



DELIVABLE 2.3 **POLICY BRIEFING** **Andalucía**

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1 DIRECTIONS TOWARDS A REGIONAL BIOBASED AND CIRCULAR ECONOMY

1.1 Introduction

Andalusia is the most populous region of Spain (8.4 million inhabitants) as well as one of the largest in Europe (87,268 km²). The region was struck severely by the recent economic crisis in 2008. Between 2008 and 2013 the industrial employment growth rate in 74% of the Andalusian municipalities has been negative¹. Another result of the crisis is Andalusia's high unemployment rate, which amounted to 35,3% in 2014². In spite of the current economic challenges, the recent attention for the Circular Economy (including Biobased Economy) on European level, could become the driver for new growth as Andalusia is uniquely positioned for a transition towards a more circular and biobased economy.

One of the reasons for Andalusia's unique position is that it features a large agricultural sector. Over 44,3%³ of its surface area and 8,4%⁴ of its work-force are dedicated to this sector, and Andalusia's agro-food industry is one of the main economic drivers of the region. It is extended all over the Andalusian area and is widely present in rural areas. The biomass resources are coming mainly from olive grove, as well as the fruit and vegetable sector. Andalusia is the world's largest olive producing region and home to a substantial horticultural sector producing fruits and vegetables. Also, there are several initiatives related to algae in Andalusia. Algae can provide a means to convert sun light and CO₂ into valuable chemicals.

The chemical sector and other related sectors (e.g. pharma) are also well represented in the region. There are two chemical clusters, Campo de Gibraltar and Bahía de Huelva, which are each managed by two cluster associations (Association of Large Industries of the Campo de Gibraltar, AGI, and the Chemical, Basics and Energetic Industries Association of Huelva, AIQB). The production plants belonging to the AIQB covers the electric generation (including biomass as a raw material), the manufacturing of basic organic products (phenol, cumene, acetone, biofuel), inorganics (fertilisers, raw material for detergents, chlorine and by-products, mineral gases...), the metallurgy of the copper and the production of the paper pulp.

In order to make the transition towards a circular and biobased economy, the challenge is to (inter)link the existing chemical sector and agricultural sector. This is a process which is already going on through multiple initiatives. Andalusia has a strong Bio-energy sector and is at the forefront of thermal biomass in Spain with almost 24.000 small installations and 11 large scale operational biofuel plants with a capacity of 1.280 ktoe/year. The region is the Spanish national leader in bio-fuels production. In addition, the region has 18 biomass fuelled power plants with a total installed capacity of 257 MW and 17 biogas facilities with almost 30 MW capacity

1 Estrategia Industrial De Andalucía 2020, Agencia de Desarrollo y Innovación de Andalucía

2 Encuesta de Población Activa (EPA), Tercer trimestre de 2014, Instituto Nacional de Estadística, 2014

3 <https://www.agenciaandaluzadelaenergia.es/ciudadania/energia-andalucia/cartografia-energetica/recursos-y-potencial/mapa-potencial-biomasa>

4 The Agricultural and Fisheries sector in Andalusia, Consejería de Agricultura, Pesca y Desarrollo Rural, 2015

sourcing their gas from landfills and wastewater treatment plants are within the Andalusian territory.

1.2 Towards a strategy for an advanced bio economy

Having sufficient alternative feedstocks available, a critical mass of chemical industry and also reasonable investment in biobased production, Andalusia is well positioned to further engage in Sustainable Production using biomass and waste. The Andalusian Government, strongly committed to the bio-economy, has recently approved (July 12, 2016) the formulation of the Andalusian Bio economy Strategy. This strategy will be further developed in the coming months. The policy briefings developed in this document aim to re-enforce the current process of formulating a bio economy strategy by providing concrete recommendations based on extensive interaction with local companies. It must be emphasized however, that the focus will be on advanced biorefineries which are beyond the state-of-the-art compared to more traditional biorefineries, which are often focused on food, feed and energy production.

Both the olive industry and other agri-food industries are already acting as bio-industries producing (by-)products for feed, fertilizers, energy and composting. However, it is in particular the new advanced biorefineries which could further strengthen Andalusia's position in the bio economy. According to the project Biorefinery Euroview, "Biorefineries could be described as integrated biobased industries using a variety of technologies to make products such as chemicals, biofuels, food and feed ingredients, biomaterials, fibres and heat and power, aiming at maximising the added value along the three pillars of sustainability (Environment, Economy and Society)."

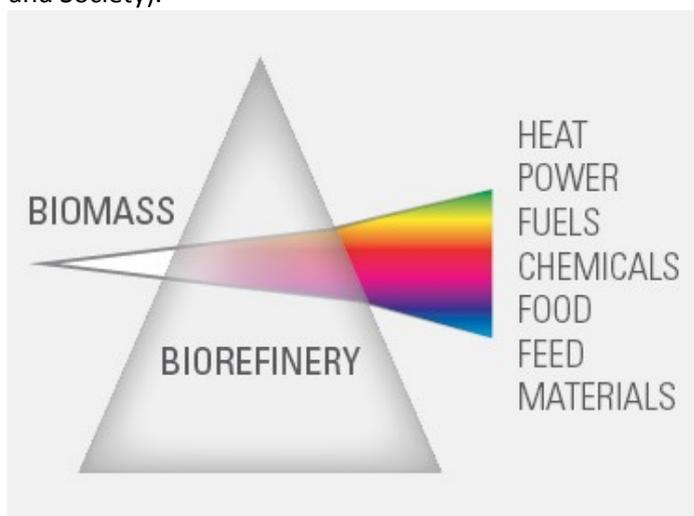


Figure Schematic representation of the biorefinery concept⁵

Significant activities have been taking place in other regions of Europe in the field of biorefineries and most of the related industries have already implemented pilot projects. Recently, a set of targets⁶ has been set which aims to cover a significant proportion of the overall European demand for chemicals, energy, materials and fibres in 2030 by using biomass as a feedstock for biorefining technologies.

