Transformació Econòmica
de les Terres de Lleida, Pirineu i Aran

BIOHUB KM0

The creation of an industry around livestock excrement

Circular bioeconomy stimulus project

The circular bioeconomy. Definition and implications of the model

The green transition promoted by Europe requires new ways of producing and consuming **to be developed.** This need for transformation affects all sectors in one way or another. **It is necessary to transform the current economic model based on fossil-origin resources and linear processes into a model centred around organic and renewable resources and circular processes.**

At the heart of the circular bioeconomy is the sustainable and efficient valorisation of renewable biological resources (plants, micro-organisms and derived biomass, including waste and organic by-products) in integrated production chains with multiple cascading outputs (biorefineries) that enable not only food but also materials, products and energy to be supplied.

That represents a huge opportunity for the Province of Lleida, since it allows all of its potential over and beyond agrifood production to be valorised in this new model for supplying goods, services and energy.

The Province of Lleida accounts for 53% of Catalonia's agricultural production and 47% of its livestock production.

This strategic sector is subject to significant pressure due to its intensive use of certain resources (nutrients, water, energy) and its generation of hard-to-manage waste, **such as livestock excrement.**

An opportunity to diversify the rural economy and create jobs

The development of the circular bioeconomy will not only allow that pressure to be reduced and resource use to become more efficient, but it also represents an opportunity to diversify the rural economy and form links with sectors, beyond food production ones, that **need to gradually replace fossil-origin materials or resources with other organic-origin renewable ones.**
That is the case of the automotive, chemical, pharmaceutical, construction and energy sectors, among others.

The use of biomass to produce materials has **the capacity to generate five to ten times more jobs and four to nine times more added value than its use as a soil substrate or as a fuel to produce energy.**

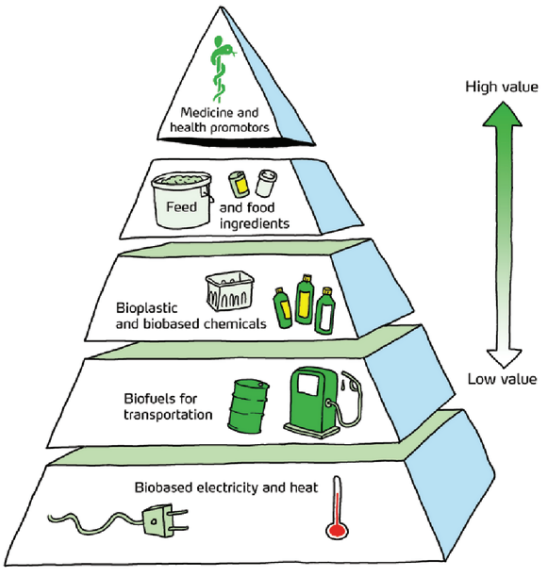


Figure 1. Biomass value pyramid. Source: Lange, L. & Lindedam, J. (2016). The Fundamentals of Bioeconomy. The Biobased Society. United Federation of Danish Workers 3F.

A new economic fabric: Bioindustry

This economic model represents a huge opportunity to develop a new industrial fabric known as **bioindustry** in the province. This knowledge- and technology-intensive **model manages resources rather than waste, and those resources** come from the territory's most strategic sector.

The local production of biofertilisers, biofuels, biomaterials, bioplastics and bioenergies for reintroduction into the primary and other sectors has potential economic, social and environmental value that needs to be captured by rural territories themselves. Only by doing so will skilled jobs be created, which will enable talent to be attracted and retained through an industrial model based **on biorefineries for the production of high value-added products.**

