

# Analysis of the procurement system of Eucalyptus residues with bundling technology



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CETEMAS



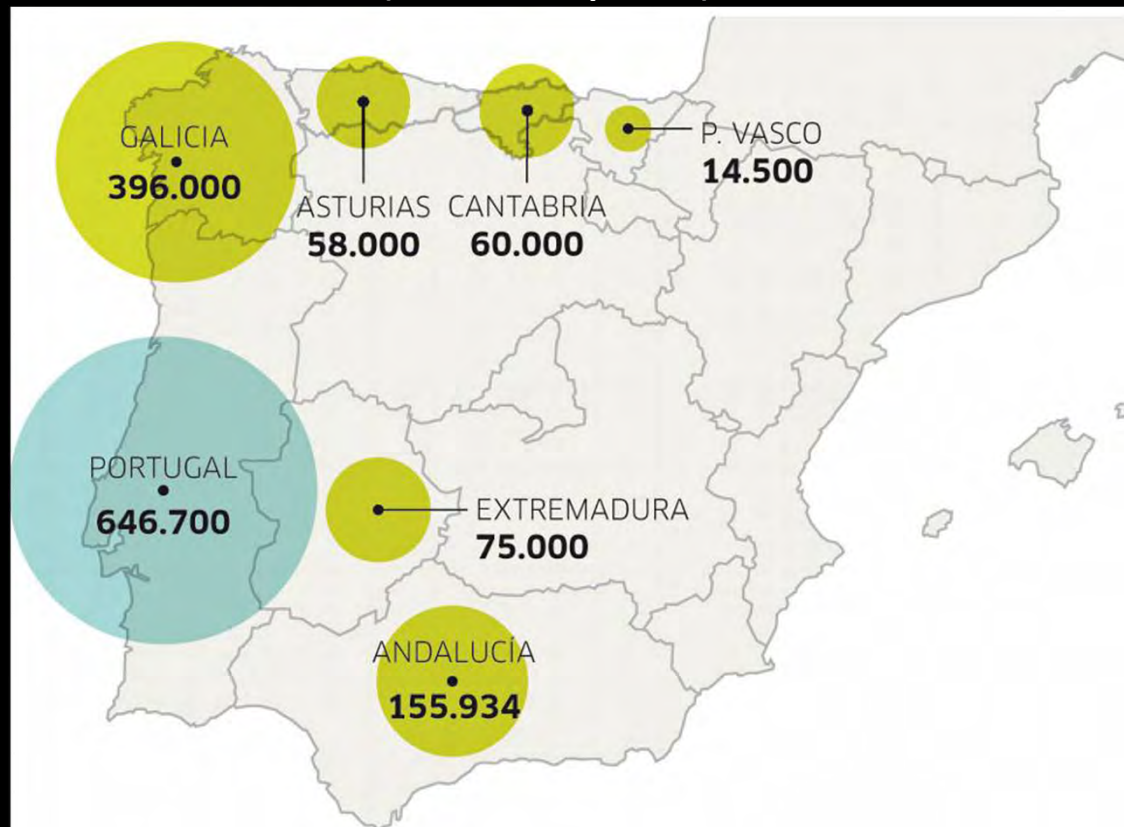
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# INTRODUCTION: Eucalyptus plantations in Spain

- The area of Eucalyptus plantations is about 760,000 ha (plus about 650,000 in Portugal)
- Atlantic areas, both rainy oceanic (north) and dry mediterranean climate (south Spain).



# INTRODUCTION: Eucalyptus plantations in Spain

- The output is 3,000,000 m<sup>3</sup> underback  Deficit 1,650,000 m<sup>3</sup>
- Industrial consumption 4,650,000 m<sup>3</sup>
  - 25 % Portugal
  - 75% other
-  4.000.000 m<sup>3</sup> ub pulp production.
- Uses  450.000 m<sup>3</sup> ub fibreboard.
-  200.000 m<sup>3</sup> mining and others.
- Most common method:
  - Coppice regeneration
  - Rotations between 9-14 years
  - 15-30 m<sup>3</sup>/ha.year



# INTRODUCTION: **Bioenergy in Spain**

- Use of renewable energies: **13%** gross final energy consumption.
- Biomass: **50%** renewable energies.

**PANER (2011-2020):** Renewable Energies Action Plan.



- States that by 2020, 22.7% of the gross final energy consumption will be provided by renewable energies.
- Establishes incentives to electric companies for the use of forest residues and short rotation forestry SRF.