⁵ IEA Bioenergy Task 42 Biorefinery, 2009

⁶ <http://www.star-colibri.eu/files/files/vision-web.pdf>; <http://www.biobasedeconomy.nl/wp-content/uploads/2012/07/Bio-Based-Industries-PPP-Vision-doc.pdf>

More specifically:

- 30% of overall chemical production is biobased. For high added-value chemicals and polymers (specialties and fine chemicals) the proportion is more than 50%, whilst less than 10% of bulk commodity chemicals are derived from renewable feedstocks.
- 25% of Europe's transport energy needs are supplied by biofuels, with advanced fuels – especially biobased jet fuels – taking an increasing share.
- The European market for biobased fibre and polymers such as viscose, carbon fibres, nanocellulose derivatives and bioplastics will continue to grow rapidly. Traditional fibre products such as paper remain 100% biobased.
- A new generation of biobased materials and composites produced in biorefineries allow the production of lightweight, better-performing components for industries including automotive and construction.
- 30% of Europe's heat and power generation is from biomass.

Given the considerable growth which is expected in these advanced biobased product markets, Andalusia aims to build on its strong position in biomass and traditional biorefineries to capture the opportunities of becoming a reference region in advanced biobased production.

1.3 Value chain overview and investment ambitions

The current state-of-play in advanced biobased and circular value chain development has been described in the investment readiness assessment (task 2.1). This assessment was taken as a starting point for discussions with companies in the region about their actual investment plans during the peer review meetings.

1.3.1 Peer review meetings

Before the actual peer review meeting itself, another event was organized in Seville a few days before so as to motivate the regional stakeholders and draw their attention to this project. As a result of this pre-meeting, the peer review meeting was organized based on the feedstock focus by these companies and allowed the organizers and the consortium which provides the service to cluster interests and pre-identified main topics and larger sectors/subsectors of interest. Lastly, the speakers were encouraged to think up-front on their investment plans, the maturity of the projects and potential barriers they encounter to make those projects happen.

The first day of the peer review meeting focus industry oriented. The peer review meetings featured a considerable number of presentations by companies active in biobased innovation. The speakers were subcategorized as; horticulture (7 companies), olive sector (3 companies), forestry (2 companies), livestock farming (3 companies) and valorisation of other subproducts, including algae (8 companies). In addition, 12 entities, including industries, RTOs and different entities from the innovation enablers (consulting entities, regional bodies, universities) participated in the discussions. In total, 35 entities (mainly industries) actively attend the event as well as a large representation from the public regional administration. The two day peer review meeting was split in two:

- The first day focused on industrial stakeholders, with the participation of more than 20 companies. During this day, the main investment ambitions of industries were discussed, together with the main hurdles for realizing these investments.
- The second day was focus on the main outcomes of the first day in a group composed of representatives of the public administration that could participate, coordinate and contribute to improving the collaboration at regional level. During this event, the main barriers and needs were discussed in the spirit of defining the main challenges from the

public administration point of view and the potential support the public authorities might reinforce in the upcoming bio economy strategy.

1.3.2 Main outcomes of the peer review meetings

Even though there is a lot going on in the region with regard to the development and demonstration of new biobased value chains, the peer review meetings have shown a couple of key issues which need to be addressed:

- There is a great absence of end-users for biobased and circular products in the region. The chemical industries present in the region are very much focused on business-as-usual or on other areas of innovation. This results in a lack of market pull, which limits the demonstration and market introduction of new biorefinery and circular concepts for which the involvement of end-users is essential.
- The biobased community in Andalusia is very fragmented. The many biobased companies are scattered throughout the vast region of Andalusia and are often unaware of the many biobased initiatives which are being implemented in the region. This hampers the creation of new value chains, because complementary companies in the value chain, technology suppliers and research institutes do not always find each other.
- There are hardly any industrial scale advanced biorefineries installed in Andalusia. This hampers the transition towards a bio economy because of a lack of a frontrunner industrial driven initiative that could trigger others to move towards new products at regional level. With the current efforts, it remains uncertain whether any biobased commercial scale plants will materialize in the short term.
- Nevertheless, there are many ongoing funded R&D initiatives on-going at regional level, which could lead to commercial scale plants, particularly if the obstacles of the lack of final users and the absence of a major cooperative platform could be overcome.

1.3.3 Value chains and investment ambitions

Due to Andalusia's strong feedstock position, the peer review meetings have been structured along the different feedstocks for which Andalusia has a strong position at European level at different level of maturity:

- Horticulture and agri-food
- Olive sector
- Forestry
- Livestock farming
- Algae (using CO₂ and nutrients from industry as feedstock)

Figure 2 below shows the main pilot, demo and commercial scale projects which are being planned in Andalusia and the value chains which could be created if these initiatives materialize into commercial scale plants.

