

# Forestal del Maestrazgo

## Process of biomass to the final consumer

Industrial Engineer: Daniel Gascón Ripollés

July 2014





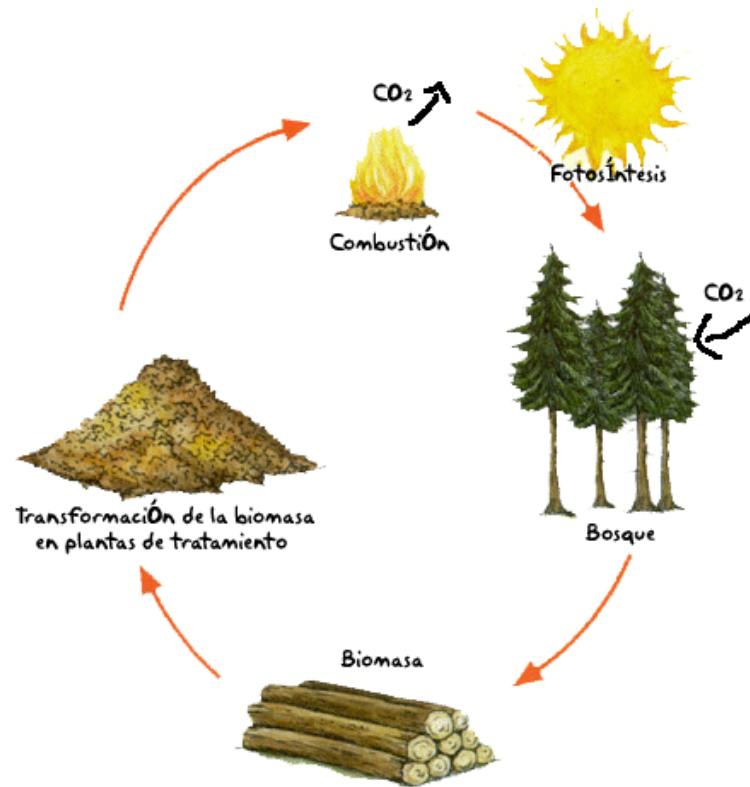
# Forestal del Maestrazgo



2004 "CC-BY-SA" License v2.0.  
fet per Montis Vicente i Sempre.