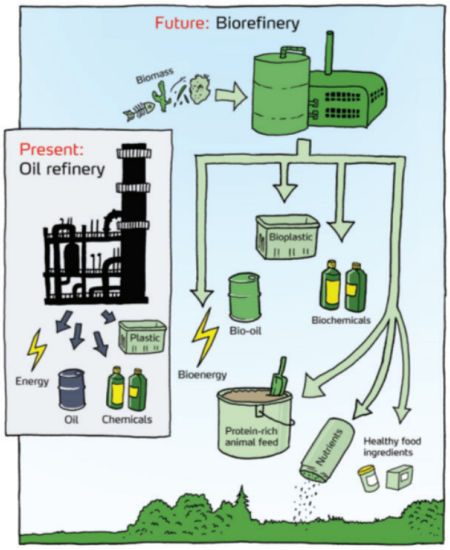


Figure 2. The biorefinery concept. Source: Lange, L. & Lindedam, J. (2016). The Fundamentals of Bioeconomy. The Biobased Society. United Federation of Danish Workers 3F.

A stimulus project for the economic transformation of the territory

A circular bioeconomy based on valorising livestock excrement and other agrifood by-products is one of the seven priority development areas identified in the Strategic Project for the Economic Transformation of Terres de Lleida, Pirineu i Aran 2020-2027.1 This is so because of its potential contribution to achieving the future vision shared and agreed upon by the territory's main institutions.

The aim of Biohub Km0 is to become the stimulus project that serves as a catalyst for the development of a circular bioeconomy in the Province of Lleida and the rest of Catalonia, and to position the territory as a referent in this area.

The project is one of the lines of action envisaged in the Circular bioeconomy focused on the valorisation of livestock manure and other agrifood by-products project included in **Next Generation Catalonia** (Appendix 1).

[1] http:/ promocioeconomica.cat/wp-content/uploads/2021/02/Document-enviat-a-G6–final_tb-v1.pdf.

Challenges for the development of the model

The need to connect the primary sector, research and industry

A recent study conducted within the framework of the Research and Innovation Strategy for the Smart Specialisation of Catalonia (RIS3CAT)2 noted that Catalonia has universities and research centres that promote projects on a variety of circular bioeconomy topics, but that t**here was a lack of transfer of such knowledge to technological and product development for the purpose of facilitating the incorporation of the industrial sector, SMEs and the primary sector into the model. Indeed, the model's success is 80% dependent on the capacity to adapt and develop these technologies.**

The analysis identified a lack of alignment between the knowledge centres' activities and business activities in opportunity areas like bioenergy and chemical and biotechnological engineering (for the primary sector and industrial and specialised service businesses alike). That can partly be explained by the businesses' lack of capacity to innovate (very small businesses that may not have sufficiently trained staff or enough investment capacity).

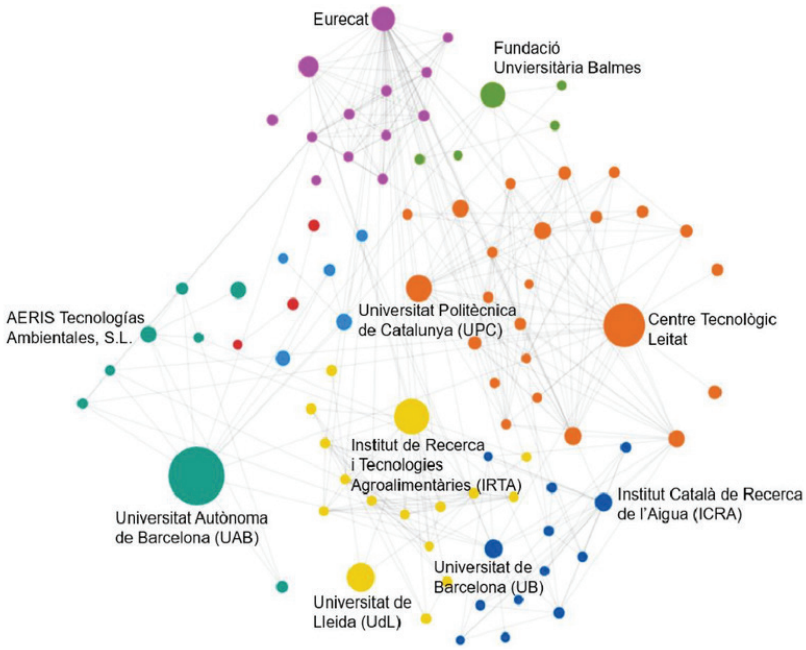


Figure 3. Collaboration networks for circular bioeconomy projects in Catalonia.
Source: Anàlisis de l'especialització en bioeconomia circular [An analysis of specialisation in the circular bioeconomy]. "RIS3CAT Monitoring" collection

