

VANGUARD INITIATIVE
New growth through smart specialisation

Bioeconomy Pilot

Action Plan 2019

30 January 2019

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Abstract

The **Pilot Bioeconomy Action Plan 2019** aims at integrating the results obtained from the demo-cases until now from a systemic perspective towards strengthening partnerships and defining a feasible financial route for the industrial results exploitation.

The Action Plan is also devoted to increasing collaboration among Vanguard Initiative regions interested in new potential demo-cases, exploring use-cases technologies and supporting regional Smart Specialization strategies.

Communication activities represent pillar tools to engage new regions interested in bioeconomy, support company involvement and increase the Pilot and the Vanguard Initiative visibility.

1. The Bioeconomy Pilot

1.1 Long term goal / vision

The **Vanguard Initiative - VI Bioeconomy Pilot** aims at setting up trans-regional value chains in the area of the innovative and sustainable use of renewable resources.

The general thematic domain of the Bioeconomy Pilot is focused on the production of high added value bio-based products besides food, feed and fibre. Biorefineries entail a mix of cutting-edge technologies with high potential for innovation and high added value.

The long-term goals of the Pilot are:

- Support the creation of new integral bio-based value chains and connections between chemistry, agro-food, bioenergy, biofuels sectors
- Promote new business opportunities through interregional cooperation and exchange of information and ideas
- Encourage projects at the demonstration and piloting stage towards their upgrading and business exploitation (beyond TRL 5).
- Support the establishment of investment pipelines based on industry-driven business cases coherent with the smart specialisation strategies of the participating regions.
- Promote the political engagement to position the smart specialisation agenda at the centre of the EU's drive for a sustainable economy

Led by **Lombardy (IT)** and **Randstad (NL) Regions**, the Vanguard Initiative Bioeconomy Pilot brings together all regions interested in the creation of a bioeconomy strategy and boosting innovation in the bio-based sector.

Thanks to a continuous mapping of funded projects on bioeconomy sector and interregional cooperation actions, **25 regions** have expressed interest and are involved in the Bioeconomy Pilot.

Most of them are directly involved in demo-cases and devoted in their regional priorities relevant interest in biorefinery, biochemicals, turning food&agri-food waste into added value products, renewable sources and bio-energy.

The participating and interested regions are listed below.

Asturias	Flanders	Navarra	Scotland	Trentino
Basque Country	Gelderland	North Netherlands	Skåne	Upper Austria
Central Sweden/Dalarna	Lombardy	North Rhein Westfalia	Slovenia	Värmland
Eastern Netherlands	Lower Austria	Piedmont	South Netherlands	Wales
Emilia-Romagna	Małopolska	Randstad	South Tyrol	Wallonia



VANGUARD INITIATIVE
NEW GROWTH THROUGH SMART SPECIALISATION

Bioeconomy - Interregional cooperation on innovative use of non-food Biomass

Led by **Lombardy (IT)** and **Randstad (NL)**, the partnership engages the participation of

25 Regions and Member States



1.2 Status and future of the demo cases

Since the start of the Bioeconomy Pilot, its activities have focused on mapping demonstration projects with a high technology readiness level and competitive impact at European level.

The most promising bioeconomy applications were identified within 7 thematic domains: lignocellulose refinery, bio-aromatics, bio-fuel (biogas, biomethane), turning waste into energy, biowaste valorisation, food&feed ingredients from agro-food waste and algae production.

In these technological areas, 7 demo-cases were established around the sustainable use of biomass for innovative material uses from their pre-industrial phase (research, development, pilot) and focused on demonstration and business potential upgrading.

Demo-cases born in the context of regional development programs or funded projects are characterized by a different level of technological maturity.

Those more recently developed, despite a high level of innovation, have required to strengthen skills and capabilities at a pre-industrial level (TRL4-5). Therefore, in 2018 in order to maximize the possibility of developing business models ready for the market, the 7 demo-cases were revised and merged into the most advanced ones.

The Bioeconomy Pilot is currently composed of **3 demo-cases**, for which of them the main thematic domain is shown in the table below.

Demo case	Thematic domains
Bio-aromatics	Creating interregional value chains to produce biobased aromatic molecules and innovative sustainable materials
Lignocellulosic biorefinery	Lignocellulosic biomass fraction conversion into intermediates and building blocks for biofuels and chemicals production
Liquified Bio-methane (LNG Blue Corridor)	Liquified Natural Gases (LNG) as a bio-based alternative for public transport and related value chains.

Thanks to the interregional cooperation activities promoted by Pilot, during the General meeting of November 13, **2 new potential demo-cases** were candidates as use-cases with high technology readiness level.

Demo case	Leader	Thematic domains
Biopolymers	Malopolska J. Haber Institute of Catalysis and Surface Chemistry of Polish Academy of Sciences (ICSC PAS)	Production of novel functionalised bioplastics (Polyhydroxyalkanoates - PHA) for medical and industrial applications from postconsumer feedstock and bio substrates
Forestry-based biomass valorization	Slovenia National Institute of Chemistry	Sustainable biomass transformation processes for the use of biomass down-streams and raw-materials

The strengthening of the potential applications of the two new demo-cases is one of the main missions of the Action Plan 2019.

1.3 Specific objectives of the Pilot

The specific objectives of **Vanguard Initiative Bioeconomy Pilot** for 2019 are:

- Objective 1.** Involve more potential users and technology providers from Vanguard regions by matchmaking events organisation
- Objective 2.** Promote proposal in H2020 and regional programs to bring new enabling technologies into the pilot plants
- Objective 3.** Support demo-cases in financing opportunities identification and business model design
- Objective 4.** Contribute to the definition of a new cross-regional circular economy alliance.
- Objective 5.** Mapping of use-cases in Vanguard regions, to identify technologies for the demo-cases pilot's enhancement and the creation of new ones.
- Objective 6.** Promote the visibility of the Pilot at European level

The Steering Committee has agreed to start an identification process of the most appropriate external service provider for the technical assistance of the demo-cases on the basis of their experience, specific knowledge of the bioeconomy and overall quality of their proposal.

1.4 Strategic activities expected by the Pilot

During 2019, main activities expected by the **Bioeconomy Pilot** will be performed by the Steering Committee, with the general aim to support the market uptake of the demo-cases industrial applications.

According to the above-mentioned Pilot objectives, relevant actions are listed below.

Activity 1. Matchmaking events organization.

The overall focus of this activity is to support the increasing participation into demo-cases by other organisations who are interested in similar fields or are part of the same industry operating in the VI regions.

The Bioeconomy Pilot matchmaking events will be organised in order to link up commercial, technological and research partners, by promoting a demo-case co-operation profile on a b2match matchmaking platform, containing relevant information on the interest, needs, skills and services that are being looked for. This profile is then made available to potential participants, so they know if there is something for them at this event.

The online tool is also beneficial because it provides support to all those interested in participating in the event. The Pilot will map all most interesting events, congress, fairs, initiative planned in 2019 all over the Vanguard Initiative and will help organisations to succeed and work together with others to advance the commercial maturity of bioindustry throughout VI regions.

Activity 2. EU funding opportunities for demo-cases upgrading

The overall focus of this activity is to provide a funding opportunities framework able to increase the demo-cases technologies upscaling. It will be also focused on help demo-case to connect to the specific consortia being formed for the most interesting call topics under analysis, introducing and supporting them into exploring new business opportunities. The Technical coordinator of the Pilot will provide an overview of EU funding opportunities towards innovations in Bio-Based and Bioeconomy sectors to bring new enabling technologies in the demo-case and help them to boost market uptake of results. The relevant call topics belonging to the BBI, H2020 funding programs have been scanned for the target period from 2019 to 2020. A mapping of international cooperation (partnership and technologies searching) by Enterprise European Network and Funding & tender opportunities of EU Participant Portal will be provided.

Activity 3. Business model support

The overall focus of this activity is to support the intended priority and activities of demo-cases to define funding instruments for supporting further infrastructure upscaling. The Pilot will support demo-cases in the definition of market development, detailed knowledge of bioeconomy stakeholders across business and academia and our understanding of the innovation process.

The business model support will help the two potential new demo-cases to strengthen interregional cooperation among Vanguard regions on their thematic domains and to identify applications and technologies ready for the market.

Activity 4. New cross-regional circular economy alliance.

The overall focus of this activity is to boost innovation and competitiveness on 30 VI regions in Europe. Most regions are aware that Bioeconomy R&I requires alliances with other regions and stakeholders, to optimise investments and develop technologies/products ready for the market.

In this regard, the Bioeconomy Pilot will create connection and partnership with the EU project and other networks operating in Bioeconomy sectors, such as:

- The European Bioeconomy Network (<https://een.ec.europa.eu>)
- ERRIN – European Regions Research and Innovation Network (<https://www.errin.eu/>)
- Pilots4U - A network of bioeconomy open access pilot and multipurpose demo facilities (<https://biopilots4u.eu/>)

This strategy will help to explore synergies with linked value chains like bioenergy, advanced manufacturing and agro-food.

Activity 5. Mapping of new potential use-cases in Vanguard regions.

The overall focus of this activity is to identify projects and initiatives of VI regions supported by H2020 and European Structural and Investments Funds – ESIF, according to the current **Smart Specialization Strategies** (RIS3), able be connected and integrated with the demo-cases.

This study will help to define similarities, commonalities and specificities among regions with a potential to be transferred to the demo-cases and to create new ones. New Bioeconomy technologies, business cases, demonstration plants with a high technology readiness level - TRL will be considered to promote knowledge exchange and support upscaling activities of the existing pilots. In order to evaluate the possible synergies with already ongoing initiatives, a mapping of the most relevant European projects in the bioeconomy and biobased sectors will be carried out.

