Project title: Brazil-EU Cooperation for Development of Advanced Lignocellulosic Biofuels



Topic: LCE 22-2016

Grant: 5 M€

Partners: 13

Coordinator: University of Bologna (IT)

Duration:





























Objective:



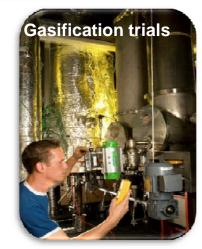
To provide affordable and innovative solutions for increasing the efficiency of advanced biofuels production from lignocellulosic biomass.

- i) integrating food/feed/fuels cropping systems along with perennial grasses grown in marginal land;
- ii) optimizing logistical concepts;
- iii) increasing the efficiency of thermochemical and biochemical conversion technologies.











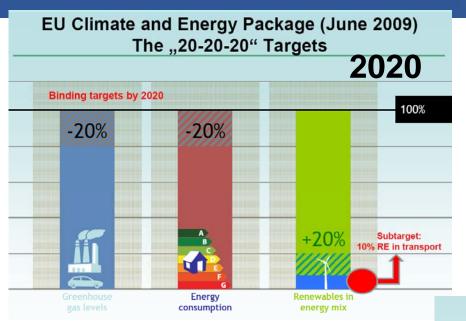


Advanced biofules:

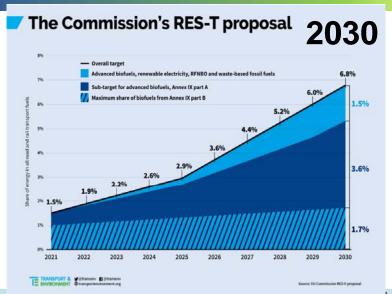


Fuels produced from lignocellulosic feedstocks (i.e. agricultural and forestry residues, e.g. wheat straw/corn stover/bagasse, wood based biomass), non-food crops (i.e. grasses, miscanthus, algae), or industrial waste and residue streams, having low CO₂ emission or high GHG reduction, and reaching zero or low ILUC impact (http://www.biofuelstp.eu/advancedbiofuels.htm)





• iLUC Directive (cap 7% biofuels produced from 'food' crops). reason marginal/idle lands viable resource for advanced biofuel.



27% (update 32%, June 2018) of renewable energy and -40% GHG 14% target for the transport sector Advanced biofuels: minimum target of 5.3%

e.g. when feedstocks are grown on land that was previously forest

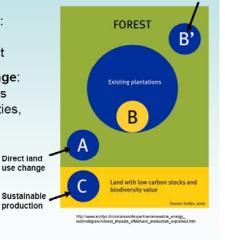
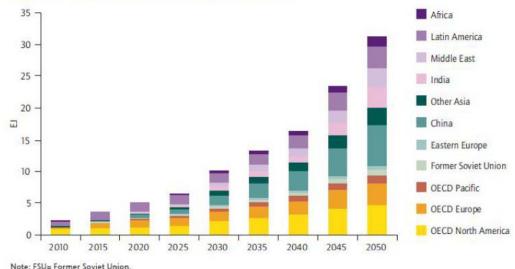




Figure 8: Biofuel demand by region 2010-50

Source: IEA, 2010c.



Biofuels demandad 10-20 times Carrying capacity of marginal land: 1%

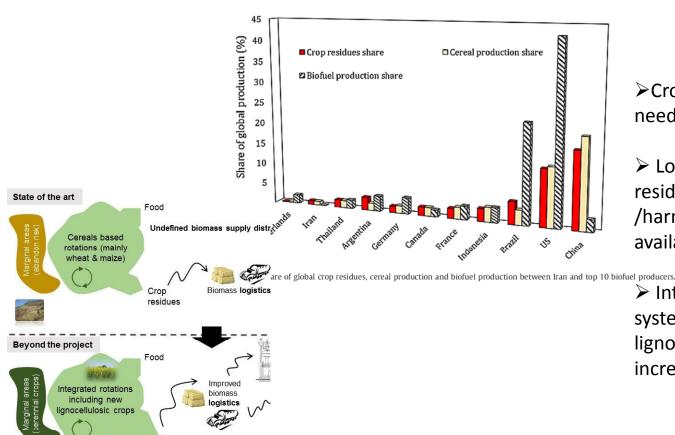
Development alternative innovative cropping systems a crucial task.

