



# REPORT BIOMASUD PLATFORM

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## Introduction

During the BIOMASUD project an on-line platform <http://trazabilidad.ciemat.es/> (although by this moment is in a provisional “pre-production” domain <Http://trazabilidad.grupotercerafase.com>) was developed to keep record of data related with batches and traceability (quantity, date of production, type of biomass, GHG emissions, etc.). The idea is to add some capabilities to the platform and keeping all the data about quality and sustainability in one database.

The objective of is that producers’ staff can easily calculate and upload on the platform all the sustainability and quality data without wasting too much time and without the necessity to hire expert personnel to do it. As specified in the proposal, the design must be very intuitive and easy to use so all producers can make use of it.

The features that have been included to the BIOMASUD platform are:

- New sustainability criteria defined in task 4.1.
- The GHG calculation tool developed in task 4.2. will be included in the platform to calculate the GHG emissions along the supply chain.
- The energy balance will be included in the platform to calculate the energy balance along the supply chain

Sensible information about the certified companies will not be accessible for the general public and only users with special profiles will be able to access.

## Development of BIOMASUD platform

This Task is dedicated to improve producers' staff interactivity with on-line platform <http://trazabilidad.ciemat.es/> allowing them calculate easily the total value of multiple biomass calculations of GHG emissions along the supply chain without the need to hire expert personnel or use external tools, and also displaying more information about related calculations like energy demand, percentage of energy demand and saving percentage.

In addition, an administrative profile was added to the platform to allow editing of GHG emissions related factors to perform all calculations. This includes creating the appropriate section on the platform to edit them friendly.

### Work performed so far

During the initial phase the platform's styles were redesigned to become more accessible and visual, using images and colours related with nature, environment and biomass.



An analysis of currently used tools (Excel sheets) was necessary to evaluate the best way to implement a user-friendly solution, finally developing a multioption web form on section of the producers' lots to set easily the values.

After calculation, result of emissions are displayed on a result table with all new information about energy demand, percentage of energy demand and saving percentage. GHG emissions could be added to the lot values table where values are summed to totalize the result.

Resultados		
Energía demandada	18.016115867558685	MJ/kg
Energía demandada	91.91895850795248	%
Emisiones GHG	1700.0382696401919	gCO <sub>2</sub> -eq/kg
Ahorro de emisiones GHG	-2068.4161602553463	%

As exposed before, GHG emissions related factors can be edited easily by the administrative profile in the configuration section.

# Production factors

Type biofuel		
Aditive (vegetable oil)	1870	<a href="#">Edit</a>
Aditive (grains)	925	<a href="#">Edit</a>
Aditive (corn starch)	1200	<a href="#">Edit</a>
Sawmill wood chips/Sawdust loading	1	<a href="#">Edit</a>
Sawmill wood chips/Sawdust transport (truk - ship)	1	<a href="#">Edit</a>
Wood chips from forestry residues (chipping)	0.9756	<a href="#">Edit</a>
Wood chips from forestry residues (seasoning)	0.95	<a href="#">Edit</a>

## Results achieved

TFS have implemented a simple solution for producers' staff that not requires technical or mathematical skills and in turn, covers the emission calculation requirements leaving behind complex spreadsheets and formulas, expanding the platform possibilities.

- A list of calculation types to evaluate agro-Industrial, agricultural, and wood chips and wood pellets residues.
- An extended list of biomass types. Olive stones, almond shells, hazelnut shells, pine nut shells, pine cone shells, pistachio shells, walnut shells, olive pruning, vineyard pruning, forestry residues, stemwood, sawmill chips, sawdust.
- A list of processing types. Chipping in the field, chipping at the production plant.
- Calculation from processing of biomass, including different steps like collection, seasoning and harvesting.
- Calculation from transport values. Loading and unloading of residues.
- Calculation from electric consumption.
- Calculation from energy consumed by heat.
- Calculation from additives.
- Calculation from bagging. Bulk product and bagged product.

