BIO-BASED INDUSTRIES
Joint Undertaking
www.bbi-europe.eu

Bio-Based Industries JU
WORK PLAN 2014

Contents

INTRODUCTION 3

RESEARCH AND INNOVATION ACTIONS 7

BBI VC1.R1 – 2014: Efficient pre-treatment of lignocellulosic feedstock to advanced bio-based chemicals and biomaterials 7
BBI VC2.R2 – 2014: New sustainable pulping technologies 8
BBI VC2.R3 – 2014: New products from sustainable cellulose pulp exploitation 9
BBI VC2.R4 – 2014: Fibres and polymers from lignin 10
BBI VC2.R5 - 2014: Sugars from effluents of the pulping process and discharged fibres 11
BBI VC3.R6 – 2014: Fermentation processes to obtain biosurfactants and specialty carbohydrates from agricultural and agro-industrial streams 12
BBI VC3.R7 – 2014: Protein products from plant residues 13
BBI VC3.R8 – 2014: Bioactive compounds from meso-organism's bioconversion 14
BBI VC4.R9 – 2014: Valuable products from heterogeneous biowaste streams 15
BBI VC4.R10 – 2014: Nutrient recovery from biobased waste streams and residues 16

INNOVATION ACTIONS: DEMONSTRATION 17

BBI VC1.D1 – 2014: Lignocellulosic residues to (di)carboxylic acids, diols and polyols 17
BBI VC1.D2 – 2014: Chemical building blocks and value-added materials through integrated processing of wood 18
BBI VC2.D3– 2014: Advanced products from lignin and cellulose streams of the pulp and paper industry 19
BBI VC3.D4 – 2014: Functional additives from residues from the agro-food industry 20
BBI VC4.D5 – 2014: Cost efficient manure valorisation on large scale 21

INNOVATION ACTIONS: FLAGSHIP 22

BBI VC3.F1 – 2014: Added value products from underutilised agricultural resources 22

INTRODUCTION

The Bio-based Industries Joint Undertaking (BBI JU) is a public-private partnership established between the European Commission and the Bio-based Industries Consortium (BIC)[1] to implement a Joint Technology Initiative on Bio-based Industries. It aims to bring together all relevant stakeholders to establish innovative bio-based industries as a competitive sector in Europe, ranging from primary production, large industry, SMEs, clusters, trade associations, academia, RTOs to end-users.

The overall objective of the partnership is to support the transition towards a more resource efficient and sustainable low-carbon economy and to increase economic growth and employment, in particularly in rural areas, by developing sustainable and competitive bio-based industries in Europe based on advanced biorefineries that source their biomass sustainably. To this avail, it will develop five new bio-based value chains from primary production to consumer markets.

With a total budget of EUR 3.705 billion, of which almost 75% will be contributed by the Bio-based Industries Consortium, the JU's work plan (WP) is industry driven. The basis of this work programme is provided by the Strategic Innovation and Research Agenda (SIRA)[2] of the Bio-based Industries JU. The SIRA was prepared by the Bio-based Industries Consortium and outlines the main challenges that need to be addressed in order to fully realise the potential of bio-based industries in Europe on the basis of the five value chains.

The Bio-based Industries JU's first Call for Proposals in 2014 includes topics for four of the five value chains, namely (see Annex for an overview of the feedstocks of each Value Chain):

- Value chain 1 (VC1): From lignocellulosic feedstock to advanced biofuels, bio-based chemicals and biomaterials;
- Value chain 2 (VC2): The next generation forest-based value chains;
- Value chain 3 (VC3): The next generation agro-based value chains;
- Value chain 4 (VC4): Emergence of new value chains from (organic) waste;

This work plan is organised around 2 types of actions:

- Research and innovation actions;
- Innovation actions:
  - Demonstration actions;
  - Flagship actions.

The present work plan is part of a long-term strategy that will deliver results in a stepwise approach: wherever potentially disruptive technologies are available at sufficiently high TRL (Technology Readiness Level), innovation actions will be launched to strengthen existing value chains or form new ones, especially by creating links between existing value chains. Parallel research and innovation actions are foreseen to provide “next generation” enabling technologies the needed impetus to deliver

1 http://biconsortium.eu/

2 http://biconsortium.eu/sites/default/files/downloads/BIC_SIRA_web.pdf

on short term results (proof of technology advancement), thereby facilitating innovations in the medium/long term (availability of new processes and products). A continuous feedback loop is foreseen from innovation actions back to research and innovation ones to address technological challenges arising from value chain demonstration.

Within this framework, priority in the first work plan is given to:

1. **Initiatives that have a high potential to deliver results on the short and medium term**: these include innovation actions that foster valorisation of lignocellulosic materials, streams and by-streams from existing biorefineries with the aim of achieving 2 to 5 higher value products than in current applications, and of bringing new bio-based products to the market that would compete with existing fossil-based ones. This also includes large scale centralised conversion of manure demonstrating the cost-efficient isolation of added-value biochemicals. These demonstration and flagship initiatives contribute to the strategic objectives of doubling the fraction of bio-based chemicals produced in Europe (from current 10% to 20%), increasing by a factor of 5 the market share of bio-based polymers and composites, increasing the value of products from agro-food residues with at least a factor 3, and reducing costs and/or weight in addition to the overall environmental footprint.
2. **Priority challenges to ensure medium and long-term sustainable biorefinery approaches**: Research and innovation actions focused on the valorisation of nutrients and proteins, and the mobilisation and valorisation of readily accessible, yet underutilised resources are essential for the creation of a circular economy and for the smart and efficient use of renewable resources. This includes developing new added-value products from available cellulose and lignin, and isolating sugars from side streams from pulp mills. These would contribute to the strategic objectives of increasing biomass mobilisation by 10%, and of reducing imports of protein for feed and fertilisers components applied to feedstock production by 15% and 10%, respectively. While reducing Europe's dependence on imports, these actions will be equally instrumental for boosting rural economies and the creation of highly skilled jobs.
3. **High impact and complex long-term issues**: these must be tackled from day one to lay solid foundations for the future - for instance, research and innovation actions that develop technologies for valorisation of heterogeneous waste streams, and cost and energy-efficient technologies for separation of lignocellulose into its individual components. These issues specifically tackle the challenge of organic waste valorisation and seek to develop resource efficient technologies aimed at increasing recovery ratios and conversion rates, developing new bio-based products. Projected benefits also include substantial energy savings and CO_2 emissions reduction (up to 40% and 80% respectively for innovative wood pulping technologies). These topics contribute to achieving a secure and sustainable supply of lignocellulosic biomass and to meeting the 15% target increase in waste and by-product utilisation by 2020.

