CENER

CENTRO NACIONAL DE ENEGÍAS RENOVABLES
NATIONAL RENEWABLE ENERGY CENTER OF SPAIN

NOVEL TECHNOLOGY FOR PRODUCING HIGH QUALITY STRAW PELLETS

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www.bio2c.es

CENER's Industrial research infrastructure for bioprocesses

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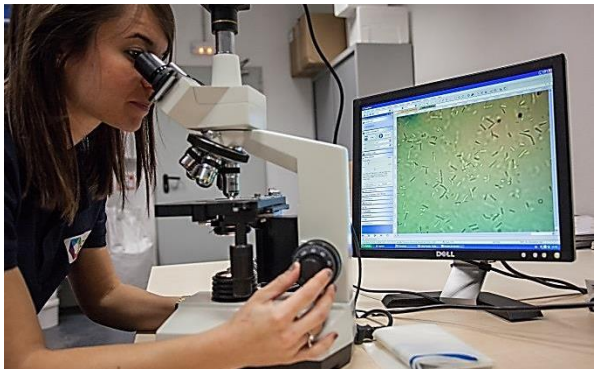
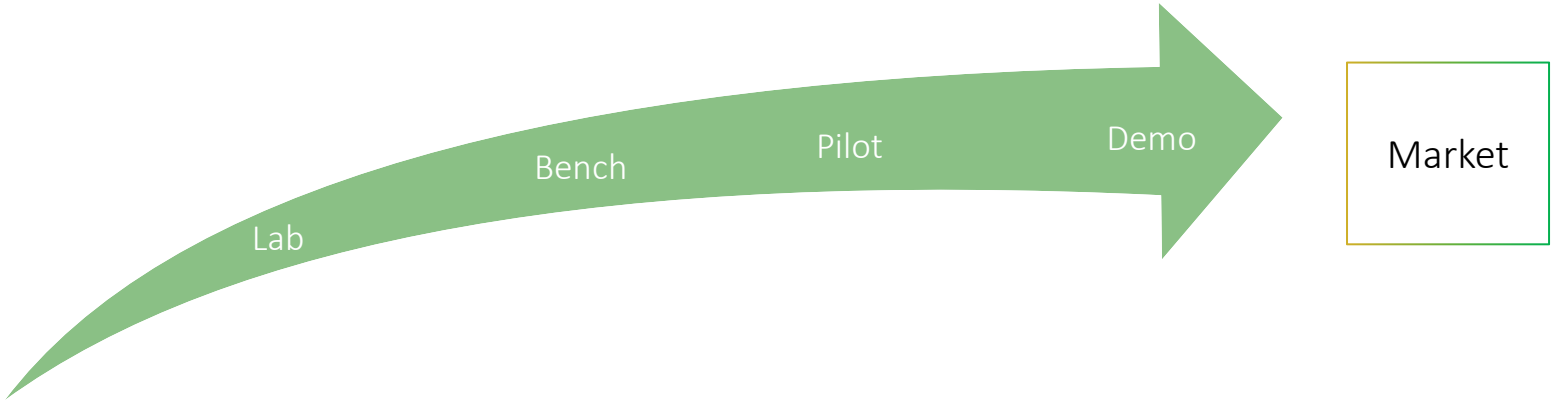


BIOREFINERY AND BIOENERGY CENTRE (BIO2C) Aoiz



BIO2C – Biorefinery and Bioenergy Centre

www.bio2c.es

PRETREATMENT UNIT

https://www.bio2c.es/pretreatment-unit/

https://youtu.be/MSpAomIG3VE

Torrefaction Unit

Pelletization Unit

The **Biorefinery and Bioenergy Centre** (BIO2C) is a semi-industrial **demonstration-scale testing facility** with different **Process Development Units** capable of **developing and validating** processes for the production of **bioproducts, solid biofuels, advanced liquid and gaseous biofuels**, as well as **biorefinery** concepts by integrating different routes of valorisation, as an intermediate stage between the laboratory and the commercialization trough the industrial **scale-up** of these technologies.

