FOR BIO

Sustainability assessment: Italian Case Study

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No691846.

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FULL RESULTS AVAILABLE: HTTPS://FORBIO-PROJECT.EU/DOCUMENTS

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SUSTAINABILITY ASSESSMENT PROCESS

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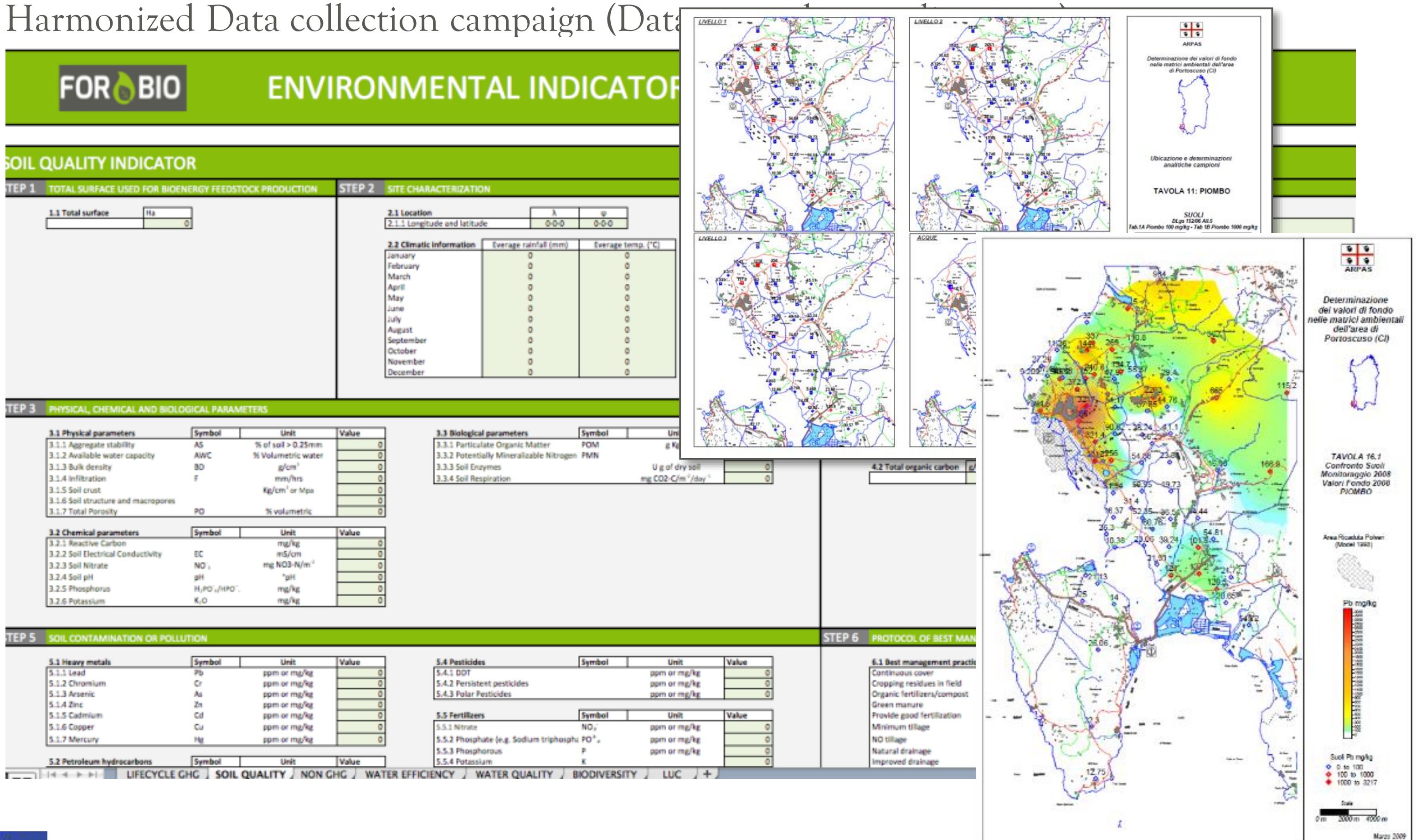
FAO’s approach to the Sustainability Assessment in FORBIO:

