GIS waste
nothing is wasted

GIS & Multi-criteria based help-decision tool for food waste valorisation in the Basque Country (Spain)

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AZTI-Tecnalia: Sustainability Area

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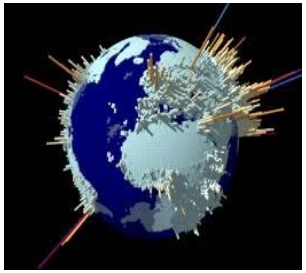
CURRENT SITUATION OF FOOD WASTE MANAGEMENT



The **world population** is increasing enormously in recent years

The **demand for natural resources**

A high **organic waste generation**, by food industry and retail trade

Almost three quartes of organic wastes **end up in a dump**

A **high potential** to be valued as raw material for:

- Animal feed
- Biogas production
- …

Need to be managed under appropriate conditions

PROBLEM ASSOCIATED WITH ORGANIC WASTE VALORISATION

Profitability of these valorisation alternatives **When they are full-scale implemented**

→

A great number of **viability factors**:

- Technical
- Economic
- Geographic
- Environmental

→

High **risk of underestimating** some of these factors

→

Unprofitable implementation of these valorisation alternatives

↓

It is necessary to **minimize that risk**

←

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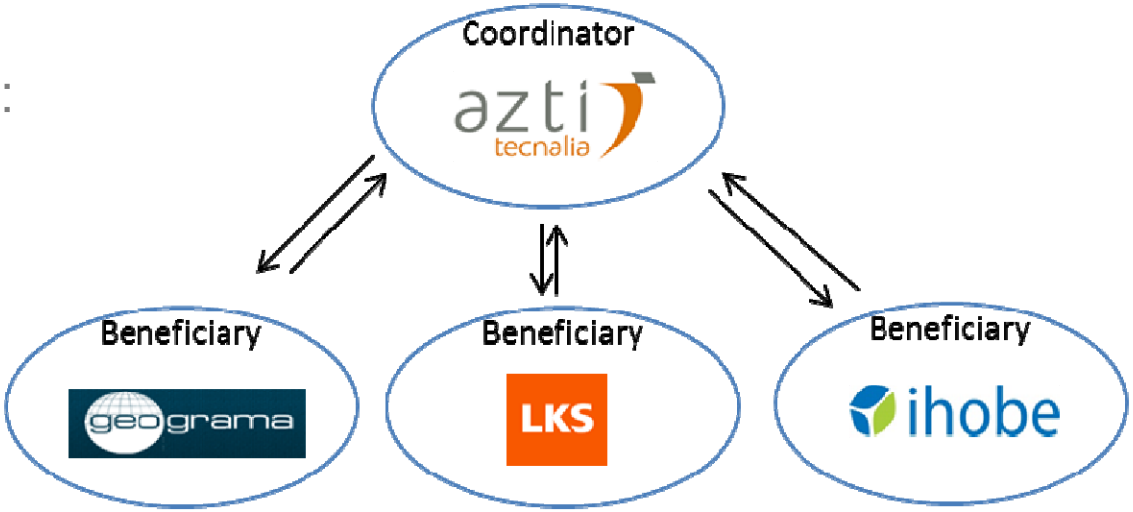
Title: "GIS based decision making tool for food by-products valorisation alternatives in Basque Country"

Co-funded by LIFE Program

GISWASTE Life12 ENV/ES/406

Start-Finish date: 15/07/2013 → 30/06/2017

Consortium:



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AZTI is a Technology Centre expert in marine and food research, committed to social and economic development of the fisheries, marine and food sector in the context of sustainable development.

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Aim:

- To develop a **GIS based tool** which…

… **helps** to take the **right decision about waste-management.**

… **minimizes** the **inherent risk of a full-scale implementation** of a new food waste valorisation facility.

Scheme of the GISwaste tool

1.-Problem Definition

2.-Key Viability Factors
- -Relative importance
- -Limiting & conditional ranges
- -Matrix & rules decision