# INTRODUCTION: **Bioenergy in Spain**

- ENCE has three plants in Spain. 180 MW.
- ENCE Navia (Asturias): 77 MW installed power.



# INTRODUCTION:

## Procurement of forest residues

Chainsaw + processor (processing, delimiting, topping) at 7cm diameter



Large amounts of residues left on the ground

- ✓ Fire hazard
- ✓ Limit the accessibility to the field

A potential source of biomass



# INTRODUCTION:

## Procurement of forest residues

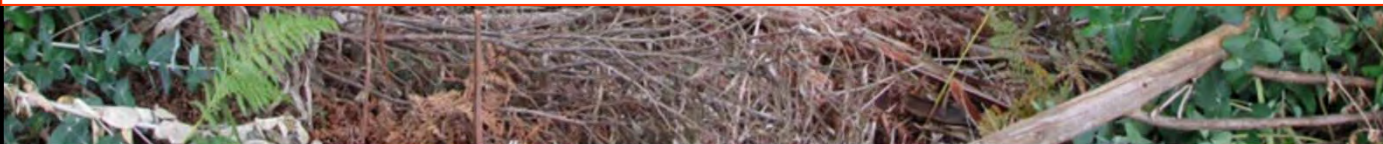
- Concentration
- Extraction
- Transport
- Comminution



It's necessary to select adequate systems and technologies to perform it efficiently



To understand the processes well!



# METHODOLOGY



- Northern Spain (Asturias)
- Eucalyptus (*E. globulus*) plantations.
- 14 years.
- Chainsaw + an excavator equipped with processing head
- **BUNDLER + FORWARDER + TIMBER TRUCK**