The results obtained are: GHG emissions in gCO<sub>2</sub>eq/kg, saving percentage, Energy demand in MJ/kg and percentage of energy demand. They are available for electricity and heat on bulk product and heat on bagged product.



## The development process

In response to task 4.3 whose objective is that producer's staff can easily calculate and upload on the platform all the sustainability and quality data without wasting too much time and without the necessity to hire expert personnel to do it, intuitively an easily to use so all producers can make use of it, BIOMASUD platform has received the following features:

- New sustainability criteria defined in task 4.1 is integrated within the new platform.
- The GHG calculation tool developed in task 4.2 is included in the platform to calculate the GHG emissions along the supply chain.
- The energy balance is included in the platform to calculate the energy balance along the supply chain.
- The necessary information was collected concerning the new criteria (PEFC), the energy balance (CIEMAT) and the carbon footprint (CIEMAT, PEFC), in order to develop the software for the web platform.

The collection of necessary information has involved the collaboration of different agents to define the platform criteria to perform all calculations so that producer's staff get accurate results.

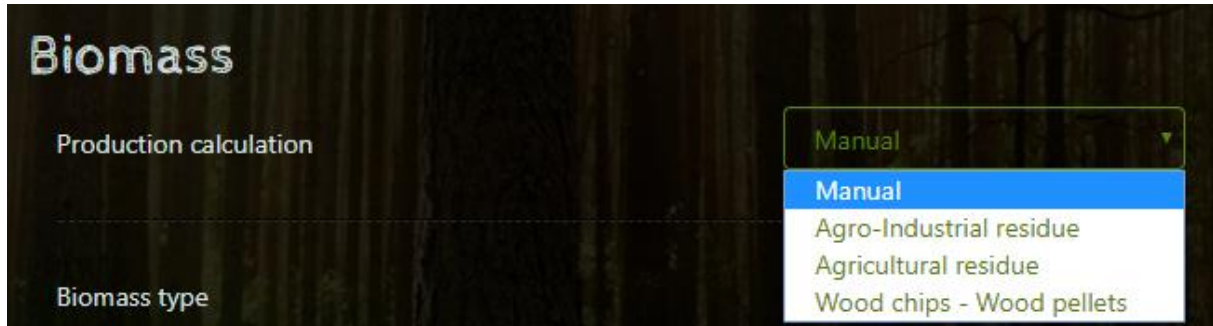
The technologies and tools used are explained below, as well as their use and implementation procedure, design pattern, architecture, etc.

## Functionalities

### The calculation process

Producer's staff have to follow simple steps to accomplish the calculation process.

Select de calculation type:

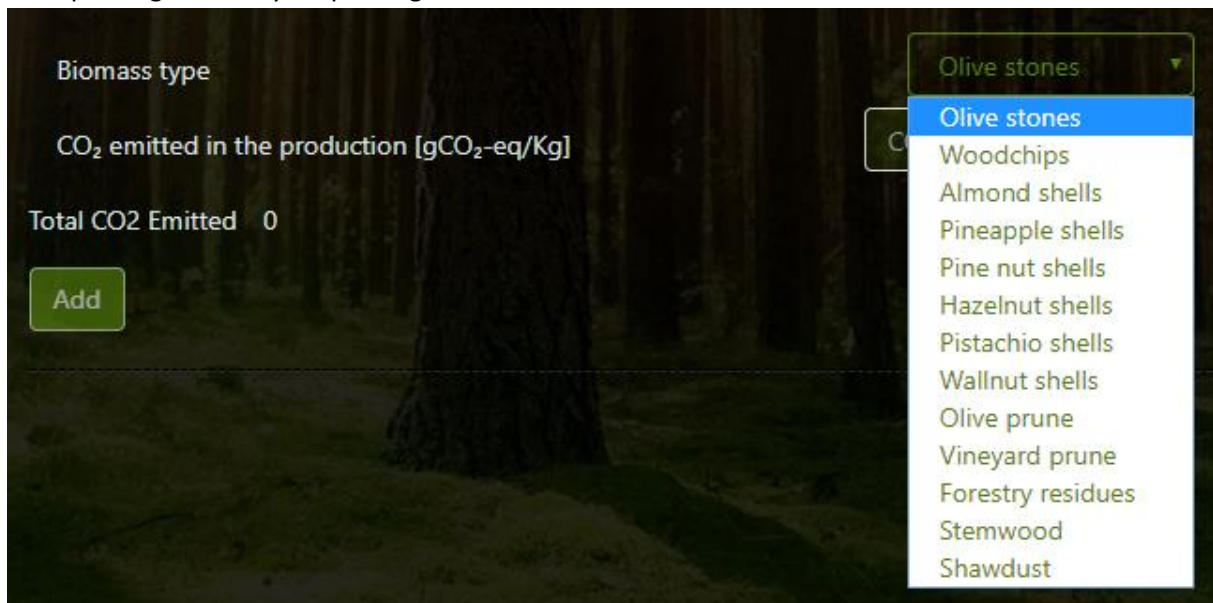


There are four types of calculation available:

- Manual.
- Agro-Industrial Residues.
- Agricultural Residues.
- Wood chips – Wood pellets.

### Manual

All biomass types are available to select: Olive stones, almond shells, hazelnut shells, pine nut shells, pine cone shells, pistachio shells, walnut shells, stemwood, sawmill chips, sawdust, forestry residues, olive pruning and vineyard pruning.



Emissions are manually introduced.

Biomass type Olive stones ▼

CO<sub>2</sub> emitted in the production [gCO<sub>2</sub>-eq/Kg] 123.5

Total CO<sub>2</sub> Emitted 123.5

Add

### ***Agro-Industrial residues***

The following biomass types are available to select: Olive stones, almond shells, hazelnut shells, pine nut shells, pine cone shells, pistachio shells, walnut shells.

To perform the calculation:

- Set the biomass type, the amount of it in tons/year, the lower heating value (dry basis) and moisture content in loading and transport.

## Biomass

Production calculation Agro-Industrial residue ▼

---

Biomass type Olive stones ▼

Produced Biomass T/year

Lower heating value (dry basis) MJ/kg

### Moisture content

Loading and transport %

- Set transport of biomass supply values (if applicable). Amount transported in tons and distances in kilometers for each means of transport.

### Transport

Amount transported	T Biomass
Medium-distance transport (road-40 t truck)	km
Medium-distance transport (road-12 t truck)	km
Medium-distance transport (coastal/river)	km
Medium-distance transport (ocean)	km
Medium-distance transport (rail)	km

- Set electric consumption in fuel valorization values. Country, total electricity consumption each year, CO2 emissions specified on electricity bill, percentage of renewable energies as noted in the electricity bill.

### Electric consumption in fuel valorization

Country	Spain ▼
Total electricity consumption each year	kWh
CO2 emissions specified on electricity bill	gCO <sub>2</sub> /kWh
Percentage of renewable energies as noted in the electricity bill	%

- Set energy consumed by heat, etc. in production values (if applicable). By-products biomass (wood, bark,...), fuel, fossil gas, diesel, coal (anthracite), coal (lignite), district heating (renewable) district heating (fossil).

### Production - Energy consumed by heat, etc

By-products biomass (wood, bark...)	Kg
Fuel	L
Fossil gas	kWh
Diesel	L
Coal (Anthracite)	T
Coal (Lignite)	T
District heating (renewable)	kWh
District heating (fossil)	kWh

- Set biomass additives in production values (if applicable). Corn starch, grain, vegetable oil.

### Production - Additives

Corn starch	T/year
Grain	T/year
Vegetable oil	T/year

- Set bagging values (if applicable). Bagging of pellets 10/15kg bag

### Bagging

Pellets 10 kg bag	T/year
Pellets 15 kg bag	T/year

- Set from production to final user values. Average distance transport (from production plant to the final user in kilometers), electrical/thermal efficiency percent, result type (bulk or bagged product), dedicated to electricity.