# Forestal del Maestrazgo

## ► Biomass cycle





# Forestal del Maestrazgo



## ► Forestry Sector





# Forestal del Maestrazgo



## ► Forestry Sector





# Forestal del Maestrazgo



## ► Forestry Sector





# Forestal del Maestrazgo



## ► Forestry Sector





# Forestal del Maestrazgo



- Forestry sector
- Forestry forwarder







# Forestal del Maestrazgo



- Forestry sector
- Forestry forwarder





# Forestal del Maestrazgo



# Forestal del Maestrazgo

## ► Forestry sector



# Forestal del Maestrazgo

## ► Forestry sector



# Forestal del Maestrazgo

## ► Forestry sector







# Forestal del Maestrazgo



## ► Forestry sector



# Forestal del Maestrazgo

- ▶ Forestry sector
  - Biomass







# Forestal del Maestrazgo



- ▶ Forestry sector
  - Biomass



- ▶ Biomass
  - Wood chip classification plant



# Forestal del Maestrazgo

- ▶ Biomass
  - Wood chip classification plant
  - Wood chip G50



- ▶ Biomass
  - Wood chip classification plant
  - Wood chip G30





# Forestal del Maestrazgo



- ▶ Possible wood chip transportation





# Forestal del Maestrazgo



- ▶ Possible wood chip transportation



# Forestal del Maestrazgo

- ▶ Possible wood chip transportation





# Forestal del Maestrazgo



- ▶ Possible wood chip transportation







# Forestal del Maestrazgo



- ▶ Biomass Installations
  - Pellet stoves

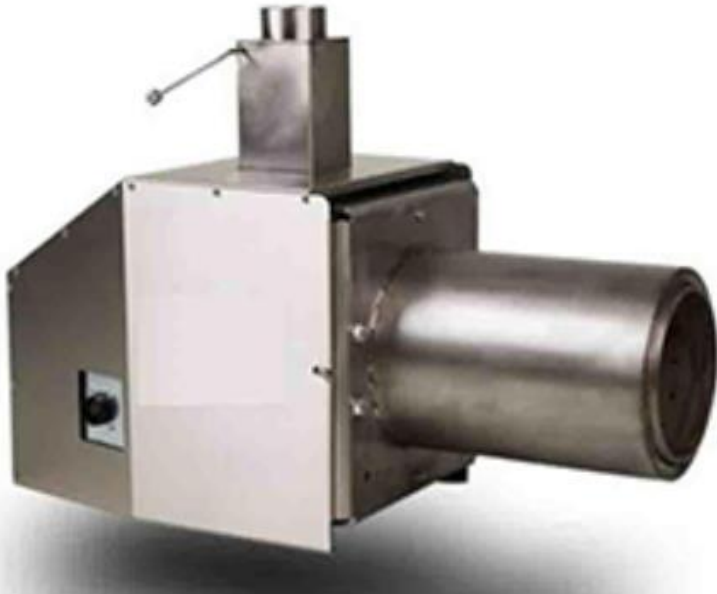


- Power between 6 and 15 kW
- Municipal Offices
- Meeting acts of medium size
- Houses up to 140 m<sup>2</sup>

Location: Forestal de Maestrazgo Offices

## ► Biomass Installations

- Pellet burner



Replacing fossil fuel boiler  
(Coal, oil, propane)

Depending on the boiler type and exhaust gas chimney, a force ventilation must be placed

Not every boiler admits a biomass burner

Biomass burner

# Forestal del Maestrazgo



## ▶ Biomass Installations

- Pellet burner
  - example:
    - Pellet Burner Sanctuary of “la Balma” (Zorita del Maestrazgo).
    - Fuel substituted propane.
    - Installed power 150 kW.
- – Manual cleaning of the combustion chamber
  - Savings achieved about 50%.

## ► Biomass Installations

- Pellet boiler



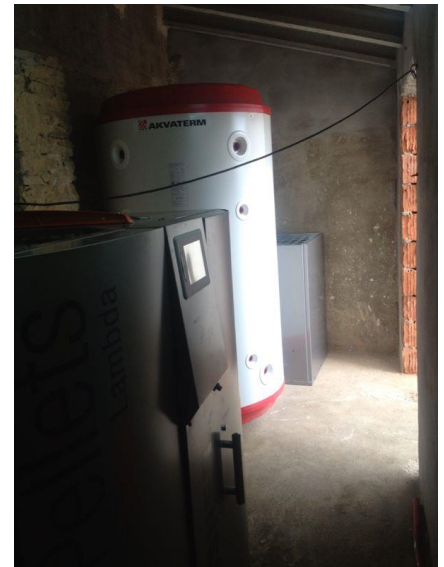
- Replacing other boilers or new facilities
- Confined Space
- Automatic cleaning
- Control up to 4 hydraulic circuits
- Recommended for medium or low potencies
- Family houses mainly

## ► Biomass Installations

### ○ Pellet boiler

#### – Example:

- Replacing diesel boilers Hostal Casa Baltasar (Zorita del Maestrazgo) – Bar–restaurant 200 m<sup>2</sup>, 16 double rooms
- – Replacing old boilers of 69 kW and 34kW
- – Boiler trademark Hargassner Classic 60kW model
- – 1000 l buffer tank with instant ACS
- – Estimated savings approx. 50%



## ► Biomass Installations

- Wood Chip boiler

- 



- Replacing conventional boiler and new facilities
  - Required storing space for wood chips
  - Savings up to 70% compared to fossil fuels
    - Higher initial investment

## ► Biomass Installations

### ○ Wood Chip boiler

- Example: Replacing diesel boilers by wood chip boiler
- Hostal El Guerrer / City Hall (Todolella)