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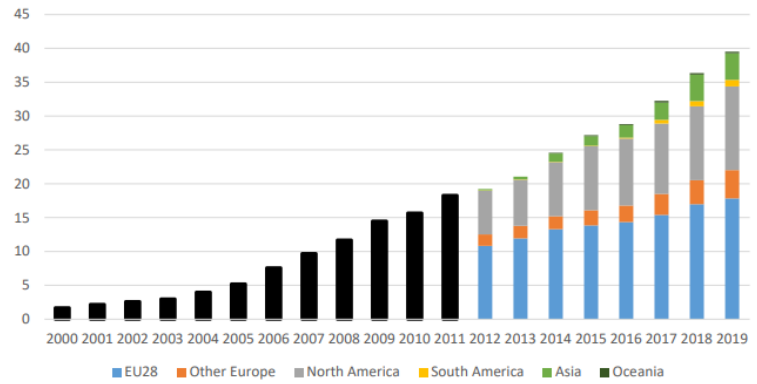
Pellet from residual agrobiomass :

Motivation

Bioenergy 's **feedstock demand is increasing** and therefore the pressure on the procurement prices for the higher quality wood fiber feedstock.

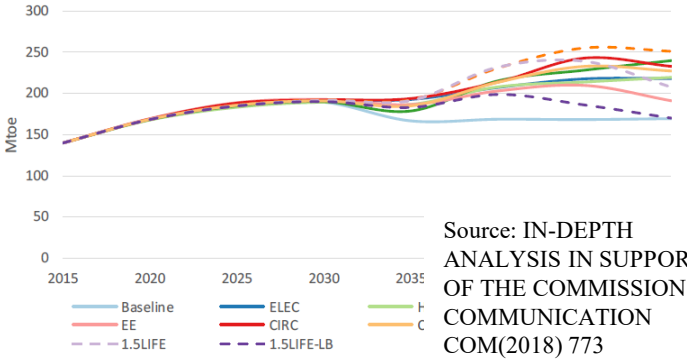
- **Growing world pellet production (**40Mt in 2019; +63% in 5 years).
- **Increasing competence for raw material**
- The aplication of the **biomass cascading principle**, **minimising** the use of high quality **stemwood** for energy, is taking force in **new EU regulations**

Figure 1 Evolution of global pellet production (million tonnes)



Source: Bioenergy Europe

Figure 82: Gross inland consumption of biomass and waste



Source: IN-DEPTH ANALYSIS IN SUPPORT OF THE COMMISSION COMMUNICATION COM(2018) 773

As consequence the consumption of lower quality and cheaper feedstocks will increase drastically in next years.

Pellet from residual agrobiomass:

Motivation

- **Agricultural residues potential** is even higher that woody biomass (**>52 Mtep** en Europe; 1/3 of total biomass potential).

- EU 2050 projections increase consumption of:
  - Waste
  - Forest residues
  - Agricultural residues
  - Grass

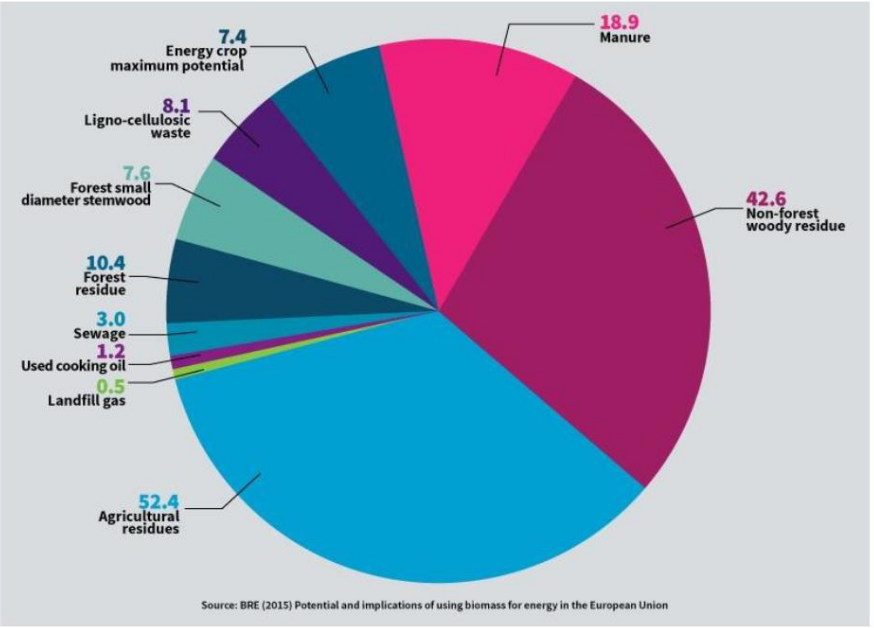
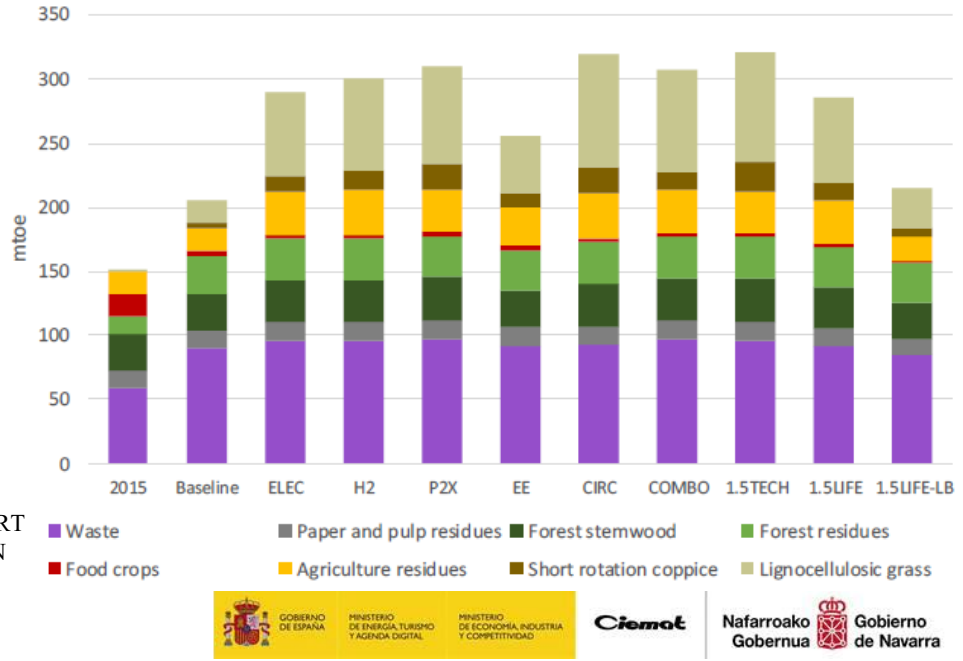