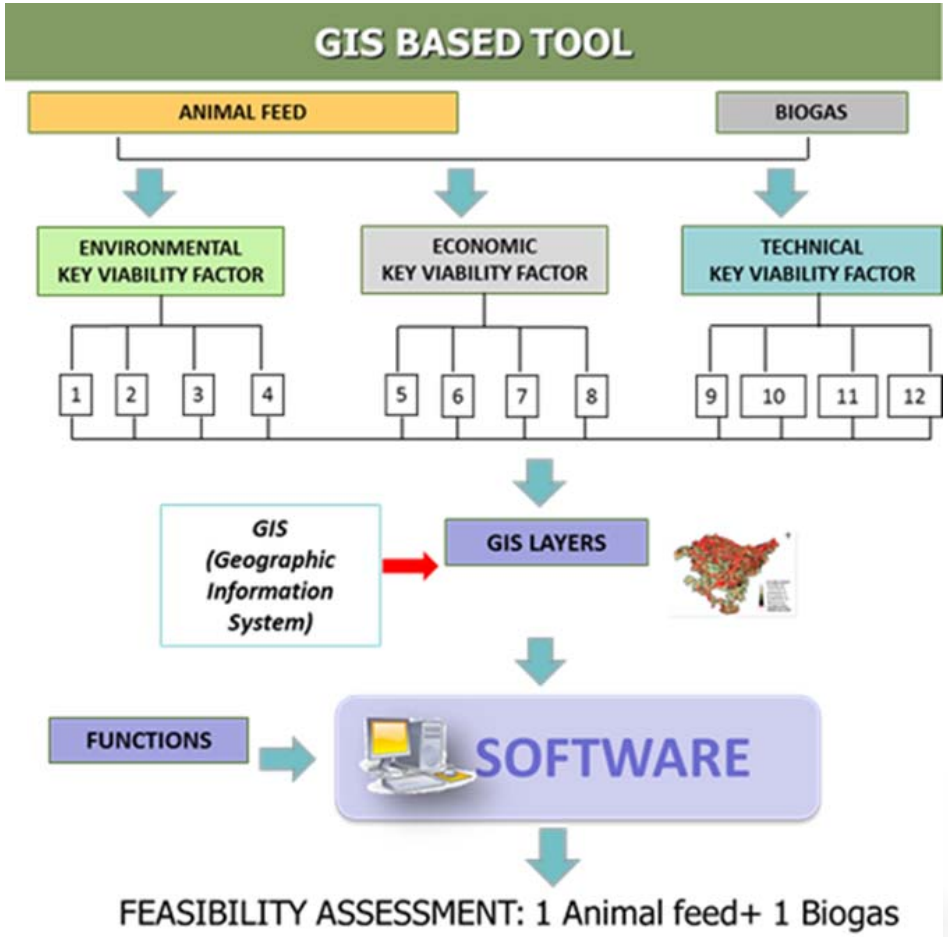
GIS layers

3.-Software programing

4.-Validation

AHP method

ArcGIS



1. Problem Definition

Case Study:

- Geographic area: **Basque Country (in Spain)**

  GISWASTE tool will be transferable to other EU regions

- Valorization alternatives: **Animal Feed** and **Biogas production**

- Organic wastes: **Vegetable; Meat** and **Dairy by-products**, generated by food industry and retail trade.

2. Key Viability Factors

IDENTIFICATION

GEOGRAPHICAL VIABILITY FACTORS
- Availability of industrial land
- Distance to main roads
- Etc…

TECHNICAL VIABILITY FACTORS
- Type
- Monthly quantities
- Etc…

BIOGAS

ENVIRONMENTAL VIABILITY FACTORS
- Carbon footprint
- Water footprint
- Etc…

ECONOMIC VIABILITY FACTORS
- Cost for 1st plant and machinery implementation
- Revenues for selling biogas into NG grid
- Etc…

2. Key Viability Factors

IDENTIFICATION

GEOGRAPHICAL VIABILITY FACTORS
- Industrial land available
- Plant size
- Etc…

TECHNICAL VIABILITY FACTORS
- Type
- Quantity per month
- Etc…

ANIMAL FEED

ENVIRONMENTAL VIABILITY FACTORS
- Carbon footprint
- Water footprint
- Etc…

ECONOMIC VIABILITY FACTORS
- Income for the management of by-products
- Income for selling the produced flour
- Etc…

2. Key Viability Factors

RELATIVE IMPORTANCE

	1st Hierarchy level		2nd Hierarchy level		Total Hierarchy level
BIOGAS	TECHNICAL FACTORS	20%	Potential methanation	40%	8%
			Total solids	10%	2%
			Volatile solids	10%	2%
			MOD/MO	30%	6%
			C/N	10%	2%
	ECONOMIC FACTORS	50%	Cost for 1st plant and machinery implementation	5%	3%
			Income for selling biogas or for heat saving	10%	5%
			Income for selling digestate	5%	3%
			Cost for collecting by-products	10%	5%
			Cost for processing by-products	5%	3%
			Cost for 1st land implementation	5%	3%
			Cost for administrative issues	5%	3%
			Cost for the hypothetic plant decomissioning	5%	3%
			Income for selling electricity	20%	10%
			Income for managing by-products	15%	8%
			Cost for buying by-products	15%	8%
	GEOGRAPHICAL FACTORS	10%	Shape coefficient	10%	1%
			Radio Maximum of the Geographic Area	30%	3%
			Minimum critical mass	40%	4%
			Industrial land available	10%	1%
			Plant size	10%	1%
	ENVIRONMENTAL FACTORS	20%	Carbon footprint	40%	8%
			Water footprint	40%	8%
			Eutrophication potential	20%	4%

