

International Hellenic University

MSc in Bioeconomy Law, Regulation and Management

**Bioeconomy Platforms - European Technology Platform for
Sustainable Chemistry**

Coursework

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Profile of the Platform

SusChem is the European Technology Platform for Sustainable Chemistry. It is a forum that brings together industry, academia, policy makers and the wider society. It was officially launched in 2004 as a European Commission supported initiative to invigorate and motivate European chemistry and industrial biotechnology research, development and innovation in a sustainable approach. SusChem was founded by six European bodies representing the main stakeholders from academia and industry in the chemical sciences sector. The six founding partners were:

- i. Cefic – European Chemical Industry Council
- ii. DECHEMA – German Society for Chemical Engineering and Biotechnology
- iii. ESAB – European Federation of Biotechnology Section of Applied Biocatalysis
- iv. EuropaBio – the European Association for Bioindustries
- v. GDCh – the German Chemical Society
- vi. RSC – Royal Society of Chemistry (UK)

The primary guiding principle of SusChem is a sustainable low-carbon economy in Europe that can avert or adapt to the impacts of major climate change and support a dynamic innovation and industrial eco-system.

To prepare this transition, the European Commission proposes that by 2050, the EU should have cut its greenhouse gas emissions by at least 80% compared to 1990 levels. The development and deployment of clean sustainable technologies will be an important part in attaining this objective.

In a globalised market, industrial competitiveness is crucial to drive inclusive economic growth and jobs, especially for small and medium-sized companies (SMEs). European businesses, small and large, must be able to compete in domestic and global markets. With the support of the European Union and member states, they can aim for that while also working towards a sustainable low-carbon economy.

Members

SusChem membership is open to everyone that is interested in SusChem activities, is active in sustainable chemistry, or engaged with SusChem in any way.

Vision and Policy

The vision of the Platform is aiming towards a competitive and innovative Europe where sustainable chemistry and biotechnology jointly supply solutions for future generations. In partnership with European and national public authorities, SusChem contributes to initiatives that aim to provide sustainable solutions to society's big challenges. It develops and leads large-scale, integrated research and innovation programs with chemical sciences at their core. These public private initiatives link research and partners along the value chain to real world markets through accelerated innovations.

The SusChem Strategic Innovation and Research Agenda (SIRA) formulates the platform's priorities in line with those of Horizon 2020 to catalyse the achievement of Europe 2020 objectives through sustainable chemistry and biotechnology. The SIRA also supports the objectives of the new European Commission to boost jobs, growth and investment, create a resilient and sustainable Energy Union and strengthen the European industrial base.

SusChem depends vitally on the partnerships with member states to provide information on national strategies and priorities. The national platforms work on initiatives within their own countries and also in joint NTP initiatives through the network organization.

All of the policies of SusChem are linked with societal challenges and many of the UN sustainability goals.

There are five main policy directions to help build a low-carbon economy:

Competitiveness is one of the aims of SusChem. The European Commission places great emphasis on competitiveness, given its significance in creating jobs and growth in Europe. This incorporates ensuring that businesses benefit from simplified public administration and a broadly, business-friendly environment, can access markets, gain from good infrastructure and the resources they need, including finance, raw materials, energy and properly skilled labor force. European businesses, on the other hand, must be at the head of research and innovation, produce goods in a sustainable method, and invest in the future.

Competitive chemistry

20% of the annual GDP of the European Union comes from the direct and indirect contributions of the chemical industry. Chemicals contribute significantly to wealth creation in many business chains, from pharmaceuticals to crop protection, transport and construction, textiles and consumer goods.

Circular Economy

The European Commission's Circular Economy Package objective is to help European businesses and consumers to have a stronger circular, low-carbon economy where resources are treated in a more sustainable way. Product's lifecycle in a circular economy is connected with recycling and reuse. Benefits for the environment and the economy derive from the utmost use of all raw materials, products and waste with a simultaneously mitigation of greenhouse gas emissions. A sustainable circular economy requires advanced processing technologies that will help us use existing resources more efficiently. Moreover, new regulations, services and business models are important for establishing stable policy framework.

Chemistry helps optimize the use of raw materials by enabling enhanced recycling options, and improve the overall efficiency of production processes. Furthermore, the chemical industry is the key to a successful sustainable circular economy with jobs, growth and competitiveness. The European Union's Energy Union strategy aims to diversify sources while maintaining security of supply in an integrated market. It also means transitioning towards a low-carbon economy based on world-class European renewable energy technologies.

