

Draft orientations

towards the cluster 5 work programme 2023-2024

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Please note that:

- All elements included in this document are preliminary and only serve the purpose of discussing possible priorities for the WP 2023-2024.
- Not all elements may be included in WP 2023-2024 and new elements may be included at a later stage.
- The number of R&I needs and impacts contained in the document is not an indicator for the number of topics to be included in the first draft WP, nor for the budget allocation to the different areas.
- Proposed R&I needs will be further simplified and streamlined based on strategic priorities for energy, transport and climate policy.

DISCLAIMER

This draft has not been adopted or endorsed by the European Commission. Any views expressed are the preliminary views of the Commission services and may not in any circumstances be regarded as stating an official position of the Commission. The information transmitted is intended only for the Member State or entity to which it is addressed for discussions and may contain confidential and/or privileged material.

Contents

Implementation issues with relevance for all cluster 5 Destinations	3
Destination 1: Climate sciences and responses for the transformation towards climate neutrality	4
Draft expected impact (Strategic Plan)	4
Addressing main policy issues.....	4
Main expected impacts (WP)	4
Preliminary list of R&I needs.....	5
Destination 2: Cross-sectoral solutions for the climate transition	7
Draft expected impact (Strategic Plan)	7
Addressing main policy issues.....	7
Main expected impacts (WP)	7
Preliminary list of R&I needs.....	8
Destination 3: Sustainable, secure and competitive energy supply	10
Draft expected impact (Strategic Plan).....	10
Addressing main policy issues.....	10
Main expected impacts (WP)	11
Preliminary list of R&I needs:.....	13
Destination 4: Efficient, sustainable and inclusive energy use	18
Draft expected impact (Strategic Plan)	18
Addressing main policy issues.....	18
Main expected impacts (WP)	19
Preliminary list of R&I needs.....	19
Destination 5: Clean and competitive solutions for all transport modes	21
Draft expected impact (Strategic Plan)	21
Addressing main policy issues.....	21
Main expected impacts (WP)	21
Preliminary list of R&I needs.....	23
Destination 6: Safe Resilient Transport and Smart Mobility services for passengers and goods	26
Draft expected impact (Strategic Plan)	26
Addressing main policy issues.....	26
Main expected impacts (WP)	26
Preliminary list of R&I needs.....	27

Implementation issues with relevance for all cluster 5 Destinations

- Ensure balance of research (RIA) and innovation-focused (IA) actions and coverage of relevant TRL range (TRL 2-8, with a main focus on TRL 4-7).
- Mix of various project sizes (in general: smaller projects for lower TRLs, more expensive projects for high-TRL projects) with an average projects size similar to WP 2021-2022.
- Support targeted international cooperation across all Destinations.
- Integrate SSH-dimension and social innovation across topics of all Destinations.
- Plan to use Prizes and pre-commercial procurement to boost deployment of technologies (especially in Destination 3).
- Ensuring synergies
 - Inside cluster 5: i.e. between 2Zero, Batt4EU and CCAM; the Clean Hydrogen Joint Undertaking and the partnerships on Waterborne transport, 2Zero, Clean Rail and Clean Aviation; the Build for People, the Driving Urban Transition and Clean Energy Transition co-funded partnerships with Destinations 3 and 4.
 - Across clusters: e.g. between Destination 1 and Cluster 6 for activities concerning polar, cryosphere and blue carbon research; between Destination 3 and Cluster 6 on biomass/bioenergy; between Destination 3 and Cluster 4 on digitalization of the energy sector; between Destination 4 and Cluster 4 on energy-intensive industries on one side and buildings and construction interfaces on the other; between partnerships on Clean Hydrogen and partnership on industry of cluster 3, Clean Steel and Process for Planet.
 - And with the European Missions: on climate adaptation, on climate neutral cities and on oceans.
 - With other pillars: e.g. destination 2 and 3 with pillar III on energy technologies.
 - Between EU initiatives: e.g. between Destination 1 and 'Destination Earth'; Destination 3 and Digital Europe Programme, destination 3 and Investment programmes, partnership on Clean Hydrogen and regional programmes; Destinations 2, 3 and 4 and the LIFE programme (market uptake activities).
 - With other EU organisations: e.g. between Destination 1 and ESA.
 - With activities of the JRC.
- Use lump sum funding for a substantial part of topics across all Destinations.
- While stating clearly the expected scope of actions and the outcomes that are targeted, the topics take a technology-neutral and open approach to research and innovation, which will allow to consider for funding a broad variety of concepts.
- Single stage calls will be used by default in order to launch projects quickly and use limited administrative resources efficiently. Single stage can be complemented with a mandatory go/no go milestone to monitor progress and mitigate execution risk. Two-stage calls will be considered for topics at low-TRL and with broad scope that are expected to extract many proposals. Two-stage calls will participate in the blind evaluation pilot.

Destination 1: Climate sciences and responses for the transformation towards climate neutrality

Draft expected impact (Strategic Plan)

Transition to a climate-neutral and resilient society and economy enabled through advanced climate science, pathways and responses to climate change (mitigation and adaptation) and behavioural transformations.

Addressing main policy issues

- Advancing climate science is essential to inform the societal transition towards a climate neutral and climate resilient society by 2050, both in the EU and globally. It must further our understanding:
 - On past, present and expected future changes in climate;
 - On its implications on ecosystems and society;
 - On the implementation of effective mitigation and adaptation solutions in a coherent manner.
- Building user-oriented knowledge, supported by improved Earth System and Integrated Assessment Models will inform human response to global change on all levels.
- Studying the interactions between climate change and ecosystems is essential for a more complete understanding of the Earth system and the effective deployment of solutions, including ecosystem-based ones.
- Incorporating and advancing social sciences and behavioural science methodologies will accelerate societal transformation and institutional development and thus enable an efficient and just transition.
- The role of communication and education on climate change is essential to change behaviours towards more sustainable patterns.

Main expected impacts (WP)

1. Advancing knowledge and providing solutions in the any of following areas: Earth system science; pathways to climate neutrality; climate change adaptation including climate services; social science for climate action; and better understanding of climate-ecosystems interactions.
2. Contributing substantially to key international assessments such as those of the Intergovernmental Panel on Climate Change (IPCC) or the European Environment Agency (e.g. European environment state and outlook reports, SOER).
3. Strengthening the European Research Area on climate change.
4. Increasing the transparency, robustness, trustworthiness and practical usability of the knowledge base on climate change for use by policy makers, practitioners, other stakeholders and citizens.

