

For the scientific track

Topics research-oriented

1. Sustainable resources for decarbonising the economy

1.1 Biomass resources and potentials

The topic addresses the assessment, mapping and optimization of biomass resources for a sustainable bioeconomy, covering the availability, accessibility and quality of biomass across diverse regions and timeframes, addressing the technical and strategic aspects of biomass mobilisation and utilisation, synergies and trades-offs.

- Assessments of biomass potentials and land availability considering temporal dynamics at various spatial scales;
- Resource mapping and socio-economic mapping entailing GIS, remote sensing and spatial modelling and analysis tools, spatial modelling and remote sensing;
- Biomass supply: by-products and residues from agriculture and forestry, agro-food waste, agro-industrial feedstocks and side streams;
- Biomass characterisation, innovative harvest methods, storage and logistics optimization;
- Biomass mobilisation strategies and approaches to increase feedstock accessibility and dynamic biomass monitoring systems tracking biomass availability;
- Assessing and managing synergies and trade-offs between biomass uses for energy, materials and food security.

1.2 Sustainable integrated agricultural management practices

The topic explores innovative and integrated agricultural and land management strategies that enable sustainable production of biomass for multiple uses, targeting efficient land use and rural development, while also delivering agro-ecological benefits, enhancing soil health, and supporting climate resilience.

- Innovative agri-forestry systems for biomass production for energy and materials integrated into traditional agri-forestry systems;
- Novel crops, multi-purpose crops, intercropping and alternative cropping systems enhancing biodiversity and land use efficiency;
- Integrated biomass production systems with low-ILUC impact feedstocks, reducing pressure on high-value land;
- Selection and optimization of novel crops on marginal, contaminated and degraded lands;
- Soil health improvement practices, phytoremediation and land rehabilitation solutions including for marginal, degraded and contaminated lands.
- Biomass plantations increasing sustainability and ecosystem services, carbon farming enhancing soil carbon stock and soil emission reduction;
- Advanced tools for sustainable land management - precision agriculture, remote sensing and data platforms supporting decision-making.

1.3 Algae and aquatic biomass production systems

The topic focuses on the development, optimization and integration of algae and other aquatic biomass production systems for energy, fuels, food, feed and high-value bio-based products. It covers both microalgae and macroalgae and the role of aquatic biomass in the circular bioeconomy, carbon capture, and nutrient recycling.

- Identification, strain selection, assessment and genetic optimisation of microalgae and macroalgae strains;
- Technologies and systems for algae cultivation, algae nutrition and resource use efficiency;
- Integration of wastewater treatment into algae systems, nutrients recovery and value-added biomass;
- Algae cultivation systems and marine marine and coastal farming systems for macroalgae;
- Valorization of waste streams from aquaculture, fisheries and marine industries as nutrient sources and bio-based product development;
- Innovations in algae harvesting, drying and pre-processing, extraction of oils, chemicals and high-value compounds;
- Techno-economic analyses and potential markets for algae-based products.

1.4 Municipal and industrial wastes

This topic explores the valorisation of municipal and industrial organic waste streams as sustainable feedstocks for the production of bioenergy, biofuels, and bio-based products. Emphasis is placed on innovative technologies, integrated waste management strategies, and the role of waste in building a circular and climate-resilient bioeconomy.

- Technical and economic potential of Municipal Solid Waste (MSW) as a bioresource for bioenergy, biofuels and bioproducts;
- Availability of biowaste from MSW, quantification and characterization of organic municipal waste;
- Techniques for source separation, mechanical-biological treatment and pre-processing systems;
- Valorisation of pulp and paper waste and various industrial waste streams;
- Treatment and valorisation of sewage sludge, slaughterhouse waste;
- Integrated waste management systems and holistic waste-to-resource systems combining collection, sorting, treatment and valorisation;
- Integration of waste streams into bio-based value chains.

2. Sustainability, impacts, policies and systems analysis

2.1 Sustainability, socio-economic impacts and public acceptance

The topic explores the environmental, social and economic dimensions of biomass applications, with a particular focus on sustainability, equity and public engagement, delivering local socio-economic benefits, supporting just transitions and enhancing societal acceptance of bio-based solutions.

