

Innovating for a Better Future

Sustainable Chemistry:
A Catalyst for Innovation and Growth in Europe



Sustainable Chemistry: A Catalyst for Innovation and Growth in Europe

The role of chemistry in European society

Chemistry and biotechnology have a clear role in providing technological solutions to the challenges facing society. By building on Europe's strengths, sustainable chemistry can be a major factor in stimulating the European economy by providing new opportunities that will benefit all citizens.

Innovative technologies will be fundamental to Europe's future. For example, nanotechnology and industrial biotechnology will play increasingly significant roles in the chemical and other manufacturing industries. Sustainable chemistry has strong cross-sector importance beyond the chemical industry.

It will be a key contributor to the competitiveness of many of Europe's industries and hence particularly important for economic growth in Europe.

At the same time, sustainable chemistry contributes to the other pillars of the 'Lisbon strategy' by creating a highly-qualified workforce and attractive employment opportunities, and by contributing to sustainable development and the protection of the environment.



Chemistry provides solutions.

SusChem will help make Europe a world-leading innovator.

Sustainable chemistry can stimulate the European economy.

SusChem: Innovating for a better future

The European Technology Platform for Sustainable Chemistry (SusChem), initiated jointly by Cefic and EuropaBio in 2004, foresees a sustainable European chemical and biotech industry with enhanced global competitiveness, providing solutions to critical societal demands and powered by a world-leading technological innovative drive. SusChem aims to define R&D priorities, timeframes and budgets in a number of strategically important issues with high societal relevance.

SusChem's strategic research agenda is in line with major European objectives, including:

- Reducing the impact of energy generation through alternatives and efficiency
- Improving public health
- Providing access to inexpensive, world-class communication systems
- Improving the environment
- Increasing competitiveness
- Enabling a framework conducive to innovation



“New technologies will be fundamental to Europe's future.”

What Europe needs to maintain competitiveness and growth

European research and industry have a leading position in many areas of the innovative (bio)process technologies, materials research, and many of the markets and applications of advanced materials and processes. To sustain and further extend this leadership in global markets, a dedicated European research effort is essential. The European chemical and biotechnology industries are committed to technological progress in these areas and rely on a strong partnership with public research.

Europe needs to be the world leader in chemistry and biotechnology in order to promote industrial growth, to maintain a vibrant economy and to maintain social welfare. To ensure the continued intellectual and entrepreneurial success in chemistry enjoyed by Europe, investment in research and innovation, as well as a business and regulatory framework that promotes innovation, are needed.

Driving Consumer Benefits and Addressing Societal Needs

SusChem will bring about change in consumer products which will provide sustainable solutions to major societal needs such as healthcare and information technology, as well as improve overall consumer experiences.

Integrated healthcare solutions

Increased life expectancy has led to the ageing of the European population. The resulting need for long-term, personalised healthcare solutions needs to be met while reducing the overall cost of pharmaceuticals and medical interventions.

New developments in medical technology and materials will allow for remote monitoring of at-risk patients, coupled with the ability to activate treatment when required. For example, nanosensors will measure medical parameters while active delivery systems, releasing drugs into the body when certain conditions occur, will act as the first line of precautionary medical attention in response to an emergency or stress situation. The "lab on a chip", an integrated microprocessor capable of data analysis, can enable early detection and diagnosis of illnesses or diseases, and combined with the smart delivery system could provide a fully personalised healthcare system supervised remotely by a physician.

Quicker, more reliable diagnostics using new types of biosensors and biochips will allow medicine and medical tests to be less intrusive in patients' lives. Similarly, new patient-friendly agents for imaging technologies will improve disease detection and accelerate intervention. Novel drugs using nanomaterials will allow the formulation of treatments optimised for specific needs, while biopolymers will provide alternative materials for medical uses, such as implants of prostheses, where biocompatibility is crucial.

Advanced pharmaceutical ingredients produced by new processes such as enzymatic ones will allow the creation of novel antibiotics or complex molecules used as antibodies for cancer treatments. By increasing production efficiency, these new processes will help reduce the cost of drugs, making treatments more accessible.

Home-based
healthcare.

SusChem impacts
almost all areas
of society.

Balancing
economics,
environmental
protection and
quality of life.





“The quality of life of European citizens is expected to be enhanced dramatically.”

Information and communications technology

Communication, information and entertainment make up a large part of modern societies' requirements. In order to meet this demand and improve the quality of these products while making them accessible to all audiences, the electronics industry continually seeks new materials to make its components more effective, more durable and cheaper.

As an example, the development of new materials in the field of optical data transfer will be extremely important: non-linear optics materials, responsive optical materials for molecular switches, refractive materials and fibre-optic materials are all a focus for research. Other examples for new materials include flexible and printable electronics, as well as improved portable energy supply and storage.

Controlling and manipulating the structure of surfaces on the molecular scale will be key to the ultimate miniaturisation of electronic devices. On the other side of the size spectrum, new scale-up technologies are needed for the potential of nanomaterials and nanoelectronics to be realised.

