

# Implementation of Biogas Technology in Spain

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GRUP DE RECERCA EN  
BIOTECNOLOGIA AMBIENTAL

Miembro de:



XARXA DE CENTRES  
DE SUPORT  
A LA INNOVACIÓ  
TECNOLÒGICA

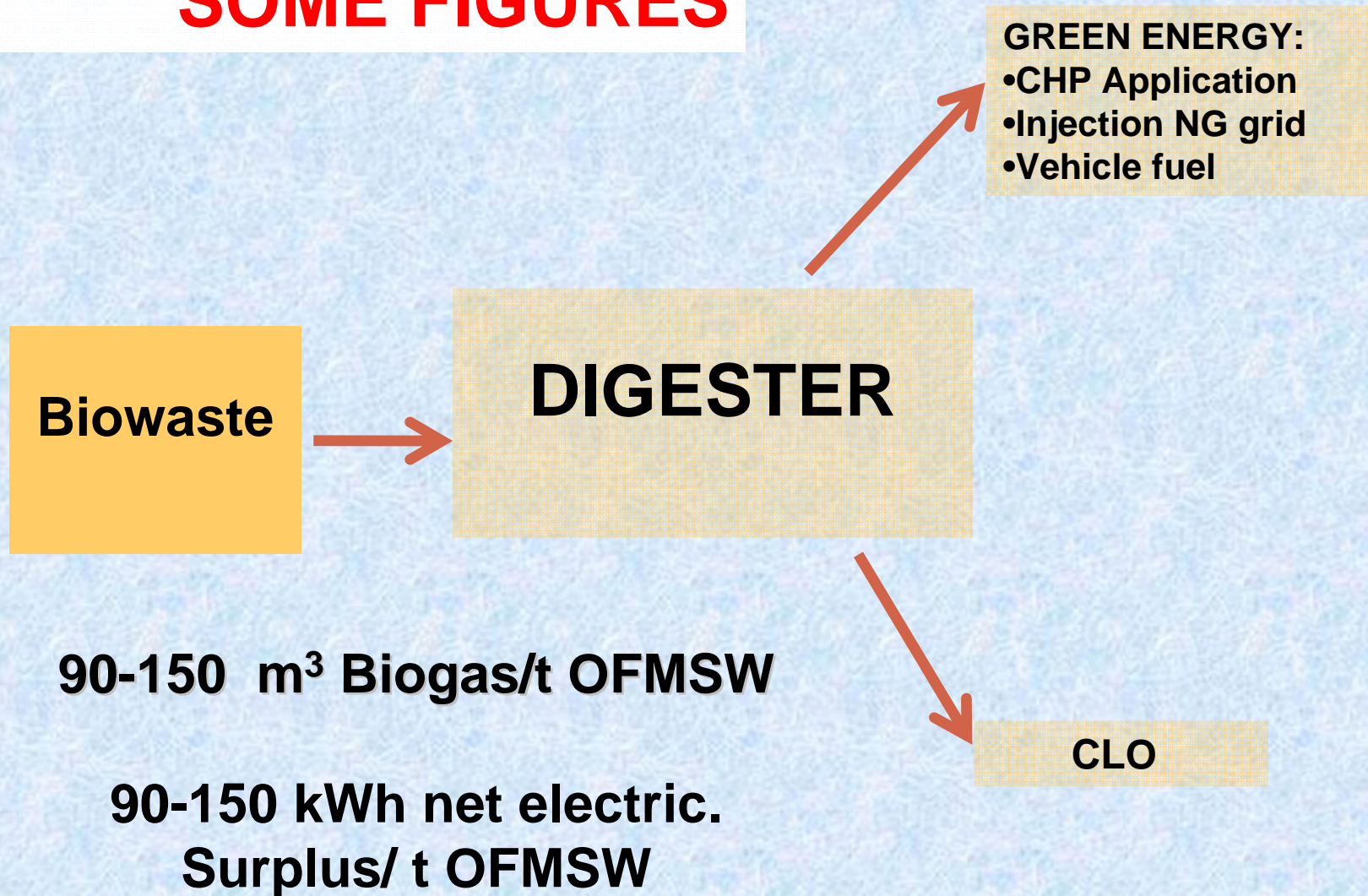


# Outline

- Introduction
- Technologies, approaches
- Objectives and trends in Europe
- Digesters for OFMSW
- Some historical data.
- Digesters for farms
- Co-digestion approach
- Some final remarks



## SOME FIGURES





# SOME FIGURES



**Biowaste**

**DIGESTER**

**GREEN ENERGY:**  
•CHP Application  
•Injection NG grid  
•Vehicle fuel

**1 m<sup>3</sup> Biogas: (60 % CH<sub>4</sub>)**  
**6 kWh**  
**1.1 kg CO<sub>2</sub> emm. savings**

**CLO**

**Soil appl.: Additional savings: ca. 3 kg CO<sub>2</sub> emm. savings**



## Advantages of compost or digestate soil application related to GHG savings and other

- C sequestration
- Peat and straw substitution (incl. transport)
- Fertilizer savings (incl. transport)
- Less irrigation requirements (better water and nutrient holding capacity)
- Better soil structure (porosity)
- Less possibilities of soil erosion



- **Technologies for AD and approaches**

# TECHNOLOGIES: Classification

SUBSTRATE FED	TEMPER.	USE OF BIOGAS	MODE OF OPERATION
Agricultural	Mesophilic	CHP	Batch
Industrial	Thermophilic	Grid Injection	Continuous
Municipal	Pyscrophilic	Vehicle Fuel	

FLOW PATTERN	NUMBER OF STEPS	SOLID CONTENTS	DIGESTATE TREATM.
Mixed	Single	Dry	No treat.
Plug flow	Two-steps	Wet	Composting



# Range of application

	Agricultural	Industrial	Municipal
<b>SOLID</b>	Wastes, crops	Agro-food industries	OFMSW
<b>SEMI –SOLID (SLURRIES)</b>	Manure slurries	Several industries	Sewage Sludge
<b>LIQUID</b>	Liquid manures	Several industries	Raw sewage