Integrated conventional crop rotations with biomass and food crops.

Favourable regulations & financial support in EU and Brazil: Consumption advanced biofuels > 5 times by 2020, a quarter by 2050.

Europe and Brazil > producers & consumers of biofuels.





> crop residues

Dedic, annual crops

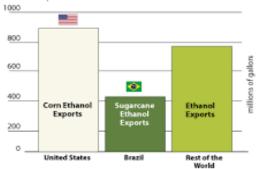
Set up of

- ➤ Crop residues: supply 16% road transport fuel needs in 2030 (< 60% GHG; > 300,000 jobs)
- ➤ Logistics and biomass supply based on crop residues poorly sustainable and difficult to organize /harmonize due to unpredictable biomass yield, availability and price.
- Integrated and logistically efficient supply systems (crop residues, annual & perennial lignocellulosic crops): a sound solution for increasing lignocellulosic feedstocks availability.



Global Ethanol Trade Benefits the U.S. & Brazil

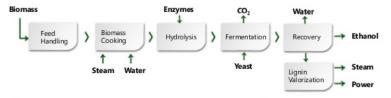
The United States and Brazil were the world's top two ethanol exporters in 2014.



Sources: SECEX, LMC International, Energy Information Administration

The Proesa[™] Process





PROESA™ Technology benefits:

- Feedstock flexibility
- No chemical addition, optimal sugar extraction and low enzyme dosage.
- Fully integrated process design using continuous equipment to enable large scale plants
- Best in class technology, backed with performance guarantees, lowest capex and opex.
- Intellectual Property 26 patent family applications filed, 14 are public



Complementarities in expertise and experience between EU and Brazil

Brazil: large biomass production potential (second largest biofuels producer in the world with the largest experience on sugarcane ethanol production and logistics.

Brazil: advanced biofuel production based on sugarcane bagasse (transforming half of the available bagasse into ethanol, Brazilian ethanol output will increase by at least 50%).

EU: cutting-edge technological base on advanced biofuels. first industrial plant in the world for the production of advanced bioethanol was built in Europe (Crescentino, Italy) based entirely on the PROESA® technology

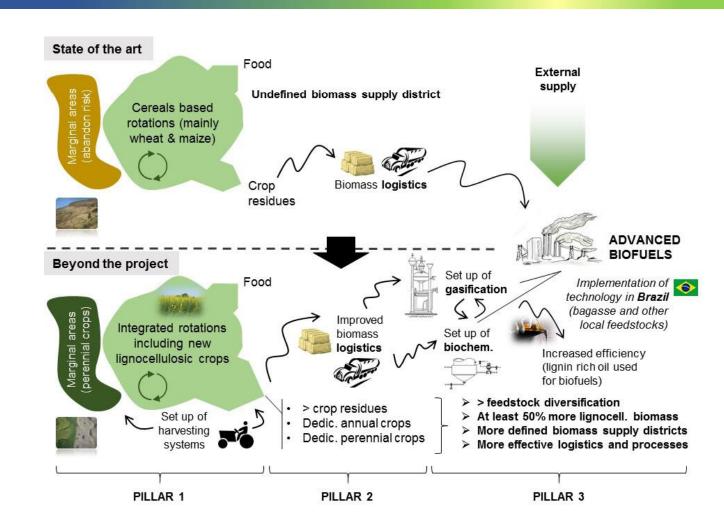
The BECOOL project pillars:



PILLAR 1 - Biomass production and feedstock diversification;