Activity 6. Communication and Networking.

The overall focus of this activity is to increase awareness, the participation of relevant stakeholders the demo cases and at supporting the exploitation of the demos' results. They will include:

- Close checking of strategic and operative planning documents
- Production of information material on the Pilot (roll-up, leaflet, poster)
- Direct contact with VI regions to identify Bioeconomy Points of Contacts
- Direct connections with VI member regions stakeholders
- Identification and contact with strategic stakeholders (cluster, associations)
- Produce/distribute information in close cooperation with Vanguard communication unit
- Organisation and participation in events where the Pilot will be promoted
- Support to Pilot members when participating in specific demo-cases related events
- Contacts with key players at European level

1.5 KPIs

Seventeen KPI's have been proposed and will be regularly updated.

The pilot will sum up all demo cases KPIs, add potential pilot-level ones, for a comprehensive reporting.

Performance indicators	KPI	Means of verifications
Critical mass - Active participation in demo cases		
Total Number of Regions identified in the partnership (pilot level)	~ 2 new regions involved	Bioeconomy Pilot database implementation
Number of active regions participation in demo case	~ 2 new regions involved	Engagement in Matchmaking events
Number of demo-case leaders committed (pilot level)	~ 2 new demo-leaders	Attending to the General Meeting
Number of RTOs/Universities	~ 10 contacts	Bioeconomy Pilot database implementation
Number of companies (large & SME)	~ 10 contacts	Bioeconomy Pilot database implementation
Number of Clusters/intermediaries	~ 3 contacts	Attending the meeting/events
Number of industrial Associations involved	~ 3 contacts	Attending the meeting/events
Knowledge creation (Learn)		
Number of distinct relevant mapping exercises (pilot + demo cases)	~ 10 potential uses-cases	Report on useful uses-cases
Number of value chains identified & workable (the pilot/demo can involve the minimum number of players for practical implementation)	~ 3 contacts	Report on useful uses-cases
Connect the actors (Connect)		
Number of R&D/business projects launched through the initiative, but that does not take place under the scope of a demo case	~ 2 business project	Report
Number of submitted project proposals directly related to the scope of the pilot/demo case	~ 1	Project proposal abstract
KPIs Launch projects and deploy technologies (Demonstrate – Commercialise)		
Number of new cooperation projects launched by project partners (in the context of demo cases)	~ 1	Project proposal abstract
Number of entities involved in started projects	~5	Project proposal abstract

1.6 Governance

The Bioeconomy Pilot is coordinated by the regions of Lombardy (Italy) and Randstad (Netherlands). They jointly supervise the management activities that have been assigned to the Lombardy Green Chemistry Cluster – LGCA.

All pilot members meet at least once annually. Participation to the Pilot is managed in accordance with the VI Internal Rules. In addition, each demo case has a leader and at least a co-leader, who is responsible for its implementation. If deemed appropriate, demo-cases may have a Core Team jointly responsible for the development of the demo. They currently are:

Demo case	Leader	Co-leader(s)
Bio-aromatics	Vito (Flanders) <u>Ludo Diels</u>	TNO / South Netherlands, Clib2021 / North Rhine Westphalia
Lignocellulosic biorefinery	Biobased Delta (Zuid-Holland) <u>Willem Sederel</u>	IBIOC/Scotland, BioComposite Centre/Wales, Government of Flanders
Liquified Bio-methane (LNG Blue Corridor)	Aster (Emilia Romagna) <u>Daniela Sani</u>	Chamber of Commerce of Milan and Lombardy Green Chemistry Cluster (Lombardy)

The Pilot has a **Steering Committee** to guide the Pilot, formed by all the case leaders, the 2 representatives of the Strategic management and the technical coordinator. The Steering Committee has regular a two-monthly meeting or calls to discuss progress and decide on actions. Given the low number of demo cases, it has been agreed that also co-leaders should be participating, to increase its representativeness.

The **Pilot technical coordination** is carried out by the Lombardy Green Chemistry Cluster - LGCA. It is responsible for the overall coordination of the pilot, participation to the different Vanguard meetings (unless another member of the pilot is identified for specific topics, e.g. communication) the support to demo cases, monitoring and reporting, and all other activities that will be specified in the agreement with the Vanguard Initiative Asbl.

1.7 Resources

The VI Bioeconomy Pilot resources for 2019 have been estimated to 85.445,07€.

The total amount of the budget is calculated as the sum of the “Net Pilot Specific Funding” (F) and the “Positive Balance to carry on to 2019” as the remaining budget from the previous year (C).

(A) Amended 2018 Pilot Funding	(B) Total 2018 expenditure	(C) Positive Balance to carry on to 2019
64.431,00	31.854,63	32.576,37

(D) 2019 Pilot Funding	(E) 2019 EUR contribution to Cross Pilot Budget	(F) = D-E 2019 Net Pilot Specific Funding	(G) = C+F 2019 Total Pilot Specific Funding
64.000,00	12.800,00	51.200,00	83.776,37

A detail description of the expected costs for 2019 is reported below.

a. Staff costs		0,00
	Sub-Total	0,00
b. External assistance costs		
Pilot Technical coordination		40.000,00
Business model support for demo-cases		8.000,00
Supporting on the mapping of new potential use-cases in Vanguard regions		8.000,00
	Sub-Total	56.000,00
c. Travel and accommodation		
Attending the VI meeting and events		2.520,00
Attending to the S3 events, matchmaking events and 1to 1 sessions		5.520,00
	Sub-Total	8.040,00
d. Other direct costs		
Public events operation costs for seminars, workshops and meeting organization (catering, fair exhibitions space renting)		8.000,00
Viral marketing and Bioeconomy Pilot communication on Social network (video, post and promotional campaigns design and development)		5.000,00
Printing of dissemination materials (flyer, roll-up, poster, public report)		4.211,25
	Sub-Total	17.211,25
e. Administration costs (overheads)		
0,10% of Total Direct costs (excluding External assistance costs)		
	Sub-Total	2.525,12
	GRAND TOTAL	83.776,37

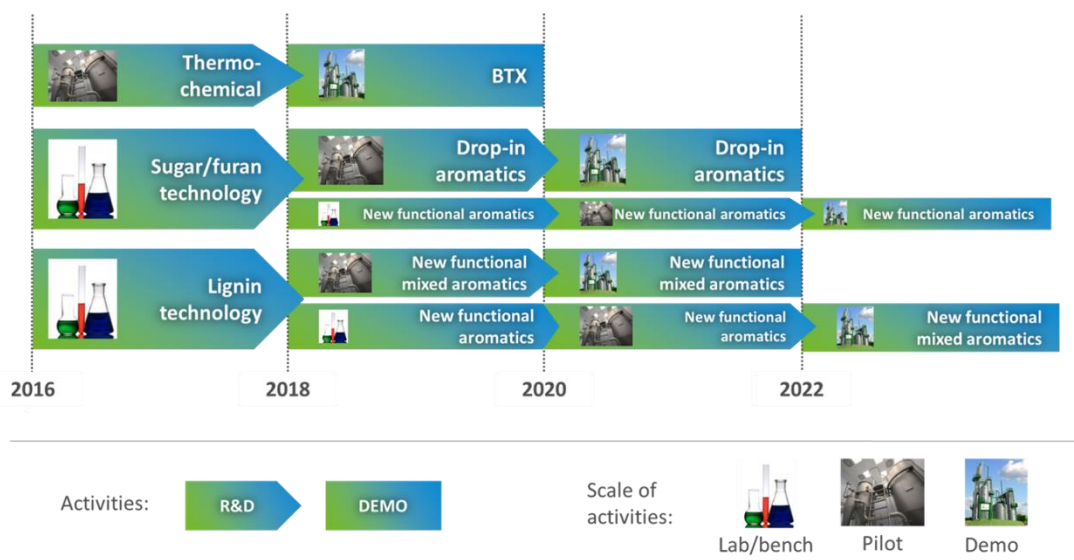
2. Demo cases

2.1 Bio aromatics

The Bio-aromatics case started in 2012 as the Biorizon initiative between VITO and TNO to evaluate the needs and potential of working on aromatic molecules of bio-origin. After a workshop with 26 industrial representatives 3 Horizons were defined:

- Thermochemical processes: leading mostly to bio-based BTX molecules
- Sugar-line based on furan and Diels-Alder chemistry: leading to functionalized furans and aromatics
- Lignin line based on depolymerisation, fractionation, conversion: leading to innovative functionalized molecules

The three Horizons are presented below.



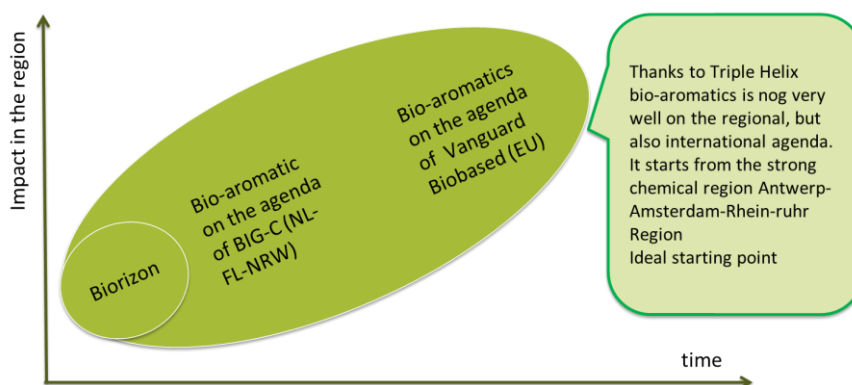
The shared research center was set up in the framework of the Green Chemistry Campus in Bergen-op-Zoom in collaboration with REWIN.