2. Key Viability Factors

RELATIVE IMPORTANCE

	1st Hierarchy level		2nd Hierarchy level		Total Hierarchy level
ANIMAL FEED	TECHNICAL FACTORS	20%	Moisture	20%	4%
			VFA	10%	2%
			Digestibility	10%	2%
			Energy	10%	2%
			Acid detergent fiber	5%	1%
			Crude fiber	5%	1%
			Neutral detergent fiber	5%	1%
			Crude fat	10%	2%
			Carbohydrates	10%	2%
			Crude protein	15%	3%
	ECONOMIC FACTORS	50%	Cost for the 1st plant and machinery implementation	5%	3%
			Income for selling the produced flour	30%	15%
			Cost for the by-products collection	10%	5%
			Cost for processing by-products	5%	3%
			Cost for the 1st land implementation	5%	3%
			Cost for adminitrative issues	5%	3%
			Cost for the hypothetic plant decommissioning	5%	3%
			Income for the management of by-products	20%	10%
			Cost for buying by-products	15%	8%
	GEOGRAPHICAL FACTORS	10%	Shape coeficient	10%	1%
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			Minimum critical mass	40%	4%
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			Plant size	10%	1%
	ENVIRONMENTAL FACTORS	20%	Carbon footprint	40%	8%
			Water footprint	40%	8%
			Eutrophication potential	20%	4%

2. Key Viability Factors

LIMITING RANGES for the Viability Factors:

Limits above or below of which a type of by-product or a valorisation option is not viable and it must be rejected.

CONDITIONAL RANGES for the Viability Factors:

Values which are within the limiting ranges, which involves that a type of by-product or a valorisation option is feasible.

However, a higher or lower value (depending on the factor) determines higher or lower viability.

VIABILITY FACTOR	Limiting ranges		Conditional ranges	
	Maximum value	Minimum value	Maximum note	Minimum note
Price of the vegetable flour for animal feed (€ / tn)	500	125	10	0

Options:
- ≥ 500 €/tn → FEASIBLE → 10 points (higher score)
- (500-125) €/tn → FEASIBLE → 10 – 1 points (lineal proportional score)
- < 125 €/tn → NOT FEASIBLE → 0 points (lower score)
- 312,5 €/tn → FEASIBLE → 5,5 points