- Sustainability aspects of biomass production and use, responsible sourcing, sustainable land use and ecosystem preservation;
- Voluntary and regulatory frameworks, sustainability schemes, sustainability standards and products certification;
- Socio-economic aspects, benefits and socio-economic opportunities for rural development, regional economic diversification, energy access, etc.;
- Competition between multiple uses, impacts on food security, land use, traditional biomass use, trade-offs and risk mitigation of the increased use of biomass;
- Bioenergy contribution to the Sustainable Development Goals (SDG);
- Strategies to building public trust and community support for bioenergy engaging society and addressing concerns;
- Promoting good practices in sustainable biomass utilisation;
- Social and economic impacts of bio-based materials in housing and construction sectors.

2.2 Environmental impacts

The topic addresses the environmental effects of biomass production and conversion, with a focus on ensuring sustainable practices that safeguard natural resources, biodiversity and ecosystem services, employing the need for robust assessment tools and governance frameworks to balance biomass utilization with environmental protection goals.

- Environmental consequences of biomass cultivation and use, agricultural intensification, water use and land use changes;
- Trade-offs and synergies between different impacts;
- Strategies for biomass production preserving biodiversity, protecting habitats and ecosystem services;
- Land use change impacts, monitoring and addressing indirect land use changes, quantification, modeling and policy approaches;
- Land use and land governance and sustainable land management practices Biomass production and water use, energy, land and water interactions;
- Environmental Life Cycle Assessments to quantify the environmental footprint of biomass pathways;
- Evaluating ecosystem services, biodiversity preservation and other benefits alongside climate mitigation.

2.3 Climate impacts and GHG performance

The topic addresses the climate-related effects of biomass, biofuels, bioenergy and bio-based products, greenhouse gas emission assessments and mitigation potential. It addresses challenges and innovations in quantifying and optimizing the carbon balance within biomass value chains, including land use dynamics and novel carbon management strategies.

- Comprehensive evaluation of the carbon footprint and climate impacts of biomass, biofuels, bioenergy and bio-based products production;
- Assessment of climate change mitigation potential of biomass production and use;
- GHG emissions accounting, Land Use, Land Use Change, and Forestry (LULUCF) and sustainable forest management practices;
- Advanced approaches to quantify and mitigate emissions associated with direct and indirect land use change;
- Assessing carbon storage on land, practices enhancing carbon storage in soils and vegetation including biochar;
- Life cycle assessment methods to quantify and compare the GHG performance of diverse biomass pathways;
- Dynamic modeling and uncertainty analysis incorporation of temporal and spatial variability in GHG assessments.

2.4 Biomass strategies and policies

The topic explores the development, implementation and impact of strategic policies that drive sustainable biomass production and utilization within the broader context of the circular economy and low-carbon transition. It addresses policy frameworks that promote the role of biomass in climate mitigation, rural development and the bioeconomy at regional, national, and international levels.

- Regulatory frameworks and incentive mechanisms promoting sustainable biomass use and resource efficiency in a circular economy;
- Agriculture, forestry and rural development policies integrating biomass use with rural development, promoting sustainable land use and biodiversity conservation;
- Role of biomass and biomass policies addressing climate change mitigation objectives;
- Biomass contribution to a low carbon economy, carbon emissions, LULUCF accounting and integration into emission trading schemes and carbon pricing mechanisms;
- Biomass and rural development, opportunities for biomass-related industries and economic diversification in the sustainable and circular economy;
- Global bioeconomy advancements, international cooperation for a bioeconomy and transnational partnerships;
- Strategies for the integration of bioenergy into a low-carbon economy;
- Strategies for the integration of bio-based products into the chemical industry.

2.5 Overall system analysis, decision making and AI applications

The topic addresses the application of digital technologies, the integration of artificial intelligence, machine learning and digital tools for optimizing biomass systems, including process control, real-time monitoring, advanced modelling, predictive maintenance and smart supply chain management to enhance efficiency, scalability and sustainability.