A large number of projects on the circular bioeconomy are carried out in Catalonia, but Catalan organisations occupy a relatively modest position in European rankings. That could be explained by the fact that the projects are spread across a large number of organisations, as well as by the lack of strategic alignment among such projects. Such a broad spread makes it hard for Catalonia to have strong territorial and thematic leadership in Europe.

[2] http://catalunya2020.gencat.cat/web/.content/00_catalunya2020/Documents/estrategies/fitxers/analisi-especialitzacio-bioeconomia.pdf

Biorefineries, an industry integrated into a farming environment

The circular bioeconomy, and the industry associated with it, manages biological resources as raw materials for manufacturing high value-added products.

The industrial processes associated with this valorisation can be integrated into rural environments, where the raw materials come from, in a way **that generates complementarity** rather than competition between food production and bioproducts.

Technologies that ensure the minimisation of impact on the environment and the landscape exist, and they should be incorporated in order to secure the necessary social acceptance of the model.

A decentralised model of small-scale biorefineries near the sources of the biological resources will allow skilled jobs to be created and local economies to be revitalised.

The training of human capital associated with the

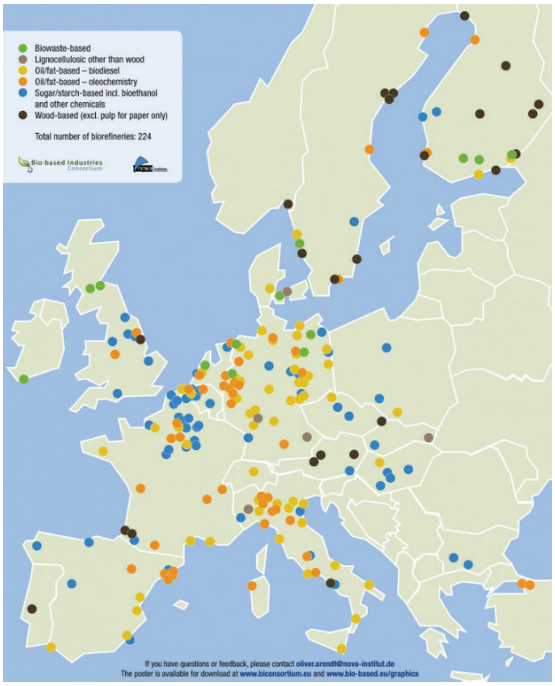


Figure 4. Map of European Biorefineries. Source: https://biconsortium.eu/news/mapping-european-biorefineries

The necessary partnership between businesses and institutions to create new business models

Promoting the bioindustrialisation of the territory is not an easy challenge. Beyond the necessary validation of technologies and products, it is crucial to validate new business models, attract and develop talent, open up new markets, and ensure competitiveness in the production and stable supply of raw materials for new industrial processes, among others.

These challenges require the development of a specialised innovation ecosystem that helps to overcome the obstacles and allows the necessary investments to be mobilised in order to capture the model's potential.

Public-private partnership is an indispensable element of this ecosystem. On a European scale, there are several benchmark initiatives that are being analysed in detail: Biobased Delta (Netherlands), BioEconomy (Germany), BioVale (United Kingdom) and Industries & Agro Ressources (France).

Biohub Km0 project

Specialised innovation in the rural environment to facilitate the creation of a bioindustry

The aim of the Biohub Km0 project is to create a highly **specialised innovation ecosystem** that is integrated into a rural environment where there is a high concentration of agricultural and livestock production (Baix Segrià) so as to facilitate the development of a circular bioeconomy model in just and smart terms.

