UNIVERSIDADE DE ÉVORA
ESCOLA DE CIÊNCIAS E TECNOLOGIA
DEPARTAMENTO DE ENGENHARIA RURAL

Instituto de Ciências Agrárias e Ambientais Mediterrânicas

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tesla Transfering Energy Save Laid on Agroindustry

Best practices for improving energy efficiency in Olive Oil Mills

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Summary

1. TESLA objectives
2. Olive oil mills energy consumption
3. Best practices for energy efficiency improvements
4. Success cases
5. Final considerations

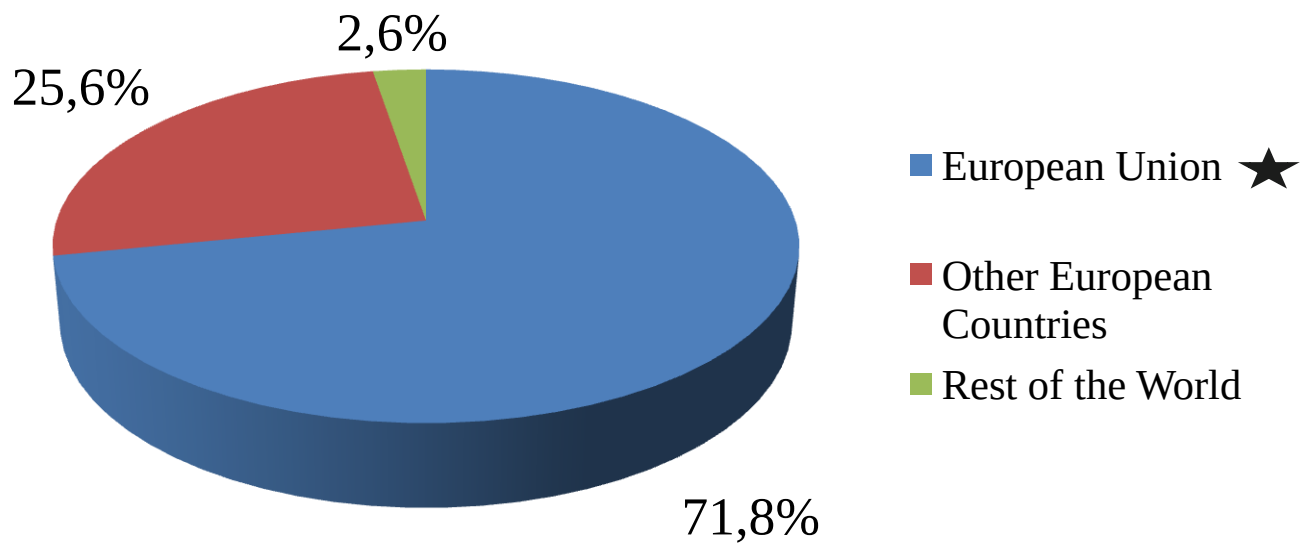
OBJECTIVES of TESLA

- increase access of agro-industries to energy efficiency measures
- to develop a management methodology for the agro-industry sector
- to promote investment in EE and renewable energies

Olive oil mills energy consumption

Near 95% of olive grove production is in the Mediterranean region.

Produção Mundial de Azeite (2010/11)



Elaborated with data from IOC (2012)