- Harmonized Data collection campaign (Data



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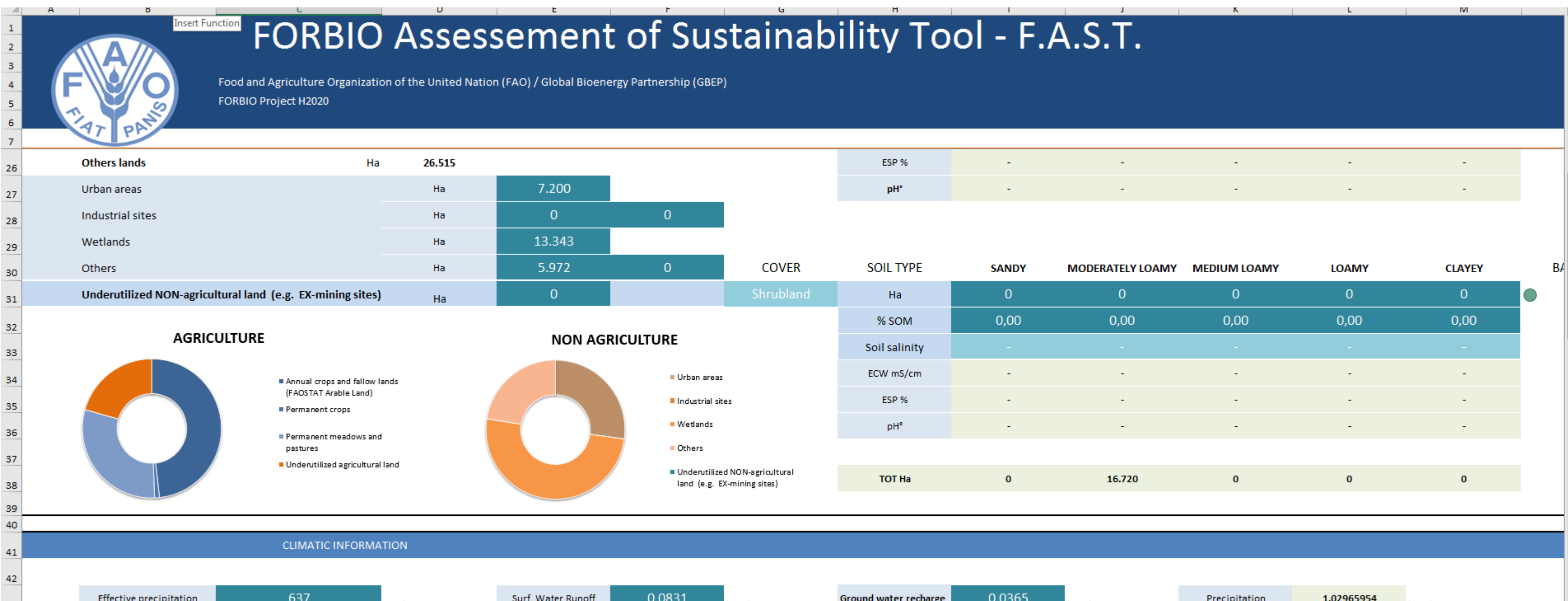
FAO's approach to the Sustainability Assessment in FORBIO:

- Harmonized Data collection campaign (Data entry sheets + literature)
- Development of tailored set of Sustainability Indicators (adapted from GBEP SI)

FORBIO SUSTAINABILITY INDICATORS		
ENVIRONMENTAL	SOCIAL	ECONOMIC
Life-cycle GHG	Land Tenure	Productivity
Soil Quality	Change in Income	Net Energy Balance
Non GHGs	Jobs in Bioenergy Sectors	Gross Value Added
Water Use and Efficiency	Modern Energy Access	Trainings
Water Quality		Infrastructures and logistics for bioenergy distribution
Biodiversity		
Land Use Change		Capacity and flexibility of use of bioenergy

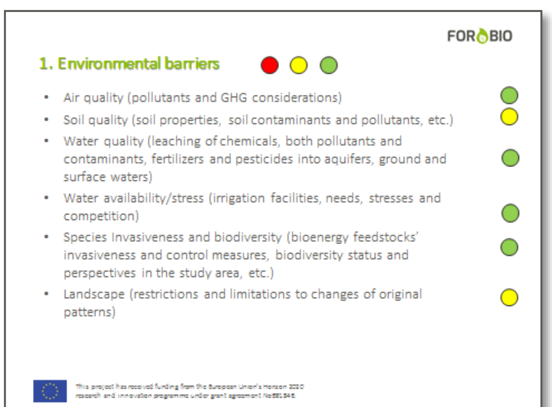
FAO's approach to the Sustainability Assessment in FORBIO:

- Harmonized Data collection campaign (Data entry sheets + literature)
- Development of tailored set of Sustainability Indicators (adapted from GBEP SI)
- Indicators measurement through purpose built calculator