Preliminary list of R&I needs

Earth system science

1. Advanced technologies for analysing EO and ESM data
2. Tipping points
3. Climate impacts of a hydrogen economy
4. Knowledge gaps in cloud-aerosol interactions (potential for a coordinated call with ESA)
5. Enhanced quantification and understanding of natural and anthropogenic methane emissions (potential for a coordinated call with ESA)
6. Polar processes/Cryosphere [to be coordinated with Cluster 6]
7. Paleoclimate

Climate change mitigation, pathways to climate neutrality

8. Improved toolbox for evaluating climate (and other environmental) impacts of trade policies
9. Science for successful carbon markets
10. Post-2030 NDCs and low-emission transformation pathways
11. Analysing the feasibility of green growth in the context of climate neutrality and resilience goals
12. Activities in support of opening up climate change scenarios, transition pathways (frameworks) and models to all user groups (beyond specialised audience/modellers)
13. Climate change foresight for primary and secondary raw materials supply

Climate change impacts and adaptation

14. Analysis of transformative pathways to forge a Climate resilient Europe (to deliver on the objectives of the new EU Strategy on Adaptation to Climate Change)
15. Developments in support of local adaptation assessments and plans (incl. improvements to adaptation modelling)

Social science, citizen science and behavioural science for climate action

16. Solar Radiation Management: governance of research (CSA, precautionary approach, no field work)
17. Understanding public authorities' and citizens' perception of changes in specific weather events and improving their understanding (this topic could include aspects related to behavioural change and transformation governance to adapt to climate change, SSH on understanding triggers for behavioural change in adaptation including by engaging the society, effective communication on climate change and climate education and action)

Climate-ecosystem interactions

18. The Terrestrial Carbon Challenge - European coordinated action (potential for a coordinated call with ESA)

International cooperation

19. Climate Adaptation - focus on Africa

20. Placeholder: "EU-China international cooperation on strengthening resilience to climate-related hazards using satellite Earth observation" (R&I China Flagship on Climate Change and biodiversity) [potentially in cluster 6]
21. Placeholder: "Blue carbon" (R&I China Flagship on Climate Change and biodiversity) [depending on the outcome of the discussion with China]
22. Placeholder: "Pathways to carbon neutrality: Improving energy efficiency, focusing on the role of electrification to achieve zero emissions; and Socio-economic consequences of decarbonisation." (R&I China Flagship on Climate Change and biodiversity) [depending on the outcome of the discussion with China]

Where relevant, topics will be coordinated with the European Space Agency calls (ESA) to ensure that ESA scientific and observation assets nurture the future projects.

DRAFT

Destination 2: Cross-sectoral solutions for the climate transition

Draft expected impact (Strategic Plan)

Clean and sustainable transition of the energy and transport sectors towards climate neutrality facilitated by innovative crosscutting solutions.

Addressing main policy issues

All 27 EU member states have pledged to **reduce emissions by at least 55%** compared to 1990 levels by 2030 and to reach **climate neutrality by 2050**. Reaching these ambitious targets requires addressing thematic areas and key solutions for climate, energy and mobility applications on an inter-sectional basis. The Green calls for a strong emphasis on circularity and recycling – in the area of batteries these principles are also highlighted by the Battery Regulation – resulting in specific research needs.

Destination 2 focuses on i) developing the competitiveness, circularity and sustainability of batteries, ii) increasing the efficiency of Europe's cities' and communities' energy, resource use and mobility patterns and overall sustainability and iii) nurturing the development of emerging breakthrough technologies, whilst at the same time more effectively engaging and empowering citizens.

Main expected impacts (WP)

Batteries

1. Increased global competitiveness of the European battery ecosystem through generated knowledge and leading-edge technologies in battery materials, cell design, manufacturing and recycling.
2. Significant contribution to the policy needs of the European Green Deal through new solutions for circularity and recycling of batteries.
3. Accelerated growth of innovative, competitive and sustainable battery manufacturing industry in Europe.
4. Development of sustainable and safe technologies and systems for decarbonisation of transport and stationary applications.
5. Contributing to the strategic independence of Europe through investigation of alternative battery chemistries using non-critical raw materials and efficient recycling technologies.
6. Increasing synergies with other partnerships and initiatives.

Communities and cities

Enable the EU to achieve targets set out by the EU Green Deal and fulfil its commitments related to the UN Agenda 2030 for sustainability, the Urban Agenda for the EU, the Habitat III New Urban Agenda and the Paris Agreement., European cities need to engage in sustainability and climate-neutrality transitions.

Breakthrough Technologies

1. Development of high-risk/high-return technologies that enable a transition to a climate neutral EU economy by 2050.
2. Lowering the technological barriers to deployment of innovative concepts that will enable higher levels of resource efficiency and a greater degree of environmental benefits on a life cycle basis than is provided by current commercial and established technologies.
3. Increasing the rate of innovation of low TRL (0-3) technologies in the areas of greenhouse gas abatement, fuel cells, efficient energy generation, energy distribution, energy storage, or negative greenhouse gas emissions in industry and transport.
4. Increasing the rate of innovation focusing on or supporting the greenhouse gas abatement potential of established technologies beyond energy efficiency measures.
5. Advance the knowledge and scientific proofs of the technological feasibility of concepts that enable greenhouse gases to be directly identified and measured, filtered, separated, concentrated or captured.

Social Sciences and Humanities (SSH), Citizen Engagement

1. A better understanding of the societal implications of the climate transition, including its distributional repercussions.
2. More effective policy interventions, co-created with target constituencies and building on high-quality policy advice.
3. Greater societal support for transition policies and programs, based on greater and more consequential involvement of those most affected.

Preliminary list of R&I needs

Batteries

1. Sustainable processing of battery grade raw materials.
2. Further developments of Li-ion batteries for mobility, including weight reduction and thermal management.
3. Generation 5 batteries for mobility.
4. Non-Li batteries for stationary storage, including flow batteries.
5. Advanced digital twins for battery cell production lines.
6. Novel battery management systems for next generation systems for mobility and stationary use.
7. Battery system design for second life batteries for stationary energy storage.
8. Hybrid battery system solutions for stationary energy storage (grid balancing and grid congestion avoidance).
9. Accelerated testing for battery aging and safety evaluation.

Circularity and recycling of batteries

10. Design to increase circularity and all aspects of sustainability.
11. Creating digital passport or blockchain solutions to track materials, battery footprint, battery performance and life.
12. Scale-up of automated battery dismantling processes including safe deactivation.
13. New recycling feeds and concepts, including direct recycling and recycling of production scrap.

Communities and cities

1. Continuation of the co-funded European Partnership on Driving Urban Transitions (DTU)

The bulk of activities related to communities and cities will be included in the Mission WP under the HE Mission 'Climate neutral and smart cities'.