Horizon 2020, the Framework Programme for Research and Innovation, will put more emphasis on innovation than its predecessor, the 7th Framework Programme for Research and Technological Development (FP7). This trend will also be reflected in the activities of the Bio-based Industries Joint Undertaking. Industry participation in all actions will be crucial to achieve the objectives of the Joint Technology Initiative. A significant part of the initiative's budget will be spent on demonstration and flagship actions.

In view of ensuring the success of the activities, applicants will need to:

- Demonstrate that the proposed activities represent progress beyond the state-of-art;

- Demonstrate cost-effectiveness, sustainability and fulfilment of technical market requirements of the proposed activities;
- Demonstrate ownership or freedom to operate on any required and proposed technology.
- Demonstrate the European dimension, added value and impact of the proposed activities.

The total of 16 topics in the WP2014 are presented according to type of actions to be supported. The selection will be made on the basis of excellence, impact and quality and efficiency of the implementation.

Research and innovation actions
This part of the call has EUR 15 million in EU funding[3]. Research and innovation actions are industry-driven and aim at filling the gaps in technological innovations at particular points of a value chain. Research and innovation projects focus on the development of specific technologies and concepts needed to realise the value chains, proving the principles in pilot installations. As such, they may include basic and applied research, technology development and integration, testing and validation on a small-scale prototype in a laboratory or simulated environment. Activities will span up to Technology Readiness Level (TRL) 5.
Industry participation is crucial to achieve the objectives of research and innovation actions. It is therefore expected that, as a general principle, industry will participate in R&I projects by making in kind contributions. This in kind contribution refers to costs incurred by the industry to implement the project. These costs are eligible for funding according to Horizon 2020 rules but are not reimbursed.
This industry contribution ideally should aim to cover at least 50% of the total budget of the project. The level of contribution by the industry will be taken into account during the evaluation of the project proposal.

Funding can only by requested by small and medium-sized enterprises, secondary and higher education establishments, non-profit legal entities, including those carrying out research or technological development as one of their main objectives, the Joint Research Centre and international European interest organisations. The reimbursement rate may reach a maximum of 100 % of the total eligible costs in line with the Rules for Participation of Horizon 2020[4].

Innovation actions
This part of the call has EUR 35 million in EU funding. Innovation actions are industry-driven and consist mainly of activities aiming at producing plans and arrangements or designs for new, altered or improved products, processes or services. They may include prototyping, testing, demonstrating, piloting, large-scale product validation and market replication. Innovations actions will address a whole value chain from feedstock sourcing to the market applications. Innovation actions cover both demonstration and flagship projects.
Demonstration projects aim to validate the technical and economic viability of a new or improved technology, product, process, service or solution in an operational environment. They contain mainly

[3] For more detailed information on the different type of actions and related funding mechanisms please refer to the relevant Guide for Applicants
[4] http://ec.europa.eu/research/participants/portal/doc/call/h2020/common/1595113-h2020-rules-participation_oj_en.pdf

demonstrator activities corresponding to TRLs levels 6 to 7 . The purpose of these value chain demonstration projects is to provide the backbone for subsequent flagships.
Flagship projects mainly include activities corresponding to TRL level 8. Flagships are the first units of value chains operating at an economically viable scale. Flagship projects support the deployment in the market of an innovation that has already been demonstrated but not yet deployed in the market. A flagship shall address a complete value chain from procurement, growth, supply of feedstock material to the final product(s). It shall include the establishment of a large scale production facility, being it a new installation, a substantial modification of an existing facility, or reconversion of old or abandoned industrial facilities.
For innovation actions funding can be requested by all participants. The reimbursement rate may reach a maximum of 70 % (100% for non-profit organisations) of the total eligible costs in line with the Rules for Participation of Horizon 2020. The industry is expected to contribute in kind to the projects and where appropriate through Additional Activities[5].

In kind contributions refer to costs incurred by the industry to implement the project. These costs are eligible for funding according to Horizon 2020 rules but are not reimbursed.

Additional activities refer to industry's investments that contribute to reaching the industrial objectives of the project. These investment costs are not to be declared as eligible costs of the action and are thus not reimbursed by the BBI-JU. They are accounted according to the usual cost accounting practices of the industry partners contributing them and not according to the Horizon 2020 rules.

- The EU funding for demonstration actions is EUR 18 million. Additional activities are **optional**. Ideally in demonstration actions, industry's contributions will cover at least 50 % of the total budget, including additional activities where appropriate. The 50% can be reached either through in kind contribution to eligible costs only or by a combination of in kind contributions and additional activities. Topics within this type of action will be competing with each other.
- The EU funding for flagship actions is EUR 17 million. Additional activities are **mandatory**. Ideally for flagship actions, industry's in kind contributions will represent at least 30 % of the total eligible costs, which is supplemented with a level of additional activities commensurate with the commercial scale nature of the activity.