Quality of life

The quality of life of European citizens is expected to be enhanced dramatically with the use of new devices enabling greater mobility, more efficient and sustainable transportation, cosmetic preparations which provide better protection from weather conditions, and improved nutrition that increase the stability and bioavailability of vitamins and food ingredients through innovative formulation techniques. Healthier food containing additives such as vitamins or nutraceuticals will be made available at ever cheaper prices by using improved process technologies like fermentation.

Materials will be more durable by incorporating smart coatings with self-cleaning properties. Longer-lasting batteries; smaller and more stable sensors; functional, self-cleaning clothing and prosthetics and implants will all stem from innovation in materials technology.

Energy, Transportation, Environment

The world's total consumption of energy originates mostly from oil and coal. As our energy requirements double – or even triple – over the next few decades, important challenges are emerging in the development of new technologies.

Limited fossil resources, continued world population growth and increasing pressures to ensure sustainability are driving research trends. Alternative energy and fuels generation, effective energy transmission and distribution, high capacity energy storage and efficient energy management are all areas in which SusChem will bring viable solutions.

The energy-generating home: Smart materials and energy management

While most houses still rely on traditional, non-renewable means for their energy requirements, technological advances and resource management techniques have made it possible to cut energy consumption by up to 90% today. In the near future, innovations will make it possible for a home to generate enough energy to meet and even exceed its daily requirements and therefore eventually contribute to increasing a power grid's overall resources.

Transportation

The mobility of citizens and transportation of goods in a growing European Union requires new, more efficient transportation systems. For the preservation of natural resources, quality of life and the environment, new material concepts and fossil fuel free vehicles have to be developed.

New lightweight construction materials will greatly enhance the efficiency and environmental sustainability of surface and air transport.

“Innovation will make it possible for a home to generate enough energy to meet and even exceed its daily requirements.”

Ground-breaking technologies and smart materials make this vision possible by reducing heat loss, improving energy efficiency and absorbing and transforming energy into electricity.

Nanostructured materials have the potential to revolutionise the insulation technology sector. Nanofoams have a significant advantage over current foams in that they have a lower thermal conductivity even at reduced thickness. This leads to significant savings in energy, by making applications such as refrigerators or housing insulation more efficient.

Biofuels are the focus of growing interest for transportation. Bioethanol and biodiesel are beginning to have a significant impact on fuel mixes in some countries, since they can be combined with conventional fuels in standard engines without modification while reducing CO₂ emissions.

In the future, fuel cells will assure the mobility of vehicles and electrical devices. One of the largest hurdles encountered in the development and production of fuel cells is their relatively low efficiency due to the insufficient performance of the membranes used to selectively transport protons between segments of the cell. With sustainable chemistry, membranes that can efficiently promote this process can be developed through the application of nano- or biotechnology.

Cleaner industrial processes

Next-generation conventional and biological catalysts will contribute to achieving zero emissions in industrial processes. They also enable the development of new catalytic transformations, new clean energy sources and chemical storage methods, utilisation of renewable raw materials, innovative processes, energy management and re-use of wastes, therefore addressing many of the global environmental issues.

Other examples for innovations in industrial processes are new materials with useful conducting and superconducting properties (which provide practical systems for the transmission of large electrical currents over long distances without energy losses) and cheaper synthetic processes using innovative energy sources such as microwaves or plasma, new solvents and agents and new reactor concepts (to provide energy-efficient and waste-free routes for a wide range of target molecules).

Catalysis and process intensification efficiently harness energy resources

The demand for natural gas will continue to increase over the next twenty years, making efficient production and processing of natural gas essential. Large amounts of natural gas are usually lost as it is burned or released in the atmosphere during the production of oil and gas. In this context, catalysis is a key technology enabling gas to liquid conversion, thereby providing efficient solutions to harness this “excess” gas.

With oil prices steadily climbing, alternative feedstock such as renewable raw materials, gas and coal in industrial processes could become very attractive. Short-term targets focus on the use of methane or biogas, but longer-term research should consider energy-efficient and clean technologies for making use of other resources in chemical production.

Biorefineries: Chemicals and energy from biological material and processes

Biorefineries can provide ecologically smart solutions to transform crop or biomass into intermediates and products for use in society. Improving on current biomass conversion techniques, these new refineries will use standard feedstock and, in the long term, raw biomass and organic waste for production.

Integrated and diversified biorefineries aim at developing the most adequate and efficient bioprocesses based on different types of raw materials to produce a wide range of bulk and fine chemicals. They will exploit all elements of biomass, reusing all secondary products and by-products of the reaction by either further processing them or by integrating them in the process as input or energy. These refineries would therefore produce little if any waste or emissions, significantly minimising pollution from industrial processes.



Challenges, Issues and Requirements

Political, social and structural reforms are necessary to give Europe the required boost to maintain its edge within the increasingly global world of innovation. Citizens of the EU will benefit from the development and use of innovations. In particular, new technologies will lead to wealth and job creation within the EU.