### From production to end user

Average distance of transport (from production plant to final user)

Energy efficiency

Result type

Dedicated to heat

### ***Agricultural residues***

The following biomass types are available to select: Olive prune, vineyard prune.

The steps to perform de calculation are similar than Agro-Industrial residues explained before.

### ***Wood chips – Wood pellets***

The following biomass types are available to select: Stemwood, sawmill chips, sawdust, forestry residues.

The steps to perform de calculation are similar than Agro-Industrial residues explained before, with the introduction of *Processed* section to apply on stemwood and forestry residues biomass. This section calculates the emissions depending on where is processed (chipping in the field or at the production plant), changing the fields where moisture content should be fill.

Forestry residues or stemwood (chipping in the field). Set moisture content: at collection, after seasoning, at transport, after chipping, at transport of wood chips.

### Procesed

Processed type

### Moisture content

Moisture content at collection

Moisture content at seasoning

Moisture content at transport

Moisture content after chipping

Moisture content at transport of wood chips

Forestry residues or stemwood (chipping at the production plant). Set moisture content: at collection, after seasoning, at transport.

### Processed

Processed type Forestry residues (chipping at the production plant) ▼

### Moisture content

Moisture content at collection %

Moisture content at seasoning %

Moisture content at transport %

**Results**

Results are dynamically updated when values change in the form and they are displayed in a table showing the energy demand (MJ/kg and percent), GHG emissions (gCO<sub>2</sub>-eq/Kg), savings of GHG emissions and total CO<sub>2</sub> emissions (gCO<sub>2</sub>-eq/Kg).

Calculated values are used by platform when users create new biomass lots to calculate the CO<sub>2</sub> emissions from biomass source to end user along the supply chain.

### Results

Danded energy	0.0107767843583681	MJ/kg
Danded energy	0.0898065363197338	%
GHG Emissions	356.974131491265	gCO <sub>2</sub> -eq/kg
Savings of GHG emissions	-1521.13190114419	%

Total CO<sub>2</sub> Emitted 356.974131491265

Add

## Used technologies

This task has required a full stack of Microsoft technologies on server and open standards technologies on client (website) to carry out a reliable implementation on current platform.

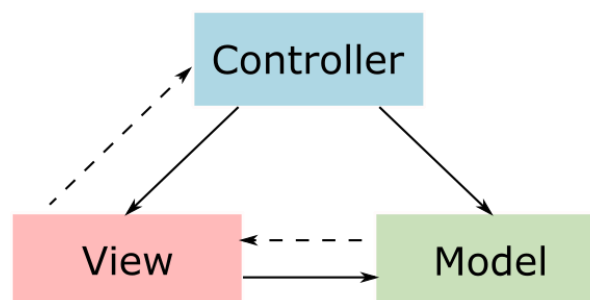
These technologies form a group of cutting-edge technologies under continuous development with broad communities and companies that support them, maintaining the stability of the products and also guaranteeing the error and security issues solving in a short period of time.

## Programming, styles and markup languages

- On server side, task has required C# as main programming language to integrate the development in current project.
- On client side, the open standard technologies used have been diverse. Web development has clear separation of concerns whose developments include its own languages and technologies.
  - HTML 5 has been used as main markup language to structure the website.
  - CSS 3 has been used as cascading style sheet to style the pages with Bootstrap, an open-source web framework, as template.
  - Javascript has been used as main programming language to allow the user interactivity and operate with server results.
- Another languages as XML (Extensible Markup Language) and JSON (JavaScript Object Notation) have also been used to interchange information between client and server or serialize data in the database.

## Web platform

- On server side, the main framework used has been ASP.net MVC. MVC (Model View Controller) is a software architectural pattern that decouples these major components allowing for efficient code reuse and parallel development.





- In relation with databases, Entity Framework has been used as object-relational mapping framework. This framework supports the development of data-oriented software applications and makes transparent all the work with database.
- On client side, libraries like Bootstrap, jQuery and Modernizr have been used to design the styles making it responsive, allowing user interactivity including validations, animations, etc., and displaying properly and user-friendly the server results.