## ► Biomass Installations

### ○ Wood Chip boiler

- Example: Replacing diesel boilers by wood chip boiler
- Hostal El Guerrer / City Hall (Todolella)



- Replace of 2 gasoil boilers of 150 and 50 kW
  - 85% Efficiency
- Roca wood chip boiler power 150 kW
  - 90% Efficiency



## ► Biomass Installations

### ○ Wood Chip boiler

- Example: Replacing diesel boilers by wood chip boiler
- Hostal El Guerrer / City Hall (Todolella)

- Automatic cleaning of the ash
- Flame backflow preventer
- Estimated investment
  - 50.000€



## ► Biomass Installations

### ○ Wood Chip boiler

- Example: Replacing diesel boilers by wood chip boiler
- Hostal El Guerrer / City Hall (Todolella)
- Location of a nearby silo of approx. 30 m<sup>3</sup>





# Forestal del Maestrazgo



## ► Biomass Installations

### ○ Wood Chip boiler

- Example: Replacing diesel boilers by wood chip boiler
- Hostal El Guerrer / City Hall (Todolella)
- Location of a nearby silo of approx. 30 m<sup>3</sup>
- Wood chip supply with a truck with pneumatic cuba



# Forestal del Maestrazgo





# Forestal del Maestrazgo



- ▶ Biomass Installations
  - Wood Chip boiler
    - Economic feasibility study

## REQUIRED GASOIL CONSUMPTION

Consumo gasóleo (litros):	15.000	litros/año
PCI gasóleo:	10,24	kWh/litros
Consumo gasóleo (kWh):	153.600	kWh/año
Rendimiento caldera gasóleo:	85%	
Energía cedida a la instalación:	130.560	kWh/año

## REQUIRED CHIP CONSUMPTION

Consumo astilla (kg):	41.448	kg/año
PCI astilla:	3,50	kWh/kg
Consumo combustible (kWh):	145.067	kWh/año
Rendimiento caldera astilla:	90%	
Energía necesaria:	130.560	kWh/año

## GASOIL CONSUMPTION & COSTS

Consumo de gasóleo:	15.000	litros/año
Coste del gasóleo:	0,84	€/litro
Coste anual de gasóleo:	12.600	€

## CHIP CONSUMPTION & COSTS

Consumo estimado de astilla:	41.448	kg/año
Coste de la astilla:	0,100	€/kg
Coste anual del astilla:	4.145	€



# Forestal del Maestrazgo



- ▶ Biomass Installations
  - Wood Chip boiler
    - Economic Feasibility study
    - Annual increase of 3%

	Año 1	Año 2	Año 3	Año 4	Año 5	Año 6	Año 7	Año 8	Año 9	Año 10	Ahorro total
Coste Gasóleo (€)	12.600	12.978	13.367	13.768	14.181	14.607	15.045	15.496	15.961	16.440	
Coste Astilla(€)	4.145	4.269	4.397	4.529	4.665	4.805	4.949	5.098	5.250	5.408	
Ahorro astilla vs Gasóleo (€)	8.455	8.709	8.970	9.239	9.516	9.802	10.096	10.399	10.711	11.032	96.930 €

- Estimated investment € 50,000
- Payback period 5.5 years
- Possible Subventions not included

# Forestal del Maestrazgo

- ▶ Wood chip burner in Morella
- ▶ Starting Facts
- ▶ Pig farm
- ▶ Number of mothers: 100
- ▶ Old coal boiler
- ▶ Annual consumption 10 tons approx.





# Forestal del Maestrazgo



- ▶ Wood chip burner in Morella
- ▶ Insatisfaction with present installation:
  - Manual loading of the combustion chamber
  - Danger of overheating of the boiler
  - Great GHG emissions to the atmosphere
  - Controversy with coal combustion in boilers.
  - *RITE "the use of solid fossil fuels in heating systems of the buildings in the scope of this regulation from January 1, 2012 shall be prohibited."*



# Forestal del Maestrazgo

- ▶ Wood chip burner in Morella
- ▶ Previous installation.