After a second workshop with authorities, it was decided to expand the collaboration as a Netherlands – Flanders collaboration.

In 2014 the business was extended to NordRhein Westfalen by establishing BIG-Cluster, the BioInnovation for Growth Cluster. This cluster had one of its flagships devoted to Bio-aromatics.

In 2016 ECN joined the Biorizon core team and took the lead of the Thermochemical Horizon.

This cluster served as the core and core team of the VI-case on Bio-aromatics.



Since the start of the VI-Bioeconomy Pilot the case of Bio-aromatics was seen as the fastest growing demo case. This was due to the strategic decisions in the directly involved region and the strong core business (BIG-Cluster) with the approval of many research and demonstration projects.

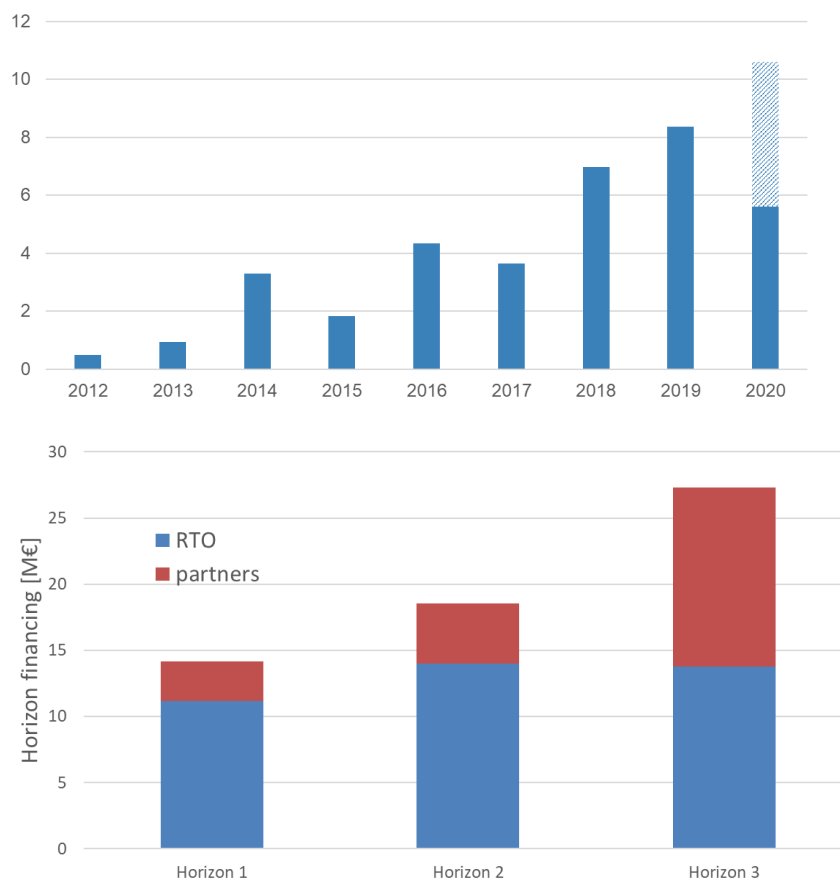
In 2017 the case started to involve also the people from different regions.

20 regions are involved now, **15** of which belonging in Vanguard regions: **Flanders, Randstad, North Rhein Westfalia, Slovenia, Piedmont, Upper Austria, Lower Austria, Wales, Basque Country, Wallonia, Värmland, Navarra, Lombardy, Emilia-Romagna, Scotland.**

Central Germany (Saxony, Ann Halt Saxony – VI Observer, Lower Saxony, Brandenburg, Thuringia), Hungary, Helsinki-Ussima, Estonia (not Vanguard Initiative members) are participating in demo-case activities.



In 2018 the case worked on the further development of the core team and its activities and on the set up of several value chains among the regions. These value chains are available in draft form but are not yet approved by all the participating regions. So, it could not be presented in this report. The graph below gives an overview of the budget growth only for Biorizo, clearly showing that there is a strong budget rise. This is due to the fact that several pilot plants are financed and operational or in preparation. The second graph gives an overview of the budget per Horizon. Especially Horizon 3 shows a high partner involvement indicating the interregional character of this Horizon, the need to share knowledge and critical mass due to the complexity and challenges of this approach.



At the moment, more than 40 companies are involved in ongoing projects.



2.1 Goal of the project

The final goal of the Bio-aromatics project is to reach the first commercial applications in 2025. This means that value chains must be set up without any gap with a certainty of the supply chain and a certainty of the market place and a certainty that production will be feasible.

The project will focus on the:

Supply chain:

- evaluation of biomass for aromatics (BTX)
- evaluation of biomass for sugar fractions (furans)
- evaluation of all kinds of biomass and lignins (lignin-aromatics)

Pilot systems of the technology

Preparation of the Demo systems

Application of the new and innovative aromatics in several domains

Production: **several pilots started in 2018** as well as projects for further development of pilot plants are approved or in the approval phase:

- Preparation of projects for the Fabiola pilot plant for pyrolysis-based lignin production
- The Lignovalue pilot plant (EFRO) in Flanders is approved and will be working beginning 2020 at 250 kg/hour.
- Acid-catalysed dehydration plant is operational
- The Diels-Alder pilot has become operational in Bergen-op-Zoom.
- Several other pilot plants are already involved or under preparation (design phase)
- A full lignin-application lab is installed at the GCC in Bergen-op-Zoom.

Applications: many applications are under development in open innovation programs (resins, polymers, polyurethanes, additives, flame retardants etc.) as well as in bilateral programs (confidential).

In Bergen-op-Zoom now the Application Lab is fully operational with more than 12 collaborators as part of the large Brabant Plan.

As part of the Thematic Smart Specialization Platforms a basis for a business plan is made to outperform fossil-based aromatics with new functionalized lignin-based aromatics. This plan is based on the availability of several lignins in the involved regions (coming from pulp & paper business, 2G-ethanol production and from innovative processes and ionic Liquids, deep Eutectic solvents etc.).

As a way of handling the complexity and lack of lignin reactivity, lignin depolymerization or thermal treatment are used. This is supported via the Lignovalue pilot plant (lignin depolymerization) and via the production of CAT-Lignin.

Besides this first set up of a business plan several other unique roadmaps are under preparation with the different involved regions linked to applications. As they are not yet approved, they will be presented in the next reporting period.

2.2 Specific objectives for 2019

Objective 1. Engagement of Vanguard Regions.

Approved program and value chains for the 18 Vanguard regions. This will not be one value chain, but about 5-8 potential interregional collaborative routes.

Objective 2. Business Plan and biomass assessment

- Business plan of the TSSP-value chain approach
- Overview of feedstock availability (linked to the lignin)
- List of potential biomasses (for thermochemical processing?)
- List of carbohydrate-containing feedstocks (waste streams, by-products from biorefineries)
- List of aromatic molecules that can be made at a reasonable scale and costs from sugars
- Design of the Lignovalue pilot plant and the start of its erection

Objective 3. Collaborative actions through financial instruments

- Set up of an INTERREG project on the further development of the Lignovalue pilot plant. Budget for the core business is approved. Several side elements in the overall scheme still need to be supported. This will be done via INTERREG, OP-Zuid, BBI, TSSP (later DG-Regio Component 5).
- Set up of a BBI-project on functionalized aromatics from sugars
- First results of the Flanders – NordRhein-Westfalen collaboration project ALIGN
- At least 5 leads with companies
- List of all involved pilot plants
- VI-core team strategy
- Overview of analytic tools and standards. This is ongoing via CSA-action supported by NRCan, FP-Innovations, WUR, RISE, VTT and VITO
- Continuation of collaboration with ECHA on the REACH-evaluation of lignin-derived products.
- Results of on-going project and first results of new projects (e.g. Catalisti project Bioresal).

2.3 Actions that need to be taken to achieve the objectives

Activity 1. Business model development

Business model development for Biorizon Shared Research Centre & eco-system (which services does Biorizon want to offer, in which manner: more than just R&D, also on eco-system development & business).

Activity 2. Validated techno-economic models that build trust at chemicals producers

- Less-mature: highly risky R&D projects: funding with comparatively high funding quota but low overall budgets (ongoing via fundamental research at the universities)
- Mature projects: funding for pilot plants; significant industry involvement; higher budgets needed

Activity 3. Stakeholder engagement

- Involvement of local governments
- Yearly Biorizon event
- Bio-aromatics workshop at the BBI-matchmaking event on 20 February 2019

Activity 4. Financial instruments access

Preparation of new BBO-proposals (e.g. BBI2019.SO2. D1)

2.4 Timeframe for the project (3 years)

- End 2019: business plan of TSSP-value chain proposal
- 28 February: first approved value chains besides the TSSP-proposal
- September 2019: full design of Lignovalue plant
- September 2019: first set up of NEWCO as a way to develop the pilot plant into a next stage, being the demoplant
- September 2019: submission of several new BBI-proposals
- June 2019: first attempt to make a broader budget overview of involved partners outside Biorizon

2.5 Milestones

- 2019: 4 pilot plants
- 2019: Full design of Lignovalue pilot plant
- 2020: Lignovalue pilot plant
- 2020: Different leads with companies leading to several demoplants
- 2021: Demonstration plant (TRL6-7) for sugar/furan-line
- 2025: 5 different full-scale economic applications

2.6 Deliverables

The deliverables will be agreed for the different value chain proposal by June 2019.