## WORK TIME STUDY

- Four days
- Continuous time study
- Siwork3 software and GPS



**Evaluate machine productivity  
and the harvesting system**

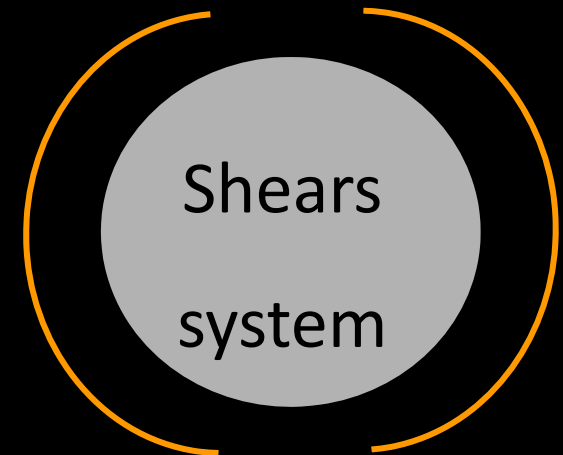


# BUNDLER Woodpac ENFO 2000



# BUNDLER Woodpac ENFO 2000

## NEW CUTTING SYSTEM





# BUNDLER Woodpac ENFO 2000

## CHARACTERISTICS

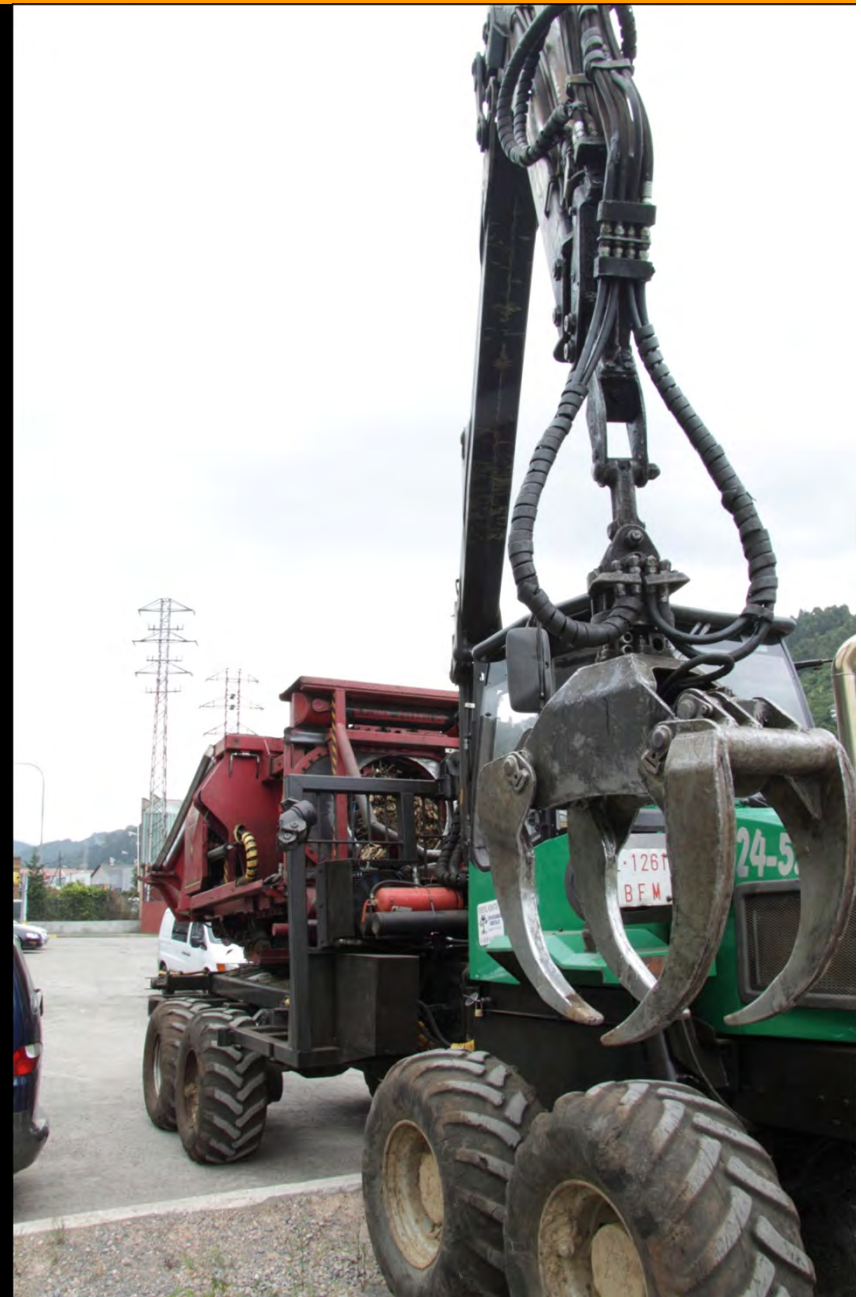
Dingo 24-52A

- 147 kW
- 8 wheel drive

Guerra 77A

- 7.7 m reach
- Bundler : 1,5 years → 7,400 bundles.

Without any maintenance of the cutting device.





# BUNDLER Woodpac ENFO 2000

## BUNDLES

- Length: 250 cm
- Diameter: 77.3 cm
- Volume: 1.17 m<sup>3</sup>
- Fresh weight : 371 kg
- Moisture: 44%
- Weight oven dry: 206 kg