Breakthrough technologies

1. Bottom up call for emerging breakthrough technologies in transport and/or energy.
2. Breakthrough carbon dioxide removal technologies.
3. Structural batteries for "massless" energy storage.
4. Affordable, high-temperature, corrosion-resistant materials or new alloys for novel energy process system components.
5. Cavitation-based energy generation.

Social Sciences and Humanities (SSH), Citizen Engagement

1. Transformative governance and energy democracy through novel processes, ownership structures and decision-making mechanisms concerning renewables.
2. Financial and organizational structures to support sustainable energy transitions.
3. Socio-ecological effects of a renewables-based energy system on ecosystems, biodiversity, and landscapes.
4. Governance, policy and incentives in shaping current transport and mobility systems and how they can become more sustainable and just for all.
5. Drivers of transport and energy poverty and mitigating strategies.
6. Engagement and trust in relation to digital technologies in energy and mobility.
7. Energy efficiency in relation to everyday practices of energy consumption and production, as well as the implications thereof for people's vulnerability and well-being.

Destination 3: Sustainable, secure and competitive energy supply

Draft expected impact (Strategic Plan)

More efficient, clean, sustainable, secure and competitive energy supply through new solutions for smart grids and energy systems based on more performant renewable energy solutions.

Addressing main policy issues

- Developing energy generation technologies, energy transmission and distribution systems to achieve the **European Green Deal** vision of a fair and prosperous society, with a modern, resource-efficient and competitive economy, with no net emissions of greenhouse gases in 2050 and decoupling economic growth from resource use.
 - Creating an affordable, secure, sustainable and reliable energy system
 - Ensuring a non environmental harming and climate neutral energy system
 - Putting citizen needs at the core of the energy system
 - Enabling a circular economy
 - Making EU a global leader working together with international partners
- On the short to medium efforts are needed to facilitating and accelerating compliance with the legislative requirements of the **Fit-for-55** legislative package, in particular actions will for the revised **Renewable Energy Directive (RED II)** with its a binding target of **40% of primary energy to be derived from renewable sources by 2030**, as well as binding shares of **2.2% advanced biofuels and 2.6% renewable fuels of non-biological origin** in the energy supplied to the EU transport sector.
- In the medium to longer term research and innovation actions are necessary to provide the necessary technologies and knowledge to achieve the **2040 climate neutrality in energy sector**, which is still representing today 75% of EU emission.
- **Digital technologies** can contribute to achieving the Green Deal objectives by integrating renewables in a more efficient way through predictability and flexibility. By making data sharing easier and using larger sets of data, digital tools can optimise the performance of the energy system and individual energy technologies, for example through the development of digital twins that can better model behaviour of assets or systems, or through innovative energy services based on enhanced data availability from multiple sources. This requires though that cyber-security and data privacy are safeguarded, that consumers' trust and engagement are duly considered, and that the energy consumption of the IT equipment itself is sustainable¹.
- Increasing the EU energy security and reliability as well as maintaining and fostering the European global leadership in affordable, secure and sustainable renewable energy technologies (as assessed by the **Report on Progress on the competitiveness of clean energy technologies² and**

¹ Activities related to digitalisation will be defined in synergy with Cluster 4 and will use social sciences and humanities to consider aspects related to citizens' trust and acceptance.

² COM(2021) 95-

the **SET Plan Implementation Plans on renewable energies and renewable fuels**³) depends on a strong EU scientific basis in all sustainable energy and fuel technologies.

- In addition, the following **policy initiatives** have to be taken into consideration: Climate Target Plan, Strategies on Energy Sector Integration, on Hydrogen, and on Offshore Renewables, Fit-for-55 legislative package (including the revisions of the Renewable Energy Directive, the Energy Efficiency Directive and the Energy Performance of Buildings, among others); the upcoming initiatives such as the Action Plan on the Digitalisation of the Energy Sector, the EU Solar Energy Strategy, the European Strategy on International Energy Engagement and the Staff Working Documents on storage and hydrogen; and the new circular economy action plan.
- Increasing impact of EU activities calls for **closer cooperation with national programmes** which will happen especially through the Co-Funded partnership Clean Energy Transition, supporting the SET Plan and boosting impact of the EU investment on clean energy technologies. A revamping of the SET Plan to adjust to the new Green Deal strategic and legislative frame is foreseen for 2022.
- Incorporating and advancing **social sciences and behavioural science** methodologies will accelerate societal transformation and institutional development and thus enable an efficient and just transition in the energy sector.

Main expected impacts (WP)

Renewable energy

1. Availability of disruptive sustainable renewable energy and renewable fuel technologies & systems in order to accelerate the replacement of fossil-based energy technologies to achieve climate neutrality in the energy sector by 2050, without harming biodiversity, environment and natural resources.
2. Reduced cost and improved efficiency of sustainable renewable energy and renewable fuel technologies and their value chains.
3. Support de-risking of sustainable renewable energy and fuel technologies with a view to their commercial exploitation to contribute to the 2030 “Fit for 55” targets (in particular, 40% renewable energy share in the EU energy consumption, 2.2% advanced biofuels and 2.6% renewable fuels of non-biological origin shares in EU fuel consumption).
4. Better integration of sustainable renewable energy and renewable fuel-based solutions in all economic sectors, including through digital technologies.
5. Reinforced European scientific basis and European export potential for renewable energy technologies through international collaborations (e.g., the AU-EU Climate Change and Sustainable Energy partnership, the missions and innovation communities of Mission Innovation 2.0).
6. Enhanced sustainability of renewable energy and renewable fuels value chains, taking fully into account circular economy, social, economic and environmental aspects in line with the European Green Deal priorities.

³ https://setis.ec.europa.eu/implementing-actions/set-plan-documents_en

7. More effective market uptake of sustainable renewable energy and fuel technologies to support their commercialization and provide inputs to policy making.
8. Increased knowledge on the environmental impacts of the different renewable energy technologies along their lifecycle and value chains.

Digitalisation of the energy system

1. Based on easy data-sharing, increased flexibility of the energy system to integrate renewables, and better predictability of return on investments in renewable and energy efficiency investments.
2. Innovative data-driven services for consumers that empower them to engage in the energy transition.
3. Early-adoption of new digital technologies in the energy sector for the benefit of the energy transition.
4. Development of cyber-security and privacy tools and technologies tailor-made for the specific requirements of the energy system.
5. Development of technologies and systemic approaches that optimise energy management of IT technologies.