# Forestal del Maestrazgo

- ▶ Wood chip burner in Morella
- ▶ Pellet burner installation.
  - Adapting the boiler door.



# Forestal del Maestrazgo

- ▶ Wood chip burner in Morella
- ▶ Pellet burner installation.
  - Placing the burner



# Forestal del Maestrazgo

- ▶ Wood chip burner in Morella
- ▶ Pellet burner installation.
  - Placing storage.



# Forestal del Maestrazgo

- ▶ Wood chip burner in Morella
- ▶ Pellet burner installation.
  - Starting up.



# Forestal del Maestrazgo

- ▶ Wood chip burner in Morella
- ▶ Pellet burner installation.
  - Starting up.





# Forestal del Maestrazgo



- ▶ Wood chip burner in Morella
- ▶ Pellet burner installation.
  - consumption
  - 90 kg / day of pellet
  - € 0.24 / kg
  - 21 € / day
  - Approximately operating 180 days year
  - € 3,780 / year



# Forestal del Maestrazgo



- ▶ Wood chip burner in Morella
- ▶ Pellet burner installation.

## REQUIRED COAL CONSUMPTION

Consumo carbón:	9.800	kg/año
PCI carbón:	8,00	kWh/kg
Consumo carbón (kWh):	78.400	kWh/año
Rendimiento caldera gasóleo:	85%	
Energía cedida a la instalación:	66.640	kWh/año

## COAL CONSUMPTION & COSTS

Consumo de carbón:	9.800	kg/año
Coste del carbón:	0,23	€/kg
Coste anual de carbón:	2.254	€

## REQUIRED PELLET CONSUMPTION

Energía necesaria:	66.640	kWh/año
PCI pellets:	5,00	kWh/kg
Consumo combustible (kWh):	78.400	kWh/año
Rendimiento caldera pellets:	85%	
<b>Consumo pellets (kg):</b>	<b>15.680</b>	<b>kg/año</b>