2.7 Resource requirements for the actions

The resources needed for the actions are estimated at more than 50 million € until 2020. Between 2020 and 2025 estimations go to 100 million € per demoplant (5 demoplants are expected). Part of it is already approved. For other parts regional budgets, INTERREG, BBI, SPIRE and FP9 are envisaged to be used together with EFSI and EDB budgets for larger investments especially from 2020 on.

The demoplants will be combined with existing lignin producers, new lignin producers, innovative lignin producers and biomass pretreatment companies. These demoplants will be in the order of 20 tot 50 million euros each.

2.8 Other resources for the actions

- Bio-Economy pilot action of DG REGIO
- Cluster organizations as Catalisti, Biobased Delta, CLIB2021 with their related funding organisations (VLAIO, OP Zuid, BMBF, ...)
- INTERREG projects ongoing or in the pipeline
- Other cluster organization of the 18 regions
- DG-Regio Component 5, to be active in 2021
- Private investments
- Public investments (e.g. from VMH)

2.9 Responsibility for each task

The core team will start now with specific meetings devoted to the other VI-members. Up to now this was in line with the BIG-Cluster team. This will be further elaborated as a team for VI.

2.10 Identify monitoring and evaluation steps in our action plan

The monitoring and evaluation steps will be based on the deliverables of the on-going projects. We suggest that we list all projects that can be considered under the VI and put in a table the progress, commitment of companies and progress toward pilot plants. An overview table is already available and improved during the last VI-bio-aromatics meeting on 14 November 2018.

An overview of involved companies will be provided. For confidentiality reasons, the topics will not be provided.

As KPI's the Bio-aromatic case proposes:

- Number of projects involved
- Budget of the projects involved
- Number of companies involved
- Number of product lines proposed

2.11 Monitoring

The VI-case Bio-aromatics will make six-months evaluations of the state of the art, progress, success and hurdles on its way towards commercialization.

2.12 Communication strategy/Marketing Pilot demo case

Biorizon has a strong communication strategy with a separate communication manager. This strategy will be further developed toward VI.

Collaboration:

The case bio-aromatics has a strong inter-case collaboration with the lignocellulose biorefinery as this can be one of the new sugars and lignin providers for the future. So, the two cases will work in strong contact with each other and align their strategies.

The case bio-aromatics has also strong inter-pilot collaboration with additive manufacturing as the case starts to work on producing materials to be used in future 3D-printing. First real steps in this collaboration will be set in 2019.

The Initiative has many contacts with networks and strategies outside the inter-regional collaboration as well:

- Lignin Club: is a collaboration between lignin producers or biorefineries and the European Chemical Association CEFIC. This Lignin-Ecosystem is now fully operational.
- International collaboration between VI-bio-aromatics and Canada via FP-Innovations, BioIndustrial Innovation Canada, National Resources Canada, etc. Formal agreement is under preparation.
- An international collaboration between VI-bio-aromatics and India via the road map for collaboration in Bioeconomy between India en Europe. Further negotiations are ongoing in view of the strong initiative in India for the set up of more than 12 2G-bioethanol plants.
- An international collaboration between VI-bio-aromatics and Brazil via the Bioeconomy strategy of the Brazilian government and especially via the Universidade Federal do Rio de Janeiro.
- Set up of a collaboration with the University of Concepcion in Chile.
- A project started between Flanders and Vietnam (universities in HCM-city and Hanoi) on the extraction of rice-lignin and its depolymerization.
- Not yet fully established collaborations with Malaysia, Indonesia, Thailand, China
- Collaboration with New Zealand via Scion

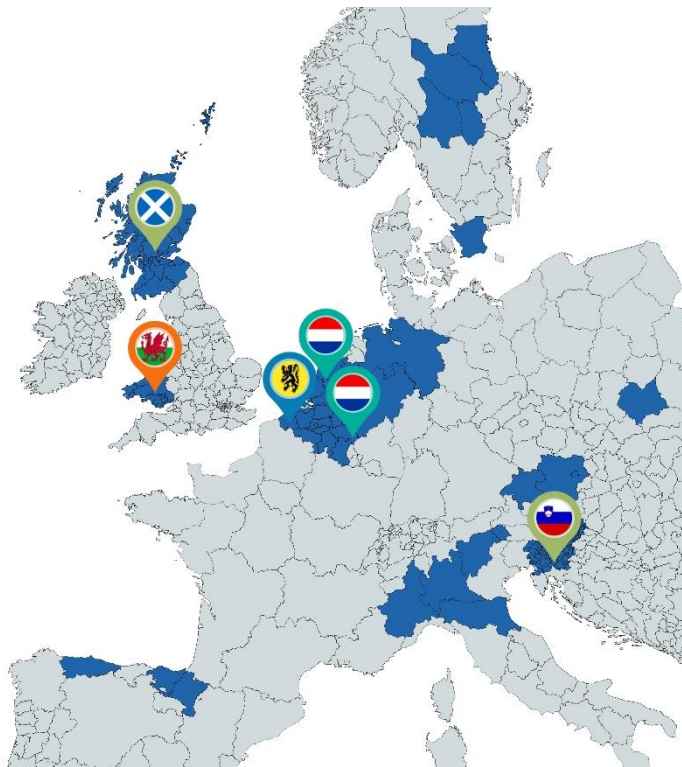
2.2 Lignocellulosic biorefinery

Facing the conceivable depletion of fossil energy sources, fostering a new economy aims at shifting the production of fuels and chemicals from a petrochemical basis to renewable resources via biorefining.

The Lignocellulosic biorefinery demo-case has embraced main projects and collaboration promoted by Core team operating in **Scotland, South Netherlands, Randstad, Wales and Flanders** focused on efficiently separate and convert the different lignocellulosic fractions into intermediates and building blocks which can be used to manufacture biofuels and chemical products.

An active European **expert group** from the regions made up of knowledge centres, industry and governments promote and accelerate Lignocellulosic Biorefining into viable, sustainable end products by sharing insight, best practices and benchmarking technical/economical as well as non-technical aspects (policies, regulations, stimulation, social innovation etc.).

During 2018, an intensive mapping of interest in lignocellulosic biorefinery among the VI regions fostered engagement of interested parties from **Slovenia** and collected useful information-analysis from Lombardy, Emilia-Romagna, Upper Austria and North Rhine Westfalia.



The Lignocellulosic biorefinery demo-case will address prominent social challenges for the next future concerning energy supply and environmental preservation. The valorization of lignocellulosic value product streams will direct the development and application of industrial biotechnology to produce high-value products such as fine and speciality chemicals.

The key research and development need outlining in the European Biorefinery Joint Strategic Research Roadmap for 2020 is to develop routes where value can be extracted from all three major components of lignocellulosic biomass. However, the biorefinery needs further develop; at present, the majority of lignocellulosic biomass is processed with the aim of producing a single product while sacrificing a significant proportion of the remaining material and furthermore during the fractionation process these materials are degraded with an unavoidable loss in their efficacy and value.

The various approaches and technologies have different TRL levels, ranging from 3 to 9, and they are consequently currently carried out at different scales. Scale is also depending on the type of biomass that is used as feedstock. Some feedstocks can be transported over distance, some cannot due to their low dry solids content or low density (fluffy). Transportation costs become then too high to be economically feasible. So sometimes the feedstock goes to a central biorefinery (advantage scale (= capex)), sometimes the biorefinery is delocalised and goes to the biomass (advantage =opex). Hence the optimal solution is very situational.

For mixed C5/C6 cellulosic sugars the conversion to **ethanol** is commercially exploited in the USA (DSM/POET and Synata BIO), Brazil (Granbio) and up till recently in Italy (Beta Renewables). Clariant is building 50 KT bio-ethanol plants in Slovakia and Romania) using wheat straw as feedstock. Lignocellulosic biomass has a great potential to produce bioethanol in significant quantities. According to the findings reported by Kim & Dale (2004), lignocellulosic waste from crop residues and feedstock can produce 442 GL/ year of bioethanol and this production can replace 351 GL/year of gasoline if it is used in E85 vehicles. Hence, the research interest for using bioethanol as a source of renewable fuel is huge.

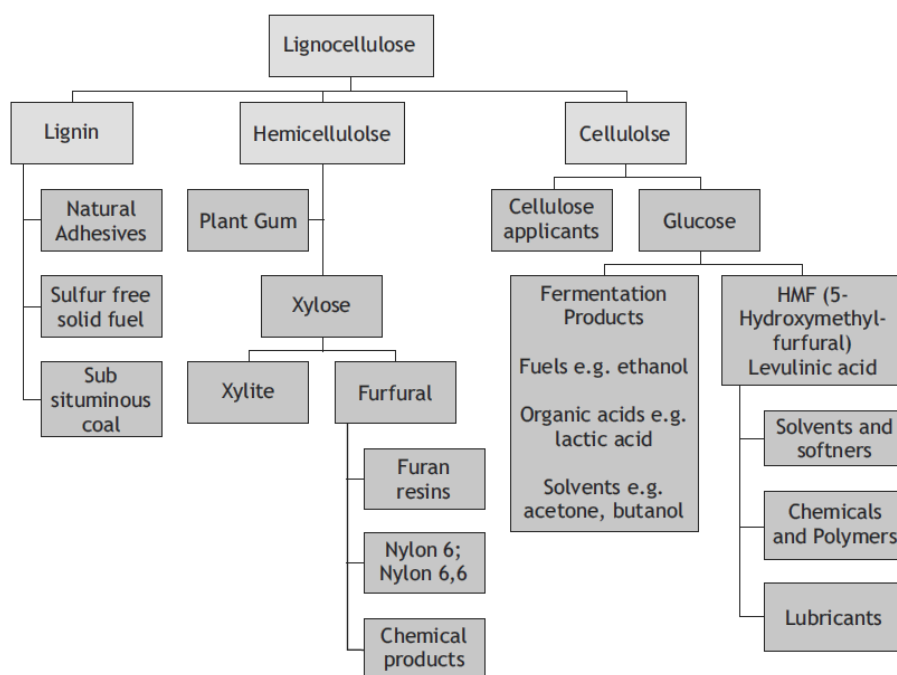


Figure 1 Biorefinery: Potential products lignocellulose biorefinery
 [Ghanshyam Dass Tandon, Bioproducts From Residual Lignocellulosic Biomass]

Other products such as **lactic acid** (Nature Works, Corbion), succinic acid (BioAmber, Reverdia, Succinity) (iso)butanol (Gevo, Butamax, Green Biologics) BDO (Novamont), amino acids (Evonik, Ajinomoto) require relatively pure C6 sugars for conversion via fermentation. Sugars can also be processed via green chemistry routes to HMF, FDCA (Avantium, Corbion, ADM) and other furans converted in oxygenated or aromatic products (see Bioaromatic case/Biorizon). Lignin can be incinerated to generate energy, be turned to panel boards, fuels (bunker fuel), replacement of bitumen in asphalt, activated carbon black or other building blocks. Conversion to aromatic compounds (Biorizon) and other high-value chemicals (Carbon fiber) are being successfully developed and scaled-up. The above outline leads to the conclusion that lignocellulosic biorefining is a strategic topic for the EU and a tremendous opportunity.