Digital single markets Developments like the Internet of Things (IoT), robotics and cloud computing are transforming products, processes and business models in all sectors by improving resource, energy and economic efficiency and creating new global value chains.

- Digital competitiveness

In 2015 the European Commission initiated its Digital Single Market (DSM) strategy to assist European competitive. Digital industry and the integration of digital innovations in all sectors

maximize growth prospective. Digital innovations are in addition a solution to maximize energy efficiency and building sustainable health systems.

- Connected chemistry

The concept of the connected factory using advanced integrated remote sensing and intelligent analysis will require employees with different skill sets including an appropriate combination of basic, soft and new technical skills. These kinds of skills are the aim of SusChem's Educate to Innovate programme.

Bioeconomy

The Bioeconomy policy refers to the production of sustainable biological resource and their conversion into value-added products such as food, feed, biobased products and bioenergy. An advanced European Bioeconomy must be implemented in order to achieve smart and green growth in Europe, but also a low-carbon economy. Sustainable production of biomass faces the challenge of depletion of vital plant nutrients in soils. There is a need for new and improved technologies for recovering and recycling these essential biological elements: phosphorus is the main challenge but other vital elements such as nitrogen and potassium should also be considered. To secure more sustainable harvests of Europe's major crops (cereals, potato, sugar beet, oilseed rape and vegetables) environmentally safe chemical compounds and formulations have to be developed as the basis for the provision of pesticides and growth enhancers.

- Boosting biomass

Exploiting sustainable carbon resources, such as biomass and CO₂ will enable production of more sustainable chemicals and materials with lower net CO₂ emissions. This shift will result in reduced utilisation of fossil resources, and take industry a step closer to a true circular economy.

Technologies

Technologies can be categorized into three inter connected areas: Advanced Materials; Process; and Digital.

1. Advanced Materials

Sustainable chemistry research and innovation will reinforce the position of Europe in low carbon energy production and storage technologies. Europe imports more than 90% of its crude oil; more than 95% of Rare Earth elements (REE) are produced in China; and platinum group metal (PGM) deposits are outside Europe. The chemical industry aims to reduce its dependence on petroleum and natural gas feedstock and to address a future scarcity of some raw materials.

2. Process

Raw materials can be transformed into value-added products. In a carbon-constrained future the need for highly sustainable processes will become even more crucial and chemical industry will provide solutions in these processes.

Innovations from the European chemical sector will augment the energy and resource efficiency of a wide range of processes, while reducing environmental impact and improving competitiveness. Sustainability is essential to the whole process and to the product life-cycle, in particular in the context of a circular economy. CONSENS Project is part of the process technology on integrated sensing, process control and online monitoring that will help close the technology gaps in a new flexible plant paradigm in order to replace traditional batch processes in chemical manufacturing.

Process is highly connected to the following technology called “Digital”.

3. Digital

Digital technology is an important, disruptive technology area for the chemical industry, which impacts all parts of value chains from logistics to modeling, product and process design, control, monitoring and repair.

Smart materials developed by the chemical industry enable new and higher performing ICT developments in printable-, wearable- and nano-electronics as well as in additive manufacturing and 3D printing techniques. Additive manufacturing makes the manufacturing of new electronic (and other) devices more sustainable by preventing material losses and waste generation.

4. Materials from transport

Sustainable chemistry provides components for safer and less polluting modes of transport, making mobility systems more sustainable. The development of advanced and sustainable alternative fuels will mitigate the environmental pollution. All vehicles can be more resource efficient if they are made from high-performance but lighter weight materials. The chemical industry is working on different ideas such as tires that have reduced rolling resistance for higher fuel efficiency.

5. Catalysis

Catalysis is, perhaps, the single most important and pervasive interdisciplinary technology in the chemical industry, and certainly one of the areas with the largest societal impact. Catalysts ensure that raw materials and energy are used efficiently in the production of a range of large scale industrial and specialty chemicals, plastics and fuels.

The development of new catalytic processes based on new more effective catalysts and biocatalysts can transform manufacturing processes. They can help decrease process temperatures and boost energy efficiency, while reducing cost and increasing competitiveness.

Innovative catalysis have applications on new raw materials and feedstocks, new industrial biotechnology processes, waste reduction and recovery, enhanced energy storage technologies, providing alternative fuels for transport and in nano-structured materials.