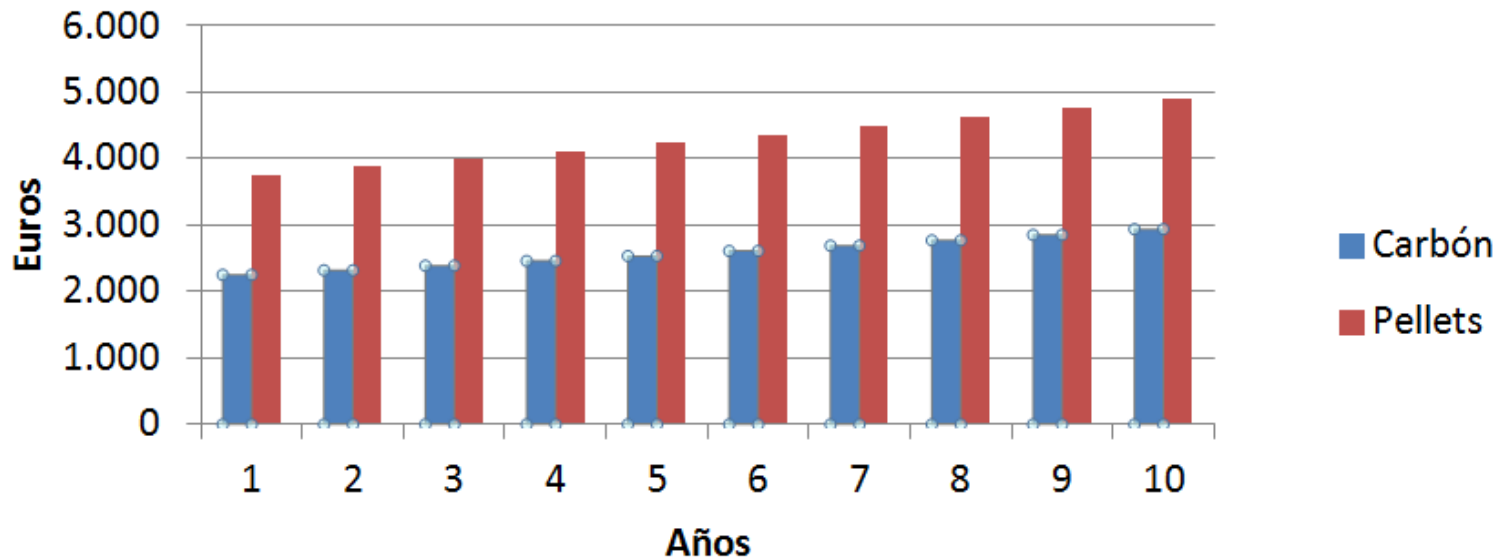
## PELLET CONSUMPTION & COSTS

Consumo estimado de pellet:	15.680	kg/año
Coste de los pellets:	0,24	€/kg
Coste anual de los pellets:	3.763	€



- ▶ Wood chip burner in Morella
- ▶ Pellet burner installation.
  - Evolution of coal /pellet costs

## Comparativa carbón vs pellets



# Forestal del Maestrazgo

- ▶ Wood chip burner in Morella
- ▶ Installation wood chip burner.



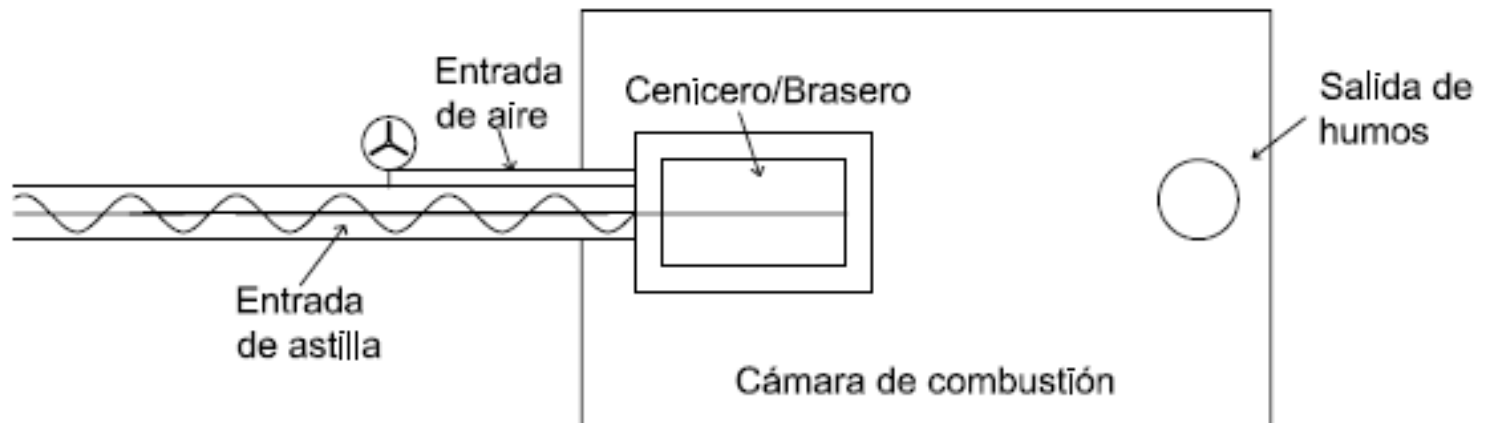
# Forestal del Maestrazgo

- ▶ Wood chip burner in Morella
- ▶ Installation chip burner.
  - Prototype



# Forestal del Maestrazgo

- ▶ Wood chip burner in Morella
- ▶ Installation chip burner.
  - Current Installation