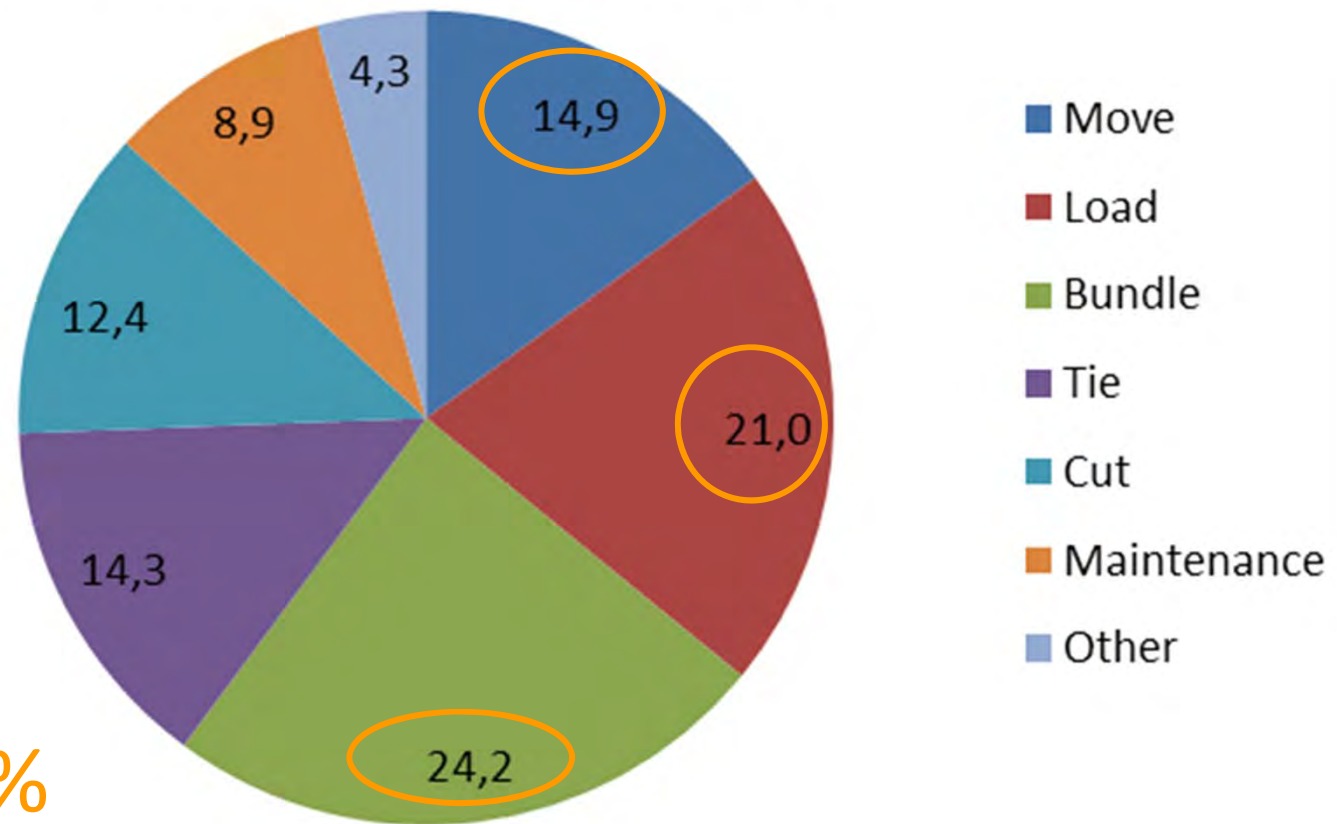
# BUNDLER Woodpac ENFO 2000 slash baler

## TIME STUDY. PRODUCTIVITY

- Time 684 bundles
- 32.79 SMH

# BUNDLER Woodpac ENFO 2000 slash baler

Break-down of bundling phases (%)





# BUNDLER Woodpac ENFO 2000 slash baler

## TIME STUDY. PRODUCTIVITY

- 684 bundles
- 32,79 SMH
- 89 % utilization rate ( $\text{PMH}_{15} / \text{SMH}$ )
- 8,8 t or 24 bundles ( $\text{PMH}_{15}^{-1}$ )
- 7,7 t or 21 bundles ( $\text{SMH}^{-1}$ )

## TIME STUDY. COST

- 90€  $\text{SMH}^{-1}$  → 4.3 €  $\text{bundles}^{-1}$  or 11.6 €  $\text{green ton}^{-1}$

# FORWARDER Dingo

## CHARACTERISTICS

### Dingo

- 92 kW
- 6 wheel drive
- 8.5 t payload

### Guerra 624

- 6.9 m reach



- Used in forwarding d... along the forest roads (one way).
- Bundles were piled: roadside, intermidate landings or directly on truck.

- Vertical metal wall on the left side and posts on the right side.

# FORWARDER Dingo

## TIME STUDY. PRODUCTIVITY

- 335 bundles
- 21 bundles average load
- 9.6 SHM
- 92% of nominal payload
- More than 90% operative time
- 35 bundles SMH<sup>-1</sup> 13 green t SMH<sup>-1</sup>

## TIME STUDY. COST

- 52 € SMH<sup>-1</sup> → 1.5 € bundle<sup>-1</sup> or 4 € green ton<sup>-1</sup>



# ROAD TRANSPORT Semitrailer truck

## CHARACTERISTICS

- Equipped with crane for self-loading.