SusChem’s priorities in this area include catalysts for the conversion of CO₂ to chemical building blocks or fuels; catalysts to directly produce renewable hydrogen from sunlight

(photo-catalysis); new catalytic technologies to enable recycling of plastic waste; more robust and versatile catalytic systems for processing variable feedstock; new catalytic systems allowing softer reaction conditions (for example lower pressure and/or temperature); new insights into fundamental reaction steps and the kinetic parameters of catalysis; high throughput experimentation methods in catalyst development; and computational modeling methods for rational development of catalytic materials.

6. Big Data

The chemical industry of the future will be awash with data, from process sensor inputs to product and raw material analysis, marketing and sales and much more. The transformation of 'Big Data' into lean and useful information is a important challenge for all industry sectors. These data will be analyzed based on statistical mathematical models and machines using tools to detect process or product abnormalities, to make predictions, to optimize and increase

knowledge of both production and commercial processes

7. Materials for Health and well being

Good quality healthcare is essential to a sustainable society, so the chemical industry continues to develop pharmaceutical and other innovative healthcare products.

SusChem is focusing on three topics complementing other European initiatives such as the Innovative Medicines Initiative (IMI). The first one is the development of improved contrast agents and novel molecular probes for a range of medical imaging technologies, which can improve diagnosis and outcome for patients.

8. Process Control

Process control and supervision of operations, from regulatory control to manufacturing planning and optimization, can improve standards and optimize the use of resources.

In-line sensing and measurement technologies are being developed to deliver massive amounts of data on process conditions and chemical compositions, in a fast, reliable and cost-effective way.

9. Digital Platforms

These platforms consist of hardware infrastructures with software services for which interoperability with other systems is well defined. Moreover, Cloud-based data platforms and standards to foster industrial cooperation will match the demand for and supply of resources (waste, energy, water etc.) between plants, industrial sites and different industries to enable the circular economy.

10. Materials for consumer goods

Increasing the sustainability of consumer goods requires developments in materials that support recycling and reuse but also the reduction of material and energy use.

11. Process Identification

Process intensification applies innovative design principles to boost process and value chain efficiency, reduce waste and costs, while improving quality and safety.

F3 factory project conducted by SusChem demonstrates the advantages of operating modular continuous plant processes that are more economical and sustainable than current operations and are only possible due to new types of equipment design, advanced digital process control and online process analytics.

12. Digital Skills

The chemical sector has an increasing need for a workforce able to rapidly learn and adapt to the use of digital technology as the central source for process optimization, control, smart data applications and plant maintenance.

13. Materials for energy efficiency

Sustainable chemistry is essential in energy efficiency in all types of buildings, from construction to renovation projects. For the sustainable development of modern housing and offices and to enable the renovation of existing buildings integrated solutions are important.

Energy efficient solutions for buildings include advanced materials such as thermal insulation foams and panels for both internal and external application, coatings that either reflect heat or light, phase change materials that can provide thermal inertia/ storage for buildings and help temperature control, and highly energy efficient lighting such as Organic Light-emitting Diodes (OLED). The industry is also investigating materials that enable the integration of photovoltaic panels in buildings, materials that enable light weight structures and the integration of renewable and biobased materials in construction products.

14. Downstream Processing

Sustainable processes must increasingly embrace renewable, often biobased, feedstock, which creates new challenges for downstream-processing.

One such challenge is the recovery and purification of products derived from biotechnological and/or hybrid biotechnological-chemical processing, like fermentation broths. Another is the targeted recycling of valuable components in waste streams and the appropriate treatment, minimization and disposal of any residual waste generated. In particular, the industry is focused on improving water treatment technologies, overall water efficiency and associated energy efficiencies. Water is used in a range of processing functions and the industry aims for near zero discharge using closed loop systems to reuse water repeatedly.

Initiatives

Academia and industry across Europe are participating in SusChem to provide a strong agenda and to merge research, development and innovation actors.

SusChem provides an open and collaborative space for a vibrant community of European researchers and innovators to formulate and implement ideas that address major societal challenges.

PPPs: The European Commission has facilitated the establishment of a number of Public Private Partnerships (PPPs) to accelerate research and innovation in key industrial sectors. The PPPs:

- i. Provide a legal structure to pool resources and to gather critical mass in the chosen sectors
- ii. Enable the scale of research and innovation effort needed to address critical societal challenges and major EU policy objectives
- iii. Enable innovative technologies to get to market faster
- iv. Improve the efficiency of research and innovation funding across the EU by sharing financial, human and infrastructure resources
- v. Facilitate the creation of an internal market for innovative products and services
- vi. Provide an appropriate framework for international companies to anchor their research and innovation investments in Europe

SusChem and the PPPs

As an industry-led stakeholder organization, SusChem supported the establishment and implementation of the PPPs. The platform communicates with various PPPs, giving inputs to help shape their work programs and their discussions with the European Commission.