# Forestal del Maestrazgo

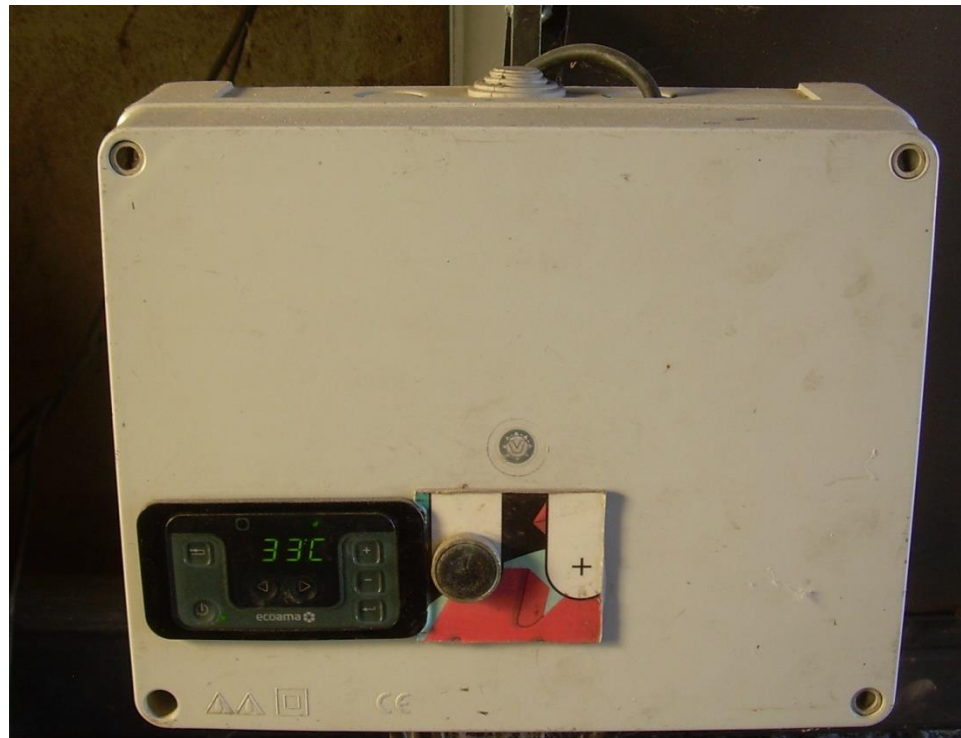
- ▶ Wood chip burner in Morella
- ▶ Installation chip burner. Installation:  
Current installation



# Forestal del Maestrazgo

- ▶ Wood chip burner in Morella
- ▶ Installation chip burner.

Current installation



# Forestal del Maestrazgo

- ▶ Wood chip burner in Morella
- ▶ Installation chip burner.
  - Current installation



# Forestal del Maestrazgo

- ▶ Wood chip burner in Morella
- ▶ Installation chip burner.
  - Current installation
  - Amount of fuel





# Forestal del Maestrazgo

- ▶ Wood chip burner in Morella
- ▶ Installation chip burner.
  - Current installation
  - Combustion control



# Forestal del Maestrazgo

- ▶ Wood chip burner in Morella
- ▶ Installation chip burner.
  - Current installation
  - Combustion control





# Forestal del Maestrazgo



- ▶ Wood chip burner in Morella
- ▶ Installation chip burner.

## REQUIRED COAL CONSUMPTION

Consumo carbón:	9.800	kg/año
PCI carbón:	8,00	kWh/kg
<b>Consumo carbón (kWh):</b>	<b>78.400</b>	<b>kWh/año</b>
Rendimiento caldera carbón:	85%	
Energía cedida a la instalación:	66.640	kWh/año

## REQUIRED CHIP CONSUMPTION

<b>Consumo astilla (kg):</b>	<b>22.400</b>	<b>kg/año</b>
PCI astilla:	3,50	kWh/kg
Consumo combustible (kWh):	78.400	kWh/año
Rendimiento caldera astilla:	85%	
Energía necesaria:	66.640	kWh/año