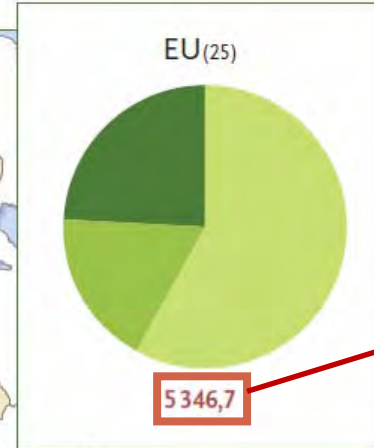
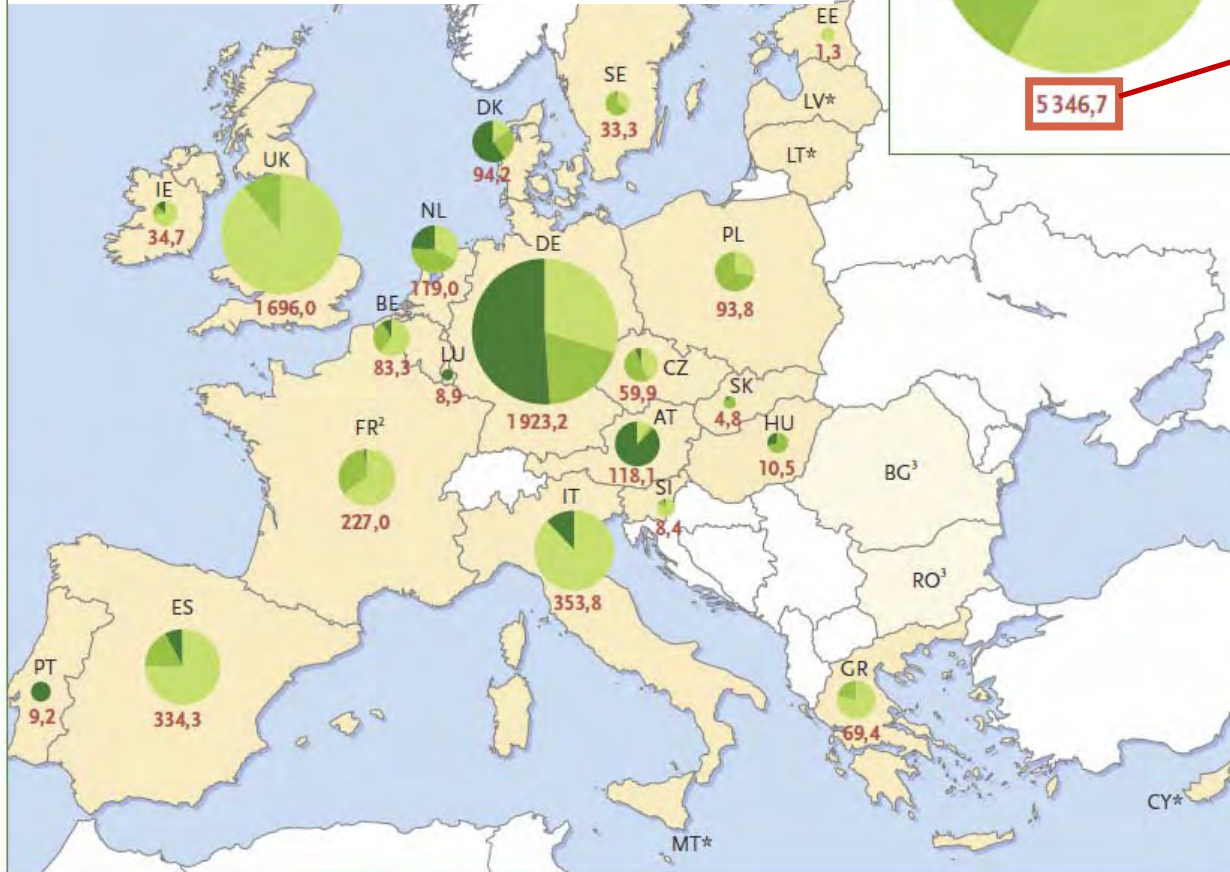


# Objectives and trends in Europe



PRODUCTION PRIMAIRE DE BIOGAZ EN EUROPE  
 PRIMARY PRODUCTION OF BIOGAS IN EUROPE

EurObserv'ER puts production at 8.2 Mtep in 2010 far to meet the European Commission's White paper targets (15 Mteps)