SusChem has particularly close ties with two PPPs: the ‘Sustainable Process Industry through Resource and Energy Efficiency’ (SPIRE) PPP and the Biobased Industries Joint Initiative (BBI JU). SPIRE is a contractual Public-Private Partnership dedicated to innovation in resource and energy efficiency and enabled by the process industries, including the chemical sector. The BioBased Industries Joint Undertaking (BBI JU) is a public-private partnership which operates under Horizon 2020, it is driven by the Vision and Strategic Innovation and Research Agenda (SIRA) developed by the industry and is a major public and private effort representing a combined €3.7 billion investment in biobased innovation from 2014-2020. SusChem coordinates certain aspects of their work programs and adds value to European research and innovation outcomes in areas of common interest.

NTPS: SusChem National Technology Platforms (NTPs) help to connect SusChem thinking with national and regional programs. It also facilitates transnational collaboration and advice SusChem at the European level on collective national priorities that need to be considered in European initiatives.

SusChem NTPs are the mean to the involvement of national stakeholders including small and medium-sized enterprises (SMEs), large companies and academic groups, in European initiatives. The SusChem network, formed by the European and the National Technology Platforms, aims to benefit from on the synergies of its members.

Currently there are 14 National Technology Platforms in Greece, Belgium, Czech Republic, Germany, Spain, France, Switzerland, Austria, Italy, Romania, Netherlands, Poland, United Kingdom and Slovenia.

The SusChem Greece Secretariat is run by the IPSEN unit of the National Technical University of Athens.

Working Groups

SusChem convenes working groups, expert workshops and ad-hoc stakeholder discussions on specific elements of the SusChem strategy and its research and innovation agenda as required by its work programme and directed by the SusChem board.

Together with discussions at the Annual SusChem Stakeholder event these inputs form the heart of SusChem's collaborative way of operating and how its research and innovation agenda is formulated and updated.

Today SusChem's Working Groups support the current innovation priorities:

- Catalysis
- Information and Communication Technologies (ICT)
- Materials for Energy
- Sustainable Bioeconomy
- WaterAgro / industrial, Marine and Environmental Biotechnology

Grant-it

SusChem and Cefic members can use GRANT-IT resources to search for funding, identify project opportunities, and propose project ideas and search for potential project partners.

Educate to innovate

The "Educate to Innovate" programme is part of SusChem's strategy to facilitate a continuing, constructive dialogue and create synergies between the chemical industry and higher education (HE). In addition, SusChem is developing a good practice innovation skills database. This online resource will assemble case studies of EU industry-university collaborations on course work, internships and industrial placements.

Suggestions/ criticism

Europe is at present at the top in chemicals production and chemistry research. Chemical industry provides revenues, exports and employment. However, the industry's competitiveness is at danger due to cost competition from countries outside Europe, low market growth, and migration of customer industries (2). It is critical to improve both innovation and sustainability to maximize future competitiveness and preservation of a sustainable chemical community both industrial and academic. Chemistry research investments should act as a major foundation of innovation. However, EU chemical research and development expenditures are lower than in competing regions of the world like the US and China.

SusChem can help manage European, national and regional initiatives, collaborating with member states, related technology platforms and other organisations. Moreover, the initiatives adopted will attribute to consolidate different chemistry disciplines and other molecular sciences, technologies and engineering.

On the other hand, for the chemical industry, the transition to carbon neutrality will entail enormous challenges, some of which are usually not under control of the chemical industry. The transition will require access to abundant and cheap carbon-neutral energy. The chemical sector then would probably demand the output of this additional 100% capacity extension. Feedstocks, including biomass and process gases such as CO₂ and CO need to be available at low prices, competitive if not lower than fossil feedstocks in the long term. Very large investments are required and major changes in the current assets are foreseen. This is related to high feedstock cost (in the case of biomass) and high cost of electricity (in the case of hydrogen based processes). In order to achieve the EU's 2050 objectives, an ambitious R&I program will be essential to improve the potential of required advanced technologies, and public-private partnership efforts will be significant to allow fast deployment and risk sharing for the investments needed. In addition, industrial symbiosis opportunities and sustainable materials recycling options should be further explored in order to improve energy and resource efficiency beyond sector boundaries (5). Besides technological challenges, the legal framework for a circular economy governing transport and reuse of waste will need to be adjusted to allow an actually sustainable future.

References

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