2.1 Goal of the project

The ultimate goal of this demo case is the realisation of new value chains starting from available (homegrown or imported) lignocellulosic feedstock by using biorefining. This will be done via smart and rapid translation and adjustment of the value chains proven successful in one region to other regions with comparable characteristics. In order to achieve this, the VI methodology will be followed, namely by first going through the learn and connect phases. The result is a kind of specific regional pre-feasibility study based on available knowledge and insights of the participating regions with the aim to translate this further by using the same process. Regions share insights to receive relevant know-how to assess their specific biorefinery business case without infringing rights of third parties.

2.2 Specific objectives for 2019

The goals for 2019 are mainly focused on connecting the right actors and learning about the opportunities.

Objective 1. Increase the VI regions participation in demo-case.

Continuous monitoring activity of interested companies and research centers in VI regions will be carried out to increase participation in biorefinery demo-case. This action will also support the **evaluation use-cases** with potential scale-up and integration of the project results within existing and future biorefineries.

Objective 2. Define new value chains.

Based on the mapping of the most promising technologies, **new potential value chains** will be designed for the transformation of different lignocellulosic fractions to discrete product streams, less energy demanding and environmentally compatible.

Objective 3. Reinforce the expert group with triple helix composition overall.

A range of demonstration and dissemination activities to engage with key stakeholders across the biorefinery value chain will be promoted. Specific activities will include a series of targeted conference and dissemination campaigns to engage biorefinery value-chain stakeholders and communicate the project results.

2.3 Actions that need to be taken to achieve the objectives

Activity 1. Regions engagement on lignocellulosic biorefinery

A systemic mapping of the most relevant actors operating in biorefinery sector into the Vanguard regions will be focused on:

- Organise meeting with core team to develop further the concept
- Involve triple helix partners or triple helix clusters, assure commitment
- Approach the other Vanguard regions by mail to participate in the expert group Test interest If sufficiently high (at least 2 other regions commit)

Activity 2. Most promising use-cases

The definition of a new most promising value chain in biorefinery sector will address to:

- Define and improve at least two value chains and common priority into the Vanguard regions
- Involve interested parties with a sound concept
- Collect all necessary information-analysis of other interesting demo use-cases

Activity 3. Increase visibility and participation on biorefinery topic

Several dissemination and communication initiatives will be promoted to increase the visibility of the demo-case, such as:

- Organise meetings with experts to develop the concept further
- Connect to experts representing the triple helix
- Development of promotion material to solicit interest by the other Vanguard regions
- Translate to other areas with similar characteristics
- Distil success factors for other value chains

2.4 Timeframe for the project (3 years)

To be defined at a later stage.

2.5 Milestones

- 2019. Vanguard regions show interest in the project beyond the core team
- 2019. Mapping of use-cases in the Vanguard regions

2.6 Deliverables

Deliverable	description	by	type	dissemination	timing
1a	Core team meeting	BBD	Email	public	Q1 2019
1b	Promotion material	Core team	Doc	public	Q2 2019
1c	Updated interest regions	Core team	Email	public	Q2 2019
2a	Meeting of Expert group	Core team	Meeting	open	September 2019
2b	Collect information from other areas	Expert group	Report	public	Q4 2019
2c	Improve the value chain	Expert group	Meeting	open	December 2019
4a	Organise events	Workgroup	Report	public	Q4 2019
4b	Design promotional materials	Workgroup	Report	public	Q3 2019
4c	Share with the regions	All	Meeting	open	Q4 2019

4d	Translation	Expert group	Meeting	open	Q4 2019
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2.7 Resource requirements for the actions

Finances are estimated at the level of 250 K€ for pre-feasibility 2 value chains. Realization of the pre-feasibility into feasibility and engineering will require multimillion euro per project.

2.8 Other resources for the actions

Project management contact with companies, knowledge institutes, regional governments at different levels, modelling, expert knowledge, consulting, maybe legislation/policy.

2.9 Responsibility for each task

Responsibility for the different tasks is allocated as follows:

- For setting- up the **core team** the region SW-NL (represented by Biobased delta) is in the lead. Responsible person: Willem Sederel.
He is also responsible for providing an updated action plan to the overall leader of the Vanguard Bioeconomy Pilot.
- For setting up the expert team, the core team is responsible. More consultation is needed for developing a more concrete action plan.
Responsible: core team Scotland/Wales/Flanders/SW-NL
- The expert team is responsible for the definition of the value chains and common priority. More consultation is needed for developing a more concrete action plan. Responsible: Wales/Scotland with Rob Elias and Ian Archer as responsible persons
- For the value chains, the leader of Workgroup 1 and 2 are responsible. More consultation is needed for developing a more concrete action plan. Responsible: workgroup leader 1 and 2, if not defined expert leaders Rob Elias and Ian Archer.

2.10 Identify monitoring and evaluation steps in our action plan (align with KPI 's)

- Regions involved and committed via regional governments
- Companies involved and committed
- Knowledge institutes involved and committed
- New Value chains identified (for regions)
- Roadmap with SMART actions and translations
- Pre-feasibility studies for Business cases evaluated by experts
- Quality assessment of the Pre-feasibility studies (usefulness for translation)

2.11 Monitoring

The following means will be used to monitor

- Reports from the core team, expert group and working groups lignocellulosic biorefining Vanguard. Report from the overall leader Bioeconomy Pilot Vanguard Initiative
- Updates on Vanguard meetings
- Communication overview

2.12 Communication strategy/Marketing Pilot demo case

One of the key communication messages of Lignocellulosic Biorefining is its climatic benefits and the valorization of novel value chains. Communication will be done with the communication channels of the participating regions, clusters, companies and scientific partners, and via the Vanguard office

2.3 Liquefied Bio-methane - LNG Blue Corridor

In the last years, the topic of Liquefied Natural Gas / Liquefied Bio-Methane (LNG/LBM) has raised growing interest as an opportunity to finalize previous efforts on a more general shared approach to the topic because of the evolving legislative framework and increasing interest & investment projects by different companies.

Region **Emilia-Romagna**, together with **Lombardy**, have been working on a draft idea for a pilot project on this topic, focusing on the deployment of technologies that would speed up the development of LNG/LBM as an alternative fuel in heavy transports.

Randstad, **Upper Austria**, **North Rhine Westphalia**, **Northern Netherland** and Brandenburg (not a VI member) have already expressed their interest and participated in several teleconferences and organized a dedicated meeting in Milan in 2018.

The LNG market has more than tripled in the period from 1995 to 2011. After a few years of stalled growth, the total trade reached a maximum in 2015 with 245 MT. Global outlook for this energy carrier anticipates further growth. To the European Union, LNG represents a mean to make the EU's gas system more flexible and diverse, thus contributing to a more secure, resilient and competitive gas supply. In the transportation sector, the energy carrier is especially attractive as fuel to heavy-duty vehicles and ships: the product comes close to the energy density of diesel while it produces far less air emissions and noise nuisance.

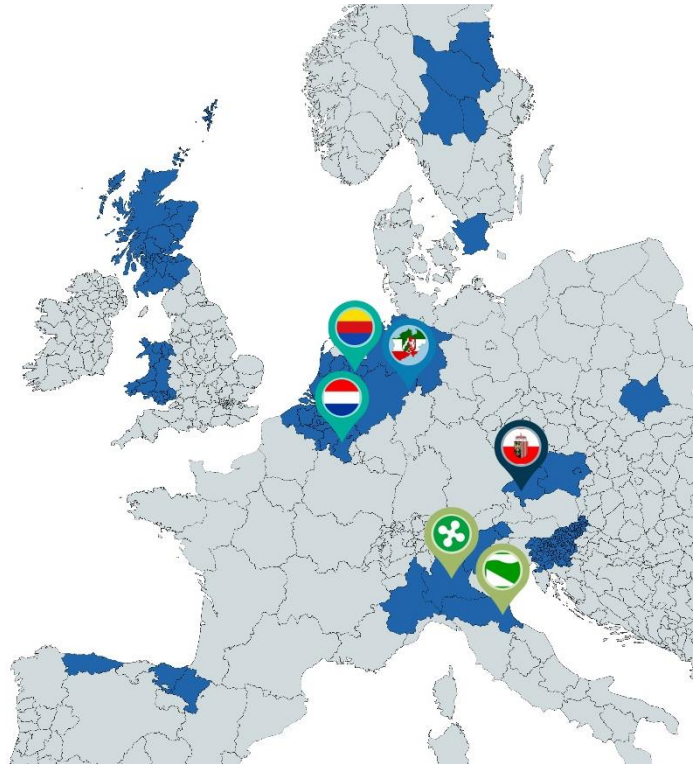
LNG is considered a transition fuel on the road to renewable energy production and use. Liquid biomethane (LBM) can further decrease net emissions and increase the sustainability of transport fuels. The raw material for this energy product is biogas from anaerobic digestion or gasification. The estimated European production potential of biomethane has been estimated to lie between 151 and 246 billion m³ per year based on biomass sources such as wood, herbaceous materials, wet biomass residues and energy crops. These numbers convert to 109-178 MT of LBM.