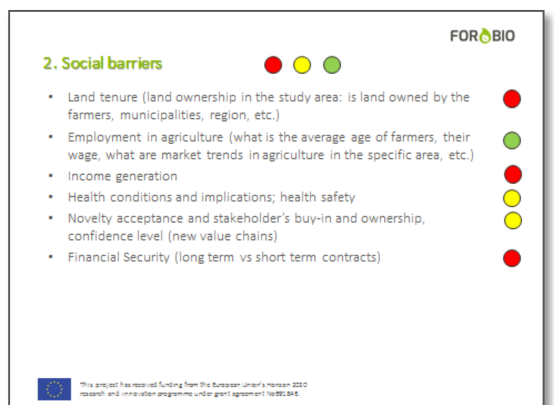
FAO's approach to the Sustainability Assessment in FORBIO:

- Harmonized Data collection campaign (Data entry sheets + literature)
- Development of tailored set of Sustainability Indicators (adapted from GBEP SI)
- Indicators measurement through purpose built calculator
- Further discussions with local stakeholders



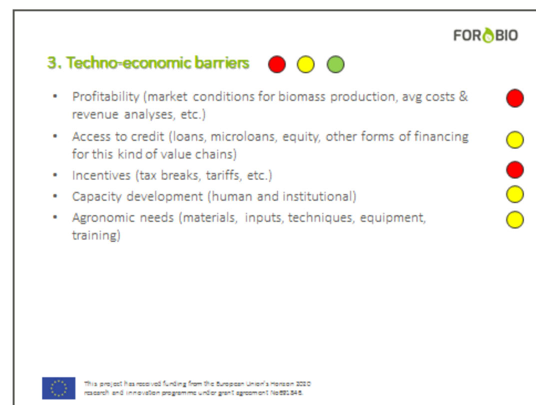
1. Environmental barriers

- Air quality (pollutants and GHG considerations)
- Soil quality (soil properties, soil contaminants and pollutants, etc.)
- Water quality (leaching of chemicals, both pollutants and contaminants, fertilizers and pesticides into aquifers, ground and surface waters)
- Water availability/stress (irrigation facilities, needs, stresses and competition)
- Species Invasiveness and biodiversity (bioenergy feedstocks' invasiveness and control measures, biodiversity status and perspectives in the study area, etc.)
- Landscape (restrictions and limitations to changes of original patterns)



2. Social barriers

- Land tenure (land ownership in the study area: is land owned by the farmers, municipalities, region, etc.)
- Employment in agriculture (what is the average age of farmers, their wage, what are market trends in agriculture in the specific area, etc.)
- Income generation
- Health conditions and implications; health safety
- Novelty acceptance and stakeholder's buy-in and ownership, confidence level (new value chains)
- Financial Security (long term vs short term contracts)



3. Techno-economic barriers

- Profitability (market conditions for biomass production, avg costs & revenue analyses, etc.)
- Access to credit (loans, microloans, equity, other forms of financing for this kind of value chains)
- Incentives (tax breaks, tariffs, etc.)
- Capacity development (human and institutional)
- Agronomic needs (materials, inputs, techniques, equipment, training)

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AIR QUALITY (GHG + NON-GHG Emissions)

In the baseline scenario the reference fuel used is petrol. The emission intensity of European petrol is 83.3 gCO2eq/MJ (Biograce, 2014).

The PROESA technology foresees the use of by- and co-products of the ethanol value chain and thus an allocation among the various products was performed (energy content).

The 40,000 tons of lignocellulosic ethanol produced yearly are equal to 1,072,400,000 MJ. The generation of 104 GWh of electricity in excess to what is used in the processing stages, equals to a further 374,400,000 MJ.

Ethanol: 74 percent
Surplus electricity: 26 percent

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AIR QUALITY (GHG + NON-GHG Emissions)

Information related to processing stage are based on the model biorefinery of Crescentino, Italy.

This plant relies on off-site production of enzymes and yeast.

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AIR QUALITY (GHG + NON-GHG Emissions)

Target 1): lignocellulosic ethanol from giant reed irrigated

Emission intensity of lignocellulosic ethanol (allocated results): 26.36 gCO_{2eq}/MJ

Emission reduction compared to baseline: 68.54%

Avoided emissions: 61,227 tons CO_2 per year

Target 2): lignocellulosic ethanol from giant reed rainfed

Emission intensity of lignocellulosic ethanol (allocated results): 30.19 gCO_{2eq}/MJ