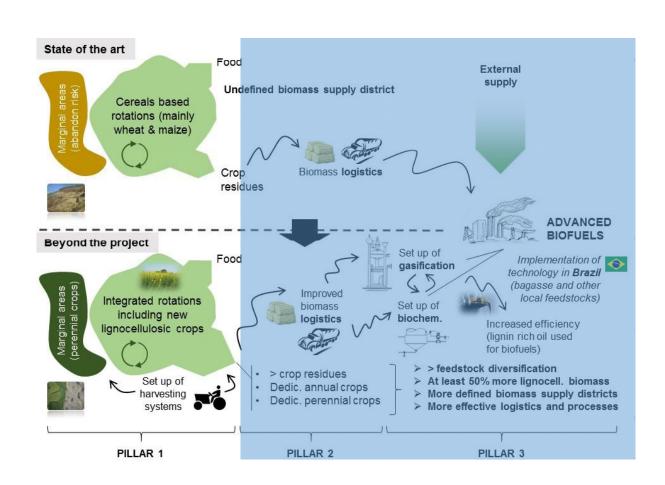
PILLAR 2 - Biomass logistics;

PILLAR 3 – Conversion processes



PILLAR 1 - Biomass production and feedstock diversification





Integrated biomass supply systems (annual & perennial dedicated lignocellulosic crops; crop/process residues)

Integrated cropping systems (conventional & dedicated lignocellulosic crops) absent in Europe

Dedicated annual lignocellulosic crops will be introduced alongside the conventional crops (>LER – Land Equivalent Ratio)

Perennial grasses grown in marginal/idle lands.

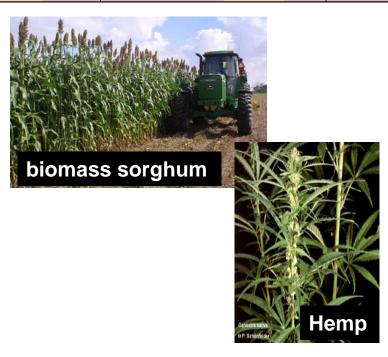
Harvesting logistics

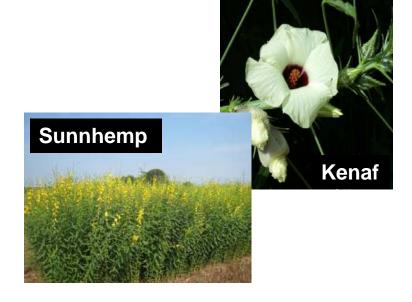
Environmental benefits (integrated cropping systems)

PILLAR 1 – Crop rotations



2	2017 2018														.9				2020						20						2021							
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R1 [Maize				Sunn Hemp				Whe	at						Sunr	n Her	mp		Maize																		
R2 [Maize				Fiber sorghum				Whe	at						Sunn Hemp				Maize																		
R3 I	Maize		1					Kenaf				Whe	at						Sunn Hemp				Maize															
R4 I	Maize			Hemp								Whe	at						Sunn Hemp			Maize																
R5		Sunn Hemp	emp Wheat						Sunn Hemp W					neat						Sunn Hemp Wheat					S						lemp							





PILLAR 1 – Perennial crops

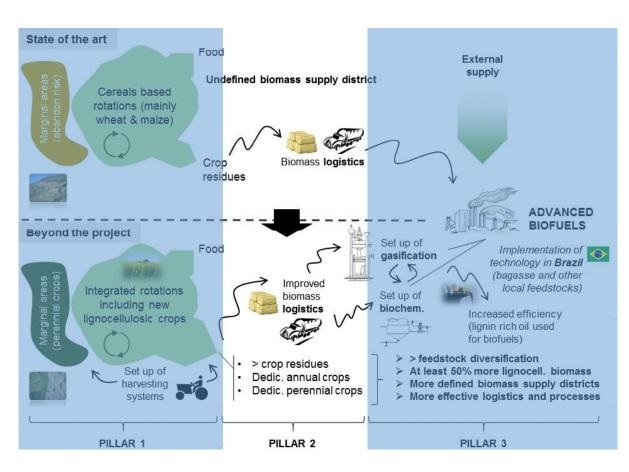






PILLAR 2 - Biomass logistics





Develop strategies to deal with supply uncertainties & logistic concepts.