2. Geographic Information

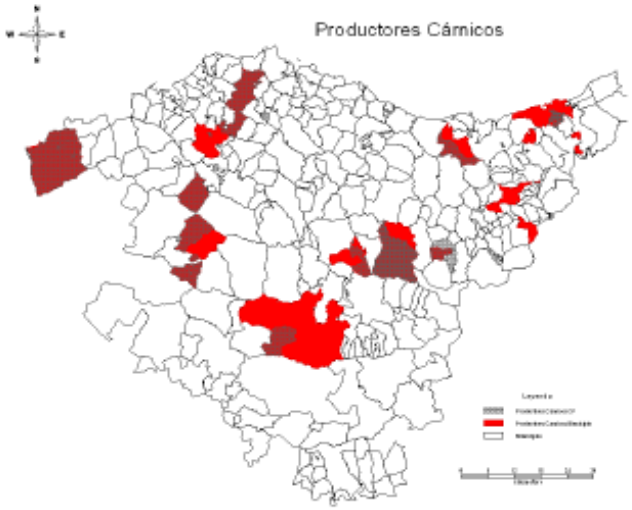
GIS LAYERS

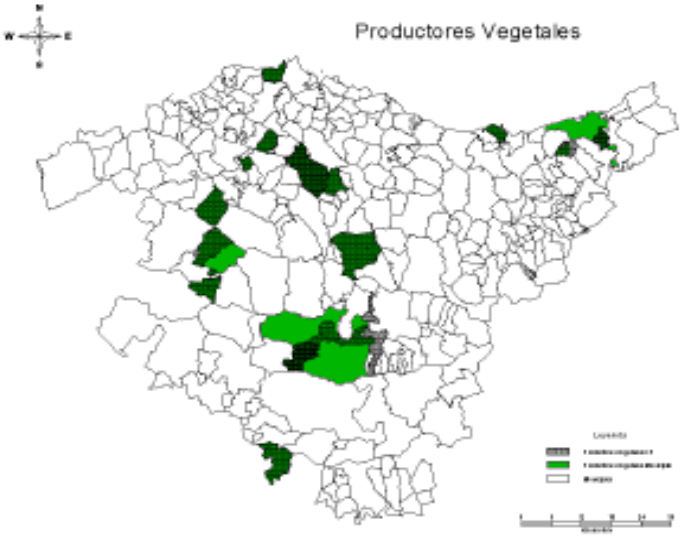
- **About specific thematic**, necessaries to assess the **geographic feasibility**:
  - ✓ **Basic mapping**: rivers, roads, orto-photo, etc.
  - ✓ **Mapping about physical environment**: geologic, etc.
  - ✓ **Uses and soil classification**: protected maps, industrial soil, etc.
  - ✓ **Weather**: isohyets, isotherms, etc.
  - ✓ **Other sectorial mapping**

2. Geographic Information

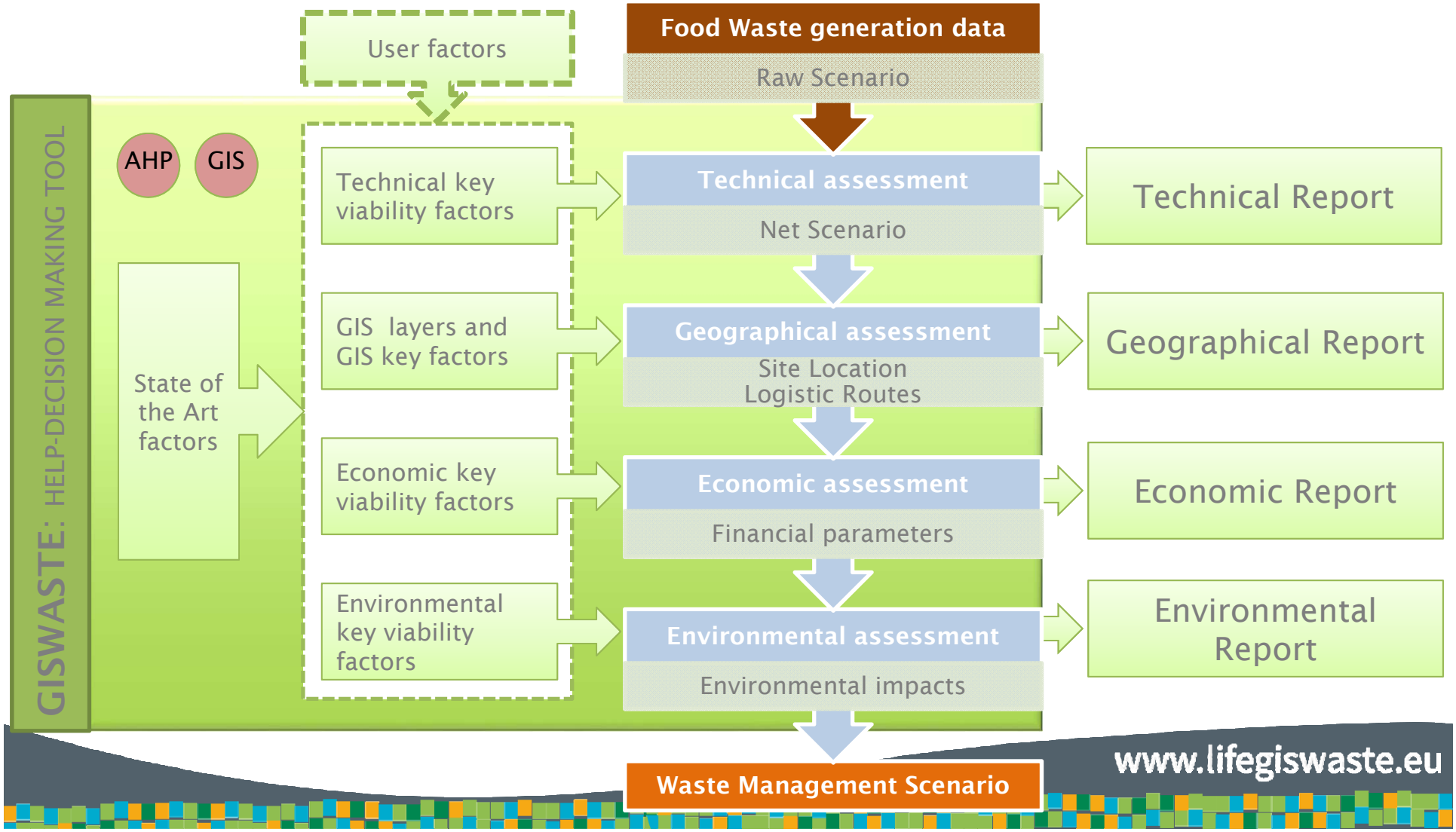
GIS LAYERS

- **About viability factors**, necessaries to assess the **technical, economic and environmental feasibility**:
  - ✓ **Quantities of by-products**
  - ✓ **Seasonality**
  - ✓ **Composition, etc.**