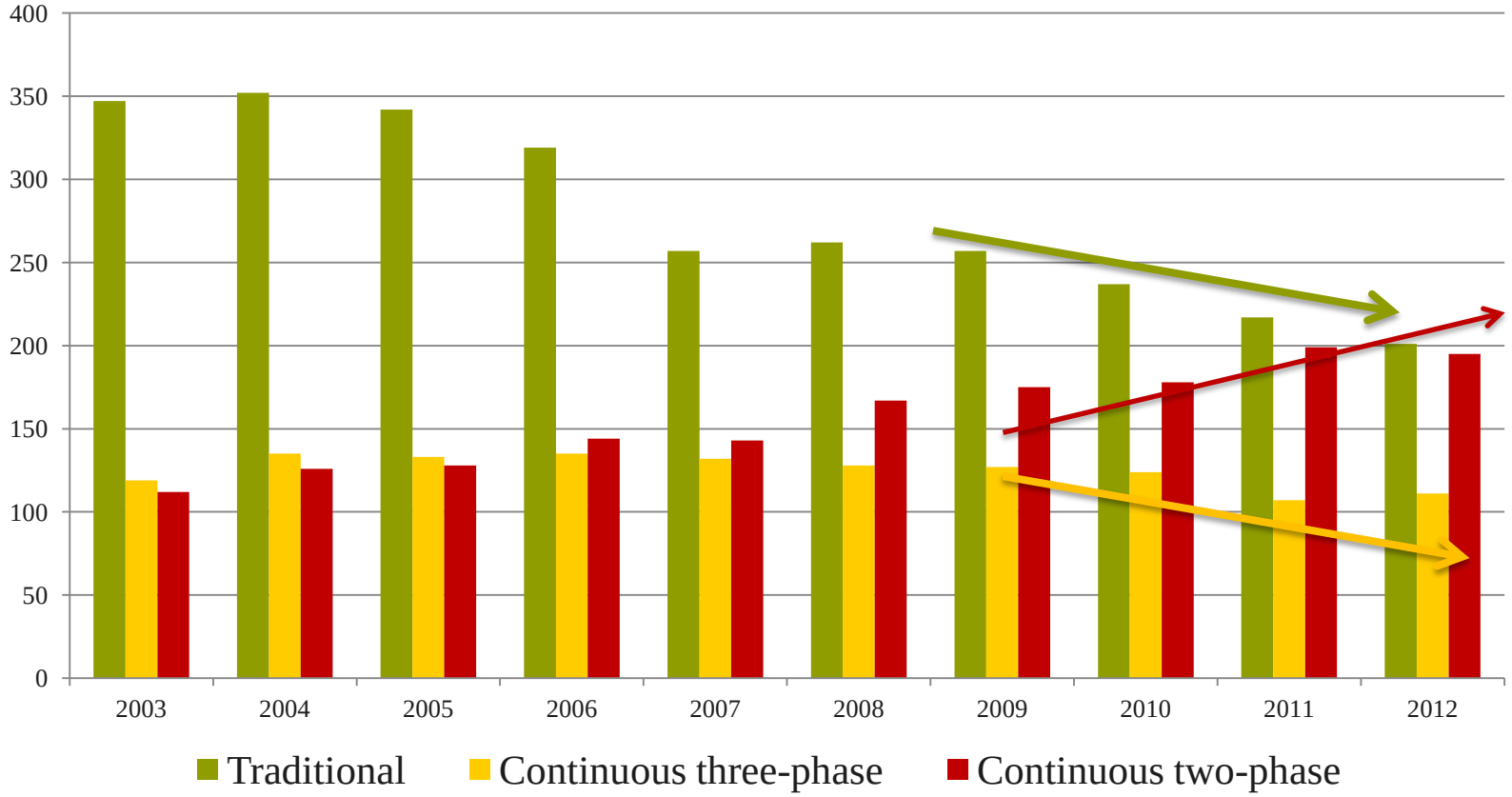
★ Spain, Italy, France, Greece and Portugal

Characteristics of the Olive Oil Sector

Olive Oil Sector - 2011	Portugal	Spain	France	Italy
Area olive groves for oil (ha)	338.048	2.584.564	55.000	1.144.400
Olives used for oil (ton)	510.733	7.820.000	16.740	3.122.500
Average productivity (kg olives/ha)	1.511	3.026	1.000	2.900
Olive mills in activity (nº)	527	1.750	254	4.809
Olive oil produced (ton)	76.200	1.651.000	3.200	464.900
Productivity (kg olive oil/ha)	227	639	58	406
Olive oil/Olives (%)	15	21	19	15
Olive oil consumption (ton)	78.000	574.000	112.000	610.000
Olive oil consumption per capita (kg)	7,4	12,3	1,7	10,3
Resident population	10.557.560	46.815.916	64.612.939	59.394.000