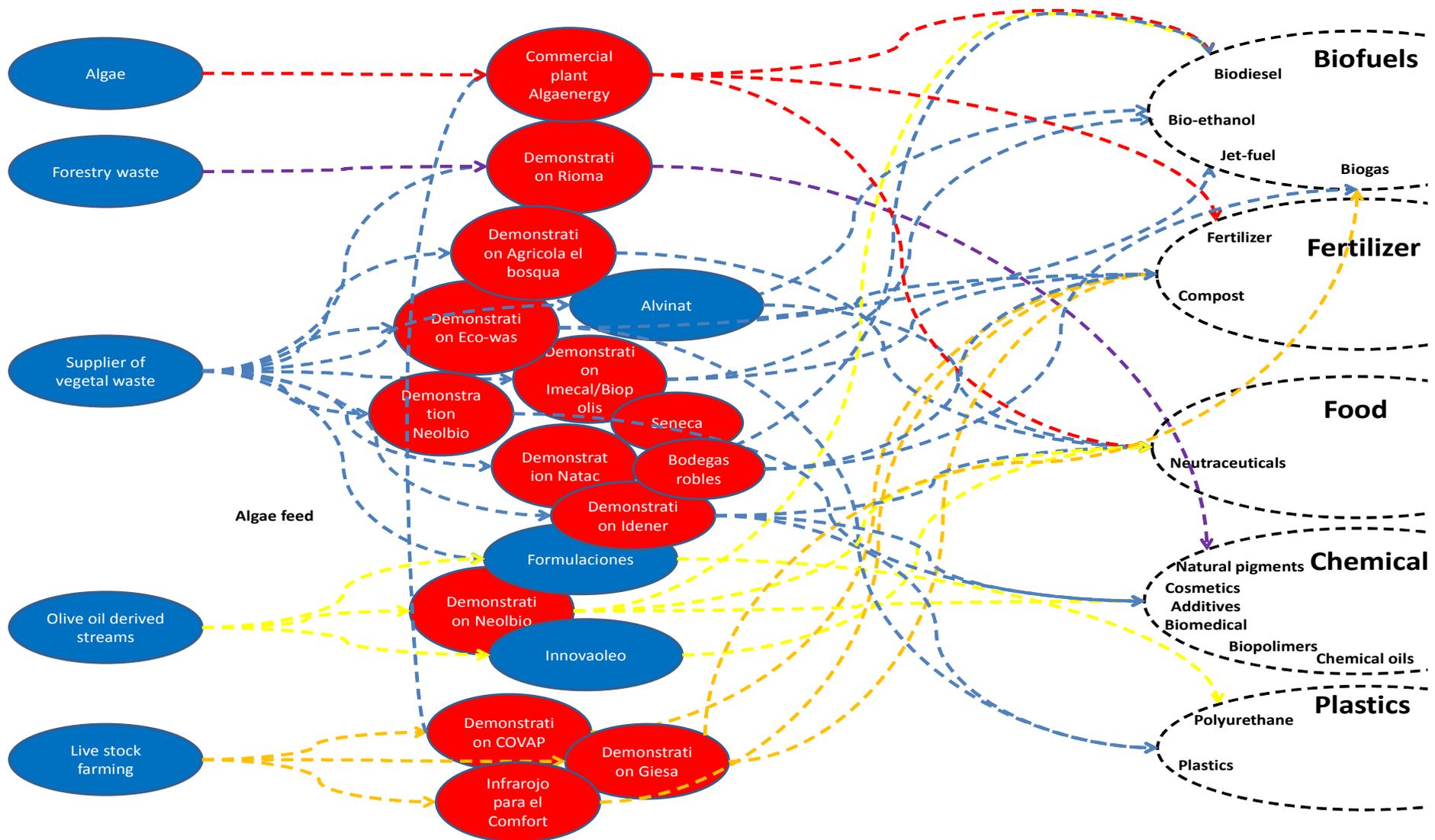


Figure 2: Overview of various investment plans by local companies showing the main value chains which could be created from the 5 key Andalusian feedstocks (blue = operational commercial plant; red = pilot/demo/commercial scale initiative). The figure has a particular focus on projects with the objective of producing high-added value (chemical) products, which have the greatest relevance for Sustainable Chemicals.

The overview in figure 1 is by no means complete in the sense that it just shows investment ambitions of companies which have attended the peer review meetings. However, it does give an idea of the potential investments which could be realized if adequate support for these investments can be provided. The figure does not show the end-users of the products produced by the biorefineries, because these were often not explicitly mentioned in the presentations by the participants. However, the overall impression after the peer review meetings was that for more established markets (food, fertilizer, fuels) the involvement of end-users or the ability to meet market specifications was often more prominent. For less developed biobased markets (chemicals, plastics) however, the involvement of end-users was often less visible.

The investments presented in figure 1 will be briefly discussed in the section below. Then, the main conclusions which can be drawn from this overview will be presented.

Value chain 1: Horticulture and agri-food

Within this value chain, the following investments are foreseen:

- Neolbio is a biotech company which has developed a number of conversion routes of both lignocellulosic vegetal waste and oils/fats (including glycerine) towards several products:
 - Microbial oils, which can be used as a building block for chemical (oil) production, nutraceuticals and biofuels
 - Biopolymers, which can be used as additives or for biomedical purposes.
- Fertiberia is fertilizer producer, which aims to set up a commercial scale plant for the recovery of nutrients from both solid and liquid waste streams, including vegetal waste streams.
- Biomasa del Guadalquivir aims to set up a project which converts vegetal waste into bio-ethanol and other bioproducts. The project will use conversion technology by the companies Imecal and Biopolis and comprises a consortium covering most of the value chain.
- Ecowas also aims to set up a demo plant for the conversion organic waste into bio-ethanol. The remaining High Quality Organic Matter (HQOM) fraction can be applied for the production of biogas, sugar syrup, chemicals (Butanol, Jet-Fuel), bioplastics and land restoration.
- Natac Innovaoleo has established a joint venture Alvinat together with the winery Alvinosa which operates a biorefinery for winery waste streams which produces nutraceuticals.
- Formulaciones is a company which is producing polyurethanes and is able to use forestry waste streams as feedstock.
- Bodegas Robles has demonstrated a anaerobic digestion process for winery residues, which produces biogas and a fraction which can be converted into compost.
- Idener has developed a process for extraction of organic compounds from agro fractions and paper mills which can subsequently be converted into plastics, nutraceuticals and cosmetics.
- Fomento de la Biomasa y Cogeneración (FBC) is a technology developer of a pyrolytic process, which can be used to convert plastics and biomass into a gaseous fraction, a solid fraction (to be used as fertilizer) and a liquid fraction (to be used as biofuel or insecticide).
- Agrícola El bosque is a company which produces blackberry, which aims to valorise its biomass towards higher added value applications. The biomass is rich in antioxidants and as such has a high potential for applications in cosmetics and pharma.
- Frutilados del Poniente is a cooperative of 21 fruit growing companies which has a project focusing on the conversion of fruit waste into animal feed.
- BIOGRINM is an interregional model project with the objective of implementing an organization system which optimizes waste treatment of the horticultural sector in Andalusia.
- Arsingier is an engineering company which designs industrial plants at demonstration scale. They have a project for converting agricultural waste streams into active carbon.