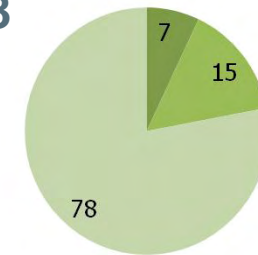


2006 Situtation

- Landfill gas
- SS gas
- Other

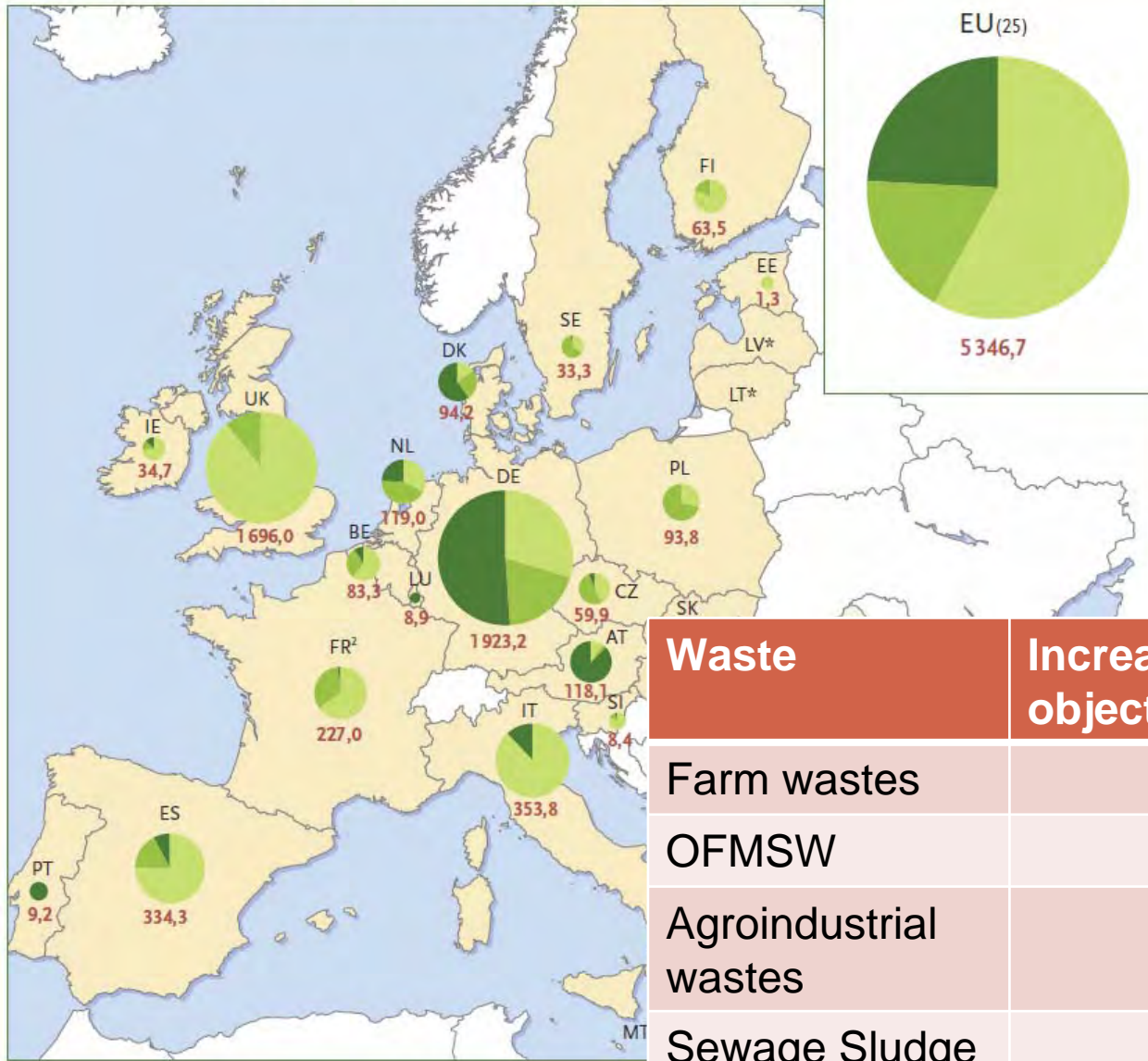
Europe  
 2008: 7,5 Mteps  
 Spain  
 2008: 0,475 Mtps

2008





PRODUCTION PRIMAIRE DE BIOGAZ EN EUROPE  
 PRIMARY PRODUCTION OF BIOGAS IN EUROPE



2006 Situtation



Waste	Increase objective (ktep)	Status (2009)
Farm wastes	8	OK
OFMSW	110	OK
Agroindustrial wastes	40	55%
Sewage Sludge	30	55%
<b>Total</b>	<b>188</b>	<b>75%</b>

# Objectives in Catalonia

Waste	Increase objective (Tep)
Farm wastes	8
OFMSW	110
Agroindustrial wastes	40
Sewage Sludge	300
<b>Total</b>	<b>188</b>

CCAA	Objetivo de incremento 2005-2010 (tep)
Andalucía	26.480
Aragón	6.487
Asturias	5.323
Baleares	8.100
Canarias	5.650
Cantabria	3.708
C-León	14.358
C-La Mancha	5.834
Cataluña	40.920
Extremadura	3.890
Galicia	6.817
Madrid	18.842
Murcia	13.472
Navarra	6.472
La Rioja	4.705
C.Valenciana	11.449
País Vasco	5.492
<b>TOTAL</b>	<b>188.000</b>

Fuente: IDAE

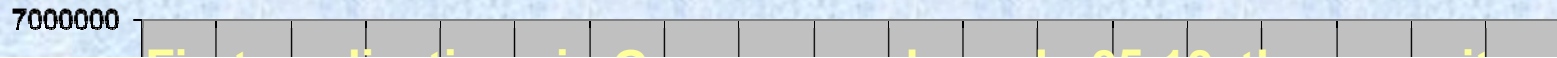
Catalonia: Generation 2007: 40.7 ktep  
 Objective 2016: 205 ktep  
 Presently 75%



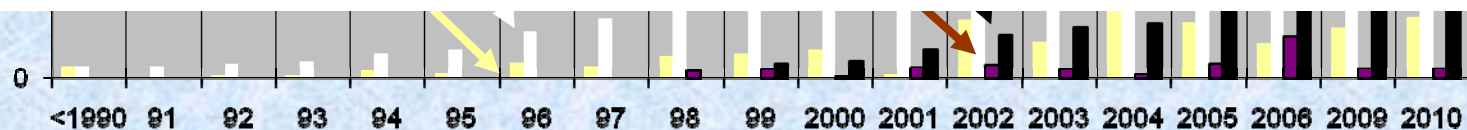
# Digesters for OFMSW

## Evolution of the installed capacity in Europe and Spain

### CAPACITY EVOLUTION



- The overall installed capacity of OFMSW – AD in Europe is around 6 million ton/year, **half of which are treating biowaste.**
- In Spain this figure is 1.4