Emission reduction compared to baseline: 63.97%

Avoided emissions: 57,147 tons CO_2 per year

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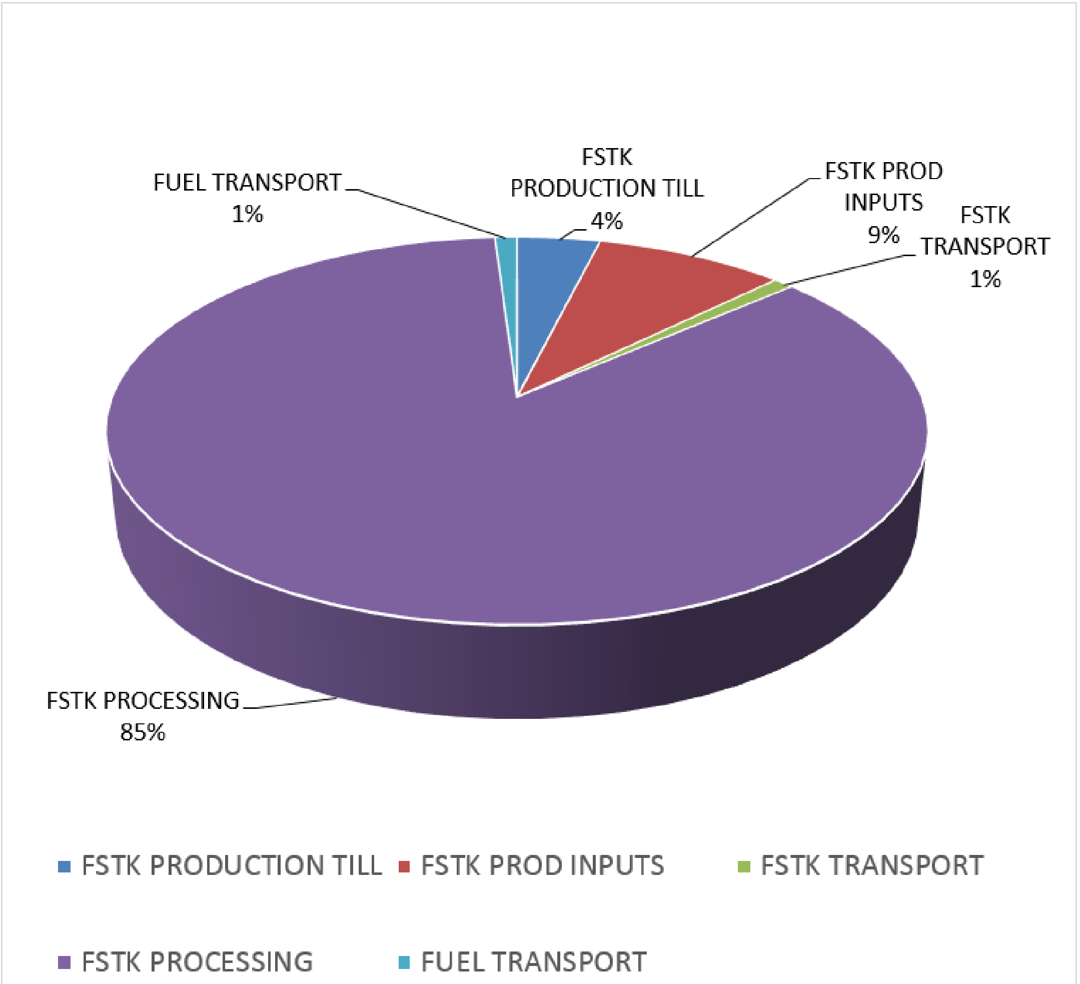
AIR QUALITY (GHG + NON-GHG Emissions)

Giant reed irrigated:

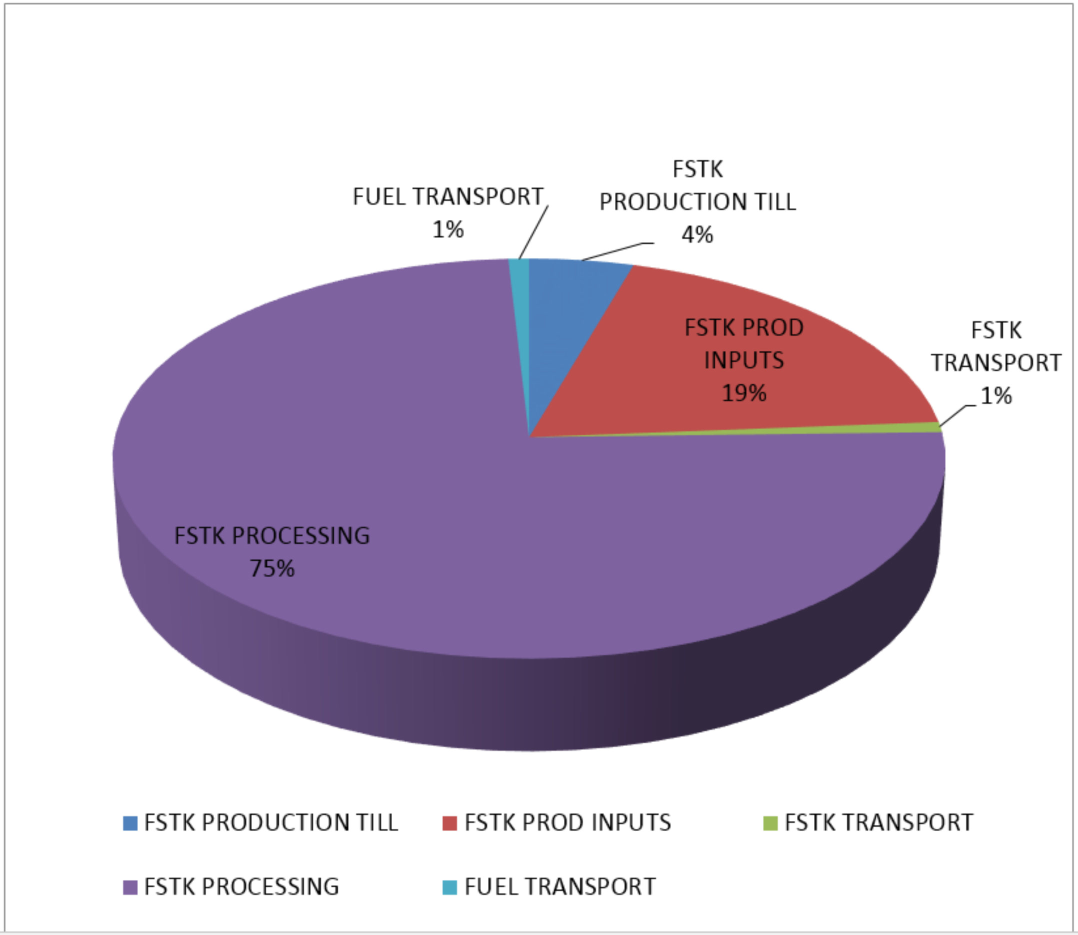
LCA GHG emission share - allocated results: 26.36 gCO_{2eq}/MJ



AIR QUALITY (GHG + NON-GHG Emissions)

Giant reed rainfed:

LCA GHG emission share - allocated results: 30.19 gCO_{2eq}/MJ



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SOIL QUALITY

In agricultural lands in this part of Sardinia, the SOC loss rates are rather high. Arca (2016) assessed these changes to be between 7.36 and 9.67 tons per ha per year.

The cultivation of a perennial reed, a plant that requires site preparation only at year of implant and zero tillage during the growing cycle of the plantation (25 years) and the plant returns considerable amounts of biomass (and thus C) to the soil. These two aspects somehow counterbalance SOC removal in the target scenario

Arca (2016), measured in three experiemental fields in the target area the changes in SOC due to the cultivation of giant reed:

The losses in the target scenario are reduced to 0.45 Mg of C ha^{-1} $year^{-1}$ from 7.36 Mg of C ha^{-1} $year^{-1}$: 94 percent reduction in SOC loss.