## Databases

The database used is Microsoft SQL Server, a relational database management system with the primary function of storing and retrieving data as requested by the application. SQL (Structured Query Language) statements are used both for interactive queries for information from a relational database and for gathering data for reports.



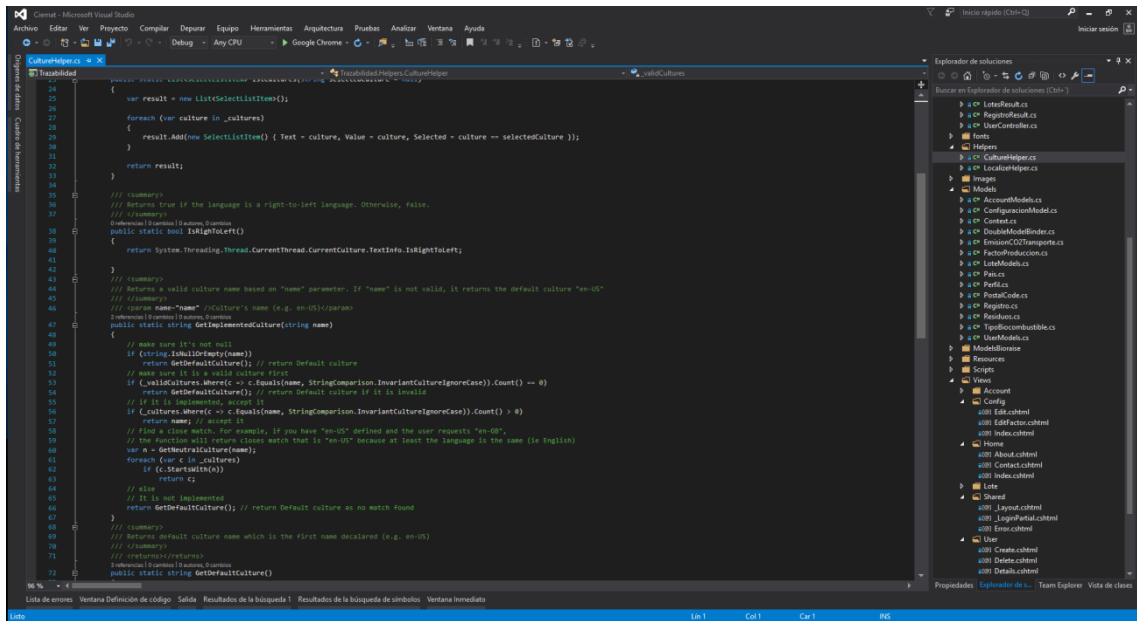
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Database tables diagram

A relational database is a set of tables containing data fitted into predefined categories. Each table (which is sometimes called a relation) contains one or more data categories in columns. Each row contains a unique instance of data for the categories defined by the columns.