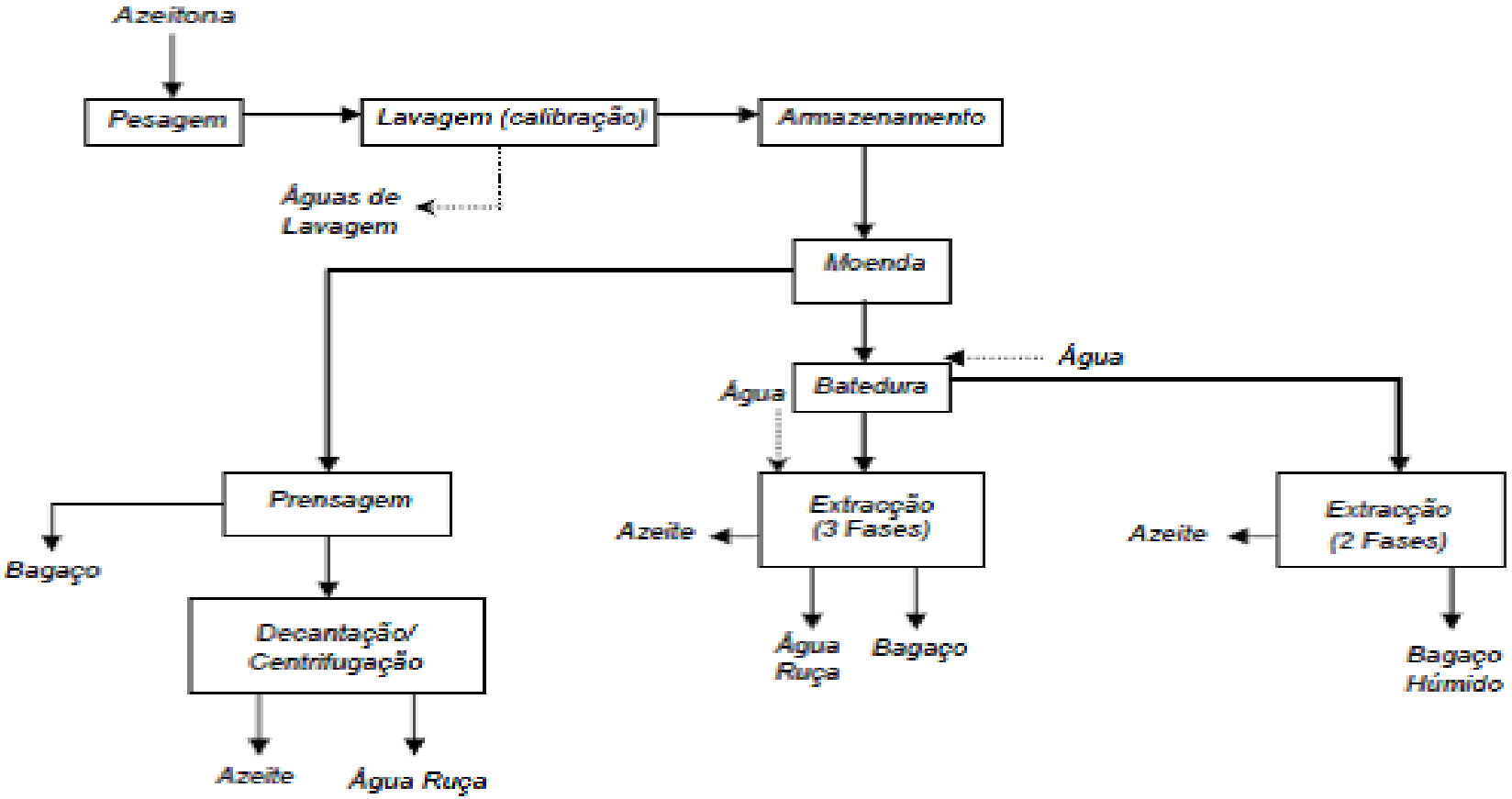
Source: INE (2012); IOC (2012); INEA (2012) and AFIDOL

Number of olive mills with different olive oil extraction systems (Portugal)