- Seneca green catalyst SL is a technology supplier which has a concept for producing biobased compounds from the agricultural and energy sector based on biocatalysis.

Value chain 2: Olive sector

Within this value chain, the following investments are foreseen:

- Natac-Innovaoleo is a collaboration between Oleícola El Tejar and Natac. The company has set up a biorefinery for olive oil waste streams, which produces nutraceuticals and some side-streams which could be used as input for the production of other biobased products.
- Formulaciones is a company which is producing polyurethanes and is able to use olive oil and fatty waste streams as feedstock.
- As stated under value chain 1, also Neolbio is capable of using oils and glycerine as feedstock for advanced biobased products.
- Oleoestepa is an agricultural cooperative which has a project which focuses on the valorization of olive oil press residues into nutritional products of high added value.
- San Isidro de Loja is another cooperative which has a project which converts waste streams from the olive oil refinery into compost and vermicompost.
- Seneca green catalyst SL has a project which obtains high added value products for the cosmetics industry from fatty streams.

Value chain 3: Forestry waste

Within this value chain, one main investment in advanced biobased products is foreseen. Rioma is a company which has developed a process for the production of pigments for the textile sector and resins for furniture from vegetal and forestal waste. Intelec is another company, which uses forestry feedstock for making energy pellets.

Value chain 4: Live-stock farming

Within this value chain, several projects are foreseen by COVAP, Giesa and Infrarojo para el Comfort which focus on the conversion of manure into biogas, compost and fertilizer. Some of them have already established a first commercial scale plant. Unlike many of the other investments, this sector is more focused on replication rather than demonstration. Given the fact that the technology is proven and the markets for bioproducts are more established.

Value chain 5: CO₂

During the peer review meetings, there was one representative of the algae sector in Andalucia. Algaenergy has really advanced algae cultivation technology and is already processing CO₂ from the energy sector. It has demonstrated the production of biofuels, fertilizer, food ingredients and cosmetics. Its technology is really advanced (TRL 8) and as such Algaenergy is very close to setting up a commercial scale plant.

1.3.4 Preliminary conclusions value chains Andalusia

A couple of preliminary conclusions which can be drawn from this figure:

- There are many potential investment opportunities in the use of vegetal waste as feedstock for advanced biorefineries. Within this value chain, there is already one commercial scale plant focusing on the production of nutraceuticals.
- Few initiatives on forestry and algae were present at the meetings, even though both are promising feedstocks. However, for both feedstocks fairly mature technology is available which could lead to unique value chains. For algae, a commercial scale plant seems possible.

- Advanced biorefinery concepts are being planned for olive derived residues, but are still in the demonstration phase. There are two commercial scale plants for the use of oil derived feedstocks.
- Value chains from live-stock farming seem to be oriented more towards 'traditional' applications, like compost, biogas, etc.
- The new regulatory framework for biofertilizers will improve the opportunities for their commercialization and will stimulate production of fertilizers from organic or waste feedstocks, which offers significant opportunities for Andalusia.
- Also the use of biomass for animal feed purposes could result in new value chains which are of interest to Andalusia.

2 POLICY MEASURES ENABLING THE REGIONAL TRANSITION TOWARDS A BIOBASED AND CIRCULAR ECONOMY

2.1 Summary of main outcomes of the investment readiness report

In the investment readiness report 8 key factors were investigated, which influenced the investment readiness of the region. The investment readiness report investigated the following key factors:

1. long term, stability and availability of the feedstock;
2. infrastructure to handle feedstocks and production;
3. access to finance;
4. skilled workforce, technical expertise, training;
5. existence of support institutions;
6. strength and availability of regional markets;
7. entrepreneurship;
8. Public support policies.

The stakeholder meetings in the region provided more insight into how these key factors affected the specific investment projects identified in the previous section. The table below identifies for each of the projects which specific barriers affect the actual implementation of this investment.