Consortia submitting demonstration or flagship proposals are encouraged to leverage further public support from Structural Funds, the European Investment Bank (EIB) and other national funds[6].

[5] Additional Activities are costs incurred by the Bio-based Industries Consortium that are outside the work plan of the Bio-based Industries JU, but that contribute to the industrial objectives of the Bio-based Industries JTI
[6] Other Union funding programmes may support those costs in compliance with the applicable rules and procedures. In such cases, Union financing shall not substitute for the in kind contributions from the Members other than the Union or their constituent entities.

RESEARCH AND INNOVATION ACTIONS

BBI VC1.R1 – 2014: Efficient pre-treatment of lignocellulosic feedstock to advanced bio-based chemicals and biomaterials

Specific challenge: Pre-treatment processes are of central importance in the lignocellulosic biomass (e.g. agricultural residues and wood pellets) to 2nd generation bio-based chemicals and biomaterials value chains. They have an impact on the composition of the isolated sugars streams and in turn on the fermentation yields / titres (e.g through the presence of inhibitors) and the quality of the (isolated) final product (e.g. through impurities carried forward from the pre-treated biomass and hydrolysis process). Despite the existence of pre-treatment methods already at demonstration plant level, the process itself still requires substantial optimisation towards a sustainable and economically viable standard.

Scope: Development of mild, sustainable processes aimed at fractionating lignocellulosic feedstock (that may include multiple biomass sources) into sugars and lignin fractions, focussing on biocatalysts (enzymes or whole cell bacteria, yeasts) with improved conversion rate and yield. Proposals should address the development at experimental bench-scale of pre-treatment/hydrolysis processes and their integration into the subsequent fermentation step up to the level of pilot-scale. Involvement of end-users could be considered towards assuring the viability of the developed concepts in the value chain. Proposals should assess the impact of the developed pre-treatment processes on the environmental, social and economic performance of the whole value chain.

It is considered that proposals with a total eligible budget between EUR 5 and 8 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals with another budget.

Expected impact:

- Developing efficient and integrated pre-treatment processes leading to a tangible reduction of investment and operating costs over the biomass to bioproduct conversion.
- Delivering fermentable sugars of suitable quality for further conversion in advanced biochemicals, at a price competitive with (preferably lower than) the current market price of sugars and a pretreatment yield of at least 80% on biomass.
- Reducing GHG emission by at least 30% over the whole value chain of the targeted products as compared to conventional ones.
- Contributing to reinforcing cooperation along the value chain from feedstock suppliers (e.g. farmers, land and forest owners) to technology providers and end-users.
- Enabling the mobilisation and conversion of lignocellulosic feedstock into cost-competitive bio-based chemicals and materials.

Type of action: Research and innovation actions

The applicable conditions are set out in the Annex of the annual Work Plan.

BBI VC2.R2 – 2014: New sustainable pulping technologies

Specific challenge: In the trend towards optimising the (cost-)effectiveness and sustainability of the transformation of wood into new value-added products, one of the key challenges is to reduce temperature, pressure and toxicity of the chemical pulping processes. A newly discovered class of separation technologies based on natural Deep Eutectic Solvents (DES), shows potential in terms of decomposing lignocellulosic feedstock at low temperatures and at atmospheric pressure. While the prospects of DES-based processes to improve cost-efficiency and environmental footprint of wood-based products are high, further development is needed with a view to move these still largely unknown technologies closer to industrial application.

Scope: Development of new DES-based pulping technologies to isolate cellulose, lignin and hemicellulose from wood and other lignocellulosic sources, including agricultural residues. Proposals should address the design and development of natural DES for low-temperature (<100°C), atmospheric-pressure, harmful chemicals-free pulping. They should map and select the most appropriate DES families, establishing the processes or combination of processes (dissolving, separation) and their optimal industrial scale to isolate high quality cellulose, lignin and hemicellulose. The recyclability of DES needs to be addressed. A life-cycle oriented assessment should be carried out in order to evaluate the environmental and socio-economic performance of the developed technologies. The feasibility of integrating the developed technologies into the current industrial processing chains should be assessed.

It is considered that proposals with a total eligible budget of at least EUR 2 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals with another budget.

Expected impact:

- Achieving technological breakthroughs spurring innovation across cellulose-based sectors.
- Reducing by at least 40% in process energy intensity as compared to traditional pulping processes.
- Reducing by 50% of investment costs as compared to current pulping installations, thanks to pressure free layout and simplified chemical recovery.
- Strengthening market position of current wood-based products (e.g. paper, board) as well as new high added value applications, like textile and chemical industries.

Type of action: Research and innovation actions

The applicable conditions are set out in the Annex of the annual Work Plan.

BBI VC2.R3 – 2014: New products from sustainable cellulose pulp exploitation

Specific challenge: Although market prospects of cellulose based products in textiles, films and thermoplastics are high, their current market share is relatively small due to environmental and cost limitations of current cellulose based processes such as viscose, lyocell and cellulose ester based ones. The need to meet tighter environmental demands and to compete with cotton and fossil based polymers counterparts calls for the development of high-cellulose content pulp, new innovative cellulose dissolution, regeneration and derivatisation processes.

Scope: Development of innovative cellulose dissolution processes and concomitant technologies enabling the production of cellulose based products with innovative properties. Proposals should address the processing and processability of pulp, including dissolving pulp, into new products such as textile fibres, films, and thermoplastic materials. If justified by improved processability or product quality, the proposals could also emphasise modification or improvements to dissolving pulp production. A life-cycle assessment should be carried out in order to evaluate the environmental and socio-economic performance of the developed technologies. The feasibility of integrating the developed technologies into existing industrial processing chains should be assessed. Proposals will consider potential standardisation-related activities expected to facilitate the market uptake of the developed products.