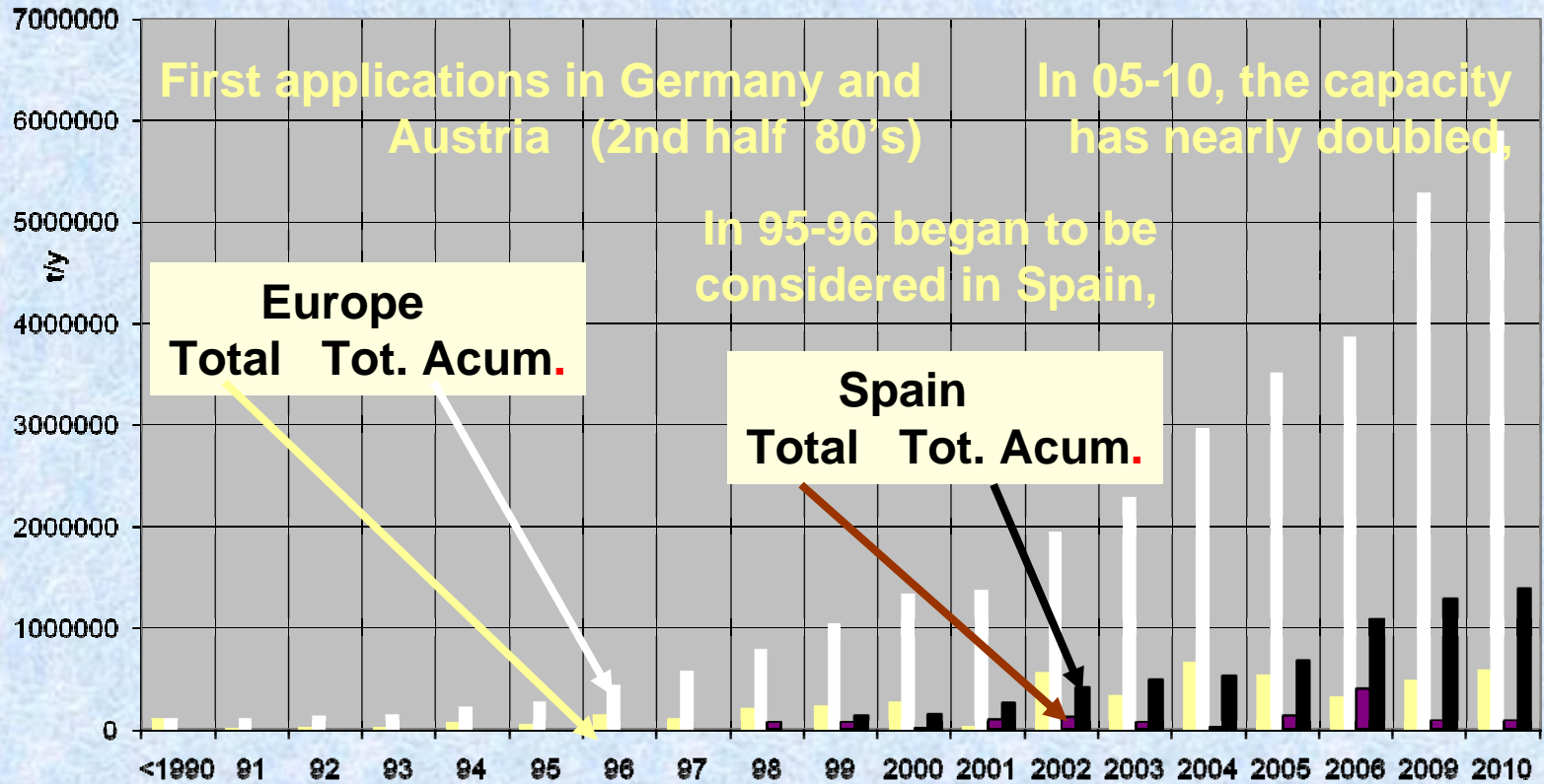


(De Baere, Wat. Sci.&Tech. 57 (7) 2008  
and own data)



# Evolution of the installed capacity in Europe and Spain

CAPACITY EVOLUTION



(De Baere, Wat. Sci &Tech. 57 (7) 2008 and own data)

## TECHNOLOGIES: Dry/Wet

- “Dry” technology is simpler (less pre-treatment and less water involved)
  - Recirculation is needed to assure adequate inoculation of the feed.
- 
- Presently, in Europe, more than 60% of the installed capacity is using “dry digestion”
  - The trend seems to be using dry technology.



**Coruña**  
70,000

**Avila**  
36,500

**Pinto**  
80,000

**Valdemingomez**  
160,000

**Salto del Negro**  
75,000

**Lanzarote**  
36,000

**Cadiz**  
115,000

**Jaen**  
20,000

**Valladolid**  
15,000

**Burgos**  
70,000

**Vitoria**  
20,000

**Logroño**  
75,000

**Pamplona**  
64,000

**Tudela**  
28,000

**Terrassa**  
20,000

**Ecoparc-1**  
140,000

**Ecoparc-2**  
80,000

**Ecoparc-3**  
90,000

**Mallorca**  
32,000

**Alicante**  
50,000

## OFMSW PLANTS IN SPAIN

**Brown: Dry Digestion**  
Black: Wet Digestion  
Capacity in t/y





Coruña  
70,000

Leon  
20,000

Valladolid  
15,000

Burgos  
70,000

Vitoria  
20,000

Logroño  
75,000

Pamplona  
64,000

Tudela  
28,000

Terrassa  
20,000

Avila  
36,000

• **WET TECHNOLOGY**

• 14 Plants:

• **DRY TECHNOLOGY**

• 9 Plantas

• **OVERALL INSTALLED CAPACITY:**

• 1,400.000 t/y (60% wet)