Energy systems, grids and storage

1. Increased resilience of the energy system, based on improved and/or new technologies, to control the system and maintain system stability under difficult circumstances.
2. Increased flexibility and resilience of the energy system to plan and operate different networks for different energy carriers simultaneously in a coordinated manner that will also contribute to climate neutrality of hard-to-electrify sectors.
3. Enhanced consumer satisfaction and increased system flexibility thanks to enabling consumers to benefit from new energy services and facilitating their investment and engagement in the energy transition, through self-consumption, demand response or joint investments in renewables (either individually or through energy communities or micro-grids).
4. Improved energy storage technologies, in particular (long-term) heat storage but also others such as electrochemical, chemical, mechanical and electrical.
5. Foster the European market for new energy services and business models as well as tested standardised and open interfaces of energy devices through a higher degree of interoperability, increased data availability and easier data exchange among energy companies as well as companies using energy system data.
6. More effective and efficient solutions for transporting off-shore energy thanks to new electricity transmission technologies, in particular using superconducting technologies, power electronics and hybrid Alternate Current – Direct Current grid solutions as well as MT HVDC (Multi Terminal High Voltage Direct Current) solutions.

Carbon capture, utilisation and storage (CCUS)

1. Accelerated rollout of infrastructure , in particular for CCUS hubs and clusters.
2. Continuing knowledge and best practice sharing, in particular on connecting industrial CO2 sources with potential 'bankable storage sites, providing greater confidence for decision makers and investors.
3. Proven feasibility of integrating CO2 capture, CO2 storage and CO2 use in industrial facilities. Demonstrating these technologies at industrial scale shall pave the way for subsequent first-of-a-kind industrial projects.
4. Reduced cost of the CCUS value chain, with CO2 capture being still the most relevant stumbling block for a wider application of CCUS.
5. Adequate frameworks for Measurement, Monitoring and Verification (MMV) for storage projects, to document safe storage and for public acceptance of the technology.
6. In view of achieving the net-zero emission target it is indispensable to further develop DACCS and BECCS as CO2 capture technologies in combination with CO2 storage.

Preliminary list of R&I needs:

Renewable energy

Availability of disruptive sustainable renewable energy and renewable fuel technologies & systems

1. Photovoltaics: Advanced concepts for c-Si technology; low-power energy harvesting PV on alternative substrates (plastic, paper, cloth) for indoor applications.
2. CSP: Next generation thermal energy storage for CSP.
3. Geothermal: Novel approaches for geothermal resource development using AI (robot drilling technologies, fast penetration rate technologies, production and stimulation technologies).
4. Fuels: Next generation advanced biofuel technologies; next generation synthetic renewable fuel technologies.
5. Cross-cutting: Next generation of renewable energy technologies to achieve the 2050 objectives.

Reduce cost, improve efficiency, support de-risking, to accelerate the availability of competitive renewable energy for all economy sectors

6. Wind energy: Short-term energy storage for wind energy; dynamic cable repair solutions.
7. Ocean energy: Test and optimise multi-devices / first array for wave and tidal energy; wave energy converter as wave breakers; tidal/current energy in low/medium current; demonstration of ocean energy devices and pilot farms to increase experience in real sea conditions; near-commercial application of ocean energy in niche markets; innovative operation and maintenance technologies/strategies for long-term operation; improvement of power take-off and control systems; new test rig devices for accelerating ocean energy technology development.
8. Photovoltaics: Low-cost, high-quality silicon feedstock, ingots and wafers; rethinking module design for improved efficiency and energy yield, minimising material use, improved circularity, increased lifetime; novel generation of PV front and back-sheet materials/coatings for recycling/reuse; new inverter technologies with increased power density and reliability; advanced equipment and processing for PV production; floating PV; large area perovskite solar cells and

modules; operation, performance and maintenance of PV systems (smart communication tools and application of machine learning).

9. Hydropower: hydropower equipment for improving techno-economic efficiency and equipment resilience in refurbishment situations; demonstration of hydropower at hidden hydropower opportunities.
10. CSP: retrofitting CSP plants by means of digital tools.
11. Solar thermal: solar thermally-driven cooling and/or refrigeration; industrial manufacturing for compact and standardized systems for solar thermal installations.
12. Geothermal: advanced exploration technologies for geothermal resources in a wide range of geological settings.
13. Fuels: improved intermediate bioenergy carrier technologies; smart concepts of integrated biorefineries for co-production of advanced biofuels, bio-chemicals, biomaterials, bio-heat and bio-power; Improvement of light harvesting and carbon fixation with synthetic biology.

Better integration in all economic sectors, to facilitate the transition towards renewable energy

14. Wind energy: Integrated forecasting of power production and demand for wind energy.
15. Photovoltaics: Transparent (or modular transparency) PV for BIPV and other integrated applications; vehicle system integration concepts, including cell, interconnection and encapsulation technologies; combined solar systems for process heat and power (PV+CSP); planning, plant optimisation tools, advanced installation criteria, construction issues to increase yield and thus economic performance of PV systems in the built environment.
16. Geothermal: Integration of geothermal electricity and heating and cooling in the energy system; innovative applications/integration of geothermal heating in cities and industry.
17. Fuels: Advanced biofuel technologies for aviation and shipping; synthetic renewable fuel technologies for aviation and shipping; microalgae production and purification technologies for advanced aviation and maritime algal biofuels; development of renewable energy technology solutions (wind, solar, biofuels, wave energy) for integration into large vessels; algal biofuels (biodiesel, biogas, and bioethanol), ocean thermal energy conversion (OTEC) and floating photovoltaic installations.

Reinforced European scientific basis and European export potential for renewable energy technologies through international collaborations

18. Cross-cutting: Demonstration action and co-funding action with Africa; support actions with Mission Innovation.

Enhanced sustainability and Increased knowledge on the environmental impacts

19. Wind energy: Development of innovative materials and innovative supply cycles; circularity of turbines.
20. Ocean energy: Application of innovative materials from other sectors; offshore multi-use pilot projects.
21. Photovoltaics: Advanced and novel approaches for metallisation and TCOs, to reduce or replace the use of silver, bismuth and indium; resource efficiency of PV in production, use and disposal (end of life recyclability, ROHS/ecolabel compliance, circularity in PV system design).

22. Hydropower: Demonstration of sustainable hydropower refurbishment.
23. Heat pumps: Circularity and sustainability aspects of heat pumps.
24. Bioenergy: Zero-emission biomass CHP including carbon capture; carbon fixation technologies for biogenic flue gases.
25. Fuels: Sustainable and feasible value chains for gaseous advanced biofuels; intermediate bioenergy carrier production by phytoremediation from polluted lands; defining sustainable and feasible value chains for aviation and maritime fuels.
26. Cross-cutting: Technologies to reduce/mitigate the use of critical raw materials in renewables; comprehensive social and environmental impact analysis of the use of different energy technologies from generation, storage, transmission to end-use.