- Digital technologies for optimizing process operations, including AI and machine learning to monitor, control and optimize processes;
- Advanced sensing, real-time process monitoring, automation and control enhancing system stability, flexibility and system integration;
- Process simulation tools and Computational Fluid Dynamics (CFD) modeling, to optimize reactor designs and predict system behavior;
- Data analytics assessing system performance and optimization and supporting resource-efficient operations;
- Digital twins and predictive maintenance in biomass processing for performance forecasting, predictive maintenance and scenario testing;
- AI-enhanced supply chain management and decision-making tools;
- Comprehensive system assessment and multi-criteria optimization tools.

3. Biomass, bio-based products and bioenergy integration

3.1 Biomass integration into energy systems

The topic explores innovative strategies for integrating biomass into modern, flexible and decarbonized energy systems, technological innovations, system-level integration and policy frameworks that support the broader deployment of bioenergy as part of a sustainable energy transition.

- Innovative solutions for small communities, new concepts for hybrid systems integrating bioenergy and other renewables;
- Integrated bioenergy RES hybrid systems and technologies;
- Bioenergy providing grid services, electricity grid stability, supporting power-to-gas systems, and enabling gas grid flexibility ;
- Bioenergy solutions for rural electrification concepts and off-grid systems;
- Biomass in district heating and cooling, poly-generation energy networks and retrofit solutions to replace fossil fuels;
- Greening the gas grids, production and injection of biomethane, biohydrogen etc. into existing natural gas infrastructure;
- Innovative systems integrating biogenic or air-captured carbon CO₂ in carbon-recycling applications and improved conversion efficiencies.

3.2 Integrated biorefineries for co-production of biofuels, biochemicals and bio-based products

The topic addresses the innovative and integrated biorefinery concepts that aim to maximize the value derived from biomass by producing a wide range of bio-based products, including biofuels, biochemicals, biomaterials and bioenergy. It also includes the integration of biochemical and thermochemical conversion processes in multi-product, multi-purpose biorefinery systems.

- Innovative and integrated biorefinery concepts for biofuels, bio-chemicals and bio-based products;
- Multi-purpose biorefinery schemes optimizing biomass use, enhancing overall efficiency and maximizing the yield of high-value products;
- Co-production of biofuels, biochemicals, bioplastics, biopolymers and energy from biomass etc.;
- Integration of biochemical and thermochemical processes and renewable energy into biorefineries, optimizing processes and biomass use;
- Process design, intensification and system-level integration, maximising performance, efficiency, conversion rates and reliability;
- Assessment tools, process simulation tools and models for evaluating biorefinery performance, feasibility and scalability of different biorefinery configurations;
- Techno-economic assessment addressing cost-effectiveness of multi-product production systems, scalability and business model development.

3.3 Resource efficient bioeconomy

The topic explores the strategies for advancing a resource-efficient bioeconomy, with a focus on maximizing the value of biomass while ensuring sustainability and minimizing resource utilization. It also addresses efficient resource management, the development of sustainable value chains, and the integration of circular economy principles to drive economic growth while protecting natural capital.

- Approaches for efficient management of natural resources (land and water) maintaining ecosystem services;
- Promoting resource efficient value chains enhancing resource recovery, optimizing logistics and tracking resource use;
- Sustainable circular economy and cascading use of biomass enabling the recovery of valuable components at the end of life and closed-loop systems, circularity by design;
- Opportunities of biomass use for food, feed, fuels, bio-based products, competition between different biomass uses and risks of the increased use of biomass;
- Innovation, growth and job creation, new business models that create economic opportunities in agri-industries, bio-based industries and sustainable agriculture;
- Cross-sectorial synergies among the bioeconomy, circular economy and sustainable agriculture targeting multiple sustainability objectives.

3.4 Market implementation, investments & financing

The topic addresses critical factors enabling the market deployment of bioenergy and bio-based technologies, investment strategies and financial mechanisms that drive the transition towards a sustainable bioeconomy, challenges and opportunities to unlock the full potential of biomass resources in competitive markets.

- Initiatives and policies for market uptake and support schemes, carbon pricing, subsidies, grants and regulatory frameworks;
- Initiatives for decarbonisation of the economy and role of bio-based solutions for climate mitigation and circular economy objectives;
- Scale-up and market implementation of new technologies: addressing challenges and barriers to scale-up;
- Economics of bio-based projects, innovative funding instruments, financial models, cost-benefit analyses and risk mitigation strategies;
- Global bioenergy and bio-based products markets, biomass trade, market dynamics, demand drivers, and competitive landscape impacting investment decisions;
- International cooperation, international funding mechanisms, and multi-lateral climate finance facilitating large scale technology implementation;
- De-risking investments through policy and finance instruments and public funding de-risking.