Salto del Negro  
75,000

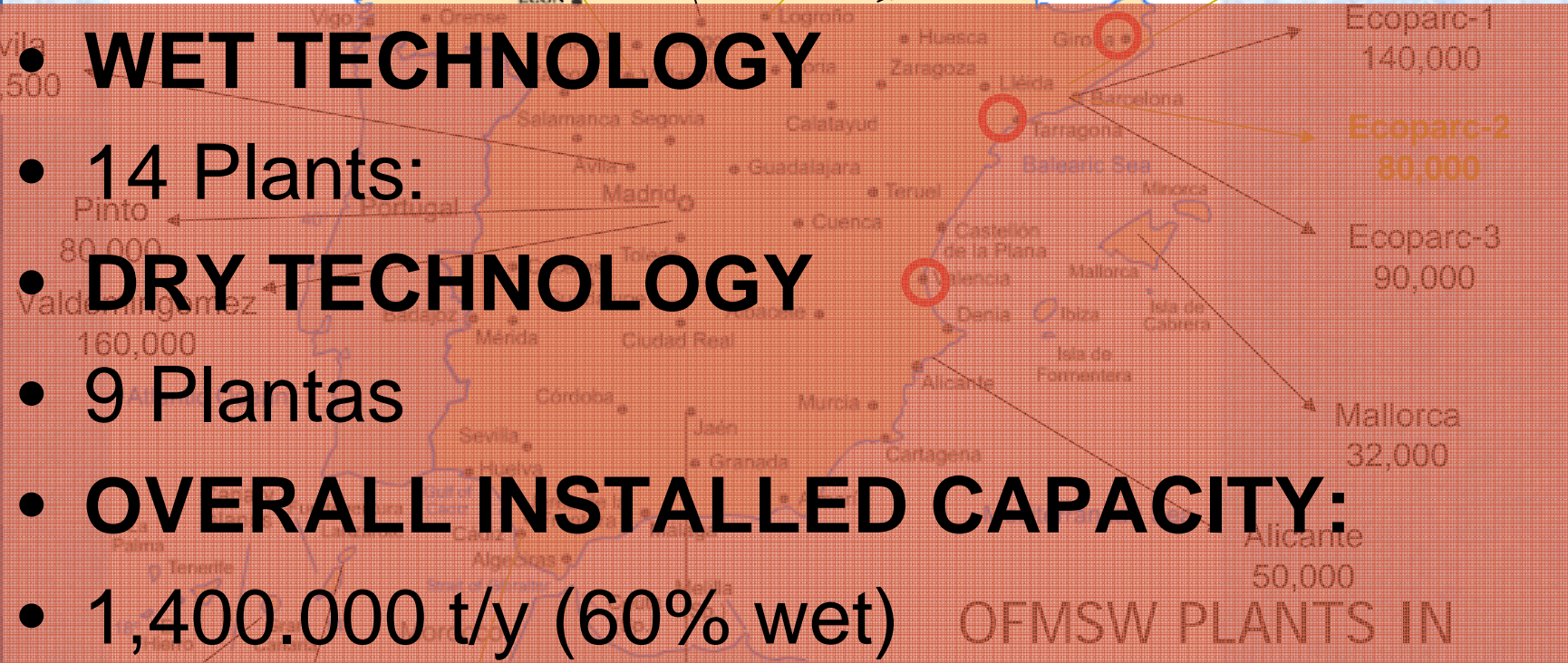
Lanzarote  
36,000

Cadiz  
115,000

Jaen  
20,000

OFMSW PLANTS IN SPAIN

**Brown:** Dry Digestion  
**Black:** Wet Digestion  
Capacity in t/y





- In Barcelona there are the 3 biggest plants



Ecoparc-1 de Barcelona, BTA

140,000 t/y



Ecoparc-2 de Montcada, Valorga

80,000 t/y



La adaptación del sistema Ros Roca al Ecoparc del Mediterrani.

90,000 t/y



# Digesters for Farms



# The codigestion approach



**Codigestion consists in the digestion of a mixture of two or more substrates with complementary characteristics so that to enhance biogas production.**

### **SUBSTRATE A**

- C/N Ratio
- Macro-micronutrients
- pH
- Alkalinity
- Inhibitors/toxic
- Biodegradable OM
- Water content