3. Software programing



3. Software programing

GEOGRAPHICAL ASSESSMENT

Food Waste generation data

Raw Scenario

↓

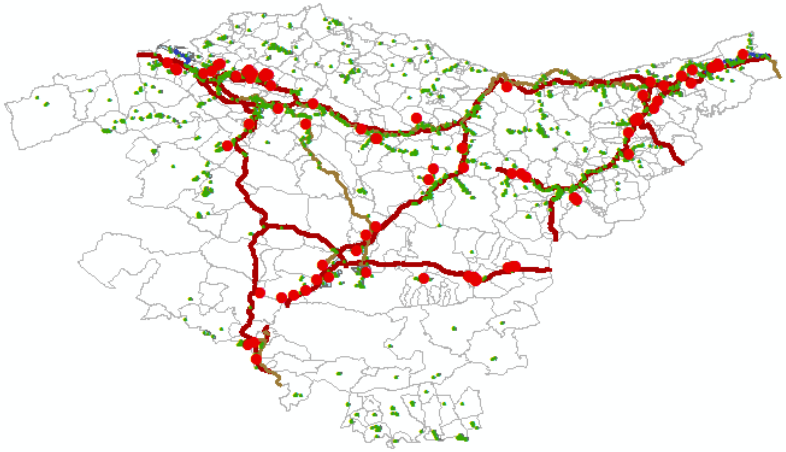
Technical assessment

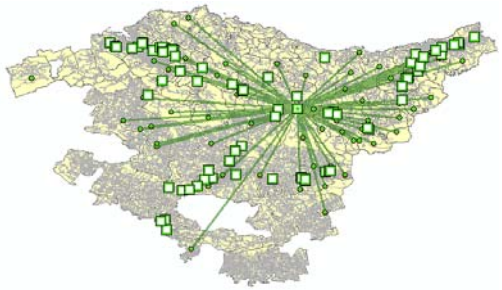
Net Scenario

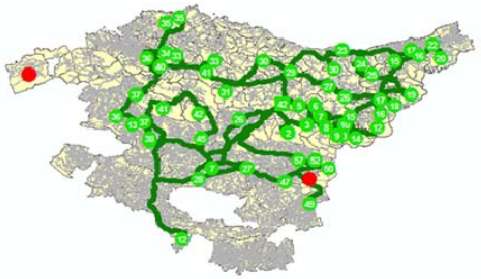
↓

Geographical assessment

Site Location
Logistic Routes



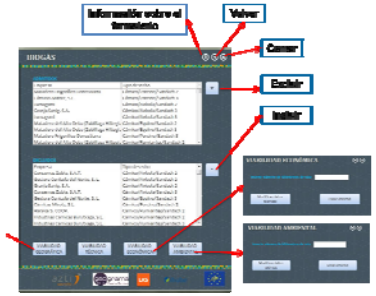




3. Software programing

FINAL REPORTS OF GISWASTE tool

Technical Report
- Suitability
- Quantification
- Etc…



Geographical Report
- Location
- Logistics routes
- Etc…

Economic Report
- Economic Balance
- Investment return period
- Etc…

Environmental Report
- Carbon Foot print
- Water Foot print
- Etc…

Final version of the TOOL

Foreseen end 2016

GIS based decision-making tool will **contribute to**:

- **Reduce the high risk associated with a full-scale implementation of a new food waste valorization alternative**
  by taking into account **all the factors that have any influence** in their feasibility and by giving **an extra information** to public or private organisms **about different waste management options.**
- **Reduce the environmental impact of waste treatment facilities**
  by taking into account **environmental aspects at the time of its implementation**.
- **Reduce the management costs**
  by analyzing the **economic profitability** of each valorization alternative and by making **simulations**.
- **Improve the synergies between different organic wastes**
  by providing **integrated and feasible solutions**.
- **Stimulate the food waste valorization**
  by promoting the **setting-up** and the development of **new economic activities**.

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THANK YOU FOR YOUR ATTENTION !

ANY QUESTION?

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