Project	Company	Specific barrier	Solution
Value chain 1: vegetal waste			
Vegetal waste to bio-ethanol and high-added value products	Neolbio	Finance for demo projects Collaboration with end-users	Funding/finance instruments Out-reach to chemical companies
Biomass pyrolysis to biofuels, bio-oils, fertilizer and	Fomento de la Biomasa y Cogeneración	Collaboration with end-users Finance	Out-reach to chemical companies
Recovery of nutrients from liquid and solid biomass fractions	Fertiberia	Supply of feedstock of the (exact) right quality Finance for demo project Adequate legislation	Monitoring/organization of feedstock supply Funding/finance instruments Modify legislation
Conversion of vegetal waste into bio-ethanol and other biobased products	Biomassa del Guadalquivir	Finance for demo projects Green infrastructure Waste management policy for bio-waste	Funding/finance instruments Dedicated areas for waste collection Ban for land-filling of bio-waste
Conversion of vegetal waste into bio-ethanol and other biobased products	Ecowas	Finance for demo projects Collaboration with end-users	Funding/finance instruments Out-reach to chemical companies
Conversion of winery waste streams into neutraceuticals	Natac-Alvinat	Finance for demo projects Infrastructure for feedstock supply Waste management policy	Funding/finance instruments Dedicated areas for waste collection Prioritization of valorisation over land-filling
Biobased production of polyurethanes	Formulaciones	Green infrastructure Adquisición capacidades técnicas Finance	Dedicated areas for waste collection Technical formation Funding/finance instruments
Anaerobic digestion winery waste	Bodegas Robles	Finance for research Collaboration with research institutes Collaboration with end-users	Funding/finance instruments Out-reach to research institutes Out-reach to chemical companies
Conversion of wet organic material into biobased products	Idener	Collaboration with end-users Infrastructure for research	Out-reach to chemical companies Joint research infrastructure
Blackberry residual streams	Agrícola El Bosque	Collaboration with end-users Scientific infrastructure Finance for demo projects	Out-reach to chemical companies Joint research infrastructure Funding/finance instruments

Conversion of fruit waste into animal feed	Frutilados	Finance Technical capacities	Funding/finance instruments Technical education
Integral treatment of waste	Biogrinm	Supply difficulties Finance	Dedicated areas for waste collection Funding/finance instruments
Conversion of agricultural waste into active carbon	Arsinger	Technical aspects Collaboration with end-users Finance	Technical education Out-reach to chemical companies Funding/finance instruments
Production of biobased compounds	Seneca green catalyst	Adquisición capacidades técnicas Finance Políticas de apoyo	Technical formation Funding/finance instruments Prioritization policy support
Value chain 2: Olive sector			
Olive waste streams conversion into neutraceuticals	Natac-Innovaoleo	Finance for demo projects Infrastructure for feedstock supply Waste management policy	Funding/finance instruments Dedicated areas for waste collection Prioritization of valorisation over land-filling
Biobased production of polyurethanes	Formulaciones	-	Funding/finance instruments
Production of nutritional ingredients from olive press residual streams	Oleoestepa	Collaboration with end-users Finance Adaptation of regulation	Out-reach to chemical companies Funding/finance instruments
Valorization of olive oil residues into compost	San Isidro de Loja	Finance Adaptation of regulation Maturity of technology	Modify regulation Funding/finance instruments
Value chain 3: Forestry			
Conversion of forestry and vegetal waste into pigments	Rioma	Finance for demo projects Infrastructure for feedstock supply Waste management policy	Funding/finance instruments Dedicated areas for waste collection Prioritization of material use over energy applications
Production of pellets from Woody waste streams	Intelec	Supply of primary material Collaboration with end-users	Dedicated areas for waste collection Out-reach to chemical companies
Value chain 4: Live-stock farming			
Manure towards fertilizer/biogas	COVAP	Technical aspects Collaboration with end-users	Out-reach to chemical companies Funding/finance instruments

		Finance	
Manure towards fertilizer/biogas	Giesa	Maturity of technology Finance Adaptation of regulation	Funding/finance instruments Modify regulation
Manure towards fertilizer/biogas	Infrarrojo para el Comfort	Finance	Funding/finance instruments
Value chain 5: CO2			
Production of bioproducts from algae using CO ₂ as feedstock	Algaenergy	Finance for research Collaboration with end-users	Funding/finance instruments Out-reach to chemical companies

2.2 Policy measures to improve the performance on the 8 key factors

This chapter describes the main policy measures (actions) needed to address shortcomings on the 8 key factors which have been identified in chapter 2.1. From the table in 2.1, the following policy measures can be identified:

1. Increased use of existing funding and finance schemes for demo projects
2. Out-reach to the chemical industry
3. Creation of a Coalition of the willing, a community which connects biobased and circular industry, technology suppliers and research institutes in those most promising areas for the region based on the available feedstock and experience.
4. Waste management policy and infrastructure
5. Creation of key research infrastructure (interlinked with point 3)

2.2.1 Coordinated use of funding/finance schemes for demo projects

Many of the companies which participated in the peer review meetings indicated a need for finance or funding. Particularly for targeted demo projects (involving only a few partners), it is difficult to obtain funding. The investments identified in this study are all led by one or multiple companies and are of key importance to the creation of value chains in the region. As such, each project should be matched with an adequate source of funding or finance. The companies leading these projects should pro-actively involve the right companies in the value chain to make sure that the project allows them to demonstrate their technologies and take a big step towards market introduction. Involvement of research institutes/academia should take place based on clearly identified technology development needs which the companies themselves cannot address. The following schemes in principle allow for fairly targeted pilot/demonstration projects:

- Regional FEDER, FEADER and Cohesion Fund schemes
- LIFE (European programme for pilot/demonstration of sustainable technologies).
- Horizon 2020, pillar Societal Challenges and Industrial Leadership, only with international partners
- SME instrument of Horizon 2020
- Biobased Industries, only with international partners.

In order to accelerate the transition towards a biobased and circular economy, at least 1 FEDER, 1 FEADER and 1 Cohesion Fund project, 1 LIFE project and 1 Biobased Industries project per year should be awarded in the area of biobased and circular economy. These schemes should clearly complement each other in the scope of the initiatives which are funded:

- FEDER and FEADER can support the creation of critical infrastructures (e.g. biotech research infrastructure) which can support the development of the biobased economy in Andalusia.
- LIFE and BBI can be used for the creation of value chains (from the collection to the delivery of the final product) and in particular to strengthen the collaboration with the chemical industry by involving them as an end-user partner. As such, these schemes play an essential role in Andalusia's strategic objective to engage with the European chemical industry.