### **SUBSTRATE B**



## ANAEROBIC CO-DIGESTION

**Co-digestion is an interesting option for improving yield of anaerobic digestion of wastes.**

$$2 + 2 = 5$$

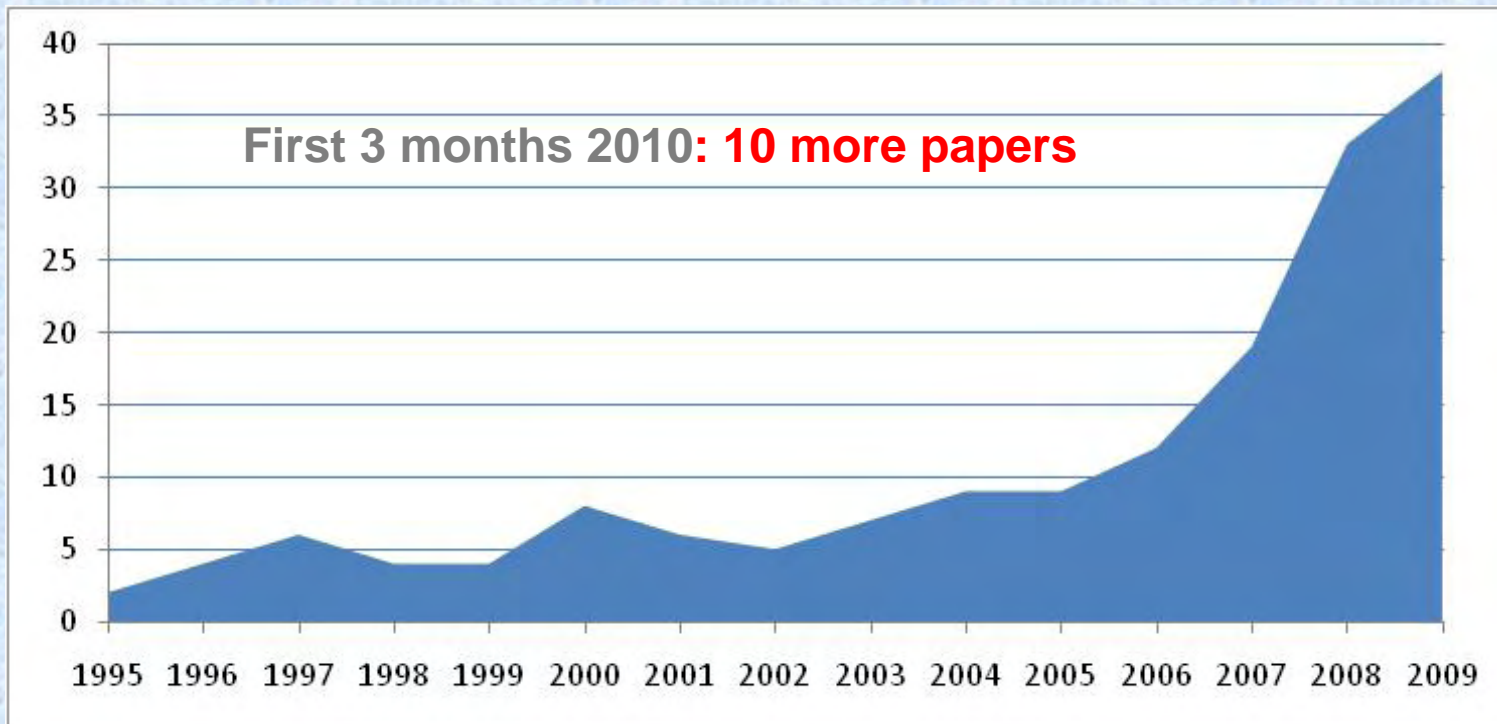
### **CO-DIGESTION:**

- **Positive synergisms established in the digestion medium.**
  - ✓ **The co-substrate supplies missing nutrients in the substrate.**
  - ✓ **Increase organic content inside the reactor**
  - ✓ **Enhance the digestate stabilization**
  - ✓ **Dilution of potential inhibitory and/or toxic compounds.**