Figure 6- The sustainable potential for biomass feedstocks (Mtoe)

Figure 84: Break down of bioenergy feedstock in 2050



Source: IN-DEPTH ANALYSIS IN SUPPORT OF THE COMMISSION COMMUNICATION COM(2018) 773

Pellet from residual agrobiomass:

New market demand for bioenergy

- Need to decarbonize fosil based industrial heat demand due to the increase of CO_2 price

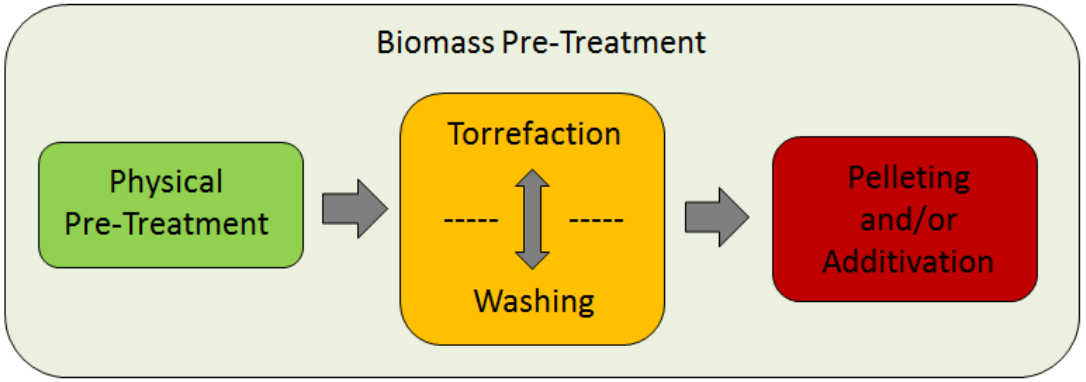
- ➔ 113 Mtoe fossil fuel consumption in the industry (EU28)

Final enegy consumption (Tep)	Coal	Petroleum coke	Natural gas	Gas oil	Fuel oil	TOTAL
Industry sector	12.657.793	4.791.937	83.492.171	9.814.791	2.591.454	**113.348.146**
Commercial and public services	734.125	82	43.151.500	8.875.423	168.438	52.929.568
Households	7.066.863	56.706	103.022.640	22.212.929	5.841	132.364.979
Agriculture and forestry	770.210	0	3.810.103	14.722.120	82.577	19.385.010
Fishing	0	0	918	1.353.228	11.465	1.365.611
Other sectors	79.041	0	931.128	879.868	22.070	1.912.107
TOTAL	**21.308.032**	**4.848.725**	**234.408.460**	**57.858.359**	**2.881.845**	**321.305.421**
Source: EUROSTAT 2019 Data;EU28						

- CENER is developing a **technology** to produce reliable, sustainable and competitive **solid biofuels from residual agribiomass**, focused on the **decarbonization of indutrial sectors intensive in thermal energy consumption**.