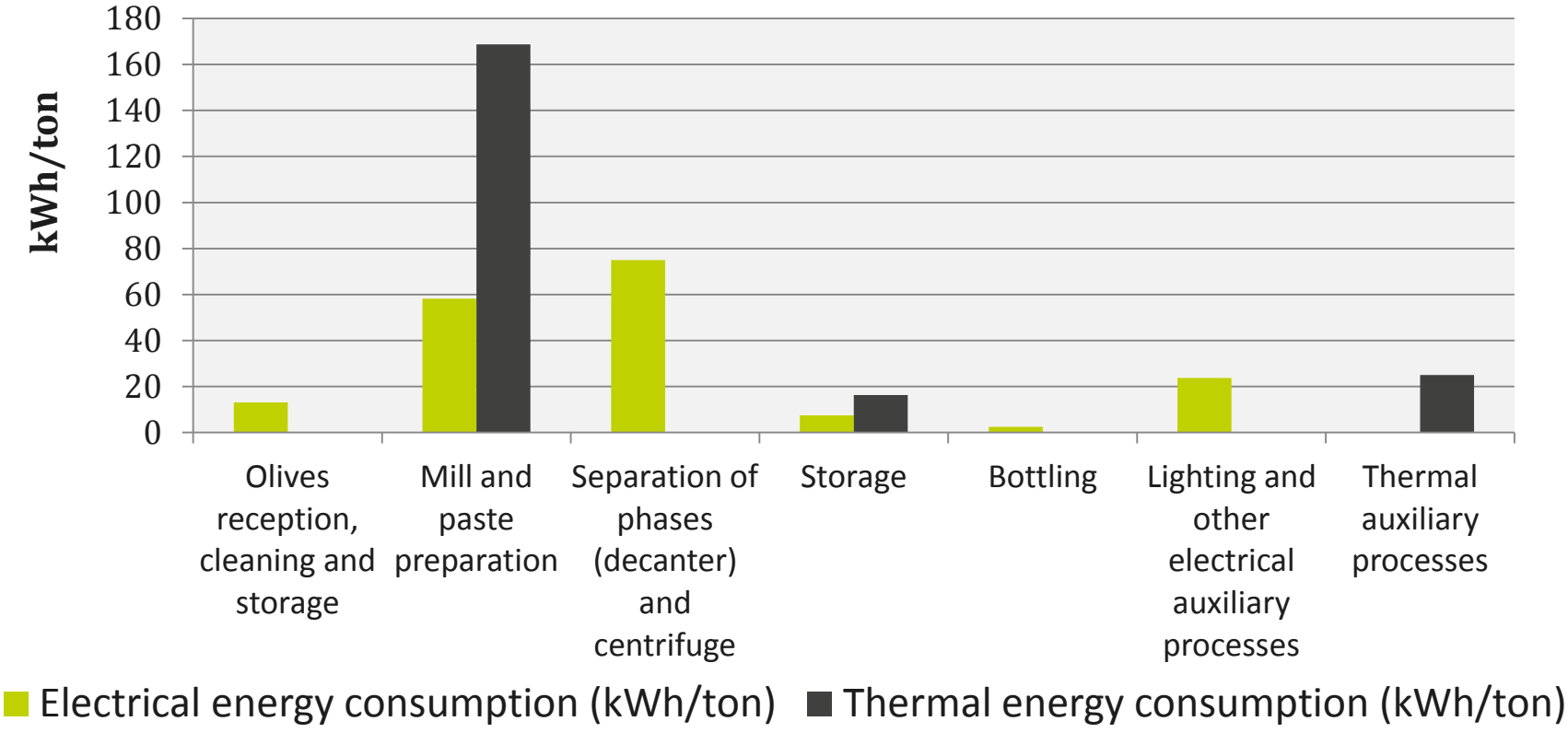


Source: INE (2011)