4. Biomass conversion for bioenergy

4.1 Biomass pre-treatment and production of intermediates

This topic explores cutting-edge biomass pretreatment technologies for enhancing the accessibility of biomass for conversion into biofuels, bio-based chemicals and other value-added products. Emphasis is placed on the development of novel pretreatment methods, process optimization and advanced production of intermediates that help bridge the gap between raw biomass and commercial bioenergy applications.

- Biomass pretreatment methods to increase physical and chemical characteristics;
- Physical, chemical and biological methods to enhance biomass digestibility, increase enzyme accessibility and improve conversion into bio-intermediates;
- Innovative pretreatment methods, such as enzyme-assisted pretreatment, supercritical fluids, or electric field-assisted treatments;
- Process development, optimisation and integration of multiple pretreatment steps, real-time monitoring and process control and optimization;
- Integration of pretreatment technologies with downstream conversion processes like fermentation, pyrolysis, or gasification, etc.;
- Characterisation and utilisation of solid fuels and intermediates for use in downstream processes;
- Innovations in biomass logistics and supply chain management targeting supply chain resilience for large-scale industrial applications.

4.2 Advanced biomass combustion

The topic explores the latest advancements in biomass combustion technologies, focusing on the development, optimization, and integration of innovative combustion systems across small, medium, and large-scale applications. It includes process improvements, efficiency gains, emission control and the integration of bio-based applications and bioenergy with carbon capture.

- Innovative concepts for small scale and medium scale combustion, improvements in process efficiency and emissions reduction;
- Large scale advanced combustion systems optimizing fuel flexibility, reducing emissions and improving overall performance;
- Development and optimization of advanced biomass combustion systems, innovations in combustion design and emission control systems;
- Process modelling, monitoring and diagnostics for combustion systems, process simulation tools, real-time monitoring and diagnostic systems;
- High efficiency plants, novel and supercritical and ultra-supercritical thermodynamic cycles improving thermal efficiency and energy output;
- Integration of Bio-based systems with Carbon Capture and Storage (Bio-CCS) enabling negative GHG emissions, system optimization, integration challenges and scaling up;
- Comprehensive evaluation of the techno-economic aspects of Bio-CCS and BECCS, trade-offs and regulatory frameworks.

4.3 Gasification for power, CHP and polygeneration

The topic explores the application of biomass gasification technologies for efficient power generation, Combined Heat and Power (CHP) systems and polygeneration platforms, enabling the simultaneous production of electricity, heat, and/or biofuels.

- Fundamental studies underlying biomass gasification, optimizing feedstock conversion, syngas quality, and energy output;
- Technology development, innovations in gasifier design, advanced process control systems, integration of hybrid systems;
- Process modelling simulating gasification processes, syngas composition and energy output;
- Syngas cleaning and upgrading for efficient syngas conditioning;
- Syngas utilisation in engines, turbines and fuel cells and system integration challenges for efficient power production;
- Valorising gasification by-products through recycling, energy recovery, or conversion into value-added material;
- Integration of gasification with other renewable technologies (e.g., solar or wind) for hybrid power generation.

4.4 Gasification for synthesis gas production

The topic addresses the advances in biomass gasification for efficient and clean synthesis gas production, including fundamental studies on thermochemical processes and gasifier design, innovations in gasification technologies and development of advanced systems. Focus areas include syngas cleaning and upgrading for various energy and chemical applications, process control and monitoring.

- Fundamental studies on gasification, reaction kinetics, feedstock characteristics and gasifier design optimization;
- Technology development, innovations in gasifier configurations and operational strategies to improve cost-effectiveness, reliability and scalability;
- Advanced gasification systems and novel gasification concepts, targeting higher conversion rates and cleaner syngas;
- Syngas cleaning, catalytic reforming and upgrading tailored for downstream applications (BTL, SNG etc.);
- Process control and monitoring systems, real-time monitoring and automation to ensure process stability and optimal operation;
- Techno-economic analysis and scale-up challenges.