Facilitating and accelerating compliance with the legislative requirements

27. Photovoltaics: Support BIPV competitiveness (standardization along the value chain); pre-normative research for eco-design and energy labelling measures on photovoltaic products.
28. Fuels: Pre-commercial procurement of aviation and maritime biofuels.
29. Cross-cutting: Market uptake measures to support the commercialization of renewable energy technologies and provide policy support to achieve the 2030 objectives (taking into account activities supported under the LIFE programme); European decarbonisation signature initiatives combining multiple Horizon Europe types of action.
30. Other actions (public procurement): Study on how to mobilize industrial capacity building for advanced biofuels; development of standardisation methods for eco-design and energy labelling of photovoltaic products; development of a recyclability index for photovoltaic products; development of tools and indicators for monitoring the renewables industry ecosystem.

Digitalisation of the energy system

This thematic area is jointly developed with cluster 4. Some of the issues listed below will be elaborated in other parts of the HE work programme.

Green digitalisation of the energy system: supporting the use of user- and energy-centred digital technologies based on enhanced data exchange, data availability and interoperability to develop new digital use cases and services supporting the energy transition, more efficient operation of the grid, renewable production or energy consumption in buildings and industry. Example for R&I needs:

1. Developing innovative infrastructure services, such as data exchange platforms and secured cloud services that are tailor-made for benefit of the energy transition.
2. Cross-sector data-driven services that engage consumers in the energy transition.
3. Accelerating the development and piloting of Artificial Intelligence & Internet of Things edge-cloud solutions for the energy ecosystem to support the green and digital transformation of the energy system.
4. Digital twins of specific parts of the energy system (e.g. of renewable generation assets to reduce operating costs; of buildings to use large data pools to promote renovation; of the electricity network to increase operation efficiency).

5. Develop digital tools to provide better information to energy consumers (household and industrial, for example for more adequate information on the energy consumption, CO₂-emissions) and digital tools to support decision-making based on enhanced data availability.
6. Tools, technologies and systemic solutions to ensure cybersecurity and energy system resilience.
7. Technologies and systemic innovations to enhance sustainable energy use of IT.

Energy systems, grids and storage

1. **Energy sector integration:** Integrating and combining power, heat, gas and other sectors (industry and mobility) to a cost-optimized, flexible energy system of systems with massively integrated RES. Example for R&I needs:
 - Integration of renewable gases other than hydrogen or methane and which have not access to gas grids.
2. **Energy system planning and operation:** Innovative grid planning tools and operation, including digital tools based on Artificial Intelligence-based forecasting systems. Example for R&I needs:
 - System approach for grid planning and upgrade in support of a dominant electric mobility (vehicles and vessels) using AI tools.
3. **Active consumers, Markets and Energy Communities:** Optimal engagement of distributed active consumers and energy communities, including through the use of digital technologies (e.g. blockchain). Example for R&I needs:
 - Controlled electricity demand and provide optimized control at appliance level.
 - Supporting the development of a digital twin of the consumer.
4. **TSO/DSO Flexibility Management:** Distributed Energy Resources (DER) flexibilities for transmission and distribution systems. Example for R&I needs :
 - Supporting the development of a digital twin of the EU Electricity System or the EU energy system.
5. **Electricity system reliability and resilience:** Development of new methods and simulation tools that integrates the impact of additional RES, investigating new grid architectures. Example for R&I needs:
 - Enhanced granularity AI forecasting methods (based on multi-source data and enhanced AI models) for high-share VRE generation.
 - LVDC micro-grid architecture and storage.

Taking into account risks associated to extreme natural events, man-made threats (including cyber-threats) and crisis scenarios. Example for R&I needs:

 - Condition and Health Monitoring in Power Electronics (PE) for offshore wind applications.
6. **Pan-European Transmission of Energy:** Demonstration of extensive hybrid Pan-European AC-DC grid control as well as of offshore grids for transporting off-shore RES energy. Example for R&I needs :
 - Floating offshore MV MT HVDC.

- Development of converter systems for a resilient grid.
- 7. **Storage development and integration:** Development, operation and integration of different forms of storage (chemical, electrical, thermal, mechanical) into innovative (RES intensive) energy systems and grid architectures. Example for R&I needs:
 - Combined generation & storage floating offshore technologies.
 - Development of novel electricity storage technologies.

Carbon capture, utilisation and storage (CCUS)

1. CO₂ transport and storage demo projects, including CCUS hubs; feasibility studies; synergies between projects.
2. CCU for production of fuels, products, mineralisation.
3. BECCS and DACCS for CO₂ removal/negative emissions; water footprint.

Destination 4: Efficient, sustainable and inclusive energy use

Draft expected impact (Strategic Plan)

Efficient and sustainable use of energy, accessible for all is ensured through a clean energy system and a just transition.

Addressing main policy issues

This Destination has at its core the ambition to deliver on the research, innovation and technological developments needs to meet EU climate and energy targets, forward-looking policy implementation and long-term carbon neutrality objective. The Destination contributes as well (e.g. through the topics that support digitalisation and smartness of buildings) to the EU digital agenda. Though biodiversity is not in the focus of this Destination, the multiple impacts of the built environment on biodiversity (e.g. in the scope of renovation) should be considered.

The Destination has a strong policy dimension – it is steered by EU policy action in the energy and climate domains, the European Green Deal overarching policy priority, the Renovation Wave Strategy (for buildings topics) the Industrial Strategy, the Industrial Emissions Directive (for industry topics) and the forward-looking policy measures proposed in the Fit for 55 – Delivering EGD package.

Buildings

The Destination will contribute to putting the EU on track for achieving climate neutrality of its building stock by 2050. It will deliver the solutions that can help increase buildings renovation rates, reduce energy consumptions, improve circularity, and improve users' comfort and well-being, while keeping housing affordable, in line with the objectives of the Renovation Wave and the revised Energy Performance of Buildings Directive. It will contribute to the uptake of digital and smart solutions in buildings, in line with the Action Plan on the digitalisation of the energy sector. The Destination's innovation will contribute to make the sector fit to support the achievement of higher ambition on energy efficiency under Fit for 55. The Destination's topics also embed the key aspects of the New European Bauhaus, on built environment sustainability, inclusivity and aesthetics, and they are consistent with the EU roadmap and policy initiatives on digitalization in the construction sector and on sustainability of buildings (e.g. Level(s)). On climate, one aim will also be to enhance the role of buildings as carbon sinks in the voluntary market for carbon removals, in line with the upcoming Communication on Restoring sustainable carbon cycles and the Proposal for a regulatory framework for carbon removal certification.

The Destination also relies on the Built4People co-programmed partnership's broader action and is complementary to Driving Urban Transitions partnership and to the Mission on Climate Neutral and Smart Cities.