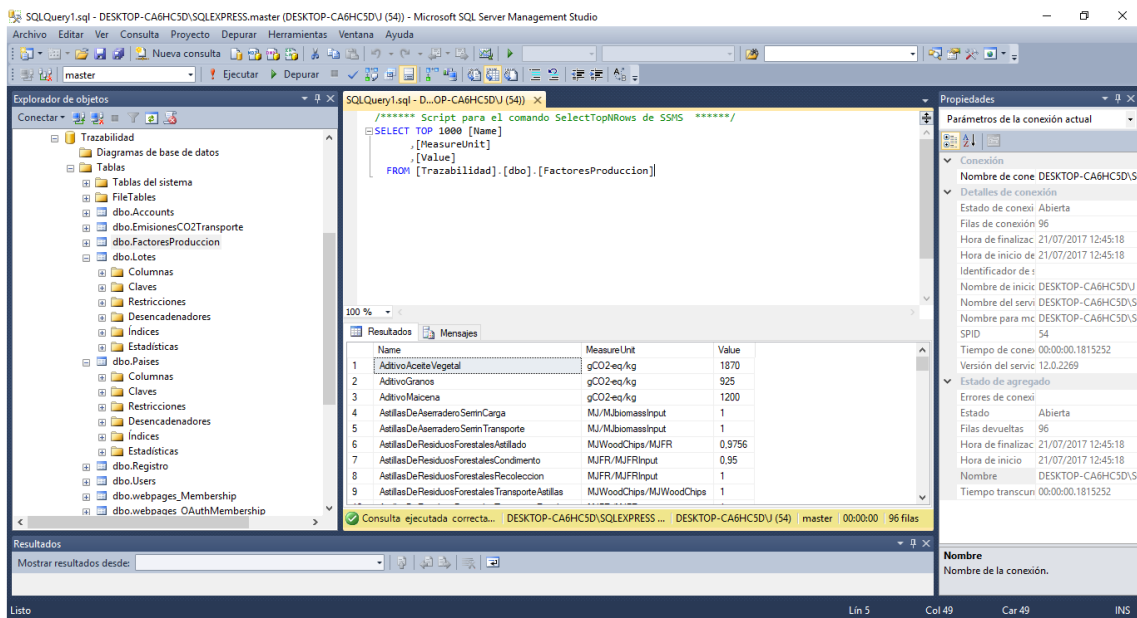
### Development tools

- The main tool used has been Microsoft Visual Studio 2015, an integrated development environment used to develop the entire platform.



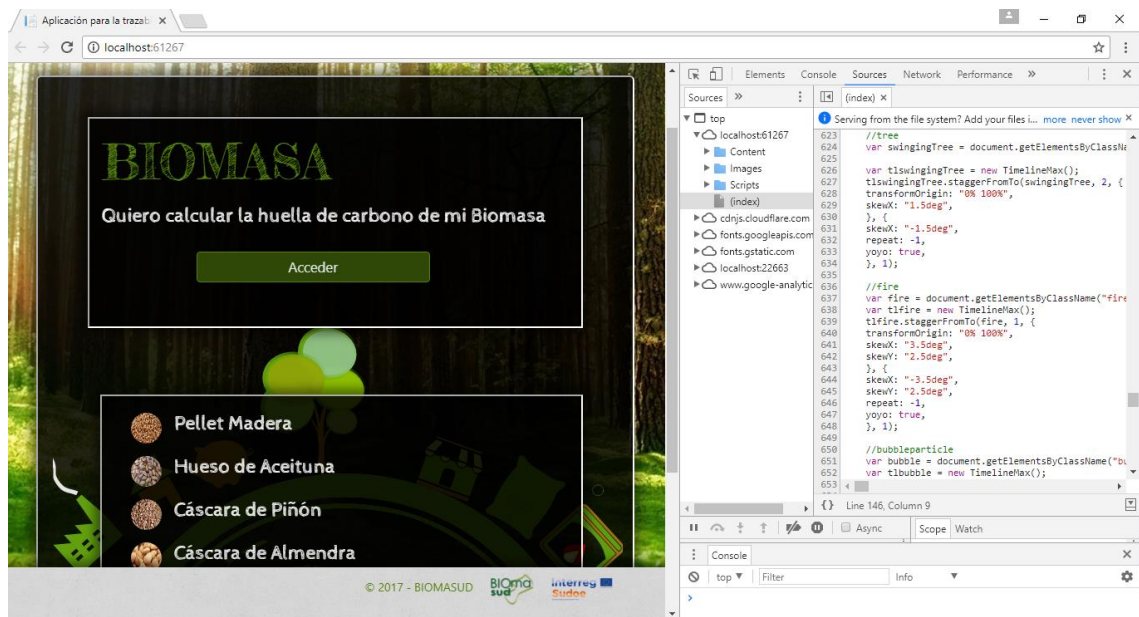
Microsoft Visual Studio 2015

- Microsoft SQL Server Management Studio has been used to manage the database.



Microsoft SQL Server Management Studio

- Development tools included in Google Chrome Browser have been used to debug the user interactivity on website.



Google Chrome development tools