4.5 Anaerobic digestion for biogas and biomethane production

The topic addresses the latest innovations and technological advancements in Anaerobic Digestion (AD) for biogas and biomethane production, including process optimization and novel feedstocks to biogas upgrading and integration into renewable energy systems.

- Advances in anaerobic digestion, process improvement and optimisation, enhanced microbial community management, bioaugmentation and process monitoring;
- Advanced plant and fermenter concepts, innovative digestion reactor designs, new modular or multi-stage systems integrating different feedstocks;
- Innovative anaerobic digestion (dry fermentation, thermophilic processes) and innovative feedstocks (straw, waste, algae, etc.) and feedstock pretreatment;
- Optimising conversion, improving design and integrating AD systems with other processes;
- Biogas utilisation and biogas upgrading to biomethane, challenges and solutions related to upgrading efficiency, cost reduction and system scalability;
- Biomethane injection into the grid, purification and gas quality requirements and grid integration;
- Nutrient recovery, organic waste valorization and fertilizer production from digestate.

5. Biomass conversion to intermediate bioenergy carriers and sustainable biofuels

5.1 Pyrolysis

The topic addresses the latest research, technological innovations, and practical applications in the pyrolysis of biomass for the production of valuable liquid bioenergy carriers and co-products, covering all aspects of pyrolysis technology from fundamental science to commercial deployment.

- Production of liquid bioenergy carriers from solid biomass, addressing feedstock flexibility, yield optimization and product quality improvements;
- Fundamental studies and investigations into thermochemical mechanisms, reaction kinetics and pyrolysis product distribution;
- Technology advances, novel reactor designs and process intensification and integration of pyrolysis with other conversion technologies;
- Process modelling, improvement and optimisation, development of predictive models for process parameters, product yields and emissions;
- Bio-oil purification, stabilisation, hydrotreatment and catalytic upgrading and utilisation (combustion, chemical extraction, gasification, etc.);
- Valorisation of by-products and wastewater treatment including detoxification, recycling and resource recovery;
- Comprehensive energy balance and techno-economic analysis Comprehensive assessments of energy inputs and outputs.

5.2 Hydrothermal processing

The topic addresses cutting-edge research and technological advancements in hydrothermal processing of biomass, fundamental insights, process innovations and practical applications of hydrothermal liquefaction (HTL), supercritical water gasification (SCWG) and hydrothermal carbonisation (HTC).

- Advances in hydrothermal liquefaction, supercritical water gasification and hydrothermal carbonisation reactor designs, operating conditions and novel catalysts;
- Process fundamentals and studies on the thermochemical phenomena, hydrothermal reactions, reaction mechanisms and kinetics;
- Technology and process improvement, innovations in process intensification, continuous process operation addressing challenges in process control and scale-up;
- Biocrude production, maximizing yields and quality through improved separation, refining, catalytic upgrading and stabilization;
- Value-added compounds extraction: recovery and characterization of specialty chemicals, nutrients, and bioactive compounds;
- Wastewater and by-product management strategies.
- Holistic assessments of process energy efficiency and techno-economic analyses.

5.3 Biofuels and renewable hydrocarbon biofuels

The topic addresses the development of both conventional and advanced biofuels, focusing on sustainable alternatives to fossil fuels across transport sectors, including road, aviation, and maritime and renewable hydrocarbon biofuels derived from diverse biomass feedstocks through innovative biochemical and thermochemical pathways.

- Conventional and advanced biofuels for road, aviation and maritime sectors;
- Oil-based fuels and renewable hydrocarbon biofuels from lipids and lignocellulosic biomass via thermochemical conversion and biochemical routes;
- Biochemical routes for alcohols, innovations in biomass pretreatment, enzymatic hydrolysis and novel C6 and C5 fermentation techniques, ;
- Biofuels production from algae, advances in conversion technologies;
- Bioprocesses for microbial oils production, development of microorganisms and fermentation strategies for microbial oil production;
- Co-processing biomass feedstock with fossil fuels in common processes;
- Novel catalysts and process intensification techniques for biofuel upgrading;
- Downstream wastewater treatment, recycling and resource recovery;
- Technology and process improvements and optimisation, energy balances and techno-economic analyses.