It is considered that proposals with a total eligible budget of between EUR 5 and 8 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals with another budget.

Expected impact:

- Delivering eco-friendly and cost-competitive cellulose products leading to a significant improvement in environmental performance, cost and quality as compared to establised alternatives.
- Strengthening market position of cellulose based products by a reduction of at least 10% of investment and operating costs of newly developed cellulose dissolving processes as compared to conventional ones.
- Achieving technological validation of at least one of the targeted cellulose-based products to be ready for demonstration.

Type of action: Research and innovation actions

The applicable conditions are set out in the Annex of the annual Work Plan.

BBI VC2.R4 – 2014: Fibres and polymers from lignin

Specific challenge: Lignin-based side streams of the pulp and paper industry are currently incinerated to produce energy while being a potential large volume feedstock resource for producing higher added value products such as fibres, polymers, resins and platform chemicals. The exploitation of these streams requires the application of new technologies to arrive at novel and economically viable solutions able to compete with fossil-based alternatives.

Scope: Development of separation, purification and conversion processes for the production of fully bio-based added value products from lignin-based side streams of the pulp and paper industry. Proposal should target one or several of the following product types: (multifilament) carbon fibres, biopolymers, thermoplastic resins, composites and small phenolic compounds for platform chemicals. Research challenges relate to the isolation of suitable quality lignin from black liquor and bleaching effluents; the development of products matching or improving mechanical, chemical and funcional properties of existing commercial products (e.g. when addressing carbon fibres, multifilament yarns that can be woven as conventional fabrics); the validation of the developed process by means of small scale prototypes with view to future demonstration. A close collaboration with the full value chain including end users is required. A life-cycle assessment should be carried out in order to evaluate the environmental and socio-economic performance of the developed technologies. Proposal will consider potential standardisation related activities expected to facilitate the market uptake of the developed products.

It is considered that proposals with a total eligible budget of at least EUR 2 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals with another budget.

Expected impact:

- Achieving technological validation of a number of lignin based products: at least 4 new bio-based materials for proposals addressing the development of chemicals, resins and precursor materials for biopolymers.
- Realising a five times cost decrease with respect to conventional carbon fibres, while at the same time meeting mechanical and stability requirements, for proposals addressing the development of carbon fibres.
- Reducing GHG emissions of the developed processes by at least 20% as compared to conventional ones.
- Increasing sustainability and competitive-edge of end-user sectors such as chemical, transportation, aerospace, textile, energy, construction industries.

Type of action: Research and innovation actions

The applicable conditions are set out in the Annex of the annual Work Plan.

BBI VC2.R5 - 2014: Sugars from effluents of the pulping process and discharged fibres

Specific challenge: A number of rejects and side streams of pulp and paper industry such as pulping liquors and discharged fibres in rejects and sludges, are currently being landfilled or incinerated. Their valorisation improves the environmental footprint of the whole process while enhancing its competitiveness. The potential to further exploit these streams requires the application of new technologies to isolate their sugars and to convert those sugars into added value bioproducts such as carbohydrate derivatives (e.g. alcohols, polyols, small organic acids).

Scope: Development of processes to isolate a constant and reliable stream of sugars from spent pulping liquors (from sulphite and Kraft pulping) or discharged fibers, for further conversion into carbohydrate derivatives via chemical or biochemical routes. Proposals should address the development of suitable separation, purification and conversion processes and include conversion trials, as well as identification and removal of possible inhibiting compounds in the feedstock. A life-cycle assessment should be carried out in order to evaluate the environmental and socio-economic performance of the developed technologies. The feasibility of integrating the proposed concept into existing industrial processing chains should be assessed.

It is considered that proposals with a total eligible budget of at least EUR 2 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals with another budget.

Expected impact:

- Creating new value chains using waste streams of the pulp and paper sector as bio-based feedstock for a number of industrial sectors such as chemical industry (solvents, intermediates), food industry (e.g. food additives), and precursor materials for bioplastics.
- Increasing the value by two to three times when using discharged fibre streams with respect to state of the art.
- Achieving a separation rate of sugars of at least 50% when processing liquor, along with an increase in value of at least four times with respect to the energy value of liquor when burnt for power generation.
- Enhancing cooperation along the value chain between the feedstock supply, processing industries (chemical, food, bioplastics), as well as providers of the required technologies (incl. SMEs) facilitating the creation of new industrial clusters.
- Achieving technological validation of at least 3 new biobased chemical building blocks for the mentioned processing industries, ready for demonstration phase.

Type of action: Research and innovation actions

The applicable conditions are set out in the Annex of the annual Work Plan.

BBI VC3.R6 – 2014: Fermentation processes to obtain biosurfactants and specialty carbohydrates from agricultural and agro-industrial streams

Specific challenge: Several hurdles hamper the full exploitation of two types of specialty biochemicals with high market interest, i.e. biosurfactants and specialty carbohydrates. On the one hand, suboptimal production methods result in large price fluctuations of the specialty carbohydrates currently in the market thus limiting their use to high-end applications (e.g. pharma and cosmetics). On the other hand, the few existing production methods for bio-based (glycolipid) surfactants rely mainly on the synthesis power of natural (wildtype) micro-organisms thus limiting the required product diversity to penetrate a large-scale market. Fermentation processes offer potential for overcoming these hurdles and for being an efficient, scaleable and cost-competive alternative for the production of these specialty biochemicals.