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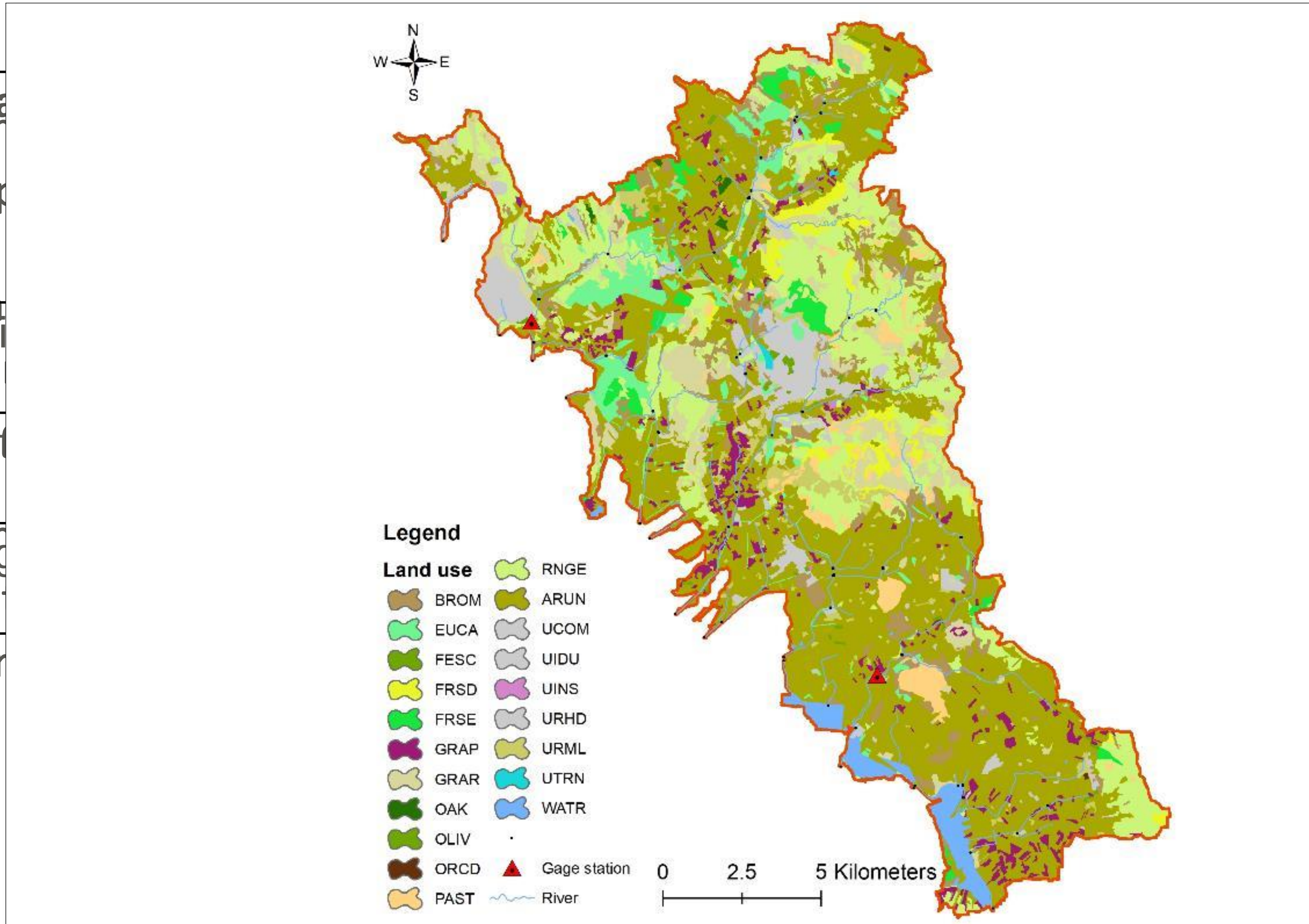
WATER QUALITY



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BIODIVERSITY

The target area in Ukraine is vast. As a consequence also the amount of high biodiversity value areas is considerable at 48,915 ha. Most of these areas are forested and shrubs.

The remaining 132,819 hectares within the *target area* that are not interested by the presence of critical habitats are likely to host species considered endangered in Europe (e.g. Hamster, Skylark, and the Ortolan bunting).

CRITICAL AREAS AND CONSERVATION OF SELECTED SPECIES OF WILDLIFE			
Total target area	**181.734** ha		
Total high biodiversity areas surface	Ha	48.915,5	BALANCE
Total areas where critically endangered species are found	Ha	48.874,5	132.819
Total important ecosystems		41,0	
Areas that contain habitat for viable populations of endangered, restricted range (endemic) or pı	Ha	48.870,0	
Areas that contain habitat of temporary use by species or congregations of species (e.g. nidificati	Ha	4,5	
Important natural landscape areas for natural ecological dynamics	Ha	41,0	
Areas that contain two or more contiguous ecosystems	Ha	0,0	
Areas containing rare or endangered ecosystems	Ha	0,0	
Not included		132.819	

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BIODIVERSITY

It was not possible to measure quantitatively species richness of the current underutilized and contaminated lands, and in literature only anecdotal information was retrieved.

According to many authors, in willow short rotation coppice plantations in England higher biodiversity was detected when compared to nearby cropland and set-aside land.

Particularly at the landscape level, the presence of SRC plantations would represent a valuable asset for species diversity and abundance as a consequence to an enhanced variety of habitats.

The presence of willow SRC seems to be superior to the current land use from the biodiversity point of view.

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INCOME

The cost-benefit analyses for the T1 and T2 scenarios are based on information from Deliverable 2.2 (techno-economic feasibility). Assuming a premium paid to the farmer for the production of biomass of EUR 24/t, the cultivation of giant reed may generate a net income of 240 EUR/ha in rainfed conditions or EUR 600/ha in irrigated conditions.