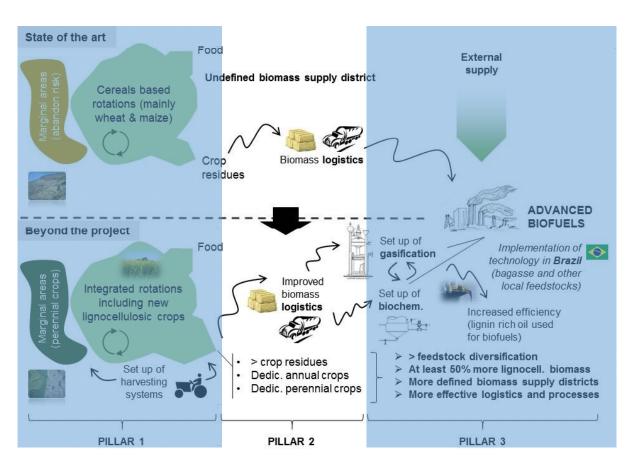
Develop logistic concepts (X crop diversification systems)

Provided cost effective and efficient logistics (connecting feedstock diversity with processing)

Develop integrated logistical handling and pre-treatment processes

PILLAR 2 - Biomass logistics





LocaGIStics, Bioloco and BeWhere: biomass yards/hubs, no/one or more intermediate collection points, different transport systems, routes, different central and decentral pretreatment steps, different harvesting systems etc.)

The logistical tools adapted to the case situation x alternative logistical designs of the biofuel delivery chains.

Cost optimization approach (tools adapted to different geographic levels)

PILLAR 2 - Biomass logistics



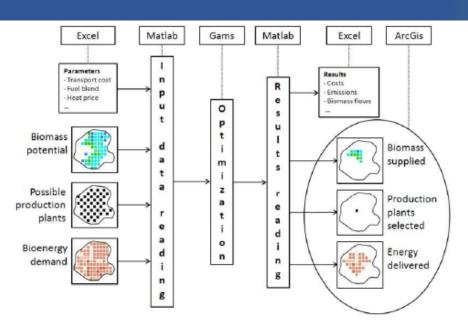
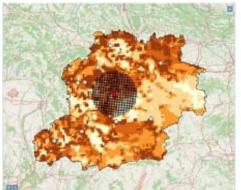


Figure 4. Overview of the modeling steps of the BeWhere model.





LocaGIStics, Bioloco & BeWhere tools developed specific case studies (collection, transport & process of the feedstock).

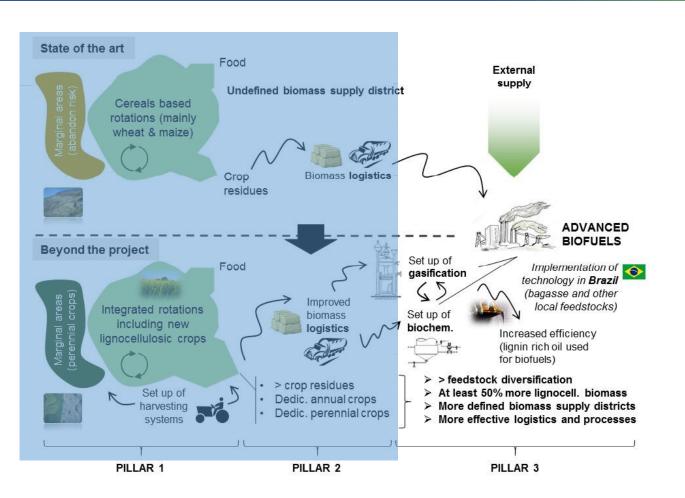
BeWhere, identifies optimal locations of biofuel production plants (<minimization cost supply chain)

LocaGIStics (based on BeWhere results) assess the feasibility of the location, based on simulation costs & emissions by logistics of the feedstock supply. This loop process ensures a robust estimation of the appreciation of the location and characteristics (capacity, technology) of the biofuel production plant.

BioLoco similar as BeWhere, but at local level.