Scope: Development of cost-efficient and sustainable fermentation processes to obtain tailor-made biosurfactants and specialty carbohydrates from agricultural and agro-industrial streams. Proposals should address (i) improvement of the methods for metabolic engineering of the production strain; (ii) improvement of the flexibility of the process with view to widen the range of attainable biosurfactants; (iii) scale-up and improvement of fermentation and downstream processing with view to reducing processing time and costs. A life-cycle assessment should be carried out in order to evaluate the environmental and socio-economic performance of the developed technologies. The feasibility of integrating the proposed concept into existing industrial processing chains should be assessed. Proposal will consider potential standardisation related activities expected to facilitate the market uptake of the developed products.
It is considered that proposals with a total eligible budget of at least EUR 2 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals with another budget.

Expected impact:

- Improving fermentation technologies enabling higher added value to agricultural and agro-industrial streams that are currently used in low-value application, resulting in a cascading beneficial effect for the whole value chain.
- Reducing by (20-fold) in price range of speciality carbohydrates and increase of the supply from the kg scale to the hundreds of tons scale, leading to a broadened portfolio of potential applications beyond the current high-end ones.
- Improving significantly the flexibility, productivity and environmental performance of biosurfactants/specialty biochemicals industrial processes.
- Contributing towards the replacement of 5-10% fossil-based surfactants with biosurfactants.

Type of action: Research and innovation actions

The applicable conditions are set out in the Annex of the annual Work Plan.

BBI VC3.R7 – 2014: Protein products from plant residues

Specific challenge: Valorisation of proteins from side streams of the agro-food sector, e.g. bioethanol or starch production from cereal grains, represents a promising alternative to animal protein products. Current processing and conversion concepts (e.g. mechanical milling, chemical extraction, proteolysis) have limitations in terms of the quality of resulting products (protein content, functionality, taste, etc) thus restricting the application range in food processing. The challenge is to overcome these limitations in state-of-the-art technologies via the development of sustainable processes yielding market attractive products that meet consumers demands.

Scope: Development of industrially viable processing concepts for the valorisation of protein products from plant residues (e.g. from bioethanol or cereal starch processing industries) fulfilling market requirements (functionality, taste, purity, cost, safety) in the food segment using animal proteins as benchmark. Proposals should address techno-functional and sensorial properties of products, showing clear advancements beyond the state of the art in terms of added value and extended product portfolio and application range. A life-cycle assessment should be carried out in order to evaluate the environmental and socio-economic performance of the developed products. Safety aspects are also to be considered. The feasibility of integrating the proposed concept into existing industrial processing chains should be assessed.

It is considered that proposals with a total eligible budget of at least EUR 2 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals with another budget.

Expected impact:

- Increasing the value of the protein fraction by at least 100%.
- Achieving a conversion rate of at least 30 % of the protein fractions in processed streams to high-value products suitable for human consumption, with a protein content at least 40%.
- Achieving technological validation of at least 3 food products based on the recovered plant-based proteins, ready for demonstration.
- Opening of new markets for the European agro industry in food applications currently dominated by animal proteins.

Type of action: Research and innovation actions

The applicable conditions are set out in the Annex of the annual Work Plan.

BBI VC3.R8 – 2014: Bioactive compounds from meso-organism's bioconversion

Specific challenge: Due to their nutritional and functional properties, bioactive compounds (e.g. specific carbohydrates, peptides or lipids) find important markets in human and animal nutraceuticals, food additives and cosmetics. Their production poses two main challenges: (i) although found in nature, many are only present at very low levels, so that massive land usage is needed to obtain sufficient amounts; moreover, the quality of harvested material is not constant. (ii) chemical production processes (as for chitosan) are associated with a high environmental impact.

Meso-organisms have been proven able to convert agro-based residues (e.g. cereal residues, sugar residues or oil rich plant residues) into unique highly bioactive protein-rich, lipid-rich and chitin-rich bioactive compounds with very high efficiency (higher than any other known eukaryotic organism) and lower costs than micro-organism-based technologies. However the development of such process is not yet fully established and resulting products still need improvements to meet the requirements of the mentioned markets, in particular concerning safety for the customers.

Scope: Development of breakthrough approaches to obtain sustainable bioactive compounds from agro-based residues through bioconversion of meso-organisms (i.e. terrestrial invertebrates), mild recovery, functionalization and activation. Research should focus on high value products, rather than commodities. Targeted applications of chitins, lipids and bioactive peptides include nutraceuticals, food additives and cosmetics markets. A life-cycle assessment should be carried out in order to evaluate the environmental and socio-economic performance of the developed products. Proposals should address full risk assessment, including HACCP, regulatory implications (e.g. market authorisation), contaminant analysis, allergy and exposure analysis based on consumption and use data.

It is considered that proposals with a total eligible budget of at least EUR 2 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals with another budget.

Expected impact:

- Increasing value for agro-based residues compared to their current application by the conversion to new higher value functional products.
- Opening of new markets for chitin, peptides and fatty acids and making available new nutraceutical and cosmetic components with enhanced bioactive properties (e.g. antimicrobial and antifungi)
- Delivering bioactive compounds with an increase of 10% in bioactivity with respect to similar products and a 25% reduction in environmental impact (GHG emissions, water pollution) as compared to conventional fatty acid or chitosan production.
- Enabling the mobilisation of currently unused sidestreams and reducing the import of materials (e.g. chitosan).

Type of action: Research and innovation actions

The applicable conditions are set out in the Annex of the annual Work Plan.

BBI VC4.R9 – 2014: Valuable products from heterogeneous biowaste streams

Specific challenge: Heterogeneous biowaste streams (e.g. biodegradable fraction of municipal solid waste and low volume agro-food waste streams like leaves, stems, bulbs, flowers) pose environmental risks while being an important potential feedstock resource for producing a wide range of bioproducts. Their valorisation is limited by the lack of technologies able to process heterogeneous mixtures beyond existing homogenisation technologies, that fully break down the valuable complexity of organic components, or specific extraction technologies, which are excessively costly.