The project is being developed around four stimulus initiatives that already have public funding of €1.1 m for the first phase, which is currently being implemented:

- The operationalisation of a p**ublic-private infrastructure to validate biotechnologies and bioproducts at a precommercial stage**. It will be located in Alcarràs, in an industrial space in the process of being developed, where a composting plant promoted by pig and cattle farmers is currently being built.
- The creation of **a space for the development of new business models and for the promotion and acceleration of entrepreneurship around the circular bioeconomy**, promoted by Alcarràs Town Council.
- The articulation of an advanced geographic **information system**, promoted by Lleida Provincial Council's Economic Development Board, that allows for the management, geolocation and analysis of data relating to biological resources available within the territory that could be valorised through new value chains.
- **Bioproduct market study** and analysis of the technical and economic viability of the potential value chains identified.

A space for the development of new products and new business models

The project must respond to the need to have spaces for experimentation and prototyping that, in controlled risk settings, enable the t**echnological, product and market** development of new value chains and business models in the area of biomaterial, biofuel and bioenergy production and consumption.

Aerial view of the space in Alcarràs where Biohub Km0 will be developed.

A pilot project validated by around 60 organisations and administrations over three years

More than 60 organisations – administrations, research centres and representatives of the local economic and productive fabric – were involved in the work carried out in the last three years within the framework of the Biolab Baix Segre pilot project, which allowed the following to be identified:

- **There is enough organic material within the territory** to articulate new value chains on a commercial scale in the sustainable circular bioeconomy area (Appendix 2).
- **There is growing demand on a European** scale for high value-added organic-origin products and materials capable of replacing fossil-origin ones.
- **There is huge potential for replacing fossil-origin products** and/or materials with organic-origin ones within the territory's agricultural and livestock farming sector.
- **A decentralised treatment and valorisation model needs to be defined and validated**, which, as a whole, should enable the various envisaged phases to be implemented on a territorial scale.
- **It is crucial to validate the set of technologies** required to operationalise these value chains based on the characteristics of available organic matter.

A project with a European precedent

In European territories where the sustainable circular bioeconomy model is being strongly developed, facilities like these already exist. These are the so-called **"open access multipurpose pilot and demo infrastructures"** (Appendix 3). They are open access pilot facilities for the validation of technologies linked to industrial biotechnology, chemical conversion, thermal conversion, fractioning and purification, material technologies, algae cultivation, anaerobic digestion, nutrient recovery and new protein harvesting, among others.

Next Generation Catalonia

8. Circular bioeconomy focused on the valorisation of livestock manure and other agri-food by-products

E2. Ecological transition
A8. Circular economy

Description:

Circular bioeconomy in the recovery of livestock excrement and other by-products of the agri-food industry. The project is composed of the following actions:

1. Improving manure management at source and reducing the environmental impact of farming by treating at source and implementing best available techniques.
2. Recovering livestock waste through the production of power and fertiliser.
3. Implementing a network of biorefineries for the production of high-added-value biomaterials and bioproducts.

Link with the 11 missions:

- M1. Equal opportunities
- M2. Sustainable economy
- M3. Energy transformation and new industry
- M4. Sustainable mobility
- M5. Natural environment
- M6. Connectivity
- M7. Technological sovereignty
- M8. Innovation
- M9. Transformation
- M10. Infrastructure
- M11. Competitiveness