The Bioeconomy strategy of Andalusia aims to apply an integral vision to the use of structural funds in order to create new opportunities for economic growth in Andalusia by means of new biobased business.

Based on an overview of the planned investments and a clear vision on how to apply the available schemes, the business cases underlying these pilot/demo and commercial scale investments

should be strengthened, partnerships with end-users should be forged and progress on the creation of new value chains should be monitored and scheduled. The main growth opportunities for biobased products lies in the markets of advanced biobased products (e.g. chemicals, materials) and as such the region should focus its efforts on obtaining a position in these markets, even though these are often not yet well established markets. As such, the region should make every effort to pro-actively bridge the gap between the abundant feedstock supply and the many biobased initiatives which are being planned and potential end-users. Given the importance of the agri-food and chemical sector in the region, agri-food/chemical companies in the region should be pro-actively informed of these opportunities with two aims:

- on the one hand to engage them in the development of active cooperative networks aimed at stimulating international collaboration and collaboration within the region
- (where possible) be involved in the evaluation committees of the regional programs, which would enable them also to participate in the set-up of new programmes and initiatives which are tailored to industrial needs.

The suggested actions are not utterly thought to be designed as a part of an on-going initiative. On the contrary, the bio economy concept requires a new and stronger cooperative approach, which should involve all the potential stakeholders along the value chain. The final aim is to launch a new initiative at regional level, including an ad-hoc monitoring platform/join Committee, an inclusive industrial frame in the field of bio economy (with special attention on the final users the chemical sector) and a sustainable and long-term framework, supported by the public authority but with a substantial role for industry. Once the bio economy sector takes off, the public side can then gradually step down and then let industry take the lead.

A start for such an overarching collaboration between industry and the regional government could be carried out by organizing one annual match-making event, which actively informs the companies of the funding calls which are opened that year, pro-active project development is encouraged. In addition, the needs for collaboration with foreign companies can be identified and more effective engagement with for example the Biobased Industries Programme can be organized.

2.2.2 Out-reach to the chemical industry

There is a lack of end-user involvement in many of the projects by Andalusian companies. This can be explained by the significant presence of feedstock suppliers, but a lack of chemical companies which are really interested in biobased products. Chemical industry in Andalusia is traditionally very fossil feedstock oriented and little breakthroughs have been achieved so far in supplying these industries with biobased intermediates for further processing.

Engagement with the chemical industry at regional, national and EU-level (Feique, Suschem, BBI, CEFIC) is needed to further involve end-users. Andalusia's great feedstock potential should be used to position the region as an attractive region for biobased production. The following actions could be carried out to accelerate the involvement of the chemical industry as an end-user for the Andalusian Biobased Economy:

- Performing a stakeholder analysis into biobased champion companies which are actively looking into horticulture/agri-food by-products, olive oil residues or algae as a source for biobased products. These companies could be invited to a match-making session with Andalusian companies.
- Participation in the Suschem brokerage event or the BBI infodays to increase Horizon 2020 participation by Andalusian companies. These events are visited by the most renowned biobased companies and will enable Andalusian companies to present themselves to this audience (already under development)

- Organize an Andalusian bio economy matchmaking event in collaboration with Feique. This event could focus on introducing Spanish bio economy champions to the Andalusian project owners.
- Hands-on support to Andalusian companies in the demonstration of new value chains can be provided by the Superbio project, which is able to deliver a set of 10 (subsidized) innovation services to companies.
- Select and promote beyond the Andalusia borders already identified strengthens and use them by the regional agencies that promote foreign investments as flagship cases.

In addition, Andalusia needs to strengthen and better integrate the chemical challenges in the bio economy strategy. Today, biorefining operations in the chemical industry are based largely on either sugar or starch and vegetable oil. Integration of primary and secondary processing of the raw material remains limited. The chemical industry uses sugar or starch for fermentation or chemical processing as a “green” alternative to oil-based feedstocks to make products with the same functionality and performance⁷. Raw materials for oleochemical production come from the well-established world market for vegetable oil and there is no integration with the companies doing the primary processing of the oil. Most biobased chemicals and oleochemicals are high value-added, speciality chemicals. Some integration of biomass primary processing with chemicals manufacture is emerging, with the diversification of product streams from some agro-industries (e.g. starch producers) towards chemical intermediates (lactic acid, succinic acid, etc.) and speciality chemicals (e.g. polyols)⁸. Choice of the right starting molecules to minimise energy inputs and capital costs – as is the practice in the petrochemical industry – can help to build efficient processes and extract greater value from some biomass-derived chemicals. One example is the use of glycerol to produce epichlorhydrin: Solvay has built two factories since 2007. This process produces the bulk chemical without the need for chlorine, which reduces energy needs considerably. Another example of the use of appropriate molecular structures present in plants is the manufacture of amino acids from biomass residues⁹.

To sum up, the bio economy strategy has to integrate the chemical point of view of the value chain and to meet this challenge, a deep analysis of the region and its capacities and market, a long plan and involvement of chemical industry is suggested.

2.2.3 Creation of a Coalition of the Willing

Biobased initiatives in the region are highly fragmented and there is a need to structure the collaboration between these initiatives and to forge synergies. Furthermore, a lot of information is generated and underused. As previously mentioned, lack of cooperation and coordination of on-going actions is hampering the potential of mutual benefits at regional level, from both, technical, structural, administrative and visible point of views.