- The technology **combines** the **torrefaction** of residual biomass with processes for the **elimination of certain unwanted inorganic elements** and the **use of additives** that improve the high temperature behavior of the mineral fraction.

- The result is **a solid biofuel** with **high calorific value, very high energy density, low emissions and a high ash melting temperature**.



- Technology development stages:
  - Lab scale testing & process optimization ✓
  - Process Flow diagramm definition ✓
  - Mass and Energy Balance ✓
  - Capex and opex estimations ✓
  - Proof of concept at pilot scale (2 tonnes) ✓
  - Process demostration in continuous long term operation at pilot scale (10 tones) **pending**
  - Product validation in industrial tests **pending**

- Pilot tests results:
  - 2 tonnes of product produced in different batches
    - **Reduction of 67% of the potassium content** (based on the energy content of the fuel; that is, in mg / kWh),
    - **>95% in the case of chlorine** and
    - **57 % in the case of sulfur.**
  - <u>Product characteristics:</u>
    - Low inorganic aerosols release. No fouling and very low particle emissions.
    - High ash melting temperature. No slaging.
    - High net calorific value
    - High bulk density
- Product cost estimation
  - 58.000-116.000 t/y plant
  - **27-32 €/MWh**

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Cleaned straw pellet characterization

Low potasium content.
Very low chlorine content.
Low sulphur content
Low inorganic aerosols release. Nofouling and very low particle emissions.
High ash metilng temperature. No slaging.
High net calorific value
High bulk density

Version 22.12.2020

Analysis Description	Min	Max	Standard Method
Proximate Analysis			
Total moisture (% a.r.b.)	7,1	8,6	UNE EN ISO 18134-2:2015
Ash (% d.b.) (1)	6,0	8,0	UNE EN ISO18122:2016.
Volatile matter (% db.)	67,0	71,0	UNE EN ISO 18123:2016
CV Net MJ/kg db	19,0	21,0	UNE-EN 14918:2011
Ultimate Analysis (1)			
Chlorine (% d.b.)	0,005	0,008	UNE-EN- ISO 16994:2015
Sulphur (% d.b.)	0,04	0,059	UNE-EN- ISO 16994:2015
Nitrogen (% d.a.f.)	0,3	0,80	UNE-EN- ISO 16948:2015
Trace Metals - Major Elements (1)			
Aluminium (mg/kg d.b.)	154	459	UNE-EN- ISO 16967:2015
Calcium (mg/kg d.b.)	5220	7480	UNE-EN- ISO 16967:2016
Iron (mg/kg d.b.)	246	658	UNE-EN- ISO 16967:2017
Magnesium (mg/kg d.b.)	829	1210	UNE-EN- ISO 16967:2018
Phosphorous (mg/kg d.b.)	349	554	UNE-EN- ISO 16967:2019
Potassium (mg/kg d.b.)	2310	3820	UNE-EN- ISO 16967:2020
Silicon (mg/kg d.b.)	13200	14800	UNE-EN- ISO 16967:2021
Sodium (mg/kg d.b.)	20	420	UNE-EN- ISO 16967:2022
Titanium (mg/kg d.b.)	9	35	UNE-EN- ISO 16967:2023
Ash Fusion (1)			
Shrinkage °C	830	1100	CEN/TS 15370-1:2006
Deformation °C	1230	1270	
Hemisphere °C	1250	1270	
Flow °C	1260	1280	
Physical Properties			
Tamped Bulk Density (kg/m³)	700	730	UNE-EN ISO 17828:2016
Pellet Diameter mm	6	6	
Fines Content through 3.15mm round hold sieve (%)	0,02	0,16	UNE-EN ISO 17827-2:2016
Mechanical Durability	96,2	98,2	UNE-EN ISO 17831-1:2016
(1) Dependent on raw material composition			

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NEXT STEPS

- Market assesment for diffrenten market segments (2021)

- Product specification requirements for each application defined by end users (2021)

- Process demostration in continuous long term operation at pilot scale (10 tones) (2022)

- Product fuel validation in industrial tests with end users (2022)

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MUCHAS GRACIAS.

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