5.4 Biofuels and synthetic fuels from biomass and hydrogen

The topic addresses the integration of biomass and hydrogen technologies to enable the sustainable production of advanced biofuels and synthetic fuels, including innovative conversion processes and system integration, innovative fuel synthesis routes, carbon recycling strategies, and the coupling of renewable hydrogen with biomass-derived feedstocks.

- Innovative processes for synthetic fuels production from lignocellulosic biomass, advances in thermochemical and biochemical conversion processes;
- Technological innovations and cutting-edge research on Power-to-Gas, Power-to-Liquids, recycled carbon fuels, etc. using CO₂ and hydrogen;
- Hydrogen production pathways involving thermochemical, electrolytic, photolytic and biological processes;
- Electrochemical pathways to produce hydrogen, synthetic fuels and high-value chemicals and intermediates;
- Alternative logistics and infrastructure for hydrogen and alternative fuels, including methanol and synthetic hydrocarbons;
- Hybrid and integrated processes combining hydrogen with biogenic CO₂ for fuel and chemical synthesis, recycling carbon;
- Techno-economic assessments: cost-effectiveness, economic feasibility, market readiness and scalability.

6. Biomass conversion to biomaterials and chemicals

6.1 Processes for bio-based chemicals and high-value compounds

The topic addresses innovative production methods and emerging pathways and advances of bio-based chemicals and high-value organic compounds derived from biomass, novel process development, catalytic and enzymatic synthesis and the integration of biotechnology with chemical conversion. It includes process intensification, process optimization and scale-up strategies aimed at replacing fossil-derived chemicals with sustainable alternatives.

- Development of bio-based chemicals, fine biochemicals (enzymes, additives, ingredients, etc.) and specialty bio-chemicals (catalysts, adhesives, solvents, etc.);
- Emerging catalytic and enzymatic processes with improved efficiency, selectivity and yield;
- Integration of biotechnological and chemical synthesis routes;
- Assessing most promising value chains, processes and concepts for bio-based chemicals;
- Strategies for process intensification and scaling-up for bio-based chemical production;
- Valorization of side-streams, residues, and waste streams for bio-based chemical production
- Perspectives for bio-based chemicals and their contribution to climate neutrality goals.

6.2 Processes for bio-materials, bio-polymers and bioplastics

The topic addresses processes for the production and application of sustainable bio-based materials, including bio-based polymers, bioplastics, biocomposites, biomaterials for housing/buildings etc. It includes nutrient recovery, waste valorization, biodegradability, and end-of-life management.

- Processes for bio-based polymers, bioplastics, biomaterials for housing/buildings, biocomposites, etc.;
- Production of organic fertilizers, biochar, plant biostimulants and compost;
- Nutrient cycles and recovery (nitrogen, phosphorus, potassium);
- Bio-based materials for housing/buildings/infrastructure: bio-composites for insulation, structural panels, natural fiber-reinforced materials etc.;
- Circular bio-economy inputs and waste valorization for materials production;
- End-of-life management, biodegradability and recyclability of bio-based materials in construction and other sectors;
- Perspectives on bio-based materials in achieving circular economy and climate neutrality goals.

6.3 Platforms for bio-based chemicals and polymer

This topic addresses the innovative chemical platforms converted through various chemical, biochemical, or catalytic processes into high-value bio-based products such as bioplastics, biofuels, specialty chemicals, etc. employing emerging technologies and integrated approaches and novel routes, process intensification and strategies to overcome technical and economic bottlenecks.

- Innovative biomass-derived platforms as precursors for high-value products;
- Chemical, biochemical and catalytic conversion of platform chemicals into biofuels, bioplastics, specialty chemicals and biomaterials;
- Lignin valorisation approaches for high-value chemicals, plastics, carbon fibers and functional monomers;
- Conversion of synthesis gas to platform chemicals and fuels, using biological, chemical or catalytic processes;
- Process intensification and optimization to enhancing reaction efficiency, maximizing yield and minimizing energy consumption;
- Technical, biological and economic challenges (feedstock variability, biocatalysis efficiency, product recovery) in bio-based production systems.