Scope: Development of pre-treatment, extraction, conversion and separation technologies for the processing of full heterogeneous biowaste streams into valuable chemical building blocks and substrates suitable for biotechnological conversion into new bioproducts. Research challenges relate to 1) pre-treatment parameters for the production of basis components (e.g. furfural, derivatives and lignin); 2) the required extraction and purification methods; development of suitable organic-based platform substrates through e.g. enzymatic hydrolysis (e.g. sugars, proteins, lipids and acids); and 3) conversion of the substrates into valuable products by e.g. microorganisms. Process and theoretical yield shall be validated at small pilot level. A life-cycle assessment should be carried out in order to evaluate the environmental and socio-economic performance of the developed products. Proposals will consider potential standardisation related activities expected to facilitate the market uptake of the developed products.
It is considered that proposals with a total eligible budget of at least EUR 2 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals with another budget.

Expected impact:

- Improving environmental performace and cost efficiency of targeted products and processes.
- Reducing of the CO_2 footprint of at least 20% with respect to currently available technologies.
- Creating of new revenues for the participating actors owning or having direct access to waste source.
- Achieving technological validation of at least 2 new bio-based products.

Type of action: Research and innovation actions

The applicable conditions are set out in the Annex of the annual Work Plan.

BBI VC4.R10 – 2014: Nutrient recovery from biobased waste streams and residues

Specific challenge: The production of nutrients and fertilisers currently relies heavily on mineral resources whose reserves are limited and depleting. Recovery of nutrients from biowaste streams (e.g. food waste, biodegradable fraction of Municipal Solid Waste, manure) represents a promising sustainable resource which could play a part when finding solutions to the foreseen global nutrient shortage. While there are a few experiences in Europe of nutrient recovery from waste water and from ashes, none of them has found application at large commercial scale. The potential to further source nutrients from waste streams requires the application of cost effective nutrient recovery processes, free of hazardous elements (heavy metals, pathogens) which provide readily available nutrients for crops, while competing in quality and price with the current fertilisers.

Scope: Development of dedicated recovery processes for nutrients from biowaste streams and bioresidues rich in plant nutrients (especially phosphorous and potassium compounds) through extraction, solubilisation, precipitation, chemical reaction and other emerging chemical or biological processes. Upgrading of recovered nutrients to new sustainable fertilisers by a cost-effective combination of specific organic and mineral components. Proposals should address the industrial integration of the process into the cascaded valorisation of the waste streams (including the isolation of other added value products) and show the economic viability of the developed products via in-vivo trials. A life-cycle assessment should be carried out in order to evaluate the environmental and socio-economic performance of the developed products in the whole value chain. Involvement of feedstock suppliers and end-users of the fertilisers could be considered towards assuring the viability of the developed concepts in the value chain.

It is considered that proposals with a total eligible budget of at least EUR 2 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals with another budget.

Expected impact:

- Achieving technological validation of fertilisers with the improved concentration of individual nutrients (at least 15% of the overall volume when using recycled nutrients alone) and a high availability to plants (at least 70%).
- Enabling the substitution of a significant percentage (at least 10%) of nitrogen and phosphorus with recycled components in commercial fertilisers.
- Contribution to a reduction of imports of mineral resources while ehancing the re-use of waste products.
- Improving fertilisers in view of environmental impact and price-competitiveness as compared to the current non bio-based alternatives.

Type of action: Research and innovation actions

The applicable conditions are set out in the Annex of the annual Work Plan.

INNOVATION ACTIONS: DEMONSTRATION

BBI VC1.D1 – 2014: Lignocellulosic residues to (di)carboxylic acids, diols and polyols

Specific challenge: At present, (di)carboxylic acids, diols or polyols are produced industrially as important source of innovative bio-based products such as bioplastics or added value fine chemicals as an alternative to existing petrochemical sources. Currently available production processes have inherent disadvantages, such as the harsh operation conditions, high pressure and high capital costs. The challenge is to overcome the mentioned technological hurdles while improving the environmental performance and cost-effectiveness of production.

Scope: Demonstration of the techno-economic viability of the integration of biotechnological, biochemical and chemical processes for the conversion of lignocelullosic residues in a cascading approach into fermentable sugars, then into (di)carboxylic acids, diols (e.g. butanediol) and polyols and further into bio-based materials as final products. Proposals should address the entire value chain, from the supply of the biomass resource to the market suitability of the targeted products. Proposals should assess the environmental, economic and social sustainability of the entire value chain on a life-cycle basis. The industrial viability of the process is to be demonstrated at medium-scale (e.g. 20 kton/year) building where relevant on existing infrastructure. Proposals should prove the economical access to sufficient raw material to set up the new supply chain. Involvement of end-users is required assuring the viability of the demonstrated concepts in the value chain. Proposals will consider standardisation related activities expected to facilitate the market uptake of the developed bioproducts.

It is considered that proposals with a total eligible budget of at least EUR 8 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals with another budget.

Expected impact:

- Reducing of energy requirements with respect to conventional processes based only on chemical and physical treatments.
- Improving process paramaters (e.g. conversion, yield) as compared to currently available dicarboxylic acids, diols and polyols production processes, (e.g. for butane diol conversion higher than 80% and yield higher than 40%).
- Demonstrating of at least 3 bio-based materials, showing favourable competition with oil-based counterparts price-, environmental- and performance-wise.
- Demonstrating bio-based materials with at least 70 % bio-based content, and less than 2.3 kg CO_2eq/kg emission.