Assuming as in the case of durum wheat that the average farm size is between 5 and 20 ha, the net income of a farm producing biomass for a lignocellulosic ethanol value chain would be 1,200 – 3,000 EUR/year for farms up to 5 hectares of surface (T2 and T1 respectively), and 4,800 – 12,000 EUR/year for a 20 ha farm (T2 and T1 respectively).

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INCOME

Durum Wheat: 3.5 t/ha
Production cost: 992 EUR/ha
Price: 234 EUR/t
Revenue: (234 EUR/t * 3.5 t/ha) – 992 EUR/ha = - 170 EUR/ha
Breakeven price for wheat in Italy is 280 EUR/t in 2018, minimum income achieved at EUR 300/t.
CAP: 150 + 50 EUR/ha
Total Income: -170 EUR/ha + 200 EUR/ha = 30 EUR/ha

Biomass – Arundo Rainfed: 10 t/ha
Production cost: 57 EUR/ha (source: FORBIO D 2.2)
Landowner fee: 24 EUR/t (source: FORBIO D 2.2)
Total Income: (24 EUR/t * 10 t/ha) = 240 EUR/ha

Biomass – Arundo IRRIGATED: 25 t/ha
Production cost: 61 EUR/t (source: FORBIO D 2.2)
Landowner fee: 24 EUR/t (source: FORBIO D 2.2)
Total Income: (24 EUR/t * 25 t/ha) = 600 EUR/ha

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PRODUCTIVITY

This indicator includes several aspects: biomass yield, fuel yield, production cost.

The estimate of production cost was performed through a number of calculations and data obtained both from direct communication with Biochemtex and information found in the specialized literature.

CAPEX:

EUR 150,000,000 for a 40,000 t/year biorefinery (Crescentino, Italy)

OPEX

Feedstock expenditure: EUR 12,780,000 per year

Enzymes, yeast, catalysts, other inputs: EUR 13,000,000 per year (E4tech, 2017)

Salaries: EUR 2,952,000 per year

Miscellaneous: EUR 1,200,000 per year

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PRODUCTIVITY

In total the production cost of lignocellulosic ethanol was calculated to be EUR 936 per ton.

This value calculated in the real case scenario of FORBIO was compared to values found in literature. According to E4TECH (2017), lignocellulosic ethanol production costs in Europe range between EUR 940 and 1,010 per ton.

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GROSS VALUE ADDED

The current European price for ethanol is registering an all-time low at 424 EUR/m^3 (534 EUR/t).

At current market prices, sales of ethanol would generate some 21,360,000 EUR/year.

At the current price of electricity for large scale biomass-fueled power plants of EUR 115/MWh as per DM 26 July 2016, (Gazetta Ufficiale, 2016) revenues for the generation of electricity would account to EUR 11,960,000 per year for the next 20 years.

Total revenues for a 40,000 t/year biorefinery at current market conditions would then be EUR 33,320,000 per year.

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GROSS VALUE ADDED

However, the total production cost of lignocellulosic ethanol in Sardinia as we have seen in previous chapter would be 936 EUR/t or 37,440,000 EUR/year

Thus, given the current market conditions, the Gross Value Added of a second generation biorefinery would be negative by some EUR 4,120,000 per year

Ethanol price volatility though is a key parameter

At 2017 prices the GVA would be positive by EUR 4.7 million

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CAPACITY AND FLEXIBILITY OF USE

This indicator measures the contribution to reaching the capacity of using bioenergy in the reference area. In other words, how much advanced bioethanol can be absorb… …e case study …

TYPE O…

BASELIN…

Current…

Current…

TARGET…

Target b…

TARGET…

Current…

	FINAL CAPACITY RATIO		BLENDING WALL	10%
		TARGET AREA	NATIONAL	EU LEVEL
	CAPACITY WITH BLENDING WALL	574	569,600	8,494,900
2017	Capacity ratio for BASELINE situation	0.40	0.39	0.50
	CAPACITY WITH BLENDING WALL	574	569,600	8,494,900
2027	Capacity ratio for BASELINE situation	0.40	0.39	0.50
	Change in %	0%	0%	0%
2027	Capacity ratio for TARGET situation	70.11	0.47	0.50
	Change in %	N/A	18%	1%
	PROJECT CONTRIBUTION TO CHANGE IN CAPACITY RATIO			
	Change in %	N/A	17.788%	0.947%

TEN. | INCOME | JOBS | ENERGY ACCESS | EC-BASELINE | EC-TARGET | PRODUCTIVITY | NET E BALANCE | G V A | INFRASTRUCTURE | CAPA