Industry

The Destination will contribute to putting the EU on track for achieving climate neutrality of the industrial sector by 2050, while also reducing other polluting emissions. It will deliver the solutions that can help a faster transition to renewable and low carbon energy sources for thermal energy generation, and a reduction of the energy consumption through waste heat recovery, storage and upgrade for reuse in other processes. These solutions will contribute to reduce GHG and polluting emissions and reinforce the frontrunner and competitive position of the EU industry. They are in line with the research and

innovations areas identified in Implementation Plan of the action of the Strategic Energy Technology (SET) Plan dedicated to 'energy efficiency in industry'.

The bulk of R&I dedicated to industry is covered in the Cluster 4 (Digital, Industry and Space), and in particular by the private public partnership Processes4Planet focussing on process industries. In Cluster 5, this Destination focusses on the management of thermal energy in industry.

Main expected impacts (WP)

Buildings

1. The European buildings and energy sectors are able to effectively support higher EU ambition on energy efficiency and the transition to zero-emission buildings, with a stronger link between innovation in technology and practices, and policy drivers and instruments.
2. Building stocks continue to evolve to combine energy efficiency, renewable energy sources and digital and smart technologies, supporting the transformation of the energy system towards climate neutrality.
3. Buildings constructed and renovated see their performance enhanced across the board (energy, life-cycle emissions, indoor environment quality), with lower environmental impacts, and rates of holistic renovations continue increasing. Buildings are able to adapt to changing user needs for dynamic and more efficient use of building space and they are more resilient to climate change.
4. A higher quality, more affordable and inclusive built environment preserving climate and environment, safeguarding cultural heritage and aesthetics, ensuring better conditions for future ways of living.

Industry

1. Increased energy efficiency in industry and reducing industry's Greenhouse Gas (GHG) and air pollutant emissions through recovery, upgrade and/or conversion of industrial excess (waste) heat and through the integration of renewable or waste energy sources in the generation of industrial heat, cold and power.

Preliminary list of R&I needs

Buildings:

Built4People Partnership:

1. Industrialisation of deep circular renovation workflows, with as-a-service solutions for sustainable, circular renovation.
2. Robotics and other automated solutions for sustainable building construction, renovation, maintenance and repair.
3. BIM-based processes and digital twins for facilitating and optimising circular energy renovation.
4. Design for adaptability, repair, reuse and deconstruction of existing and new buildings, in line with the principles of circular economy and including bio-based materials.
5. Innovative uses of lifecycle data monitoring for the management of building and building portfolios.

6. Solutions for the identification of vulnerable buildings and infrastructure, and for improving their resilience in disruptive events and altered conditions in a changing climate.
7. Demonstrate built-environment decarbonisation pathways through bottom-up technological, social and policy innovation for adaptive integrated sustainable renovation solutions.
8. Fast-tracking and promoting built environment construction and renovation innovation with local value chain.
9. Solutions to foster dynamic and participative design, planning and management for climate-neutral and climate-resilient sustainable buildings and neighbourhoods/urban districts.
10. New design of buildings, infrastructure, multi-modal hubs and public spaces for accessibility and inclusiveness.

Other collaborative R&I:

11. Low-disruptive construction and retrofitting processes for energy-efficient buildings.
12. Innovative cost-efficient solutions for zero-emission buildings.
13. Future-proofing historical buildings for the clean energy transition.
14. Interoperable solutions for positive energy districts, including a better integration of local renewables and local heat exchange.
15. Smart-grid ready buildings.
16. Energy efficiency of high energy demand IT systems in tertiary buildings.
17. Innovative solutions for cost-effective electrification of buildings.

Industry:

1. Alternative heating systems for electrified and efficient heat generation in industry.
2. Waste and renewable heat to cold conversion.
3. Heat/cold recovery & storage.
4. Poly-generation (heat, cold, power) and hybrid plants.
5. Full-scale demonstration of heat upgrade technologies with supply temperature 90 - 160°C.
6. Industrial waste heat-to-power conversion.

Destination 5: Clean and competitive solutions for all transport modes

Draft expected impact (Strategic Plan)

Towards climate-neutral and environmental friendly mobility through clean solutions across all transport modes while increasing global competitiveness of the EU transport sector.

Addressing main policy issues

Transport represents almost a quarter of the EU's greenhouse gas emissions and is the main cause of air pollution in cities. Consequently, EU's **Sustainable and Smart Mobility Strategy** calls for a drastic cut in emissions across all transport modes by 2030, leading to an overall 90% reduction in the transport sector's emissions by 2050. This includes clear targets along the way, such as the operation of 30 million zero-emission vehicles on European roads and the introduction of zero-emission vessels by 2030, as well as large zero-emission aircraft by 2035. The **European Climate Law** further commits to at least -55% reduction in EU greenhouse gas emissions by 2030, leading to climate neutrality by 2050. The **Fit for 55 package** in turn, translates these policy objectives into specific legislative measures, including the Alternative Fuel Infrastructure Regulation and new initiatives on ReFuelEU Aviation and FuelEU Maritime.

In this policy context, Destination 5 supports initiatives that accelerate the uptake and innovation of zero-tailpipe emission technologies in vehicles, as well as the development of interoperable, affordable user-friendly charging infrastructure concepts.

Furthermore, Destination 5 backs projects that accelerate the reduction of emissions in the aviation and waterborne transport sectors, in line with the ReFuelEU Aviation and the FuelEU Maritime Initiatives. The initiatives respectively require fuel suppliers to blend increasing levels of sustainable aviation fuels in jet fuel and set a maximum limit on the greenhouse gas content of energy used by ships.

Both Destination 5 and Destination 6 offer possibilities for synergies to accelerate the green and digital transition. For example, technological demonstration of smart and automated zero-emission fleets for people and goods could help to make European mobility system greener and more efficient by developing user-oriented mobility services and by providing viable alternatives for private vehicle ownership, complementing public transport as the backbone of urban mobility. Such synergies are particularly relevant for the purposes of the EU Mission "100 climate-neutral and smart cities by 2030".

Main expected impacts (WP)

Zero-emission road transport

1. Affordable, user-friendly charging infrastructure concepts and technologies that are easy to deploy with a wide coverage of the road network and include vehicle-grid-interactions.
2. Accelerated uptake of affordable, user-centric solutions for optimised energy efficiency (vehicles and services).
3. Effective design, assessment and deployment of innovative zero-emission solutions for the clean road transport challenge.
4. Innovative demonstrations use cases for the integration of zero tailpipe emission vehicles, and infrastructure concepts for the road mobility of people and goods.