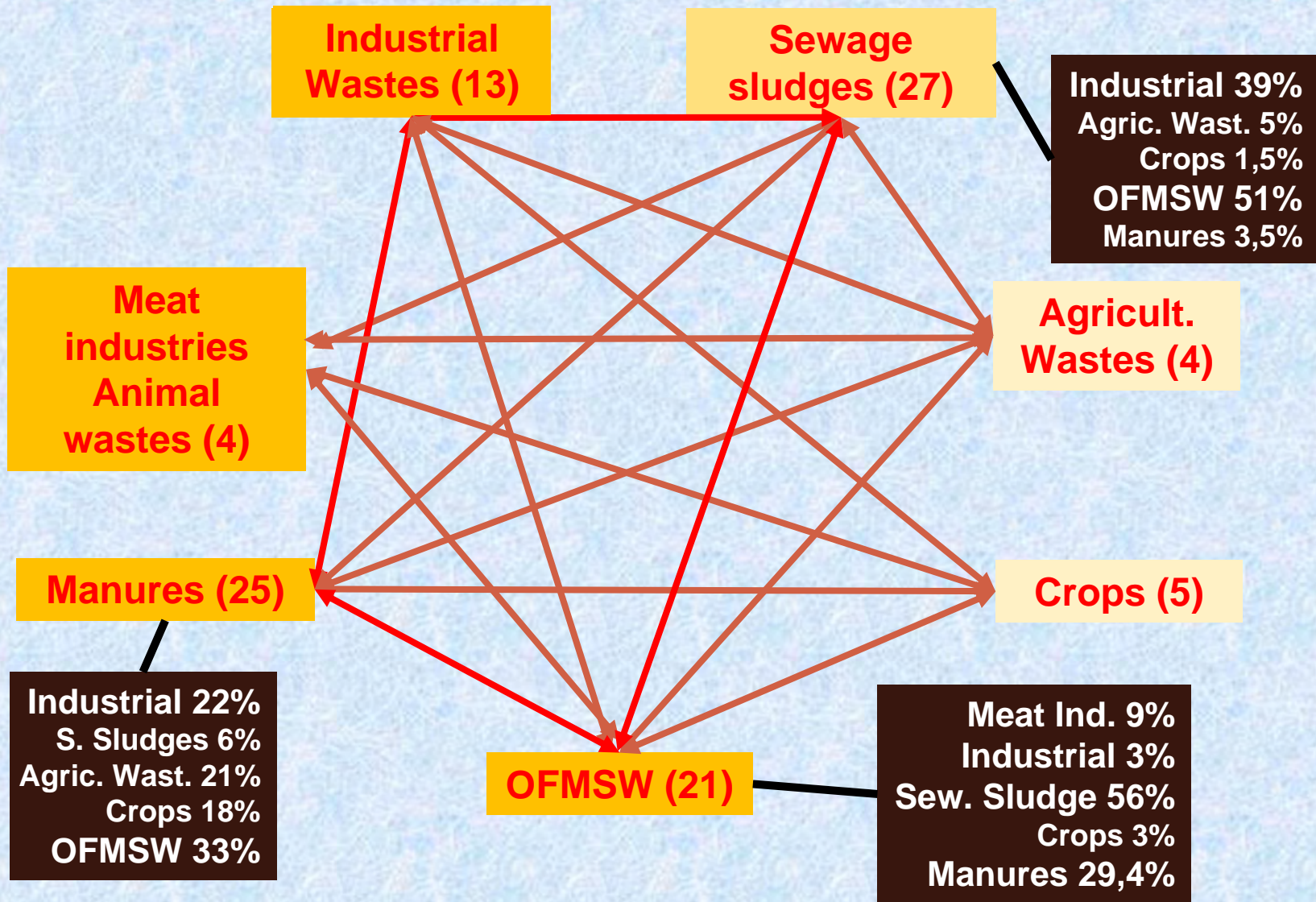
## CO-DIGESTION: Hot topic in AD

**Co-digestion: More than 40% of the papers dealing with co-digestion were published in 2008 and 2009.**



+ N

+ C



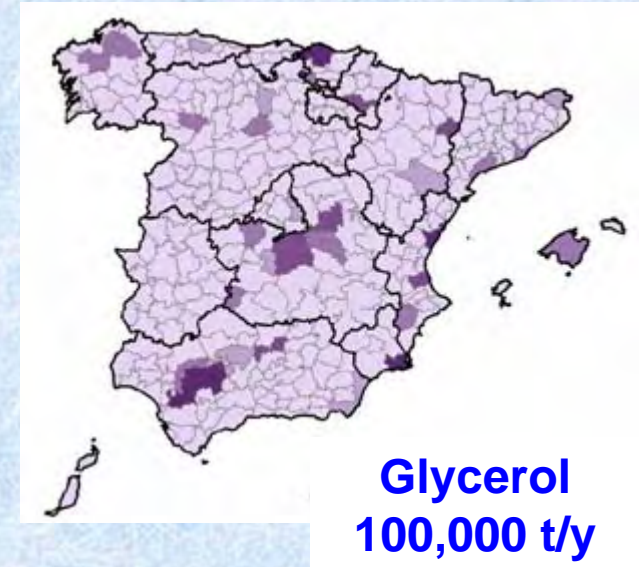
Percentage of 200 papers examined (%)



# Legal Framework

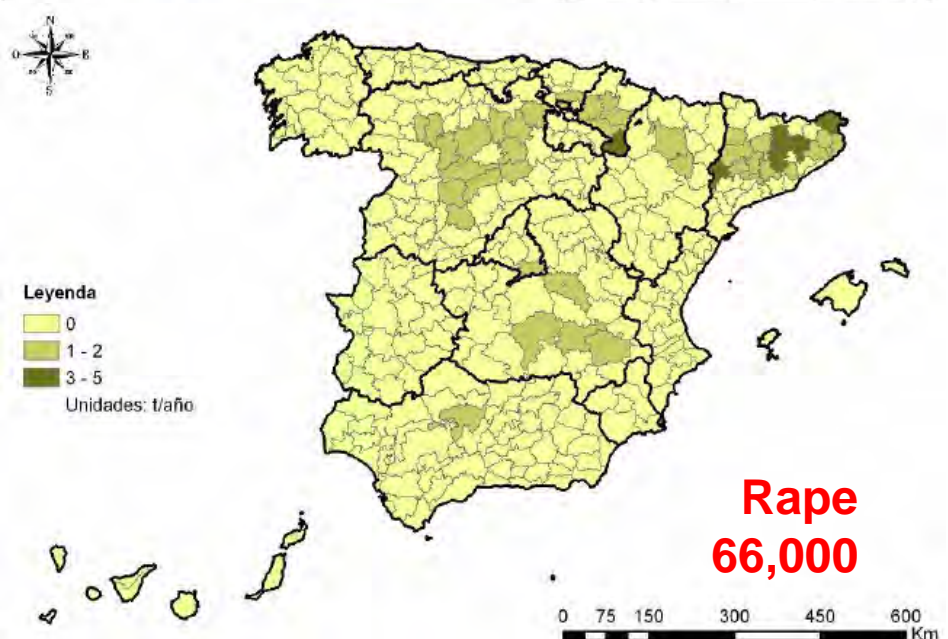
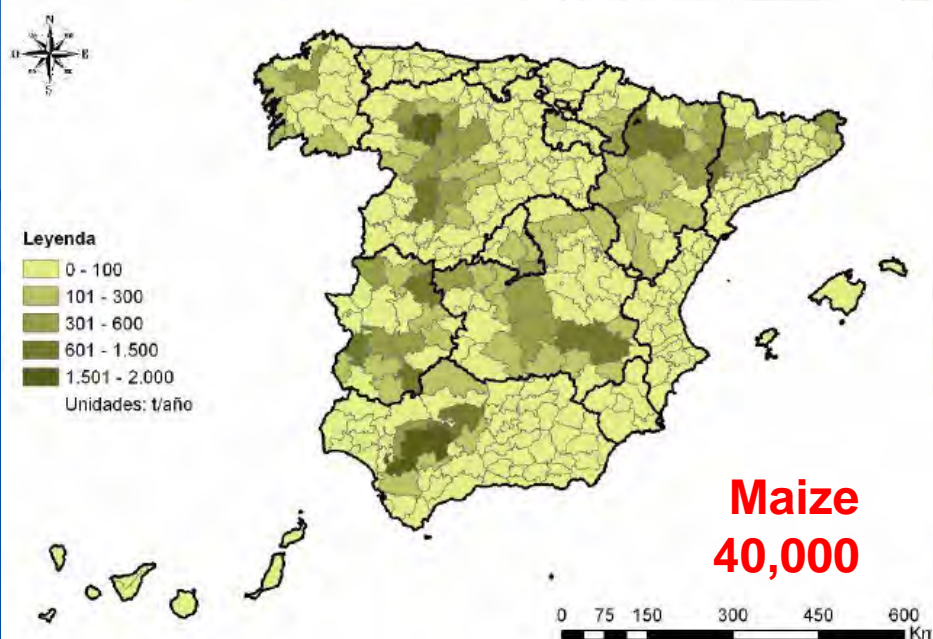
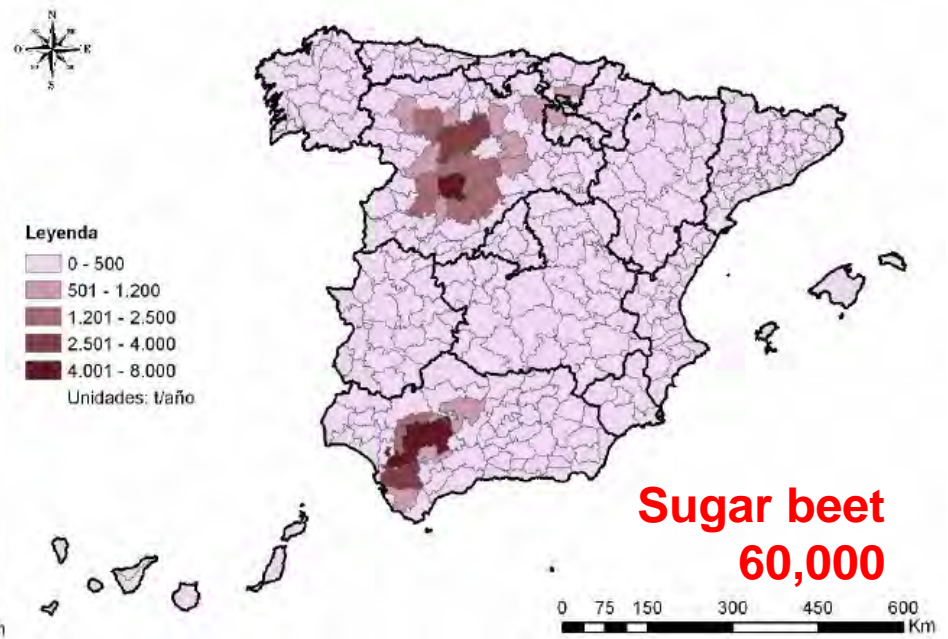
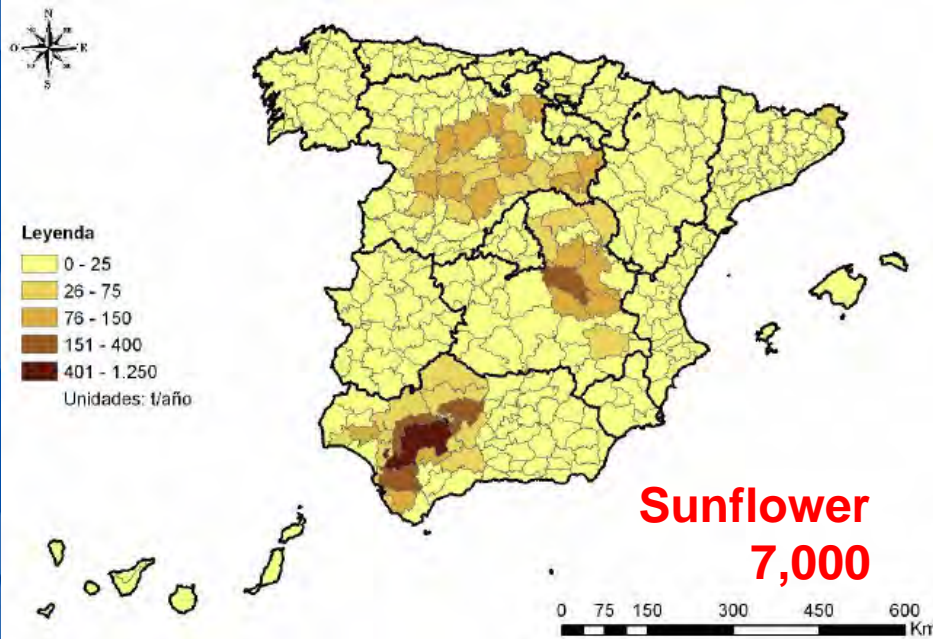
- Up to 2007, the development was centered mainly in AD plants treating OFMSW.
- RD 661/2007 established a fee of 13,95 c€/kWh, for installed power < 500 kW
- Investment can obtain subsidies up to 25% (Industry and Energy dept.)