Type of action: Innovation actions – Demonstration actions

The applicable conditions are set out in the Annex of the annual Work Plan.

BBI VC1.D2 – 2014: Chemical building blocks and value-added materials through integrated processing of wood

Specific challenge: There is a strong, but currently underexploited, potential for valorisation of sugars and lignin streams from wood. Although a number of fractionation routes are available such as: dilute acid, ammonia fiber expansion, steam explosion followed by enzymatic hydrolysis, supercritical fluid, concentrated acid and organosolv processes none of them have been proven at demonstration scale for wood fractionation, or for production of other chemicals than ethanol. There is thus a lack of adequate (combinations of) technologies able to efficiently process wood into sugars and lignin and further convert them into biochemicals.

Scope: Demonstration of the techno-economic viability of efficient and sustainable processes for disintegration of wood into sugars and lignin and to further conversion of both fractions into high added value products, building where relevant on existing infrastructure. Proposals should address the realisation of new wood-based value chains for the production of chemical building blocks, materials and biofuels (other than ethanol) in a cascading approach, by a combination of biotechnology and chemical processes. Proposals should prove the economical access to sufficient raw material to set up the new supply chain. A life-cycle assessment should be carried out in order to evaluate the environmental and socio-economic performance of the developed technologies. Involvement of end-users is required assuring the viability of the demonstrated concepts in the value chain. The proposal will consider standardisation related activities expected to facilitate the market uptake of the developed bioproducts.

It is considered that proposals with a total eligible budget of at least EUR 8 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals with another budget.

Expected impact:

- Developing cellulosic/hemi-cellulosic-based products with a value which is at least 2 -3 times higher than current products. Lignin-based products with a value which is at least 3 - 4 times higher than current lignin energy value.
- Enhancing of process yields with respect to conventional methods, targeting at least a 75% conversion rate of lignocellulosic biomass into value added products.
- Revitalising of rural areas as well as forestry and wood-harvesting stuctures.
- Improving measurably the sustainability and efficiency levels of processes for competitive products compared to current processes.

Type of action: Innovation actions - Demonstration actions.

The applicable conditions are set out in the Annex of the annual Work Plan.

BBI VC2.D3– 2014: Advanced products from lignin and cellulose streams of the pulp and paper industry

Specific challenge: The transformation of chemical pulp and paper mills into advanced biorefineries involves maximisation of the value derived from their cellulose main streams as well as their lignin-containing side streams by converting them into new and higher added value products. This in turn improves resource- and cost-effectiveness of their operations. Two important strategies in this endeavour are (i) the conversion of cellulose streams into innovative light weight structures for packaging and other applications (e.g. new concepts include foam-formed cellulose fibre based structures); (ii) the isolation of lignin from cooking spent liquors and its further conversion into value-added products.

Scope: Demonstration of the techno-economic viability of the production of at least two product ranges: one based on isolation and application of lignin and one based on the production and application of lightweight foam-formed cellulose. Proposals should demonstrate the feasibility of the different process stages of the manufacturing process. They should also specifically address the technological challenges related to: (i) for cellulose-products in particular wet pressing and drying of foam formed web and (ii) for lignin products in particular the separation of a constant quality lignin stream from black liquor, solving the problem of Na_2SO_4-emission. Developed products should match application requirements in terms of functional properties. For the case of cellulose-based lightweight structures applications include, among others, packaging solutions for food as well as high value products (e.g. electronics packaging, papers, construction and car sectors), while for lignin streams applications include e.g. fibres, glues, composite materials, or aromatic chemicals. A life-cycle assessment should be carried out in order to evaluate the environmental and socio-economic performance of the developed technologies within the entire value chain. The feasibility of integrating the developed approaches into existing industrial processing chains should be assessed while the involvement of end-users should be considered. Proposals will consider standardisation related activities expected to facilitate the market uptake of the developed bioproducts.

It is considered that proposals with a total eligible budget of at least EUR 8 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals with another budget.

Expected impact:

- Demonstrating of cellulose based light weight structures exhibiting high strength, matching the performance of competing conventional products, but with at least a 20% reduction in energy and raw material consumption.
- Demonstrating of lignin separation processes enabling on one side the elimination of Na_2SO_4 emissions and on the other side production of bioproducts having a value of at least 10 times the current value of black liquor when burned for energy.
- Opening up new applications and markets and increase the competitiveness of the European pulp, board and paper making industries, additionally showing high potential in terms of job creation in rural areas, moreover showing high potential for replicability in Europe.

Type of action: Innovation actions – Demonstration actions

The applicable conditions are set out in the Annex of the annual Work Plan.

BBI VC3.D4 – 2014: Functional additives from residues from the agro-food industry

Specific challenge: Residues from the agro-food industry (e.g. beet pulp, potato pulp, brewer's spent grain) are currently being utilised as feed, while having significant opportunities for further valorisation in new applications and markets. Given that many of the high added value components in these residues are present in small amounts, their cost-effective production requires the development of cascading concepts that fully valorises all components of the side stream. While various technologies to fractionate and convert the raw material into a high added value functional additives are available (though at different level of maturity), the main challenge is to integrate the different parts of the process into a functioning demonstration chain that meets the requirements for their production in terms of costs and environmental impact.