5. Increased user acceptance, improved air quality, a more circular economy and reduction of environmental impacts.

Aviation

1. Disruptive low TRL technologies that have potential to lead to 30% reduction in fuel burn and CO₂, by 2035, between the existing aircraft in service and the next generation, compared to 12-15% in previous replacement cycles (when not explicitly defined, baselines refer to the best available aircraft of the same category with entry into service prior to year 2020).
2. Disruptive low TRL technologies that have potential to enter into service between 2035 and 2050, based on new energy carriers, hybrid-electric architectures, next generation of ultra-high efficient engines and systems, advanced aerostructures that will enable new/optimised aircraft configurations and their cost-competitive industrialization.
3. New technologies for significantly lower local air-pollution and noise.
4. Increased understanding and analysis of mitigation options of aviation's non-CO₂ climate impacts.
5. Accelerated uptake of sustainable aviation fuels in aviation, including the coordination with Member States and private initiatives.
6. Maintain global competitiveness and leadership of the European aeronautics ecosystem. Focus on selected breakthrough manufacturing and repair technologies that have high potential to lower the overall operating cost.
7. Further develop the EU policy-driven planning and assessment framework/toolbox towards a coherent R&I prioritization and timely development of technologies in all three pillars of Horizon Europe. Contribute to the mid-term Horizon Europe impact assessment of aviation research and innovation.

Waterborne transport

1. Increased and early deployment of climate neutral fuels, and significant electrification of shipping, in particular intra-European transport connections.
2. Increased overall energy efficiency and use of renewable energies such as wind to drastically lower fuel consumption of vessels. This is increasingly important considering the likelihood of more expensive alternative fuels, where in some cases the waterborne sector will have to compete with other transport modes.
3. Enable the innovative port infrastructure (bunkering of alternative fuels and provision of electrical power) needed to achieve zero-emission waterborne transport (inland and maritime).
4. Enable clean, climate-neutral, and climate-resilient inland waterway vessels before 2030 helping a significant market take-up and a comprehensive green fleet renewal which will also help modal shift.
5. Strong technological and operational momentum towards achieving climate neutrality and the elimination of all harmful pollution to air and water.
6. Achieve the smart, efficient, secure and safe integration of maritime and inland shipping into logistic chains, facilitated by full digitalisation, automation, resilient and efficient connectivity.
7. Enable safe and efficient fully automated and connected shipping (maritime and inland).

8. Competitive European waterborne industries, supporting employment and reinforcing the position of the European maritime technology sector within global markets. Providing the advanced green and digital technologies which will support European jobs and growth.

Impact of transport on environment and human health

1. The reduction of road vehicle polluting emissions (looking at both regulated, unregulated and emerging ones) from both existing and future automotive fleets in urban areas.
2. The better monitoring of the environmental performance and enforcement of regulation (detection of defeat devices, tampered anti-pollution systems, etc.) of fleets of transport vehicles, be it on road, airports and ports.
3. Substantially understand and provide solutions to reduce the overall environmental impact of transport (e.g.: as regards biodiversity, noise, pollution and waste) on human health and ecosystems.

Preliminary list of R&I needs

Zero-emission road transport

1. Static, smart slow low power charging pervasive solutions and solutions for peak periods.
2. Integration and testing of high voltage electrical powertrains beyond state of the art.
3. User-centric design for energy efficiency of electric vehicles.
4. Advanced battery system integration (BMS, mechanical, thermal).
5. Future zero-emission vehicles for smart mobility systems and services in cities.
6. Frugal zero-emission vehicles concepts for the urban transport challenge.
7. Circular economy approaches for zero emission vehicles.
8. Ultra-high efficiency, high power charging systems technology.
9. Advanced methods and tools for digitalisation along the zero emission vehicle value chain.
10. New designs, shapes, functionalities of light freight transport.

Aviation:

1. Aircraft energy storage and energy conversion technologies for hydrogen and electrified-propulsion that exceed the state-of-the-art.
2. Low weight and low energy aircraft systems, including novel heat dissipation technologies.
3. Advanced joining composite technologies, with emphasis on new designs, high-volume manufacturing with integrated inspection.
4. New advancements in wing aerodynamics and aeroacoustics (with emphasis on interference).
5. Advancements in physical and digital research infrastructures, with emphasis on hydrogen and electrified aircraft.

6. Minimisation of non-CO2 emissions, with emphasis on trajectory optimisation and aircraft drop-in fuel research.
7. Development of new European unmanned aircraft platform for R&I - in the first call emphasis on atmospheric physics measurements in collaboration with space and ground measurements.
8. Impact monitoring of aviation research and innovation with emphasis on the assessment and definition of future EU aviation policies, support the EU position in ICAO and communicate the impact of EU aviation research and relevant policies.
9. Coordination and support actions on European aviation research policy and specific ones on noise, non-CO2 emissions and sustainable aviation fuels and support to EASA.
10. A new approach to communication of the impact and advances of European aviation research.

Waterborne transport:

Zero Emission Waterborne Transport Partnership:

1. Developing the next generation of power conversion technologies for sustainable alternative carbon neutral fuels in waterborne applications.
2. Demonstrating the safe use of new sustainable alternative carbon neutral fuels in waterborne transport.
3. Achieving high voltage, low weight, efficient electric powertrains for sustainable waterborne transport.
4. Combining state of the art emission reduction and efficiency improvement technologies to demonstrate a ship capable of achieving "Fit for 55" objectives within an important waterborne transport application
5. Design, test and demonstrate technologies to minimise underwater noise generated by waterborne transport.
6. Integrated real-time digital solutions to optimise navigation and port calls so as to reduce emissions from ship and port operations.
7. Structuring the Waterborne transport sector, including through changed business and industrial models in order to achieve commercial zero-emission waterborne transport. .
8. Coordinating and supporting the combined activities of member and associated states towards the objectives of the Zero Emission Waterborne Transport partnership so as to increase synergies and impact.
9. Demonstrating efficient fully DC electric grids within waterborne transport for large ship applications.
10. Advanced digitalization and modelling which fully utilizes operational and other data to support zero emission waterborne transport.
11. Developing a flexible offshore supply of zero emission auxiliary power for ships moored or anchored at sea deployable before 2030

Other collaborative R&I:

12. Reducing the environmental impact from shipyards and developing a whole life strategy to measure and minimise the non-operational environmental impacts from shipping and.
13. Developing small, flexible, zero-emission and automated vessels to support shifting cargo from road to sustainable Waterborne Transport

Impact of transport on environment and human health

1. Monitoring of toxic emissions, noise, and vehicle tampering on roads, ports, and airports.
2. Impact of underwater noise and pollutants from transport to the marine environment and subsequently on human health and ecosystems.
3. Assessment of pollutant emissions from deploying sustainable fuels in heavy duty road transport and waterborne.

