Meeting the Challenges of Europe 2020

An Enhanced Strategy for SusChem

1. Context

The European Technology Platform for Sustainable Chemistry (*SusChem*[1]) is a forum that brings together industry, academia, governmental policy groups and the wider society. Its mission is to initiate and inspire European chemical and biochemical innovation to respond effectively to society's challenges by providing sustainable solutions. *SusChem*'s vision is a competitive and innovative Europe where sustainable chemistry provides solutions for future generations. *SusChem* was launched in 2004 as one of the first European Technology Platforms (ETPs) to coordinate and improve industrial and academic engagement with relevant European Commission research initiatives. In particular *SusChem* has managed to have *SusChem* relevant priorities incorporated into the Commission's Seventh Research Framework Programme (FP7), and has obtained substantial strategic funding for new sustainable chemistry and biotechnology research projects over the past five years. The funding programmes were inspired by recommendations made to the European Commission from *SusChem* in its Implementation Action Plan[2], and especially in the thematic areas of Knowledge Based Bioeconomy (KBBE)[3] and Nanosciences, Nanotechnologies, Materials and new Production Technologies (NMP)[4]. Since 2007, *SusChem* has been successful in helping the chemical and biotechnological industries and their stakeholders to benefit from FP7 funding[5]; this has meant in practice that Commission funding of ~€300 million each year has been invested in various projects supporting these industries over the first five years of FP7. This is an excellent basis for building on in future years.

The European Commission has recently launched Europe 2020, which is the EU's growth strategy for the next decade. Its aim is to make the EU a smart, sustainable and inclusive economy. As a result, the new Research and Innovation Framework programme, entitled Horizon 2020 and due to commence in 2014, will differ in nature from FP7. Horizon 2020 will work to support the goals of smart, sustainable and inclusive economic growth through the addition of an innovation component larger than that in FP7, whilst continuing to support fundamental and applied research. Horizon 2020 programme priorities are largely defined by major societal challenges, which include climate change, energy & food security, health and the ageing population, in line with the Europe 2020 strategy, and a substantial part of Horizon 2020 priorities are identified and focussed *via* major Europe 2020 "flagship innovation initiatives". These include European Innovation Partnerships (EIPs) and Public Private Partnerships (PPPs) for which industry and academia are both invited not only to engage in the setting of key objectives but also to commit to their implementation[6].

In response to all this, *SusChem* has enhanced its strategy, and has now been formally recognised as a "2020 ETP" by the European Commission. This recognition means that *SusChem* is acknowledged formally by the EC as a body which will help to play a key role in delivering the Horizon 2020 programme and hence the Europe 2020 objectives.

[1] Abbreviation for *SusChem Europe*, only used in the context of discussions of the *SusChem* National Technology Platforms [¶4(iii)]
[2] See page 2 at http://suschem.org/publications.aspx
[3] "Knowledge Based Bio-Economy (KBBE)", http://cordis.europa.eu/fp7/kbbe/home_en.html
[4] "Nanoscience, nanotechnologies, materials and new production technologies (NMP)", http://cordis.europa.eu/fp7/cooperation/nanotechnology_en.html
[5] €32,413 million *in toto* over 7 years - see http://cordis.europa.eu/fp7/budget_en.html
[6] "Horizon 2020", http://ec.europa.eu/research/horizon2020/index_en.cfm

2. "Sustainability" – a Foundation Stone of *SusChem*

When the concept of the sustainability of a process or product is considered, it is vital to optimise the solutions using the three pillars of sustainable development, addressing together environmental, economic and societal issues along whole value chains. This means that a truly sustainable innovation must meet three sets of criteria, which are that the innovation must be environmentally sound, societally beneficial and economically robust:

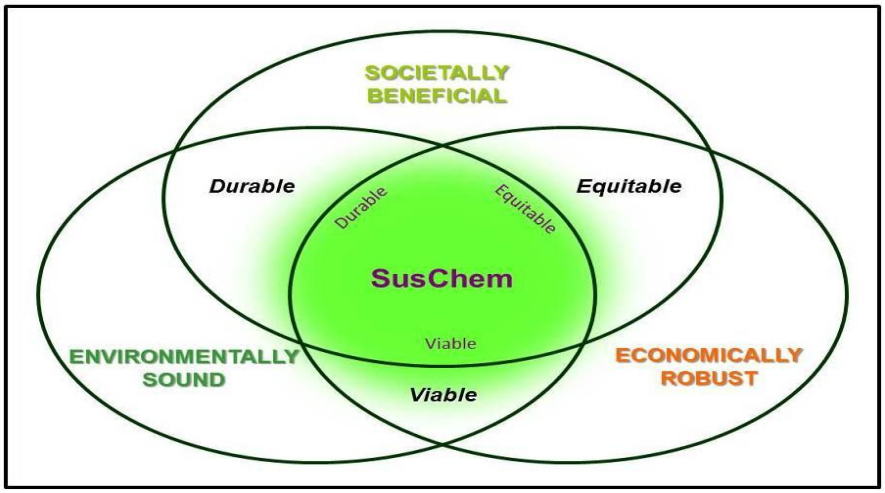

Figure 1: Criteria for sustainability shown as a Venn schematic

These three sets of criteria should be utilised in concert to ensure as far as possible that new products or processes launched onto the marketplace are truly sustainable, providing solutions that are not only viable but also equitable and durable at every stage along the value chain, with measurables that are scored using independent proof points. *SusChem* aims always to set its operations to sit squarely in the central region of this Venn schematic ***(Figure 1)***.

3. The Need for a Renewed Strategy

The evolution of *SusChem* towards a much stronger emphasis on innovation is above all about concentrating more on outputs rather than inputs. To date, European Technology Platforms, including *SusChem*, have commonly been technology driven, concentrating mainly on knowledge creation, and measuring success from the number of grants received or how much funding support has taken place. The intention of *SusChem* as a 2020 ETP is now to emphasise much more strongly innovative outputs, such as demonstrator projects that highlight novel options and technologies which will benefit the environment, economy and society as a whole. The key measures of success are then quite different, being concerned with whether the funding support has resulted in tangible outputs, which quintessentially for *SusChem* must be new sustainable processes and products on the market that change and benefit society. This shift of thinking impinges strongly on five areas where *SusChem* is currently active, *viz*:

(i) Research and Innovation: Research is about turning money into knowledge and ideas, whereas innovation is about turning knowledge and ideas into money. Consequently, for *SusChem* just to foster and produce excellent research is not enough: it is essential to make use of this high-quality research to innovate, to transform society for the better, in line with Europe 2020 policy (see section 1). It is the view of *SusChem* that this stronger strategic emphasis on value creation through innovation will also enhance the importance of doing more academic research into new sustainable solutions in the future.

(ii) Education and Skills: Research and innovation form two of the three apices that together make up the so-called "Knowledge Triangle"[7]. The third apex is education and skills, but again, it is not input in terms of course and syllabus content that the enhanced *SusChem* strategy aims to concentrate on, but rather on outputs from good educational

[7] "ERA in the Knowledge Triangle", http://ec.europa.eu/research/era/understanding/what/era_in_the_knowledge_triangle_en.htm

practice. Naturally, our overall goal is to attract every year the very best available students to study chemistry, biotechnology, the life sciences and engineering, but a key further requirement is that they must be able, and want, to think across traditional boundaries. In the light of this, a first priority is to identify the right mixes of knowledge and skills that these students require to address the growing needs Europe has for such innovative young scientists and technologists. Secondly, prospective students need to appreciate that to choose chemistry or related disciplines is to make a very positive choice – they need to see that a professional career in chemistry and biotechnology is not only exciting and financially rewarding but also critically important for helping humanity to overcome the grand challenges it faces in order to have a sustainable future. Thirdly, having attracted such students, it is necessary to maintain and grow the students' interest through effective delivery of training.

These three requirements and challenges are of course far beyond what *SusChem* can deliver alone. However, partners with *SusChem* are currently concentrating on the creation of synergies between the chemical industry and higher education, in order to systematically introduce key skills for innovation into curricula.

(iii) Multidisciplinary Working and the Chemistry/Biosciences Interface: Although it is one of many interfaces between sectors and disciplines, the chemistry/bioscience interface deserves particular comment. *SusChem* has benefitted in particular from the commitment and direct support of two European trade associations which have together played the role of key partners in *SusChem*, namely, the European Chemical Industry Council (Cefic)[8] and the European Association for Bioindustries (EuropaBio)[9]. It is the experience of *SusChem* that research at this interface is particularly fruitful for future sustainable innovation. Consider parts of a typical supply chain which starts with biomass and ends with familiar materials and other products:

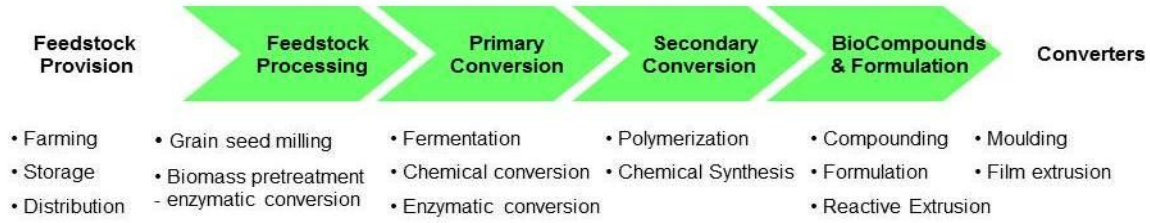

Figure 2: General schematic of a supply chain that demonstrates the indivisibility of chemistry and biotechnology

In ***Figure*** 2, at every point along the supply chain, chemistry, chemical engineering, biochemistry and bioengineering overlap in a near-seamless manner.

Although in this section the chemistry/bioscience interface has been highlighted because of its singular importance, this is not the only interface that is important to *SusChem*. Experience within many of *SusChem*'s existing partnerships has shown that other interfaces between academic disciplines and industrial sectors are also very fertile ground for providing sustainable solutions to the major environmental, economic and societal challenges that we all face.

(iv) Cross-sectoral Working along Value Chains: It is clear that new sustainable chemistry, chemical engineering and biotechnology are all greatly needed at the origin of a value chain, in raw material transformations and processing. It is equally important to recognise that these technologies are of importance further along value chains, even though the companies involved may not sit in the chemical and biotechnology sectors.

The enhanced *SusChem* strategy therefore includes a key commitment to collaborate with companies further along value chains, with companies which do not belong to the chemical and biotechnology sectors, and to work concurrently with them, rather than sequentially. Thus *SusChem* aims to help solve any chemically related problems that other parts of the value chain may have when they arise, even while new technologies for processing raw materials are still being

[8] "The European Chemical Industry Council", www.cefic.org
[9] "About EuropaBio", http://www.europabio.org/about-europabio

developed. Such concurrent working is new and strongly synergistic. It should not only stimulate, but could also speed up, the achievement of tangible sustainable outputs.

(v) Chemistry and Biotechnology are Key Research Tools for the Development of Sustainable Materials: An important report[10] from the High Level Expert Group on Key Enabling Technologies (KET) concentrates on the so-called "valley of death" that any promising new research concept has to cross before a sustainable product or technology can reach the market place. Three pillars must be put in place to facilitate crossing the "valley of death", which are technological research, product demonstration and world-class advanced manufacturing. Under technological research, six Key Enabling Technologies have been identified, namely, nanotechnology, micro and nano-electronics, advanced materials, photonics, industrial biotechnology and advanced manufacturing systems. The role of chemistry and biotechnology in the invention and exploitation of sustainable advanced materials is particularly relevant: *SusChem* had highlighted this in a *SusChem* Hybrid Materials Workshop which demonstrated where new chemical technologies will be critical in five application areas: automotive technology, solar energy, solid state lighting, civil engineering and aviation & aerospace[11].

Therefore, the important contribution that chemical technologies and biotechnology will make in the area of advanced materials is one key focus for *SusChem's* enhanced strategy. Partnerships involving the development of advanced materials will be a key component of future actions involving *SusChem.*

4. How *SusChem* will Deliver its Enhanced Strategy

SusChem possesses three key sets of instruments to help it implement its enhanced strategy (hereafter referred to as its "2020 Strategy"). These are:

(i) Networks*: SusChem* is quintessentially about developing and using networks that in turn facilitate the delivery of innovative sustainable solutions using chemistry and biotechnology. It therefore follows that as part of its 2020 Strategy, as *SusChem* extends its activities further along value chains, it is committing itself to expanding its academic networks and its links to society and other stakeholder groups across more disciplines and industrial sectors. In addition, interfacing with other value chain related 2020 ETPs is now also of strategic importance, not only in order to present integrated agenda recommendations towards the European Commission, but also because of the important brokerage roles that platforms are playing in helping to ensure the production of high quality cross-sectoral project proposals and inclusive consortia. Some of this will take place as a consequence of *SusChem's* direct work within EIPs, PPPs and other projects (whether these are research, demonstrator or education linked) but there are also two further sets of networks where the 2020 Strategy prompts some specific actions for *SusChem*. These are the Technology Pillars and National Technology Platforms, described in ¶¶ 4(ii) and 4(iii) below.

(ii) Technology Pillars: In 2005, when *SusChem* was formed, three Technology Pillars were brought into being[12], namely, 'Industrial Biotechnology', 'Materials Technology' and 'Reaction & Process Design'. These Technology Pillars, comprising groups of experts from both academia and industry, were identified as representing comprehensively the enabling technologies that *SusChem* required to achieve FP7 objectives.