PILLAR 3 – Conversion technologies





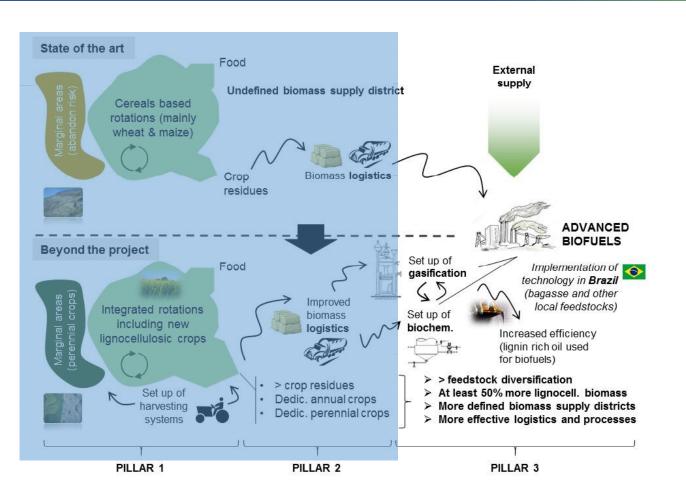
Thermochemical & biochemical

<u>Thermochemical:</u> an intermediate energy carrier produced by pyrolysis & gasification

Intermediate carriers advantages: i) allows accommodating specific logistics requirements, ii) improves efficiency of gasification.

PILLAR 3 – Conversion technologies



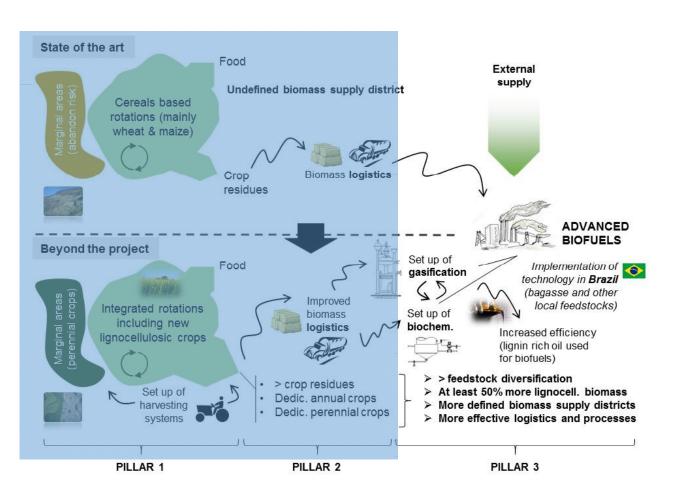


<u>Biochemical:</u> new fermentation and separation processes (pretreatments, hydrolysis and fermentation validated on pilot scale)

Improved enzyme mixtures for specific feedstocks.
Enzyme dose will be reduced (sugar concentration increased, through selecting microorganisms for higher resistance to inhibitors)

PILLAR 3 – Conversion technologies





Biochemical/thermochemical:

integrated systems for valorizing lignin-rich and other types of biofuels rsidues to increase the energy efficiency of the advanced biofuels production process.

Lignin-rich residue burnt on-site to generate steam and power.

New conversion routes (lignin rich will be converted into lignin oil additional feedstock for advanced biofuels.

General information about the BEECOL project



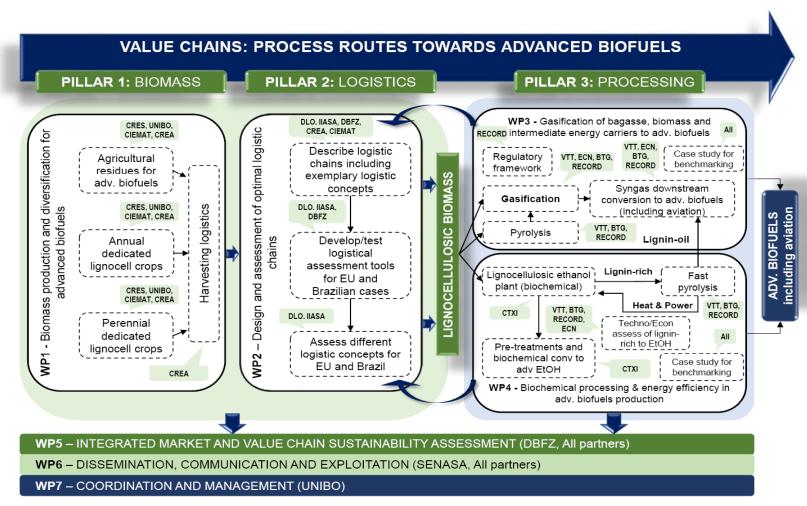


Fig. 1.7 - Simplified BECOOL workflow



www.becoolproject.eu