DRAFT

Destination 6: Safe Resilient Transport and Smart Mobility services for passengers and goods

Draft expected impact (Strategic Plan)

Safe, seamless, smart, inclusive, resilient, climate neutral and sustainable mobility systems for people and goods, thanks to user-centric technologies and services including digital technologies and advanced satellite navigation services.

Addressing main policy issues

EU's **Sustainable and Smart Mobility Strategy** calls for a sustainable, smart, resilient, seamless and multimodal transport system for passengers and goods. This includes a number of clear targets, such as the large-scale deployment of automated mobility by 2030. EU's **Strategic Transport Research and Innovation Agenda (STRIA)** further addresses the multimodal issues in the transport sector, such as in the areas of infrastructure, logistics and network and traffic management.

At the same time, **EU's Road Safety Policy Framework** provides a plan towards **Vision Zero**, aiming for zero serious road injuries and fatalities by 2050.

In this policy context, Destination 6 supports research and innovation actions to accelerate the implementation of connected, cooperative and automated mobility (CCAM) for passengers and goods; to develop efficient multimodal transport systems and enable sustainable and smart logistics; as well as to deliver resilient, green and smart infrastructures, while improving transport safety.

Main expected impacts (WP)

Connected, Cooperative and Automated Mobility (CCAM)

1. Seamless, affordable and user oriented CCAM based solutions for mobility and goods deliveries for all and high public acceptance of these solutions.
2. Validated safety and security, improved robustness and resilience of CCAM technologies and systems.
3. Vehicle technologies and solutions which optimise the on-board and off-board experience in terms of well-being, security and privacy.
4. Comprehensive set of verification, validation and rating procedures of CCAM systems
5. Secure and trustworthy interaction between road users, CCAM and "conventional" vehicles, infrastructure and services to achieve safer and more efficient transport flows (people and goods) and better use of infrastructure capacity.
6. Clear understanding of user needs and societal aspects of CCAM, in particular with regard to ethics and impacts on employment and skills development.
7. European framework for collection and exchange of CCAM data and best practices

Multimodal and sustainable transport systems for passengers and goods

1. Upgraded and resilient physical and digital infrastructures for clean, accessible and affordable multimodal mobility.
2. Sustainable and smart long-haul and regional (including links to urban) freight transport and logistics, through increased efficiency and improved interconnectivity.
3. Reduced external costs (e.g. congestion, traffic jams, emissions, air and noise pollution, road collisions) of passenger mobility and freight transport, as well as optimised system-wide network efficiency and resilience.
4. Enhanced local and/or regional capacity for governance and innovation in passenger mobility and freight transport.

Safety and resilience - per mode and across all transport modes

Safety in Urban Areas/ Road Transport Safety

1. Drastic reduction in serious injuries and fatalities in road crashes by 2030 and establishing a framework to improve traffic safety culture in the EU.
2. Improved reliability and performance of systems that aim to anticipate and minimize safety risks, avoiding risks and collisions, and reducing long term consequences of road crashes.
3. Minimising the effects of disruptive changes on transport safety and improving smart care and rescue measures.
4. Better infrastructure safety on urban and secondary rural roads throughout a combination of adaptable monitoring and maintenance solutions.
5. Ensuring the right level of driver vigilance with new human technology interfaces.

Waterborne Safety and Resilience

6. Comprehensive understanding of the safety risks associated with emerging alternative fuels and energy systems.
7. Digitalization, Internet of Things, and sensors are transforming the ship's systems design; system and system of systems approach to exploit the potential of these technologies in a safe and secure way.

Aviation Safety and Resilience

8. Anticipate emergence of new threats that could generate potential accidents and incidents (short, medium, and long term).
9. Ensure safety through aviation transformation (from green/digital technologies uptake up to independent certification).

Preliminary list of R&I needs

Connected, Cooperative and Automated Mobility (CCAM)

1. Large-scale demonstration of smart and automated zero-emission vehicles for user-oriented mobility services for people and goods.

2. Centralized, reliable, cyber-secure and upgradable electronic control architectures for CCAM using edge computing.
3. User-centric development of vehicle technologies and services to optimise the on-board experience and ensure inclusiveness.
4. Collection and processing of data for a comprehensive set of scenarios (including edge cases) for virtual testing and validation of CCAM.
5. Scenario-based safety assurance of CCAM in a dynamically evolving transport system (including HMI, AI-based systems, connectivity).
6. Digital twins and innovative solutions supporting communication and data exchange for enhancing the readiness of CCAM services.
7. AI for advanced decision making of CCAM systems.
8. Integrate specific user aspects (in particular regional and cultural factors, equality, ethics) in design, development and implementation of CCAM solutions in support of mobility equity.
9. CCAM effects on jobs and education & employment and skills matching CCAM development.
10. Robust European Knowledge Base on CCAM and Framework for cooperation amongst CCAM stakeholders, including an extended CCAM test data space.

Multimodal and sustainable transport systems for passengers and goods:

1. **Climate resilient maritime ports**- Innovative solutions to ensure sea port infrastructure resilience, safe port access and port operations as a means to mitigate disruptions caused by a changing climate.
2. **Improved transport infrastructure performance** – Innovative digital tools and solutions to monitor and improve the management and operation of infrastructure to increase the reliability, safety and sustainability of the network. The use of IoT, edge computing and decentralised artificial intelligence should be explored, in view of its potential to facilitate real-time decision-making, improve security and privacy and save bandwidth and energy.
3. Developing, testing and integrating new indirect **vehicle-assisted data-driven methods for monitoring transport infrastructures** for a more resilient road network
4. Accounting emissions from transport and logistics operations to drive logistics offer, retailers and customers to green choices.
5. Scaling up logistics horizontal collaboration through automated logistics operations.
6. Decarbonising regional logistics (linking long-haul and urban logistics).
7. Optimising multimodal network and traffic management, harnessing data from infrastructures, mobility of passengers and freight transport.

Safety and resilience - per mode and across all transport modes

Safety in Urban Areas/ Road Transport Safety

1. Effects of disruptive changes on transport safety issues.

2. Establishing a framework to improve traffic safety culture in the EU.
3. Road infrastructure safety (in particular for urban and secondary rural networks).
4. New ways of reducing serious injuries and long-term consequences of road crashes.
5. Human-technology interaction: ensuring the right level of driver vigilance.

Waterborne Safety and Resilience

6. Pre Normative Research and risk assessment addressing the safety of emerging alternate fuels and energy systems.
7. Ensuring the safety, resilience and security of waterborne digital systems.

Aviation Safety and Resilience

8. Big data processing and data science for safety intelligence and risk management.
9. Safe introduction, standardisation and certification of new technologies.

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