## COAL CONSUMPTION & COSTS

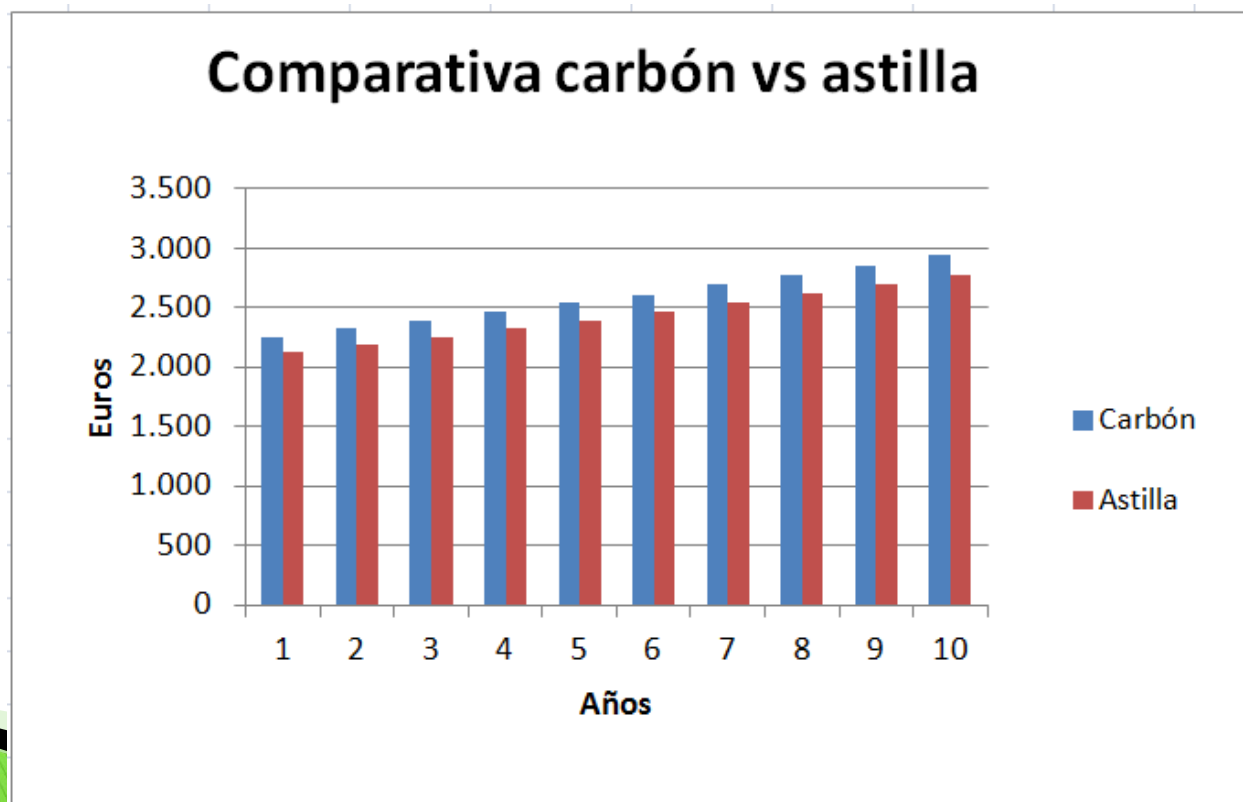
Consumo de carbon:	9.800	kg/año
Coste del carbón:	0,23	€/kg
Coste anual de carbón:	2.254	€

## CHIP CONSUMPTION & COSTS

Consumo estimado de astilla:	22.400	kg/año
Coste de la astilla:	0,095	€/kg
Coste anual del astilla:	2.128	€

# Forestal del Maestrazgo

- ▶ Wood chip burner in Morella
- ▶ Installation chip burner.
  - Evolution of coal /wood chip costs





# Forestal del Maestrazgo



- ▶ Current situation in Valencian Region
- ▶ Difficulties from the authorities for forest harvesting
- ▶ Grants for extraction of fire biomass
- ▶ No promoting the consumption of biomass locally
  - New livestock facilities prefer GLP



# Conclusions



- ▶ Reduction of GHG emissions
- ▶ Cost savings up to 70%
- ▶ Increased need for spaces
- ▶ Sustainable, local and economic energy