The roles of these Technology Pillars throughout FP7 were entirely consistent with what was then required for the effective operation of the *SusChem* Technology Platform. However, with *SusChem* now placing a stronger emphasis in its strategy on innovation, this means that the Technology Pillars will now have a new and important role as feeds for value creation, led by market pull ***(Figure 3)***. This means that at times it may now be appropriate for effort from a Technology Pillar to be primarily concentrated on work related to one particular EIP or PPP. Specifically, ***Figure 3*** shows that *SusChem* is now not only an active partner in four EIPs but also in two new, major Horizon 2020 Public-Private Partnerships (SPIRE 2030[13]and BRIDGE 2020[14]). These PPPs

[10] "High Level Expert Group on Key Enabling Technologies", http://ec.europa.eu/enterprise/sectors/ict/files/kets/hlg_kets_report_en.pdf
[11] "SusChem Hybrid Materials Workshop Report", http://ec.europa.eu/research/industrial_technologies/pdf/suschem-hybrid-materials-report_en.pdf
[12] "Enabling Technologies", http://www.suschem.org/priorities/enabling-technologies.aspx
[13] "What is SPIRE?", http://www.spire2030.eu/
[14] "BRIDGE 2020", http://bridge2020.eu/about/

concentrate on sustainable processing, and are planned to operate in parallel with each other, representing the two strands of technology that have characterised *SusChem* since its inception, namely, chemical technology and white biotechnology. For both of these PPPs, the three Technology Pillars will have major contributions to make over the next few years.

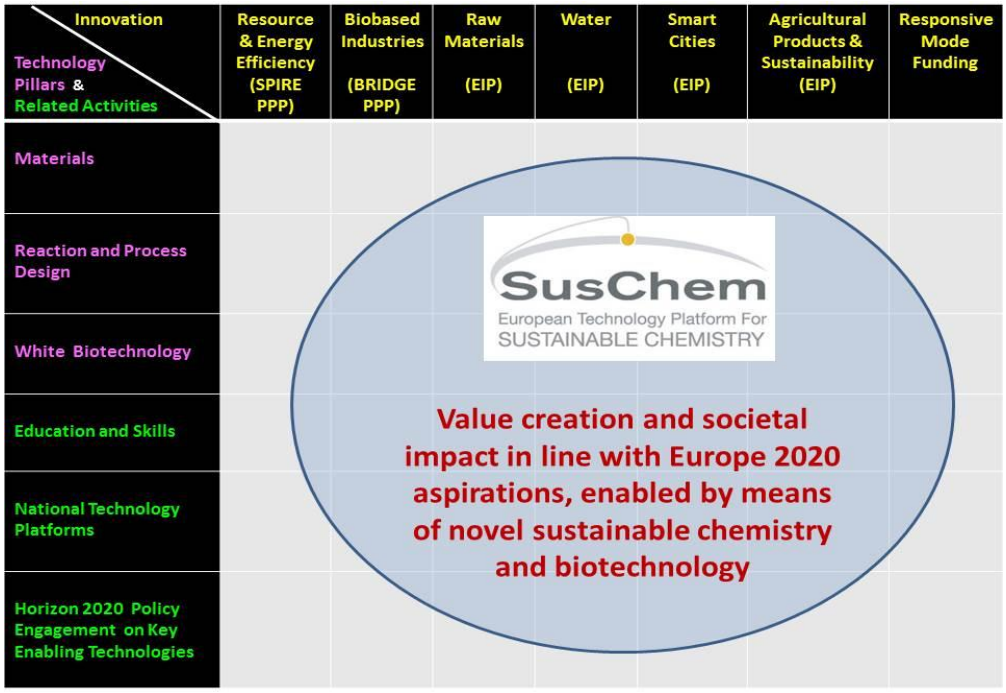

Figure 3: Matrix depiction of the contributions that SusChem is making to the Europe 2020 agenda with the columns representing Innovation Flagship initiatives where SusChem is already intimately and actively involved and the rows defining the areas of current activity within SusChem where it aims to create value

(iii) National Technology Platforms (NTPs): 12 member states of the EU (Belgium, Czech Republic, France, Germany, Italy, Netherlands, Poland, Romania, Slovenia, Spain, Switzerland and UK) have their own *SusChem* National Technology Platforms[15], all linked to *SusChem Europe*. They underpin nationally all that *SusChem Europe* aims to achieve at the EU level and are a key part of the 2020 Strategy. Roles of National Technology Platforms include:

- developing impact and critical mass, both in policy shaping and technology development, through networks of EU and national *SusChem* activities involving national research programmes;
- fostering networking and cooperation by identifying synergies between national and EU policy agenda and within trans-national collaborations;
- building industrial and academic links from *SusChem Europe* into their own countries, including identification and subsequent involvement of innovative SMEs in European programmes and PPPs ;
- coordinating important regional activities on sustainable chemistry and biotechnology that are pertinent to *SusChem Europe's* overall mission.