# ENERGY CROPS IN SPAIN: t/year (Ainia, 2009)







**In Spain**  
**Digesters: 22**  
**Treating aproxim.**  
**1,450,000 t/y**



**In Catalonia**  
**Digesters : 9**  
**Treating aproxim.**  
**410,000 t/y**



# Farm digesters in Spain

Location	Region	Volume m <sup>3</sup>	Substrates	Flow rate (t/y)
Consuegra (centralized)	Toledo	2x3000	Pig manure / others	100,000
Polán (centralized)	Toledo	2x3000	Pig manure / others	100,000
Zaidín (centralized)	Aragón	2x2500	Pig manure / others	100,000
Granja San Ramón	Valencia	2x1200	Pig manure and Orange waste	70,000
Picassent	Valencia	2x1360	Pig manure and fruit waste	90,000
Capella	Aragón	2X1360	Pig manure / others	35,000
Valderrobres	Aragón	2X2000	Pig manure / others	70,000

# Farm digesters in Catalonia

Location	Volume m <sup>3</sup>	Susbtrates	Flow rate (t/y)	CHP Power
Vilasana	2x1360	Pig manure / others	15,000	230 kW
Montagull	2x1360	Pig manure / others	25,500	350 kW
Sant Esteve Guialbes	2100+1400	Cow manure / others	19,000	310 kW
Cassa de la Selva	1900+1400	Pig manure / others	20,500	360 kW
Torregrossa	2x1060	Pig manure / others	12,350	190 kW
Os de Balaguer	3x1200	Pig manure / others	16,750	360 kW
Juneda I (centralized)	2x3000	Pig manure / others	150,000	1,33 MW
Juneda II (centralized)	2x3000	Pig manure / others	150,000	1.33 MW

**Overall installed power: 975 kW**



# Digesters for Farms

## SANT ESTEVE DE GUIALBES

- Farm with 650 cows
- 12,500 t/y manures
- 5,700 organic wastes
- 2100 + 1400 m<sup>3</sup>
- CHP: 320 kW
- Absortion Engines to generate cold air.





## Some final remarks

- AD is **a mature technology** for treating biowaste, after almost 30 years of experiences.
- Similar to other technologies, plants shows economical and or operational problems
- Even the drawbacks related to higher investment costs, **AD is a growing technology in all its applications**, due to its advantages related to energy and GHG emission issues



- Regarding technologies related to OFMSW no general rules can be given, as each case has its optimal approach.
- **Mesophilic is the preferred range**, even the advantages of thermophilic range. Heat transmission problems can be a reason for its use in residual waste.
- Attention should be paid to the opportunities posed by **codigestion to reduce costs and emissions**.



- There is a large number of over-dimensioned agricultural as well as **WWTP digesters that can be improved** with a very low investment by the co-digestion option. **The ROI period is usually low** and with the energy /climate change the perspectives seems to be good.
- Co-digestion offers also a large potential also for BNR in WWTP



Vilen danke fürs Zuhören!

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