.

7. Environmental Transmission of AMR & Targeted Interventions

Despite progress in recent years in our understanding of the role of the environment in the transmission of antimicrobial resistance (AMR), highlighting the significant threats that exist, for example, in the aquatic environment, further research is needed to continue to identify and prioritise risks and solutions. Specifically, research will address potentially significant environmental routes of transmission, persistence and dissemination of AMR, the role of environmental pressures, impacts on human and animal health, the development of harmonised monitoring approaches and targeted and effective interventions.

8. Exploring the Health Impacts of Poor Water Quality

Poor water quality can have serious impacts on human and animal health and healthcare systems whether it arises from agriculture, industry, wastewater treatment, natural sources or because of climate change. Making direct connections between environmental and health data is necessary to identify potential solutions but can be difficult and requires co-operation across multiple disciplines. Research is needed to further explore the health impacts of poor water quality on human and animal health, the spread of waterborne diseases and development of solutions.

Protecting and Restoring our Natural Environment

Our natural environment provides clean air and water, food and the raw materials to sustain us and our economy. Research under this hub is focussed on informing cross-sectoral approaches to protecting and restoring our natural environment, regulation of emissions and activities, and the protection of our water, land and ecosystems. Eight thematic research priorities have been identified under this hub; these are presented in Table 6 along with their relevance to selected national and international plans and policies.

Table 6: Alignment of Natural Environment Hub Thematic Research Priorities with Selected Plans and Policies

Protecting and Restoring our Natural Environment	International				National			
	EU Zero Pollution Action Plan	EU Nature Restoration Law	EU Water Framework Directive	EU Soil Strategy	Food Vision 2030	Land Use Review	National Biodiversity Action Plan	Draft Water Action Plan
Supporting nature, ecosystems and biodiversity in our waters	✓	✓	✓				✓	✓
Sustainable management of our water resources – water quantity			✓			✓		✓
Sustainable management of our water resources – water quality	✓		✓		✓		✓	✓
Knowledge and evidence to support soil monitoring for nature, ecosystems and biodiversity		✓		✓	✓	✓	✓	
Supporting the transition to sustainable land-use planning and management					✓	✓		
Integrating Nature into Decision-Making		✓				✓	✓	
Implementing effective protect and restore solutions	✓	✓	✓				✓	✓
Understanding the environmental impacts of plans and policies	✓		✓		✓	✓		✓

1. Supporting Nature, Ecosystems and Biodiversity in our Waters

With greater species loss in aquatic, rather than terrestrial habitats recorded on a global scale, solutions for multiple benefits are required, specifically in the context of National Water, Climate and Biodiversity Action Plans. In particular, the monitoring, evaluation and development of prediction tools for multiple pressures is critical, along with developing and applying solutions including green/blue infrastructure, ecological engineering and ecohydrology for restoration of vulnerable ecosystems, species and habitats.

2. Sustainable Management of our Water Resources – Water Quantity

In the context of a changing climate and increasingly frequent storm and drought events, resilience, adaptation and mitigation to hydroclimatic extreme events is critical to support infrastructure, livelihoods and lives. To support this, integrated water resources management to understand water scarcity, flooding and disaster management is required. Research is required to understand barriers to implementation of natural flood mitigation actions, and the use of natural water retention measures that develop, embed and assess catchment-based approaches.

3. Sustainable Management of our Water Resources – Water Quality

To support the critical role clean, fresh water plays in supporting healthy communities, knowledge is required to further develop mapping, measurement and mitigation of known and emerging pollutants in our marine, freshwater and groundwater ecosystems. In particular, measures that develop, embed and assess the catchment-based approach are required in the context of National Water, Climate and Biodiversity Action Plans.

4. Knowledge and Evidence to Support Soil Monitoring for Nature, Ecosystems and Biodiversity

With the critical importance of soil to nature and agri-food systems being recognised through the EU Soil Strategy, there is a need for mapping, measuring and mitigating known and emerging pollutants and other pressures on our soil, across the range of soil types in Ireland. Advancing our understanding of reference conditions is required for the range of soil types in Ireland, including those which are not productive from an agricultural perspective, and how sustainable soil management practices can support the health of these soils. This includes understanding, monitoring and managing atmospheric deposition of pollutants.

5. Supporting the Transition to Sustainable Land-use Planning and Management

Land is a finite resource that is under demand for a variety of purposes and how we use our land has implications for human life, biodiversity and climate action. At EU level and nationally, the AFOLU sector has been identified as part of the solution to address urgent climate mitigation efforts and biodiversity loss. Research needs in land-use planning and management relate to the development of indicators for soil monitoring, food system impacts, land-use measures and actions, and urbanisation, amongst others. Consideration should also be given to socio-economic and cultural dimensions of transition in land use to ensure a fair and sustainable distribution of effort.