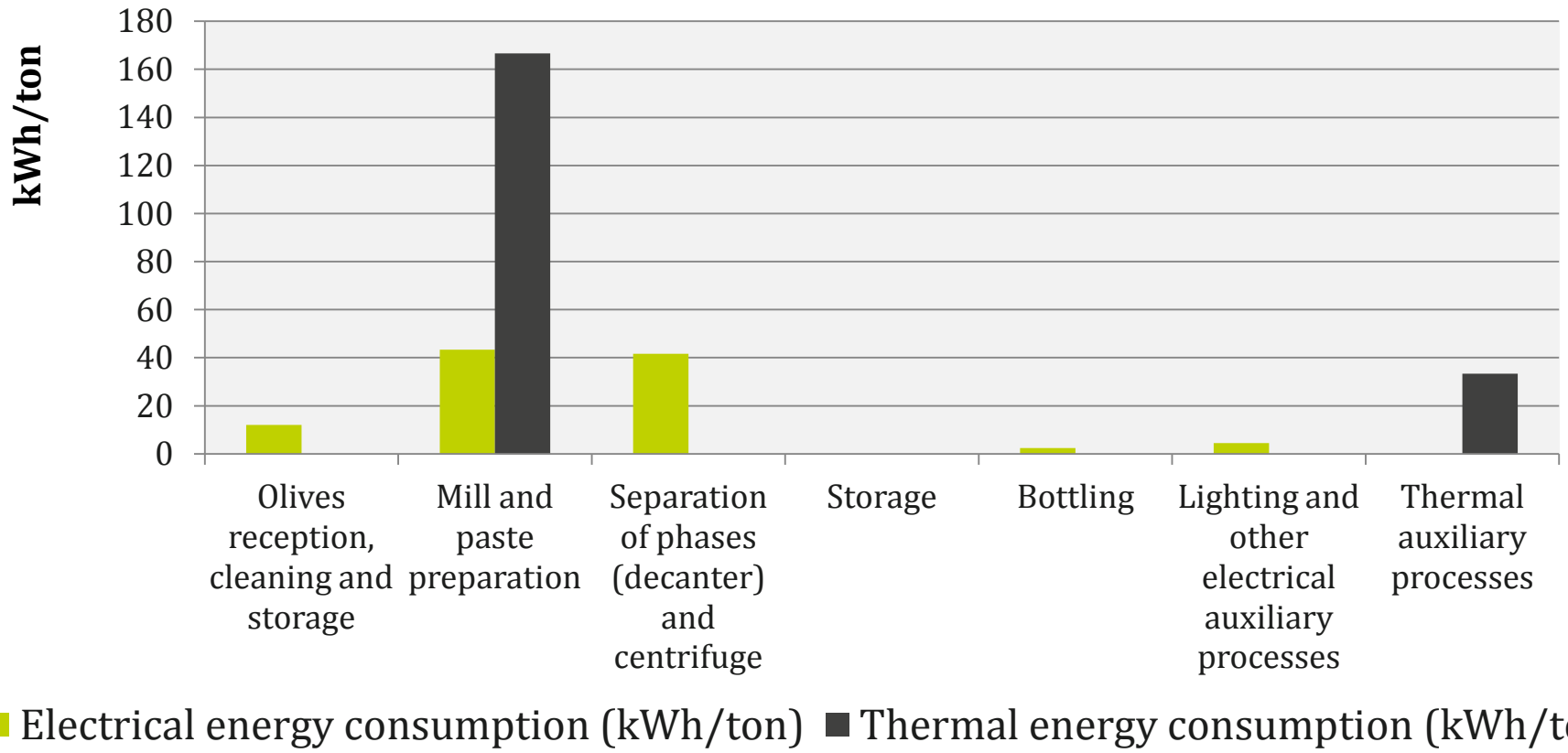
Olive oil extraction processes



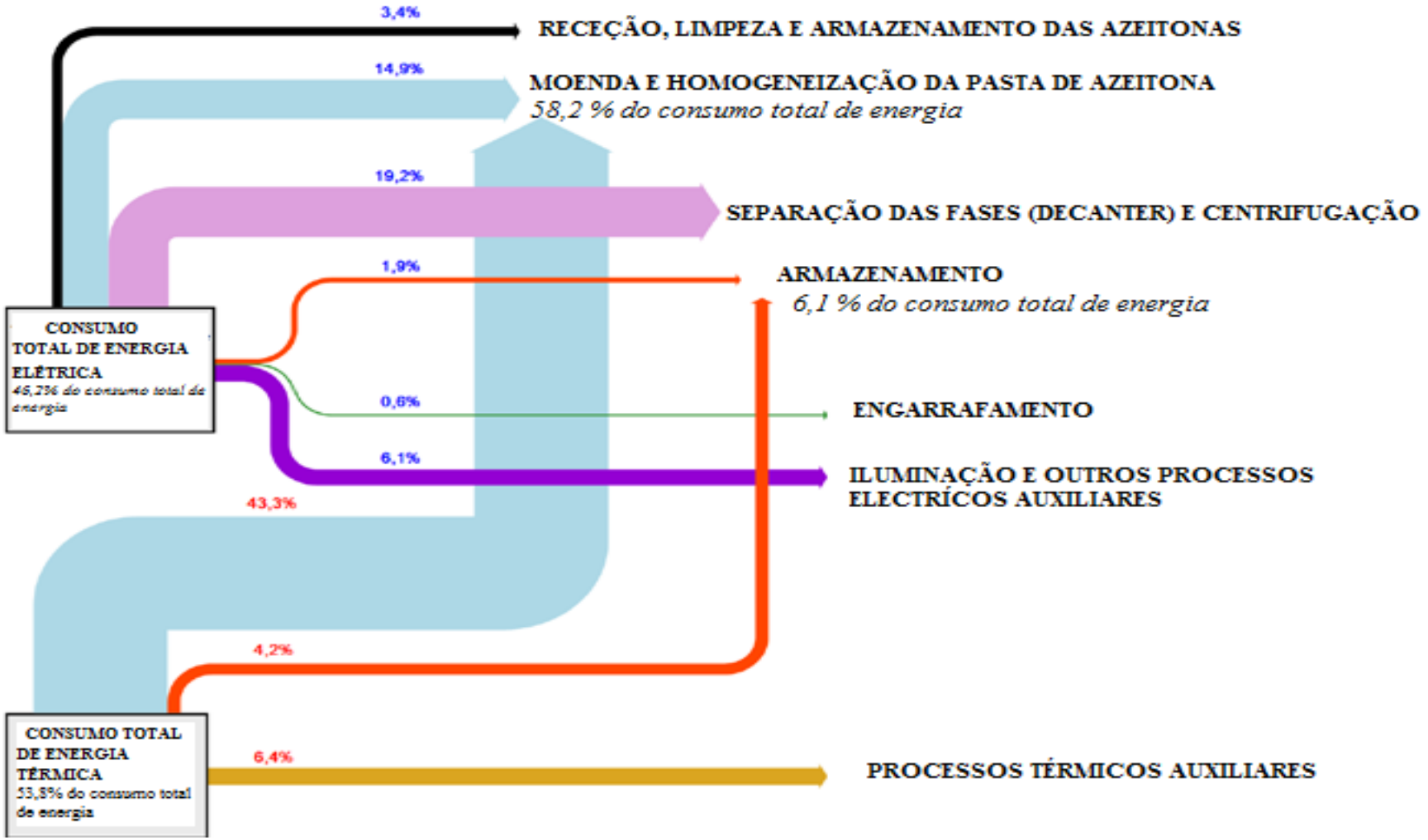
Energy consumption for olive oil production (example for a olive oil mill producing 1.600 ton of olive oil per year)



Energy consumption for olive oil production (example for a olive oil mill producing 300 ton of olive oil per year)



Energy Balance for the standard production industry of 1.600 tons of olive oil per year



Best practices for improving energy efficiency

Energy Efficiency
Sustainable production

- Buildings
- General equipment
- Specific equipment
- Efficient management

Building techniques

Energy Efficient Design

- EED has been proven to be the most cost-efficient and attractive way to improve energy efficiency in industry achieving **savings up to 20–30 % of total energy consumption**.
- An important barrier against success is that manufacturers are conservative or unwilling to change a well-proven standard design and/or to update product guarantees, etc..

Design of natural ventilation systems

- Ventilation allows controlling air properties such as temperature, humidity and air quality without any electricity demand.
- In olive oil mills, p.e., it is important to control air conditions in the bottling area in order to avoid condensation on the bottles surface causing problems with labelling.
- **Nat. ventilation saves between 13-44 kWh/m^2 annually (comparison with mechanical ventilation)**

Materials for building industrial facilities

- Choosing more sustainable materials implies considering the environmental properties (select those that are **abundant, non-toxic, have low embodied energy, and meet or exceed the regulations**) and the physical properties.
- **With good insulation and a suitable ventilation system, we can significantly decrease heat exchanges (losses or gains) and with that reduce air conditioning needs (cooling or heating).**

Insulation of external walls : 33–60% energy savings

(Balaras et al., 2007)

General equipment

Cold and heat

IEE > 3

COP > 4

Insulation of tubes transporting fluids

Potencial savings of 85% depending on the insulation level

Motors and pumps with high efficiciency

Design and motors control systems

Light

LED - reduction of the needed power up to 65%.