Currently, two EU-projects have been launched which could play a key role in the creation of this community: SuperBio and AGRIFORVALOR. Both platforms are running in parallel and might maximize the current networking initiatives or lay the foundation for future management and organizational platforms to support and boost cooperation in the bio economy field. At the same

⁷ World Economic Forum report The Future of Industrial Biorefineries.
http://www3.weforum.org/docs/WEF_FutureIndustrialBiorefineries_Report_2010.pdf

⁸ Scott, E.L.; Peter, F.; Sanders, J.P.M., 2007. Biomass in the manufacture of industrial products - the use of proteins and amino acids, Applied Microbiology and Biotechnology 75 (4). - p. 751 - 762.

⁹ Haveren, J. van; Scott, E.L.; Sanders, J.P.M., 2007. Bulk chemicals from biomass. Biofuels Bioproducts and Biorefining 2 (1). - p. 41 - 57.

time, the regional FEADER policy is boosting other initiatives of great interest to Andalusia by means of the action line of support to collaborative innovation. In its first joint meeting, Bioeconomy proved an important theme with more than 30 presented projects.

SuperBIO is an innovation project funded by the H2020 call Cluster facilitated projects for new value chains managed by EASME (Executive Agency for SMEs). The project aims to build new industrial value chains by integrating and supporting groups of SMEs in collaboration with other innovation actors. The Andalusian partner in this project is the Fundación Corporación Tecnológica de Andalucía (CTA). The project could play an important role in addressing the innovation needs of Andalusian companies, but could also provide important recommendations for policy making.

The AGRIFORVALOR project aims to connect industries from agriculture and forestry with research and academia as well as with associations and clusters, bio - industry, policy makers; business support organisations, innovation agencies and technology transfer intermediaries in multi-actor innovation partnership networks. The overall aim is to valorize and exploit sidestream biomass resources from agriculture and forestry. The Andalusian partners in this project are the Agencia Andaluza del Conocimiento (AAC), Agrifood cooperatives of Andalusia, the Association of Enterprises of Forest and Landscape in Andalusia and GIESA. Important spin-offs of these projects could be:

- Both projects could be used to start organizing annual events to bring together the biobased community in Andalusia.
- Both projects could provide important input to an Andalusian Biobased Economy Strategy. A thorough analysis of the outcomes of these projects and their potential to improve bio economy policy and governance in Andalusia is strongly recommended.
- Both projects could re-enforce the intermediary role of the CTA and the AAC between the Andalusian Government and the local companies and as 'managers' of the local biobased community.

2.2.4 Waste management policy and infrastructure for the biobased and circular economy

Many of the proposed demo projects rely on an adequate biomass collection and logistic infrastructure. For conventional value chains (e.g. towards food or waste management) this infrastructure is in place. However, new value chains require also new collection infrastructure and logistics or at least the incentives to separately collect biomass residues of a specific quality.

There is a great dependence on the current waste management infrastructure and policy, because the rates of waste treatment (landfill, incineration or even composting) to a great extent influence the propensity of feedstock suppliers to consider innovative valorisation routes for their feedstock. The waste management regime could be changed in favour of innovative value chains by:

- Raising the environmental standards for waste management, which will both reduce the environmental impact of landfill and incineration towards the environment and increase the disposal rate for waste management.
- Imposing a tax on biomass which is landfilled or incinerated in order to divert waste streams towards high added value applications.
- Analysis of the available sources of biomass as a function of the distance, quantity, available logistic systems, cost effective regimes and industrial users willingness in the hope of facilitating a strong and target oriented cooperation at local level, all in all strongly related to the local authorities. Also assessing the opportunities for sharing current logistics centers for setting up new collection systems could be valuable for strengthening the collection.

2.2.5 Create key research infrastructure in central locations to attract and cluster companies

Because of Andalusia's vastness, it is difficult to really create a community and to accelerate the process of bringing research to the market. A key element of a Biobased Economy strategy could be the creation of research infrastructure in biotechnology or other key enabling technologies (e.g. reactors/downstream processing) to bring together local champions in specific value chains. This document has provided an initial overview of which companies are active in each value chain. For each value chain, an open research infrastructure could be set up to form a cluster, which will attract local companies with complementary activities, for example:

- In Almeria, a cluster could be focused on the valorisation of vegetal waste from horticulture.
- In Granada or Cordoba, a biotech cluster could be set up with equipment tailored to the conversion of typical Andalusian feedstock (e.g. olive oil residues or algae).
- In Huelva, an algae cluster could bring together companies active in algae.
- Andalusian companies whose products or technologies have an important link with local chemical industries (e.g. situated at AIQB or AGI site) could be situated at these sites in order to show local companies the possibilities of biobased production.

The development of the Bioeconomy in Andalusia could be given an impulse by the Andalusian government through the coordination of these different sub-clusters, each focusing on a specific potential value chain. A cluster approach would enable the coordination of an action plan which would benefit the individual projects belonging to the different value chains. This action plan could identify model projects, new business models and their implementation by means of alternative sources of finance, networking activities, benchmarking and international collaboration with other clusters. It would also better position the region to obtain funding sources which are specifically earmarked for the support of clusters.

Again, the SuperBio and AGRIFORVALOR could provide important inputs as to where these clusters could be set up and what their focus should be. Also the Agri-food campus (Ceia3) which comprises more than 3.000 researchers offers opportunities to develop coordinated actions to obtain knowledge in this regard.

3 ROADMAP OF POLICY MEASURES AND INVESTMENTS

3.1 Timing

3.1.1 Timing investments

The timing for the identified investments is presented in the Gantt chart below. Obviously, this is a highly indicative timing which cannot be predicted with certainty, but it shows what is possible if all the investment projects which are planned right now are actually implemented.