At the same time, production cost needs to be lowered by innovations on liquefaction, gas upgrading and biogas production. The Seventh Framework Program project "LNG Blue Corridors" has assessed the potential of LBM in Europe and concluded on a number of recommendations to realize a renewable share in the heavy-duty transport sector. These range from financial instruments to standardisation and further technical developments.

The production of LBM based on anaerobic digestion requires an R&D effort. Biogas production costs are very much determined by the cost of marketing & disposing of the digestate (fertilizer) and the cost of the biomass. Cheap biomass usually produces a low amount of biogas unless an effective energy-efficient and robust pretreatment technology is being used. In addition, methanization of CO₂-emission from biogas plants could help to reduce cost if excess renewable energy is available. Biogas upgrading technologies are available (in 2013, there were already 282 plants in operation that produced upgraded biomethane from biogas) and so are liquefaction technologies.

Yet, they need to be more cost effective (especially liquefaction) on lower scale levels to be feasible for use in the EU's anaerobic digestion plants. There is a need for an R&D and knowledge exchange strategy to boost this development in the required direction and realise the EU's potential.

A few LBM plants in Europe are in production (Sweden, UK, Norway) or under development (The Netherlands, where an innovative liquefaction technology has been successfully tested on a proof-of-principle scale level using a variable quality of biogas). These initiatives could provide valuable information on the present-day state of the art and the opportunities for economizing the value chain. Trucks, buses and coaches are responsible for about a quarter of CO₂ emissions from road transport in the EU and some 5% of the EU's total greenhouse gas emissions. Looking at the public bus transport system, shifting towards greener fuels is the best way to lower emissions. While city centers will very likely be served by electric-powered vehicles in the near future, the only clean solution for substituting existing diesel-powered heavy-duty vehicles (HDV) on extra-urban areas is the natural gas in its liquid form (LNG).



Therefore, there is a positive ground for entering the demonstration phase in order to acquire and spread information and experiences to overcome key barriers for the early market stage development. This is confirmed by the recent relevant regulatory changes affecting the approval of vehicles using LNG. The adoption of amendments to United Nations Economic Commission for Europe (UNECE) Regulation 110 now allows LNG vehicles to be homologated and represents a major breakthrough for LNG-powered mobility. The modified regulation came into force in July 2014.

LNG could be produced also from biomass. LNG infrastructure in Europe is increasing very rapidly (<http://Ingbc.eu/>) for the distribution of fossil LNG. However very few are the bio-LNG producers in Europe. There is a clear lack of knowledge on practical experiences that could trigger relevant industry investments as well as create a favourable regional policy framework.

2.1 Goal of the project

The main goal of the proposal is to focus on transport, considering that also the chemical industry can be involved in the value chain.

Specific objectives of the demo case can be identified as follows.

- Enhance a wide diffusion bio-LNG at Vanguard level by creating a “Vanguard Regions Blue Corridor” crossing the Vanguard Regions associated with the demo case
- Increase knowledge and skills on bio-LNG among professionals and policymakers (inspire and mobilize professionals and policymakers by implementing a pilot education activity strictly connected to the demonstration actions)
- Increase competitiveness of industry and local biomass producers (bio-LNG)
- Support policy makers in the investment choice for a more sustainable public transport
- Promoting renewable fuel consumptions by the use of Bio-LNG
- Reduction of emissions: particulate pollution, as there is no particulate in the emissions of natural gas-powered vehicles, reduction of NO_x, CO, VOC
- Reduction of greenhouse gas emissions
- Provide reliable and scientific proven well to wheel analysis on bio-LNG.

The final Blue Corridor Demo case will be the integration along with the Blue corridor of Vanguard Region associated to the demo cases and implemented at local level but connected and integrated as a unique infrastructure project. Thanks to the Vanguard Blue Corridor it will be possible to cross the participating Regions by fueling LNG vehicles with bio-LNG (pure or blended).

2.2 Specific objectives for 2019

The specific objectives are the following:

Objective 1. Expand the interest and commitment of regions

In the first set of regions (Emilia Romagna, Lombardy, North Rhein Westfale, South Netherlands, Upper Austria) a information/interest raising campaign is already underway. Its goal is to identify the players of the following step;

Objective 2. Increase stakeholder engagement

Set up a network of committed companies, research centers, stakeholders and public authorities interested in cooperation in view of the setting up of the Blue corridor of Vanguard Regions

Objective 3. Technological roadmap design

Design a roadmap of further actions, scientific & technological cooperation, policy design and value chain(s) development. Several regions in 2018 are already advanced in the task as they already have strategies for the production of bio-LNG from agricultural waste and the final use in public buses and its related use.

2.3 Actions that need to be taken to achieve the objectives

Each participating Region should draft its own specific focus, identifying major interested players – in particular companies – willing to actively participate: a formal declaration of interest from both private players and public organizations is recommended – and the topics they deem as more strategic. Final integration of the different tracks will come out later on, when all experiences will be properly integrated.

As a reference, actions will focus on:

- Activity 1.** Identification of the optimal biomass value chain to valorize in close relation to the regional context
- Activity 2.** identification of upgrading/liquefaction technologies
- Activity 3.** demo plant realization and test
- Activity 4.** bio-LNG delivery and blending
- Activity 5.** sustainability assessment (emission monitoring and test, well to wheel analysis)

2.4 Timeframe for the project (3 years)

To be defined in due time during 2019

2.5 Milestones

- March 2019: assessment of the results in the different regions:
- June 2019: first draft of a business plan

Following milestones, depending on business plan(s):

- Analysis of grant opportunities available (in cooperation with external consultant)
- Project idea(s) and core consortium ready

2.6 Deliverables

Deliverable	description	by	type	dissemination	timing
1a	Identification of committed regions/players	Coordinators	Email	Vanguard regions	Q1 2019
1c	Promotional material	Coordinators	Doc	public	Q1 2019
1d	Go/No go forward decision	Committed regions	Report	Vanguard regions	Q2 2019
2b	Development plan	Value chain participants	Report	Committed regions	Q4 2019

- Production of technical guidelines and roadmap in order to assess the replicability at regional and European scale addressed to Public Authorities in designing the policy for the development of bio-LNG; transport actors (public transport companies, manufactures, transport agencies), general public.
- One position paper on replication and transferability strategy for bio-LNG in the public transport sector at EU level. General report on bio-LNG in the participating regions

2.7 Resource requirements for the actions

- Internal resources: contacts, data collection, coordination
- Experts: specific expertise on specific technical topics; companies & stakeholder representatives; RTOs; public authorities with specific responsibilities on bio-LNG (energy, transports, circular economy, innovation)
- External experts: business plan design & event organization (ReConfirm); value chain development; financing opportunities; links with other related initiatives

2.8 Other resources for the actions

To be defined at a later stage, depending on business plan(s) and committed partners

2.9 Responsibility for each task

It will be defined together with the business plan(s). Currently, Emilia Romagna provides most of the technical expertise, while the two leaders carry on in close cooperation with the other partners all other activities.

2.10 Identify monitoring and evaluation steps in our action plan

KPI: to be defined with reference to more general VI debate

2.11 Monitoring

In the course of 2019, the demo-case strategy for stakeholder engagement will be implemented with the mapping exercise of the “status quo” at regional/national/European level (available R&D&I infrastructure, ongoing projects, key players and events) and the identification of different value chains, depending on the resource availability and related regional strategies (e.g. LNG for heavy road transports, ships, etc.).

Given the nature of the approach, additional value chains could be identified and tested for further development: a few examples may be the valorization of digestate (a byproduct of the biogas production) as raw material for fertilizers and/or recovery of nitrogen and phosphorous, the production of methane (gas) as fuel and/or for the grid (raw material for the chemical industry), as well as the exploitation of the CO₂ (bioproduct of the upgrade process), also as chemical feedstock.

2.12 Communication strategy/Marketing Pilot demo case

Activities should primarily be concentrated on taking off of the initiative.

External communication activities, in close cooperation with the proper VI Group, will be defined only on the basis of the contents/characteristics of the business plan(s) adopted.

2.4 Biopolymers

The world plastic market is still dominated today by the production of traditional plastics, understood as those made from fossil and non-biodegradable products. In 2015, 322 million tons of plastic materials were produced worldwide (not counting PET, PA, PP); China is the largest producer of plastic and contributes 27.8% to world production while Europe produces about 18.5% (60 million tonnes) (Plastics-the Facts, 2016).

The continuous demand for plastic on the market is linked to the characteristics of this material, including the main price (usually less than € 1 per kg), durability, lightness and workability, factors that make it versatile and usable in various commercial areas (PlasticEurope, 2017). In Europe, the total demand for plastics is about 49 million tonnes and the sector in which plastics are most used is packaging, which accounts for 40% of total demand (Figure 1). Following are the construction sector and the automotive sector, which hold respectively 19.7% and 8.9% of the demand, other areas of application are the electrical and electronic sector, the agricultural sector, furniture, sport, health and security (Plastics-the Facts, 2016).