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THE ROADMAP

ITALY

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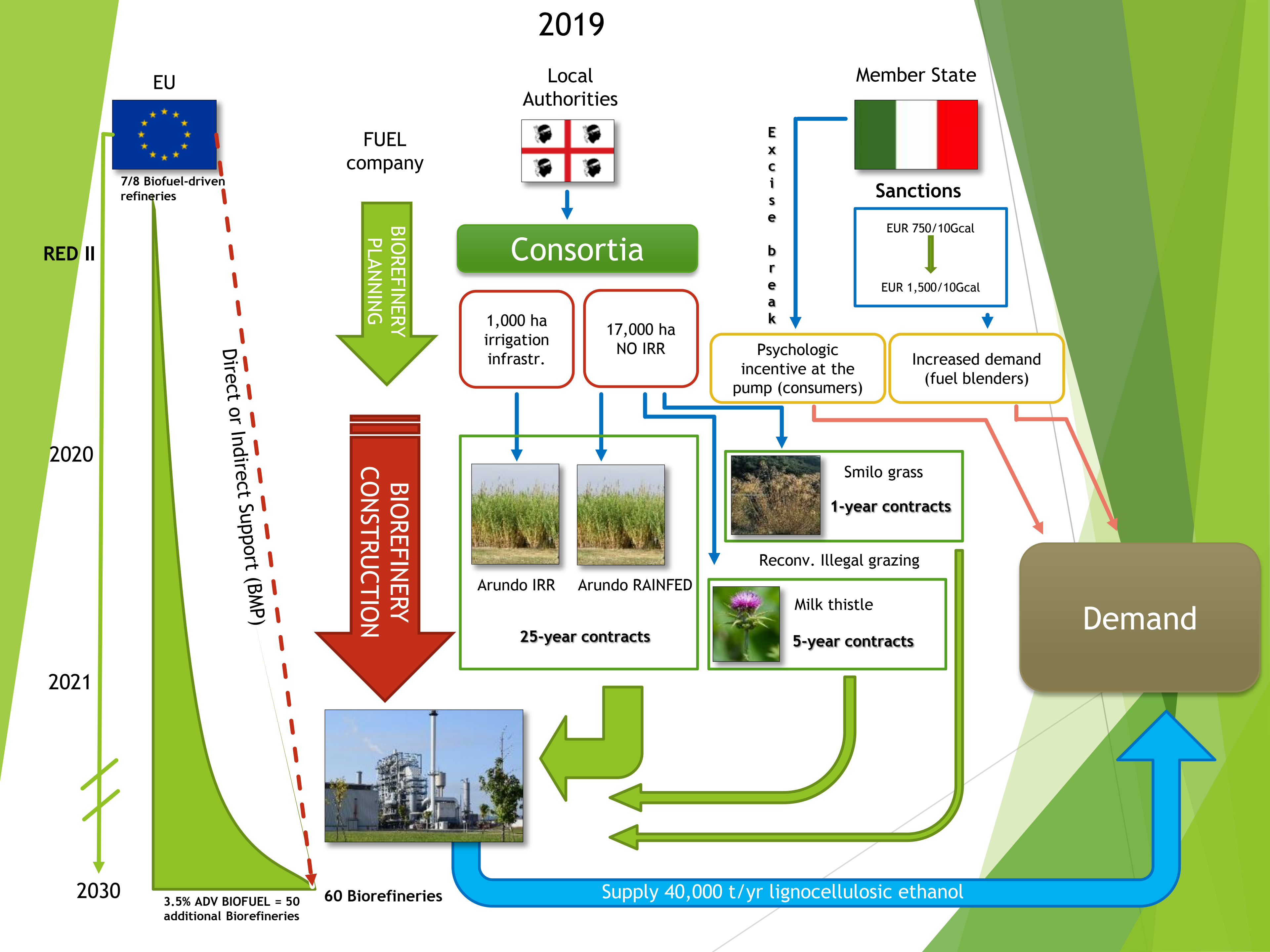
2019
EU
7/8 Biofuel-driven refineries
RED II
2020
2021
2030
3.5% ADV BIOFUEL = 50 additional Biorefineries
Direct or Indirect Support (BMP)
FUEL company
BIOREFINERY PLANNING
BIOREFINERY CONSTRUCTION
60 Biorefineries
Local Authorities
Consortia
1,000 ha irrigation infrastr.
17,000 ha NO IRR
Arundo IRR
Arundo RAINFED
25-year contracts
Excise break
Member State
Sanctions
EUR 750/10Gcal
EUR 1,500/10Gcal
Psychologic incentive at the pump (consumers)
Increased demand (fuel blenders)
Smilo grass
1-year contracts
Reconv. Illegal grazing
Milk thistle
5-year contracts
Demand
Supply 40,000 t/yr lignocellulosic ethanol

Thank you

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