# ROAD TRANSPORT Semitrailer truck

## CHARACTERISTICS

- Posts or net-walls





# ROAD TRANSPORT Semitrailer truck

## CHARACTERISTICS

- Load volume: 65.6 m<sup>3</sup>





# ROAD TRANSPORT Semitrailer truck

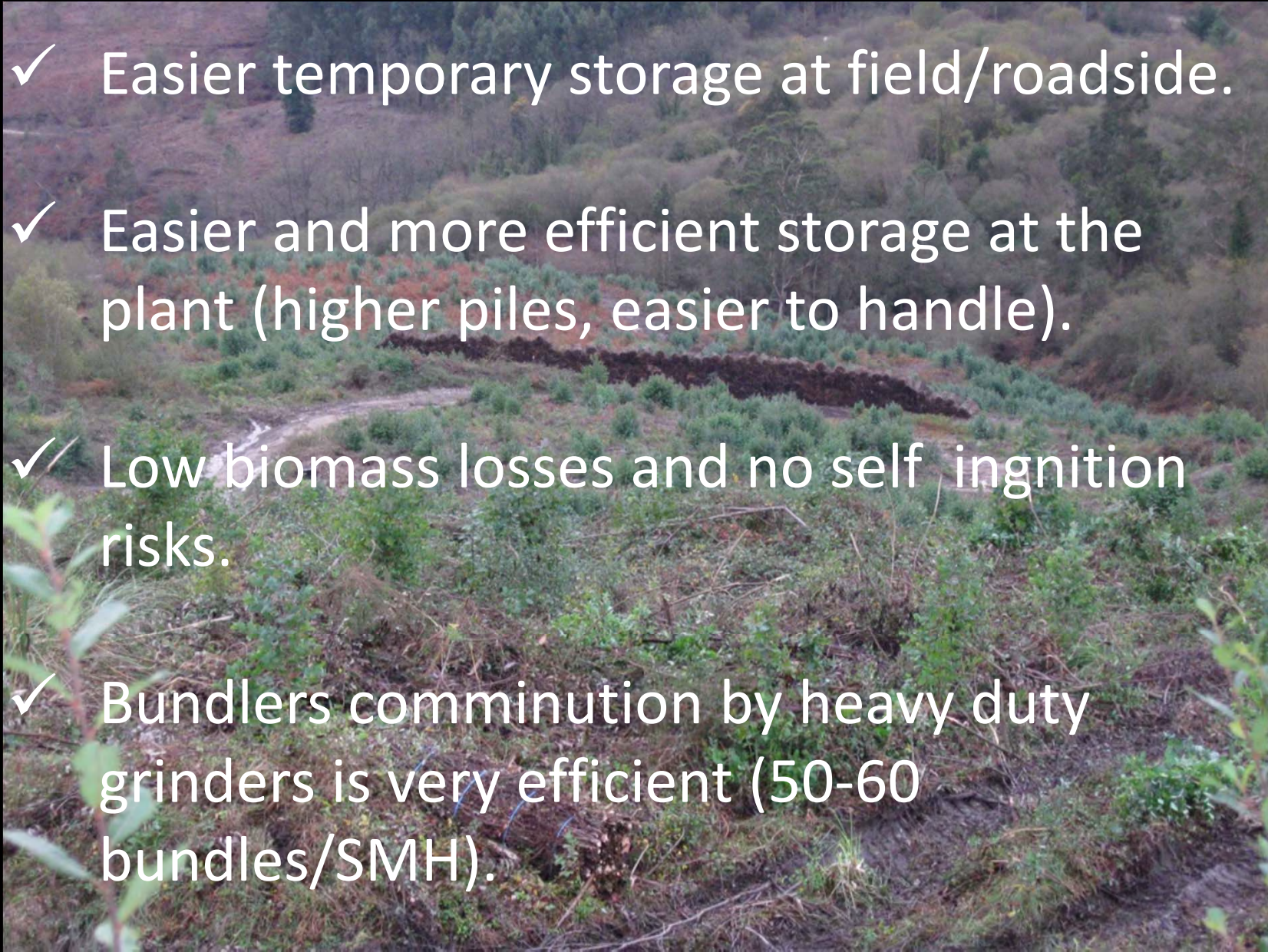
## TIME STUDY. PRODUCTIVITY

- Average load: 69 bundles or 25.8 tons load<sup>-1</sup>
- 29 to 49 min loading time
- 21 to 25 unloading time
- 140 km (3.5 h round trip)

## TIME STUDY. COST

46 € SMH<sup>-1</sup> → 2.9-3.2 € bundles<sup>-1</sup> 7.7 - 8.4 € green ton<sup>1</sup>

# Storage and comminution

- 
- ✓ Easier temporary storage at field/roadside.
  - ✓ Easier and more efficient storage at the plant (higher piles, easier to handle).
  - ✓ Low biomass losses and no self ignition risks.
  - ✓ Bundlers comminution by heavy duty grinders is very efficient (50-60 bundles/SMH).



# Storage and comminution

Stationary grinder as planned by the power plant.





# Conclusions

- ✓ The bundler has a productivity comparable to that reported for other machines (piled or windrowed residues).
- ✓ The cutting system (shears) appears to be slower than chainsaw but more reliable (lower maintenance cost).
- ✓ The studied system had an overall calculated cost of 9 €/bundle, thus with a very interesting economic margin (power plant buys for 12-13 €/bundle)



# Thank you!



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