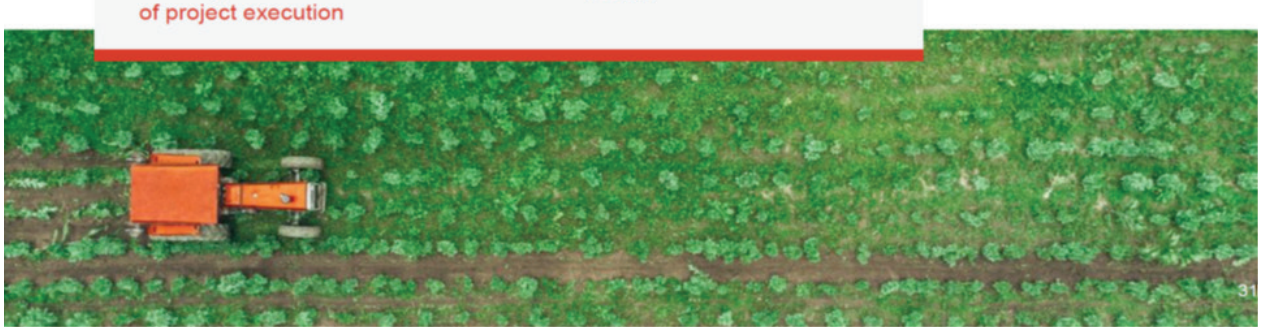
Actors involved in the definition and implementation of the project*:

- Government of Catalonia
- Provincial council of Lleida
- Energy companies
- Livestock-rearing partnership companies
- Farmers' associations
- Food and meat industry
- Research centres and others

(*) This project will be managed by the Technical Office for Economic Transformation and the Promotion of the Bioeconomy in Lleida province.

Budget (EUR millions):

62	620
First year of project execution	Total



Appendix 2

Input-output tables for the agricultural and livestock farming sector of the municipalities forming part of the Biolab Baix Segre initiative (2018 data).[3]

LIVESTOCK								
Municipality	Live-stock farm¬ing sector	Drinking water con-sumption (m^3)	Elec-trical energy con-sump-tion (kWh)	Energy con¬sump-tion for heating (kWh)	Food con-sump¬tion (kg)	Volume of ex¬crement (m^3)	Weight of excre¬ment (tonnes)	Dry matter (tonnes)
Albatàrrec	Cattle	0	0	0	0	0	0	0
	Pig	12.018	233.983	349.634	3.184.466	6.553	5.242	459
	Poultry	2.244	77.000	187.688	1.029.600	1.200	600	360
		14.262	310.983	537.321	4.214.066	7.753	5.842	819
Alcarràs	Cattle	468.542	843.601	0	128.177.432	79.268	63.414	13.317
	Pig	526.275	9.899.357	19.212.726	147.118.246	54.355	46.202	22.082
	Poultry	28.772	941.808	1.785.342	13.623.345	15.139	7.614	4.568
		1.023.588	11.684.765	20.998.068	288.919.023	148.743	117.230	39.967
Almenar	Cattle	74.155	123.148	0	20.183.225	12.376	9.901	2.079
	Pig	348.207	4.622.486	9.341.733	98.433.012	197.609	158.087	13.639
	Poultry	6.695	229.717	559.934	3.071.640	3.580	1.790	1.074
		429.056	4.975.351	9.901.668	121.687.877	213.565	169.778	16.792
Montoliu de Lleida	Cattle	737	294	0	185.176	108	86	18
	Pig	2.574	14.280	54.348	772.065	1.425	1.140	100
	Poultry	1.436	49.280	120.120	658.944	768	384	230
		4.746	63.854	174.468	1.616.185	2.300	1.610	348
Seròs	Cattle	7.158	19.265	0	2.069.628	1.317	1.054	221
	Pig	128.901	3.153.132	5.333.925	34.550.239	87.386	69.909	5.472
	Poultry	1.047	35.933	87.588	480.480	560	280	168
		137.107	3.208.330	5.421.512	37.100.347	89.263	71.242	5.861
Soses	Cattle	55.220	100.573	0	15.175.601	9.363	7.491	1.573
	Pig	164.014	3.902.486	7.053.994	44.784.326	116.004	92.803	6.886
	Poultry	20.453	305.975	151.401	17.484.802	9.970	7.818	4.691
		239.687	4.309.034	7.205.395	77.444.729	135.338	108.112	13.150
Sudanell	Cattle	11.605	13.897	0	3.070.263	1.848	1.478	310
	Pig	3.544	19.666	74.848	1.063.283	1.963	1.570	137
	Poultry	0	0	0	0	0	0	0
		15.150	33.564	74.848	4.133.545	3.810	3.048	448
Torres de Segre	Cattle	76.613	282.855	0	22.117.279	14.447	11.557	2.427
	Pig	104.349	1.565.990	3.304.864	29.709.348	64.893	51.914	4.333
	Poultry	5.684	109.443	92.593	9.623	2.293	1.147	790
		186.645	1.958.287	3.397.456	51.836.250	81.632	64.618	1.633
		2.050.241	26.544.169	47.710.736	586.952.023	682.404	541.482	79.018