Competitiveness in Europe

The current leading position of the EU in chemical manufacturing is slowly eroding because of dynamic development in Asia. Further investment in chemicals is not particularly favourable in Europe because of low returns on investment due to relatively high production costs, high cost of meeting regulation requirements, a changing regional balance in manufacturing, and the absence of good feedstock. The EU needs innovative leadership to reduce or even reverse this trend and to beat international competition.

The SusChem Strategic Research Agenda is an ambitious plan that will require significant funding and a high level of commitment from both public bodies and private enterprises in order to be successfully implemented. Different funding sources including EU framework programmes, national and regional initiatives as well as private sector spending need to be accessed. The estimated resources needed amount to approximately €5.5 billion per year. According to the Barcelona Summit, one third of this funding should come from public sources. SusChem thus requires €1.8 billion per year in EU and Member States funding.

Europe needs innovative leadership.

Improving the competitive environment.

EU lags behind in research funding.



Public dialogue

The successful introduction of new technologies is dependent on an effective public dialogue on its benefits, risks and costs.

Political dialogue and the resulting media attention often focus on the negative aspects of the debate. There is a need to establish an optimal socio-political balance between the benefits of emerging technologies and the level of acceptable risk to society, taking into account societal concerns regarding risks, as well as societal perspectives on desirable benefits. SusChem aims to help provide this balanced perspective.

One of the key challenges in communicating the benefits and risks associated with novel technologies will be to manage the consistency and direction of messages about these technologies.

Regulatory support framework

There is a great need for supportive political and fiscal measures to create an environment conducive to innovation and the adoption of innovative technologies in Europe. Specifically, the exploitation and protection of Intellectual Property rights; increasing public and private subsidies and support for R&D; and refining knowledge and technology transfer mechanisms are some of the important issues to address in the European regulatory framework.

In addition, increasing access to venture capital and other loans for start-up companies as well as developing mechanisms to facilitate access to the output of collaborative R&D to SMEs are major challenges to resolve.

In order to facilitate the introduction of new products onto the EU market it will also be important to contribute to a more joined-up strategy with respect to EU-wide regulatory processes on health and safety. The establishment of an Integrated Decision Support Framework for regulatory health, safety and environment (HSE) assessment of SusChem products and processes will assist in developing targeted intelligent risk assessment and management strategies.



“There is a need for supportive measures for innovation in Europe.”

Education, skills and capacity building

Creating knowledge and leveraging knowledge and innovation for growth is at the heart of the European effort to reinvigorate the Lisbon Agenda. Europe's knowledge, diversity and creativity are the key factors for creating a competitive advantage.

However, Europe is witnessing a sharp decline in the number of students graduating in chemistry and chemical engineering. To reverse this, education systems are required that present chemical sciences and technologies as an essential and relevant part of modern society.

The image of chemistry is an important factor in attracting potential students; explicit attention to sustainable chemistry and engineering in secondary and tertiary education could contribute positively to engaging the minds of the next generation.

Industry must also clearly communicate and commit to its longer-term needs and requirements. The availability of a skilled labour force is essential to the long-term viability and innovative capacity of the European chemical industry. The challenging target of ensuring the highest possible standard of skills at all levels of the chemical industry and research necessary to support society's economic, ecological and social needs requires many different kinds of actions (short-term steps as well as long-term and long-lasting input and activity) from SusChem stakeholders.

"The availability of a skilled labour force is essential."



Working Together to Improve Innovation

To achieve its full potential in support of common European goals, the European Technology Platform for Sustainable Chemistry needs involvement from stakeholders in a wide range of industrial, academic, political and public organisations. The Platform also cooperates with many other European Technology Platforms to achieve common goals. Involvement in the SusChem process is open to all. During the implementation stage increasing involvement in the four SusChem working groups is more critical than ever. If you would like to contribute please get in contact with us.

There are many ways that individuals and organisations can become involved in platform activities:

- Feedback: Comments on the working documents are welcome from all stakeholders and should be sent to the SusChem secretariat.
- Communication: Stakeholders are encouraged to circulate information on Technology Platform activities to other parties that may be interested in participation or feedback.
- Participation: Participation in stakeholder workshops and other events is encouraged. Suggestions for proposals or initiatives that will contribute to or complement the activities of the platform as a whole and/ or individual working group objectives are welcome.

For more information about our activities, visit www.suschem.org

To contact one of the working groups, write to:

- Materials Technology materials@suschem.org
- Reaction & Process Design rpd@suschem.org
- Industrial Biotechnology biotech@suschem.org
- Horizontal Issues Group horizontal@suschem.org



For more information about our activities, visit **www.suschem.org**

To contact one of the working groups, write to:

Materials Technology	materials@suschem.org
Reaction & Process Design	rpds@suschem.org
Industrial Biotechnology	biotech@suschem.org
Horizontal Issues Group	horizontal@suschem.org

General information: suschem@suschem.org



European
Commission

The European Technology Platform for Sustainable Chemistry is supported by the Sixth Framework Programme of the European Community for Research.

<http://cordis.europa.eu.int/>