The overall *modus operandi* of the 2020 Strategy of *SusChem* is summarised above, in ***Figure 3.*** These are activities arising from the enhanced strategy and are therefore an addition to the normal (and ongoing) research activities that will also continue and were a key characteristic of *SusChem*'s operations under FP7.

[15] "National Technology Platforms", http://www.suschem.org/about-suschem/organisation-and-structure/national-technology-platforms.aspx

5. Summary of the Key Elements of *SusChem's* 2020 Strategy

The Europe 2020 strategic goals focus on smart, sustainable and inclusive economic growth. The Innovation Union aims to achieve these goals through aligned research coupled with a very much enhanced innovation component, funded primarily from Horizon 2020 ***(Figure 3)***. *SusChem* has evolved its strategy in line with Europe 2020 imperatives to help ensure that chemistry and biotechnology deliver its contributions to these goals. The key elements of the new 2020 Strategy[16] are:

- ***Strong engagement with key stakeholders in helping shape research and innovation policies is a continuing imperative:*** Since 2011 *SusChem* has been regularly engaged in political discussions that have taken place at a high level within the European Commission in preparation for Horizon 2020. *As Horizon 2020 commences in 2014 SusChem will continue to do this as part of its new role as a recognised 2020 ETP.*

- ***The concept of what constitutes a truly sustainable invention or innovation is being further developed and articulated:*** Sustainable development remains at the core of our *SusChem* strategy but the issue of sustainability will now be more comprehensively addressed across environmental, societal and economic issues along the whole value chain in conjunction with our stakeholders, so that as far as possible *SusChem* activities fulfil concurrently sustainability criteria pertinent to each area. *A team within SusChem is working on this issue.*

- ***Value creation in sustainable development is now a core objective for SusChem:*** The new strategy aims to make *SusChem* a cross-sectoral catalyst for value creation and EU growth. This means moving away from measures of success based primarily on the extent and nature of funding inputs, towards measures based on research, innovation and education outcomes. *This thinking is at the heart of the 2020 SusChem Strategy.*

- ***Research, innovation and education all remain at the centre of SusChem activities:*** The mission of *SusChem* remains as it was but there is now an enhanced emphasis on innovation, with tangible outputs being defined in the form of new processes, demonstrator projects and skills development that support innovation. *Emphases are also now being placed on further involving and upgrading the capabilities of innovative SMEs as a pillar for a new European re-industrialisation policy, (for examples see the BIOCHEM[17] Bio-Tic[18] MatVal[19] and R4R[20] projects).*

- ***Multidisciplinary and cross-sector working down value chains is being substantially increased:*** As a result of its enhanced emphasis on encouraging innovation at every point along value chains, *SusChem* is actively extending its collaborative activities further, into new disciplinary and business sector territories. *This process is already well underway particularly through the SPIRE PPP (**Figure 3**).*

- ***Partnership Activities are being expanded strategically***: *SusChem* is using its extensive networks and skills to help boost innovation across sectors and disciplines, specifically by acting as a fully committed partner in those European Innovation Partnerships and Public-Private Partnerships where new sustainable chemistry and biotechnology can impact most effectively in achieving the goals of Europe 2020. *A key example of this is the BRIDGE PPP (**Figure 3).***

- ***Cooperation between SusChem Europe and its National Technology Platforms is being enhanced***: Support for the Innovation Union goals of smart, sustainable and inclusive economic growth through sustainable innovation requires working at the European, national and regional levels simultaneously. *Ongoing actions have been agreed therefore to bring SusChem and the National Technology Platforms further together to strengthen sustainable research and innovation in the face of the challenges of globalised competition.*

[16] For current activities see http://suschem.blogspot.co.uk/ and https://twitter.com/SusChem
[17] "About BIOCHEM", http://www.biochem-project.eu/
[18] "BIO-TIC", http://www.industrialbiotech-europe.eu/about/
[19] "MatVal", http://www.matval.eu/web/guest
[20] "R4R to Build Regional resource Efficiency", http://suschem.blogspot.co.uk/2013/01/r4r-to-build-regional-resource.html