Scope: Demonstrate the techno-economic viability of the production of high added value functional additives (e.g. emulsifiers, plasticisers, anti-scaling, for e.g. detergents, food, personal care cosmetics, paints and coatings) from a side stream of the agro food industry (e.g. beet pulp, potato pulp, beer fines), building where possible on existing infrastructure. Research challenges relate to the demonstration and integration of pre-treatment, extraction and purification technologies, (bio)chemical conversion technologies and downstream processes in a cascading and integrated concept for the cost-effective and sustainable production of high value functional additives. Safety, quality and purity of the end products should meet commercial requirements. The feasibility of integrating the proposed concept into existing industrial processing chains should be assessed. Proposals should foresee an engineering study for the scale up of the proposed concept into industrial scale. A life-cycle assessment should be carried out in order to evaluate safety, as well the environmental and socio-economic performance of the developed products. Proposals should also demonstrate that they can economically access a sufficient quantity of raw material to set up the new supply chain. Involvement of end-users is required assuring the viability of the developed concepts in the value chain.

It is considered that proposals with a total eligible budget of at least EUR 8 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals with another budget.

Expected impact:

- Demonstrating a complete new value chain with higher added value products for new markets, produced from a residue from the agro-food industry.
- Improving of environmental impact and cost efficiency of resulting products as compared to state of the art benchmarks.
- Integrating a process with more than 40% of the agro-food side stream to be valorized to high added value additives.
- Demonstrating of products with a 5 times higher value than the current applications of the side stream, leading to a significantly higher total valorisation of the agricultural crops, thus improving the competitive position of food crops and contributing to rural developments and growth of jobs in rural areas.

Type of action: Innovation actions – Demonstration actions

The applicable conditions are set out in the Annex of the annual Work Plan.

BBI VC4.D5 – 2014: Cost efficient manure valorisation on large scale

Specific challenge: A number of EU regions are confronted with manure surpluses due to intensive livestock production. While large amounts of animal manure pose a management challenge for the livestock industry, its conversion into bio-based chemicals can be turned into an economical solution. State-of-the-art manure-based processes, which are applied at small scale and mainly for the production of biogas alone, do not represent an economically viable alternative. The valorisation of manure requires the development and demonstration of large scale (centralised) concepts and the integration of advanced separation and conversion technologies in a cascading approach to transform manure into a range of higher added value products.

Scope: Demonstration of the techno-economic feasibility of a manure valorisation process, by centralised cascading processing into added-value biochemicals, including biogas. Proposals should aim for a demonstration unit in which technologies proven at lab-scale will be efficiently combined and scaled-up. Conversion of processing residues should deliver mineral-enriched products for soil fertilisation as well as other higher added value chemicals. Involvement of actors owning or having direct access to manure, as well as end-users of the fertilisers and chemicals is to be considered to ensure the viability of the developed concepts in the value chain. Proposals will consider standardisation related activities expected to facilitate the market uptake of the developed bioproducts.

It is considered that proposals with a total eligible budget of at least EUR 8 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals with another budget.

Expected impact:

- Increasing cost–efficiency of manure processing towards a positive business case.
- Reducing GHG emissions of manure by 30% as compared to conventional processes.
- Turning negative value of manure into positive one, thus creating extra revenues for livestock industry currently coping with the manure as a costly problem.
- Enabling the decision making process to move into industrial scale by the successful demonstration of the whole value-chain from manure to application.

Type of action: Innovation actions – Demonstration actions

The applicable conditions are set out in the Annex of the annual Work Plan.

INNOVATION ACTIONS: FLAGSHIP

BBI VC3.F1 – 2014: Added value products from underutilised agricultural resources

Specific challenge: The agro-industry has significant opportunities for developing high added value products by valorising currently underexploited resources in new applications and markets. Two main feedstocks have been identified in this context: 1) growing dedicated non food feedstock in regions that are unsuitable for the production of food crops (e.g. oil crops in dry or marginal land); and 2) residues and side-streams from the agro-food value chain that are currently un- or under-utilised (e.g. vegetable pulp, bran, leaves). While demonstration activities are already being pursued to this end, the challenge lies in demonstrating at industrial scale a first of a kind, cost-effective new bio-based value chain for the conversion of the targeted streams into biochemical intermediates and subsequent production of added value products, e.g. biolubricants, bioplastics or biofillers.

Scope: Demonstration of the techno-economic viability of the sustainable conversion, by an integration of chemical and biotechnologies, of currently underutilised agricultural streams (which can be either oil crops grown in dry environments, crops from marginal lands, or residues from the agro-food value chain) from a local integrated supply chain into bio-chemical intermediates, and their subsequent processing into end-products (e.g. biolubricants, bioplastics and biofillers) at industrial scale (e.g. more than 30 ktons per year). Proposals should employ all possible means of industrial symbiosis and energy integration with the industrial environment and, wherever possible, make use of existing facilities. Safety, quality and purity of the end products should meet commercial requirements. Proposals should prove the economical access to sufficient raw material to set up the new supply chain and provide evidence that the used feedstock streams are either grown on land that is unsuitable for food production or represent a underutilised residue from the agro-food industry. A life-cycle assessment should be carried out in order to evaluate the environmental and socio-economic performance of the demonstrated value chain. Involvement of end-users is required with a view to ensuring the viability of the developed concepts in the value chain.

It is considered that proposals with a total eligible budget of at least EUR 25 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals with another budget.

Expected impact:

- Demonstrating a new local bio-based value chain maximising the use of currently underutilized agricultural resources for the production of chemical building blocks and consumer products e.g. biolubricants, bioplastics and biofillers.
- Developing new products with more than 70% bio-based content and less than 2.3 kg CO_2eq/kg emission.
- Demonstrating products with a 3 times higher value than the current application of feedstock side streams, leading to a significantly higher total valorisation of the agricultural crops.
- Creating green jobs facilitating the development of entrepreneurial activities throughout the entire region, with advantages for the primary sector (i.e. agriculture and livestock farming), the secondary sector (e.g. logistics, bioproduct transformation industry) and the tertiary sector.

Type of action: Innovation actions – Flagship actions

The applicable conditions are set out in the Annex of the annual Work Plan.