[3] Resource analysis performed within the framework of the Biolab Baix Segre initiative.

AGRICULTURE

Municipality		Water con-sump-tion (m^3)	Diesel consump-tion (m^3)	Fertiliser (t)	Packaging (kg)	Production (t)	Residual biomass (t)	Dry residual biomass (t MS)
Albatàrrec	Herbaceous	428.862	18	111	506	854	145	127
	Grassy	152.373	5	28	119	339	512	451
	Woody	2.639.373	692	416	13.989	18.305	1.620	1.296
		3.220.608	715	555	14.613	19.498	2.276	1.874
Alcarràs	Herbaceous	24.192.447	762	4.229	19.223	39.478	4.937	4.344
	Grassy	9.332.308	284	1.648	7.101	21.048	31.762	27.953
	Woody	17.248.590	16.621	4.501	82.042	108.944	9.209	7.367
		50.773.345	17.667	10.377	108.366	169.471	45.908	39.664
Almenar	Herbaceous	10.722.564	566	3.050	13.865	20.124	5.011	4.410
	Grassy	5.165.938	157	912	3.929	11.787	17.775	15.642
	Woody	4.386.806	3.190	1.111	20.566	25.359	2.270	1.816
		20.275.308	3.913	5.072	38.360	57.270	25.056	21.867
Montoliu de Lleida	Herbaceous	456.470	31	170	770	837	288	253
	Grassy	858	<0,1	0	1	2	3	3
	Woody	1.387.297	663	270	7.259	9.440	824	659
		1.844.625	694	440	8.030	10.279	1.114	915
Seròs	Herbaceous	128.581	112	615	2.796	1.781	1.111	977
	Grassy	32.281	1	6	25	73	111	97
	Woody	9.734.104	8.040	4.501	68.246	68.362	8.410	6.728
		9.894.966	8.153	5.122	71.066	70.216	9.631	7.802
Soses	Herbaceous	1.362.708	42	229	1.042	2.544	191	168
	Grassy	727.468	22	128	551	1.653	2.493	2.194
	Woody	7.407.614	7.034	1.970	36.090	46.972	3.975	3.180
		9.497.790	7.098	2.327	37.683	51.169	6.660	5.543
Sudanell	Herbaceous	189.008	6	35	159	297	47	41
	Grassy	305.063	9	54	231	693	1.046	920
	Woody	2.443.817	1.832	551	11.959	15.912	1.355	1.084
		2.937.888	1.848	639	12.349	16.903	2.448	2.046
Torres de Segre	Herbaceous	3.950.387	118	693	3.149	6.937	1.045	927
	Grassy	1.588.547	49	285	1.230	3.440	5.212	4.588
	Woody	12.141.649	10.644	3.061	59.722	79.981	6.682	5.346
		17.680.583	10.813	4.039	64.101	90.357	12.940	10.861
		116.125.112	**50.900**	**28.571**	**354.568**	**485.162**	**106.032**	**90.571**

Appendix 3

European biotechnology validation facilities.

Location of technology validation plants. Source: Biopilots4u.eu

Diputació de Lleida
La força dels municipis

LA PAERIA
Ajuntament de Lleida

Generalitat de Catalunya

Universitat de Lleida

Cambra de Comerç de Lleida

Cambra de Comerç de Tàrrega