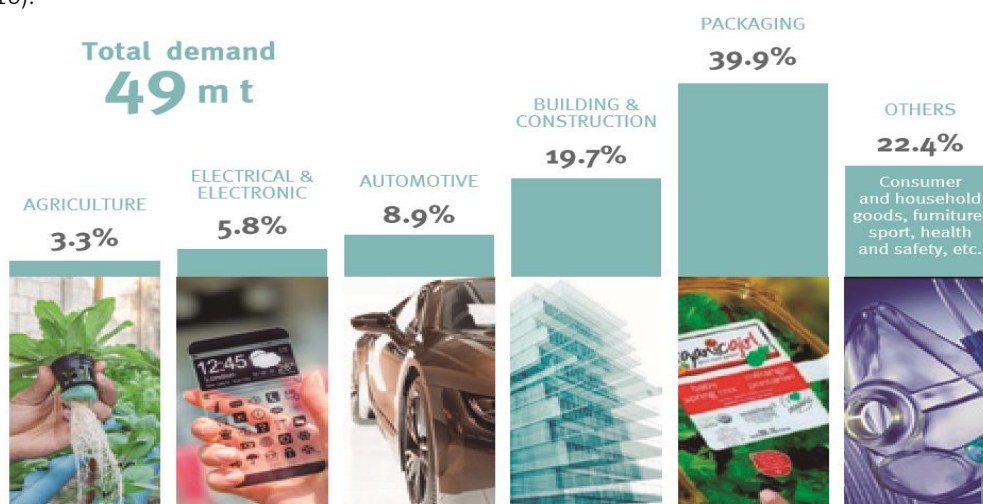


Figure 2 Distribution by sectors of European plastic demand (Plastics-the Facts, 2016)

However, the production of traditional plastics has become unsustainable both from a production point of view (4% of world oil is destined for plastic production) and from an environmental point of view.

The limited biodegradability causes environmental impacts persisting in time frames of 100-1000 years (PlasticEurope, 2017). Because of disposal problems and environmental legislation, therefore, the plastics industry has focused on developing new plastic materials that are alternative to traditional plastics (Povolo et al., 2003).

One of such alternatives are biopolymers of bacterial origin, namely polyhydroxyalkanoates (PHAs). These polyesters of (R)-3-hydroxyalkanoates (HAs) are synthesized and stored in the cell cytoplasm as water insoluble inclusions by various microorganisms. PHAs are gaining increasing attention in the biodegradable polymer market due to their promising properties such as high biodegradability in different environments and processing versatility. These biogenic polyesters represent a promising replacement for fossil fuel-based thermoplastics due to their structural diversity and close analogy to common plastics. More than 150 HAs have been marked as PHAs components, thus potentially providing various mechanical properties (i.e. solid crystalline polymer or elastic rubber) that depends on the incorporated monomer unit in a given PHA polymer.

The described features of PHAs allow them to find applications in both medical and non-medical fields (Figure 2).

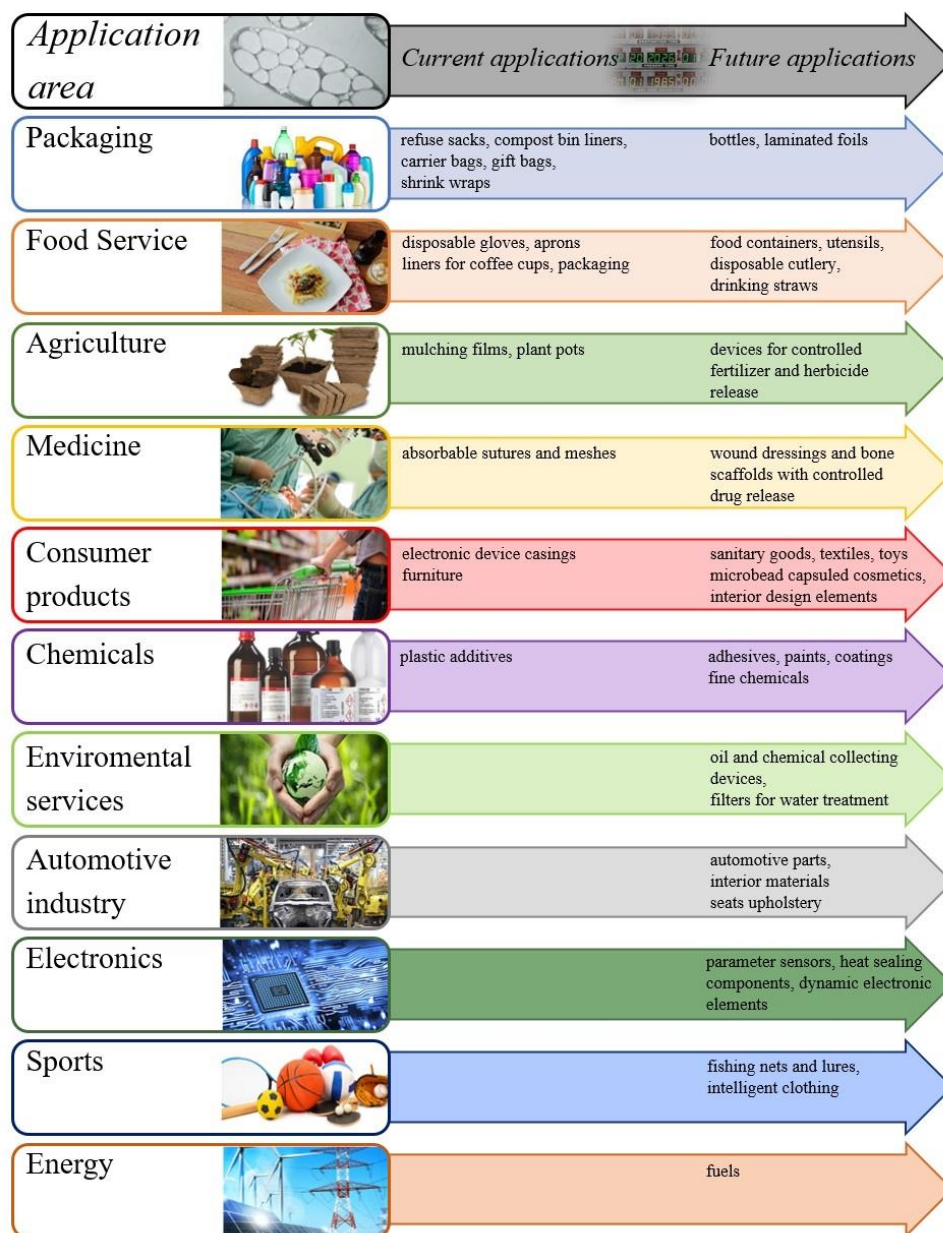


Figure 3 Current and future application of PHA polymers

2.1 Goal of the project

The demo case promoted by Małopolska is in line with the region Intelligent Specializations and is strongly supported by the local government and Klaster LifeScience. The Leader on this demo-case, J. Haber Institute of Catalysis and Surface Chemistry of Polish Academy of Sciences (ICSC PAS), has already secured funds (€3.7 mln) that will allow for the construction of a demo plant for PHA production.

It is envisaged that in the next year a facility capable of carrying out 200L PHA fermentations, with up- and down-stream facilities, will be built. In parallel technologies for PHA applications are being developed: construction of drug-functionalized wound patches, implants for cartilage and bone regeneration and biodegradable packaging solutions.

The main objectives of the new-potential demo-case are:

- Establishment of facilities with up and downstream for PHA production
- Feedstock development – virgin or postconsumer oils (fatty acids, glycerol)
- Production of two PHA polymers – brittle, crystalline (PHB) and elastomer to liquid (mcl-PHA)
- Processing of PHA polymers – blends of PHB and mcl-PHA

- Development of technologies for the spatial formation of PHA-based plastics into biomedical implants (soft tissue) and day-to-day objects (including *3D-printing* technologies)
- Development of polymer-ceramic blends for bone implants

2.2 Specific objectives for 2019

As reported in the first part of the Action Plan 2019, the mission of the project was shown during the General Meeting of November 13, 2018. During 2019, the Bioeconomy Pilot will support the growth and strengthening of the new potential demo-case on biopolymers, led by the ICSC PAS (Małopolska region). This support will be focused to define main strategic applications and technological use-cases among the Vanguard regions useful for demo-case market value proposition.

Main specific objectives are:

Objective 1. Improve collaboration on PHA solution implementation

To identify partner(s) interested in PHA solution implementation for either medical or packaging sector, or both, based on technologies being developed at ICSC PAS

- Medical area: drug-functionalized wound patches; PHA-based cartilage scaffolds; PHA-ceramic-based bone scaffolds
- PHA polymer blends with a variety of physicochemical properties (different levels of hardness, elasticity, elongation at break, etc.)
- PHA based pellets, filaments, etc
- 3D printing (technology and supplies) and other spatial formation techniques

Objective 2. Improve collaboration on scaling up process development

To identify partner(s) interested in scaling up of fermentation process from 200L upwards

- Scl-PHA production (PHB)
- Mcl-PHA production (elastomers, glue-like polymer)

Objective 3. Support of Policy instruments at the regional level

To identify partners interested in the development of regional policies with regards to biopolymers, especially to PHAs (policies, strategies, LCA, cooperation plans, etc.)