	2017		2018		2019		2020		2021		2022		2023		2024		2025		
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	
Value chain 1: vegetal waste																			
Vegetal waste to bio-ethanol and high-added value products			Demo project								Commercial roll-out								
Biomass pyrolysis to biofuels, bio-oils, fertilizer and			Pilot/demo project				Commercial scaleplant												
Recovery of nutrients from liquid and solid biomass fractions			Commercial scaleplant																
Conversion of vegetal waste into bio-ethanol and other biobased products			Demo project							Commercial scaleplant									
Conversion of vegetal waste into bio-ethanol and other biobased products			Demo project							Commercial scaleplant									
Conversion of winery waste streams into neutraceuticals			Demo project							Commercial scaleplant									
Biobased production of polyurethanes			Commercial scaleplant																
Anaerobic digestion winery waste																			
Value chain 2: Olive sector																			
Olive waste streams conversion into neutraceuticals			Demo project							Commercial roll-out									
Biobased production of polyurethanes			Commercial scale project																
Value chain 3: Forestry																			
Conversion of forestry and vegetal waste into pigments			Demo project							Commercial roll-out									
Value chain 4: Live-stock farming																			
Manure towards fertilizer/biogas			Commercial scaleplant																
Manure towards fertilizer/biogas			Commercial scaleplant																
Manure towards fertilizer/biogas			Commercial scaleplant																
Value chain 5: CO2																			
Algae to biofuel, neutraceuticals, fertilizer			Commercial scaleplant																

The figure shows that already around 2020 the first new commercial scale plants could be realized, if the hurdles to their implementation can be adequately removed. In 2025 there would be commercial scale plants for most of the value chains, based on commercial scale follow-up projects to the currently planned demo projects.

3.1.2 Timing policy measures

The timing for the identified policy measures is presented in the Gantt chart below:

- Better use of funding/finance instruments could be tackled by organizing an annual event, which ensures that all the Bioeconomy stakeholders meet at least once a year. Based on this meeting, further project development targeting these schemes can be initiated.
- Also the outreach to the chemical industry could take place by attending key events, like the BBI infodays and the Suschem brokerage event using the projects which have been identified in Andalusia's own annual Bioeconomy event.
- The stakeholder analysis should be carried out in the 2nd half of 2017 in order to identify key companies for Andalusia's development as a Bioeconomy region.
- The projects SUPERBIO and AGRIFORVALOR will run in the coming four years and should by the end have engaged with the Andalusian Bioeconomy community and provide innovation support in line with needs of local companies.
- The creation of key infrastructure at strategic locations can be initiated in the coming two years.

3.2 Responsibilities

The project owners of the foreseen investments have been discussed in chapter 1 and 2. The parties involved in the policy measures have been discussed in chapter 2.2

3.3 Funding

3.3.1 Funding investments and policy measures

The following schemes in principle allow for fairly targeted pilot/demonstration projects:

LIFE (European programme for pilot/demonstration of sustainable technologies).

SME instrument of Horizon 2020

Fast-track-to Innovation (part of Horizon 2020), only with international partners.

Biobased Industries, only with international partners.

Other funds, which could be used to fund highly regionally oriented investments, but also some of the policy measures are the regional FEDER, FEADER and Cohesion Fund schemes, but also the Agricultural Fund for Rural Development (EAFRD).

3.4 Monitoring

This chapter provides an overview of how progress of the roadmap will be monitored.

3.4.1 Investment

The following indicators could be used for monitoring the progress on investments:

Number of demonstration projects

Number of commercial scale plants

Amount of investment

3.4.2 Policy measures

The following indicators could be used for monitoring the progress on investments:

Better use of existing funding sources

For this policy measure, the following indicators can be used:

Number of new funding instruments created

Number of funding platforms of which the region is a member (e.g. BBI)

Number of project consortia for funding/finance

Amount of funding/finance secured

Out-reach to the chemical industry

Number of Spanish chemical industries involved

Number of foreign chemical industries involved

Creation of a Coalition of the Willing

Number of meetings with stakeholders organized

Waste management policy and infrastructure for the biobased and circular economy

Legislative or policy proposal on waste management

Create key research infrastructure in central locations to attract and cluster companies

Number of clusters with key research infrastructure created

4 IMPACTS

4.1 Description of quantitative targets

Andalusia has a great feedstock potential for innovative biobased and circular investments which could lead to the creation of new value chains. Following the outcomes of the peer review meetings, the main feedstock-driven value chains where significant investment are expected are the following:

- Horticulture and agri-food. In this value chain, significant investment are expected, particularly at demo level. It is expected that by 2025 at least 3 new commercial scale plants using these feedstocks will be operational in Andalusia.
- Olive sector. In this value chain, already some innovative commercial scale plants are operational and at least 2 more are expected up till 2025.
- Forestry. This feedstock is currently mainly used for energy purposes, but could in the future be used for the production of biobased chemicals.
- Livestock farming. Several commercial scale plants have been constructed for the production of fertilizer and biogas. Given the higher TRL of the technology, in the order of 10-20 more are expected up till 2025.
- CO₂ as feedstock for algae cultivation. Andalusia's great potential for growing algae, together with its strong position in terms of algae cultivation technology, should be able to result in 2 commercial scale plants.

It is difficult to estimate the investments related to the projects identified in this report. As a rule of thumb, the investments in the olive sector which are currently on-going will be taken as a starting point. Currently, approximately 90 smaller projects of each €500.000 are on-going already in the area of olive residues alone. This amounts to an investment of approx. €45 million. If this amount would be applied to each of the investigated value chains, then the related investment to biobased innovation would amount to approximately €200 million. In 2025, investments of up to €500 million should be possible if the demo projects described in this report will lead to a commercial scale follow-up project.