6. Integrating Nature into Decision-Making

Knowledge and evidence is required to advance the development, deployment and assessment of approaches to recognise and value nature and its ecosystem services in public policy in Ireland. In particular, the development of innovative policy instruments that integrate ecosystem accounts to ensure sustainable land use and restoration of nature and the assessment of the long-term investment risks associated with climate change, nature degradation and biodiversity loss are needed. There is

also a need for research that will ensure that financial flows and investments are directed for the benefit of ecosystem restoration and protection, including development of Green Finance guidance for key sectors in Ireland on the integration of nature into relevant decision-making processes, including through the use of Natural Capital Accounting.

7. Implementing Effective Protect and Restore Solutions

Wider and more rapid implementation of solutions will be essential to address climate change, changes to water quality and quantity, biodiversity loss, and nature restoration, but there is limited knowledge on monitoring and scaling-up such solutions. Improved knowledge to develop, deploy and assess protect and restore solutions for multiple benefits is required, particularly in the context of national Water, Climate and Biodiversity Action Plans.

8. Understanding the Environmental Impacts of Plans and Policies

With a wide range of national and international plans and policies published to inform action by government, the impacts of these plans, not only on the systems and sectors for which they have been developed, but the potentially unintended cross-sectoral impacts may be poorly understood. Research is required to improve environmental assessment of plans and policies, including increasing public engagement, identifying and communicating the value (including financial) added by environmental assessments. Work is also required to understand the attributes of good governance for the implementation of these plans and policies, enabling the production of plans whose outcomes can be identified and measured, providing the evidence base to close the policy implementation gap.

Cross-cutting Priorities

Consideration of the interactions between social, behavioural and economic factors is an integral component of environmental research and will lead to enhanced governance and more effective implementation of environmental strategies, policies and regulation. As part of the process of identifying the Thematic Research Priorities, six priority areas were identified that were considered critical issues that cross-cut or sit at the nexus of the four EPA research hubs.

1. Policy Implementation, Effective Regulation, and Innovative Governance Models

Effective implementation of policy and regulation, across all sectors and at all levels from national to local, is critical to Ireland achieving our climate and environmental targets. This requires new integrated approaches to ensure policy coherence; appropriate governance structures; and effective regulation and enforcement. Research can support this through, for example, international benchmarking, learnings on national and local enforcement strategies, and ex-post analysis of current policies to assess how well they deliver on their environmental objectives, particularly in areas such as industrial emissions, waste management, and drinking and waste water treatment. Research can also explore new and agile governance models that incorporate systems and socio-ecological considerations in complex, multi-stakeholder, multi-sectoral policy areas; and the development of indicators to measure progress in implementation.

2. Environmental and Social Inequities

There exist significant inequities in respect to exposure to environmental risks, with vulnerable groups or communities with lower levels of income or education being exposed to higher levels of noise and air pollution and with reduced access to green and blue spaces, with associated impacts on health and wellbeing. Research is needed in areas such as identifying social determinants of inequalities in environmental risk; assessing policies and practices that promote environmental justice; and developing financial mechanisms and business models to ensure a just and sustainable transition.

3. Data & Digitalisation Solutions to Support the Protection and Restoration of the Environment

The rapid development of digital technologies and growth of data represent new opportunities and challenges for environmental protection. An integrated approach is needed to harness the potential of digital and data technologies to support environmental policy, while ensuring transparency, authenticity, interoperability and public accessibility of the data and information. Research will be essential in the development of novel tools, technologies and digital solutions to address environmental issues; to fully exploit earth observation data, geospatial data, socio-economic data sources, artificial intelligence and emerging technologies; and to explore integrated, cross-sectoral data management systems.

4. Societal Transformation to Support the Protection and Restoration of the Environment

The European Green Deal is an ambitious plan to transform the EU into a modern, resource-efficient and competitive economy that ensures no net emissions of greenhouse gases by 2050, economic growth is decoupled from resource use and no person and no place is left behind. To enable this transition, we will need to engage individuals and communities, drive behavioural change, and achieve systems-level change across all sectors. Research is needed in areas such as assessment of strategies to promote inclusive and active community engagement and empowerment; behavioural change analysis to support the transition to sustainability; and understanding of the economic opportunities and trade-offs that can arise from policies focused on innovation, sustainable practices and clean technologies.

5. Social and Geopolitical Risks to the Environment

Ireland has set out an ambitious and necessary objective to transition to a competitive, low carbon, climate-resilient and environmentally sustainable economy by 2050. National roadmaps and action plans outline the decisive action required to navigate this transition, but there remain risks, geopolitical, economic and otherwise, that fall outside the remit of these plans that could impact their success. Research is needed to understand and address denial of science and misinformation relating to environmental issues; to assess the risks posed by geopolitical instability and impacts on supply chains; to conduct horizon scanning and consider futures; and to build resilience to mitigate these risks.

6. Alternative Economic Paradigms for Sustainability

In moving toward a competitive, low carbon, climate-resilient and environmentally sustainable future, consideration should be given to alternative economic paradigms that could enable or accelerate this transition. Research can explore the feasibility and impacts of alternative economic paradigms in Ireland, including a 'post-growth' system and how economic growth could be 'decoupled' from climate, waste, pollution and biodiversity impacts.

Annex: List of Key References

The policies, plans, strategies and publications represent the key references used in the initial desk-based review phase of identifying the Thematic Research Priorities 2024–2026.

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