Objective 4. Increase demo-case visibility

To promote business opportunity through matchmaking events

2.3 Actions that need to be taken to achieve the objectives

Activity 1. Involve demo-case partner in matchmaking events

Activity 2. Select EU funding opportunities for demo-cases upgrading - select partners, begin negotiations and draft a proposal

Activity 3. Support in the definition of market development, detailed knowledge of Bioeconomy stakeholders across business and academia and our understanding of the innovation process.

Activity 4. Engagement in scale-up activities and technology transfer from academia to industry

2.4 Timeframe for the project (3 years)

To be defined in due time during 2019

2.5 Milestones

- March 2019: definition of matchmaking events and EU funding opportunity
- June 2019: mapping of most promising projects and use-case in Vanguard regions

2.6 Deliverables

Deliverable	description	by	type	dissemination	timing
1a	Identification of committed regions/players	Coordinators	Email	Vanguard regions	Q2 2019
1c	Promotional material	Coordinators	Doc	public	Q2 2019
1d	Attending to the matchmaking events	Committed regions	Report	public	Q3 2019
2b	Definition of list of collaborations	Value chain participants	Report	Committed regions	Q4 2019

2.7 Resource requirements for the actions

- Internal resources: contacts, data collection, coordination
- Experts: specific expertise on specific technical topics; companies & stakeholder representatives; RTOs; public authorities with specific responsibilities on biopolymers.

2.8 Other resources for the actions

To be defined at a later stage, depending on business plan(s) and committed partners

2.9 Responsibility for each task

Currently, Małopolska and J. Haber Institute of Catalysis and Surface Chemistry of Polish Academy of Sciences (ICSC PAS) (with its consortium PHATechMat incorporating 3 universities and a company in Poland) provide most of the technical expertise, while the two leaders carry on in close cooperation with the other partners all other activities.

2.10 Identify monitoring and evaluation steps in our action plan

KPI: to be defined with reference to more general VI debate

2.11 Monitoring

Refer to the KPI list for the whole pilot. The demo case is currently in its “Learn” phase, therefore the number of regions & players involved will be a key variable.

In the course of 2019, the Learn phase will be implemented with the mapping exercise of the “status quo” at regional/national/European level (available R&D&I infrastructure, ongoing projects, key players and events) and the identification of different value chains.

2.12 Communication strategy/Marketing Pilot demo case

Activities should primarily be concentrated on taking off of the initiative.

External communication activities, in close cooperation with the proper VI Group, will be defined only on the basis of the contents/characteristics of the business plan(s) adopted.

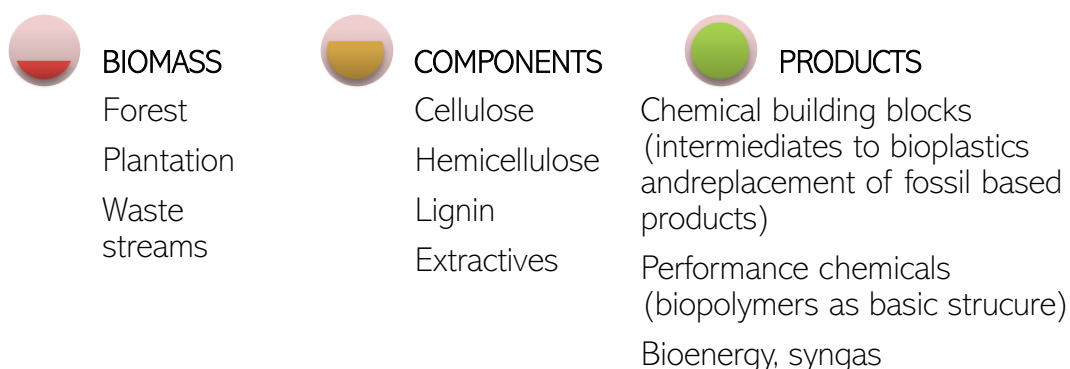
2.5 Forest-based biomass valorization

The forest plays an essential role in climate change mitigation, safeguarding biodiversity, providing fresh-water, non-wood forest products and recreational environments.

Forests occupy 38% of EU land and provide a wide range of ecosystem services such as carbon storage and sequestration, habitat provision, water regulation (quality, quantity, flow), regulation of air quality, soil erosion control, recreation, wood and non-wood products (JRC, Biomass production, supply, uses, 2018).

The forest-based sector includes all stakeholders with a significant interest in forestry, forest-based materials and products. Wood is the key component of the pulp and paper industry, it can be used for energy production, it is an important construction material and for the furniture industry.

Forest-based biomass is also used for many different bio-based products, such as insulation material, barrier materials for damp protection, biopolymers, bio-based plastics and composites, carbon fibre, chemicals and cellulose-based textiles, smart packaging materials (Swedish Forest Industries Federation 2013).



In addition to raw materials, forests also provide a wide range of vital ecosystem services. The forest-based sector depends on a broad range of scientific disciplines and technologies. Recent advances in for example physics, cell biology and genomics have enabled new tree-breeding technologies for enhancing wood qualities and pest resilience as well as enzymes for use in papermaking (Forest-based Sector Technology Platform 2013).

2.1 Goal of the project

Slovenia, the initiator of a new BPP VI Demo-case initiative, is one of the most forest covered regions/countries in Europe, a rich source of raw materials: wood, waste biomass from agriculture and industry (green residuals, annual plants, invasive plants)

Currently, there is a big gap in Slovenia between the availability of resources and added value when used as end products. There is interest from businesses and regions to valorise the feedstock towards certain product value chains by creating a small/medium size biorefinery that can do fractionation at the front-end into cellulose fibre and convert the residue lignin/hemicellulose into syngas.

The syngas will serve the methanol-formaldehyde value chain. The cellulosic fiber will serve the textile and composite markets. This fits well with Slovenian chemical industry, typically existing of SME, making fibers, diols, acrylates, PF resins for wood panel board etc. Some initiatives are underway to make more sustainable PF resins, eg from biomethanol, sourced from and certified by Scandinavia (Sweden). The pilot plant should integrate all relevant technologies and help prove and validate a viable business case.

Towards this end, Slovenia wants to have its pilot plant for development and scale-up. It is considering to apply mobile fractionation, i.e. the pre-treatment equipment goes to the biomass,

2.2 Specific objectives for 2019

As reported in the first part of the Action Plan 2019, the mission of the project was shown during the General Meeting of November 13, 2018.

During 2019, the Bioeconomy Pilot will support the growth and strengthening of the new potential demo-case on forest and waste management, led by the National Institute of Chemistry (Slovenia region).

This support will be focused to:

- Objective 1.** Define main strategic applications and technological use-cases among the Vanguard regions useful for demo-case market value proposition.
- Objective 2.** Define a sustainable route for integration of existing mature technologies, to create adaptable, mobile, interoperable and more flexible bio-refineries on smaller - intermediate middle scale.
- Objective 3.** Increase visibility of new-potential demo-case

2.3 Actions that need to be taken to achieve the objectives

- Activity 1.** Involved demo-case partner in matchmaking events
- Activity 2.** Select EU funding opportunities for demo-cases upgrading
- Activity 3.** Support in the definition of market development, detailed knowledge of bioeconomy stakeholders across business and academia and our understanding of the innovation process.
- Activity 4.** Engagement in scale-up activities and technology transfer from academia to industry to improved connections with the forestry and waste management in the VI regions.
- Activity 5.** Set up a plan for feasibility demo-case scaleup
 - Technologies for sustainable biomass transformation and new bio-based materials
 - Technologies for use of secondary and raw-materials and reuse of waste
 - Production of energy based on alternative sources

2.4 Timeframe for the project (3 years)

To be defined in due time during 2019

2.5 Milestones

- March 2019: definition of matchmaking events and EU funding opportunity
- June 2019: mapping of most promising projects and use-case in Vanguard regions
- December 2019: the pilot technology development for the local biomass fractionation to fibers (> 1000 kg), methanol synthesis assessment (basic balance calculations), as well as the production of the larger polymer (resin) quantities (> 10 kg) from green MeOH (produced *via* scaled-up MeOH oxidation (formaldehyde) unit).

2.6 Deliverables

Deliverable	description	by	type	dissemination	timing
1a	Identification of committed regions/players	Coordinators	Email	Vanguard regions	Q1 2019
1c	Promotional material	Coordinators	Doc	public	Q1 2019
1d	Attending to the matchmaking events	Committed regions	Report	public	Q3 2019
2b	Definition of list of collaborations	Value chain participants	Report	Committed regions	Q4 2019
3a	Defining existing available infrastructure, available regionally	Value chain participants, as well as coordinators	Stakeholder LoCs (all committed stakeholders' expressed interest)	Committed regions, as well as Slovenian ministries	Q4 2019

2.7 Resource requirements for the actions

- Internal resources: contacts, data collection, coordination
- Experts: specific expertise on specific technical topics; companies & stakeholder representatives; RTOs; public authorities with specific responsibilities on forest-based biomass valorisation

2.8 Other resources for the actions

To be defined at a later stage, depending on business plan(s) and committed partners

2.9 Responsibility for each task

Currently, Slovenia and the National Institute of Chemistry provide most of the technical expertise, while the two leaders carry on in close cooperation with the other partners all other activities.

2.10 Identify monitoring and evaluation steps in our action plan

KPI: to be defined regarding more general VI debate

2.11 Monitoring

In the course of 2019, the demo-case starting phase will be implemented with the mapping exercise of the "status quo" at regional/national/European level (available R&D&I infrastructure, ongoing projects, key players and events) and the identification of different value chains.

2.12 Communication strategy/Marketing Pilot demo case

Activities should primarily be concentrated on taking off of the initiative.

External communication activities, in close cooperation with the proper VI Group, will be defined only on the basis of the contents/characteristics of the business plan(s) adopted.