Specific equipment for olive oil mills

Biomass boilers

Diesel boiler ⇨ Biomass boiler

reduced from 46 €/MWh to 13 €/MWh

Installation of Listello - With the same energy consumption it is possible to increase olive oil production up to 35%.

Microwave radiation - Reduces the time (55 min to 30 min) during the malaxation of the olive paste to reach optimal temperature (28 ° C)

Decanting tanks - Reduction in water consumption and a decrease in liquid effluents from oil washing process. 100% of energy savings are possible. Needs larger areas.

Oleosim – similar to the previous but needs less area. Consumes approximately 96 % less energy than using vertical centrifuges.

Two-phase system allows reducing waste water to 0,33-0,35 m3/t of olive oil comparing with the 6-8 m^3/t of olive oil for the three-phase system and 2-5 m3/t of olive oil for the traditional extraction method.

In addition to the water saving, energy saving is about 20%.

Energy management

ISO 50.001 : International norm for energy management

Renewable energy

Solar – savings of 50 to 70% fucntion of the location

Geothermal – high investment and avalability

Cogeneration - olive oil mills sludge treatment: reductions in the primary energy demand (16%) as well as in the CO2eq emission. The main limitation of the combined heat and power (CHP) scheme is the economic viability, since a high simultaneous utilization of heat and power is required in most applications.

Management - Bottling

- Optimising packing line efficiency
- Use of in-line check-weights to prevent overfilling of packing

In general, a systems approach for energy reduction, includes elimination of unnecessary processes and upgrading inefficient equipment

Success Cases

Cooperativa Agrícola de Olivicultores do Cano

País: Portugal
Sector: **Lagares**

Medidas implementadas:
Alteração do sistema de extração, de 3 fases para 2 fases
a) Substituição da máquina de lavagem;
b) Substituição do moinho de martelos;
c) Substituição da batedeira (passou de 1.000 kg/h de massa a 7.000 kg/h);
d) Eliminação de uma das centrifugas
e) Substituição da caldeira por outra de maior potência e capacidade

Cooperativa Agrícola de Olivicultores do Cano

País: Portugal
Sector: **Lagares**

Produto: Azeite
Produção: 344 ton (+156 ton)
Poupança Energética: 11.690 (1) kWh **(60,35 kWh/ton)**
Diminuição dos custos: 170 (1) €
Redução das emissões de CO2eq : 1(1) ton **(23 kg CO2eq/ton)**
Investimento: 333.000 €
Período de retorno: 8

(1) A vermelho, representa um aumento no valor total de energia consumida. No entanto, por tonelada de produto produzido, temos uma redução.

Redução energética, de custos e de emissões de CO2

S.C.A. Ntra. Sra. Del Carmen

País: Spain

Sector: **Lagares**

a) Substituição dos motores por outros mais eficientes

b) Optimização das operações do lagar

c) Substituição da centrifuga vertical por um tanque de sedimentação

d) Instalação do Oleosim

e) Isolamento de tubos

f) Instalação de um sistema fotovoltáico

S.C.A. Ntra. Sra. Del Carmen

País: Spain

Sector: **Lagares**

Produção: 4.500 ton

Poupança Energética total: 645.000 kWh **(143 kWh/ton)**

Diminuição dos custos: 86.000 €

Redução das emissões de CO2: 260 ton **(58 kg CO2/ton)**

Investimento: 1.000.000€

Período de retorno: 4,5 anos

Redução energética, de custos e de emissões de CO2

Final considerations

Introduction of new technologies/modification of production processes.

- to change from the 3 to 2 phases
- substitution of hold equipment by more efficient new ones
- Automation systems
- substitution of lamps
- use of more efficient motors
- Period maintenance practices
- biomass use
- Management practices, etc.

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