

# Escalado industrial de la generación de biogás en Castilla y León

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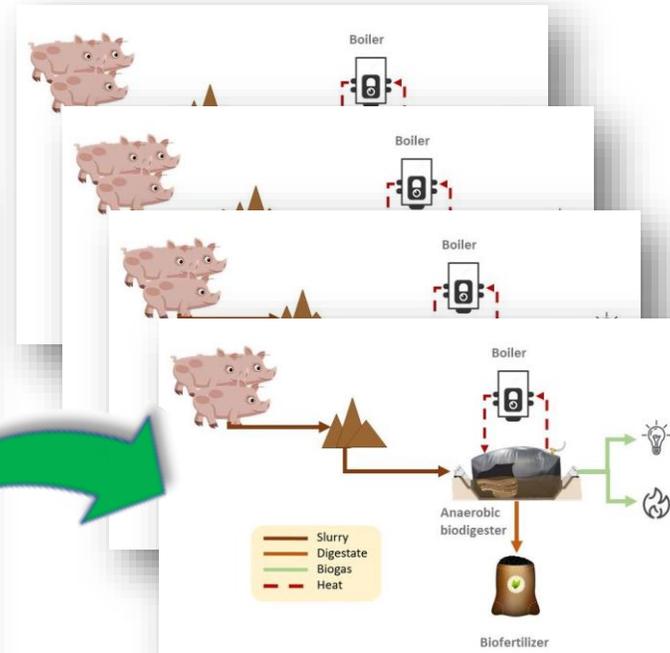
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- Punto de partida
- Ubicación del potencial energético
- Metodología
- Resultados
- ¿Y si se hace codigestión?
- Conclusiones





**applied sciences** 

Article

## A Distributed Biogas Production Model and Its Use in the Livestock Sector. Case Study: Castile and León

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**Abstract:** The population increase and the food demand increase the fight against climate change. Porcine production in Europe continues to increase, and Spain is the leading country in pig production. Manure management has a significant environmental impact that requires anaerobic digestion technologies for its mitigation. This technology helps produce biogas, a fuel that will reduce CO<sub>2</sub> emissions. This study defines a distributed biogas generation model, determining the expected incomes from the development of this technology in small manure generation facilities (digestible organic waste). The development of this technology will contribute to reduce the demand for fossil energy and increase revenues by 22.7% regarding the expected revenues from the use of biogas for electricity generation.

**Keywords:** climate change; anaerobic digestion; biogas production; sustainable energy; economic model

**1. Introduction**

In the last decades, the world population has increased constantly, reaching 7.8 billion people in 2020, even though the growth rate has decreased by 1% yearly in the last few years [1]. Europe is the third most populated region on the planet, after Asia and Africa, also showing a constant population increase [2], and it is foreseen that this pattern will remain until 2050 [2]. Furthermore, the European society is quickly turning into an aged society [3] and mostly metropolitan, with 74.73% of its population living in large cities [4]. The population growth matches the need to reduce greenhouse gas emissions and, thus, help fight climate change. With a CO<sub>2</sub> concentration in the atmosphere of 416 ppm [5] and a thermal anomaly in the atmosphere that reaches +0.99 °C [6], the use of renewable energy sources is a necessity, including the improvement of the efficiency, the capture, and the geological storage of CO<sub>2</sub>.

This shaping of the population makes it necessary to change the food chain production, for example, the production of meat from farm animals, ensuring access to a wide range of food. Spain is the country with the highest animal production in the European Union [7], with pigs being the most important group. In Spain, as well as in other countries, the tendency to farm livestock in the last years has led to the specialisation and concentration, which has meant a decrease in the number of farms but an increase in the average number of animals per farm [8,9]. This industrial model entails a series of environmental impacts, where manure is considered among the most relevant [10]. The management of this waste has an importance similar to any other phase of the commodity chain and is considered a principal factor of the success of the efficiency management [11]. In Spain, it is estimated that the production of this waste reaches 50 million tonnes annually [12].

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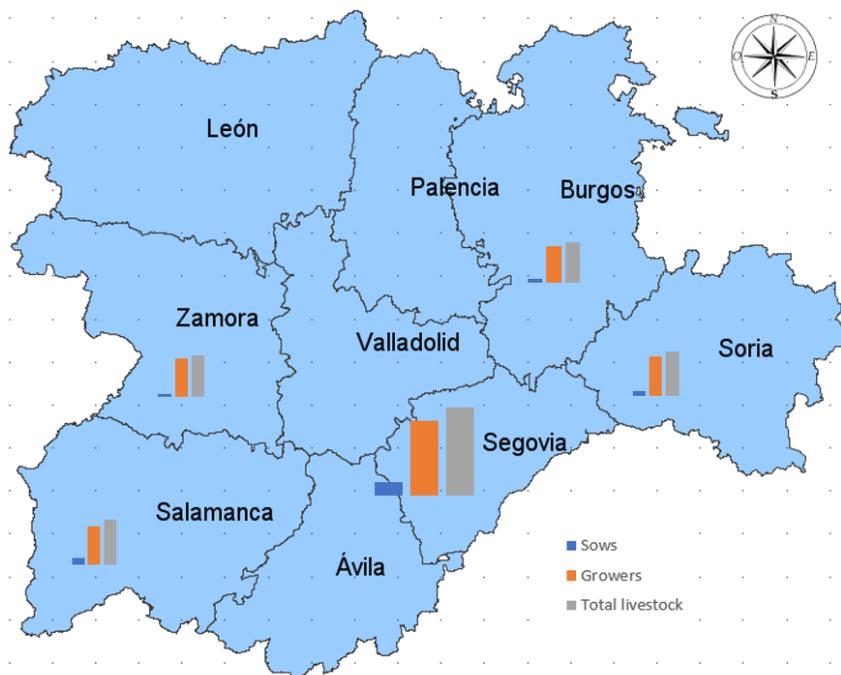
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# Ubicación del potencial energético



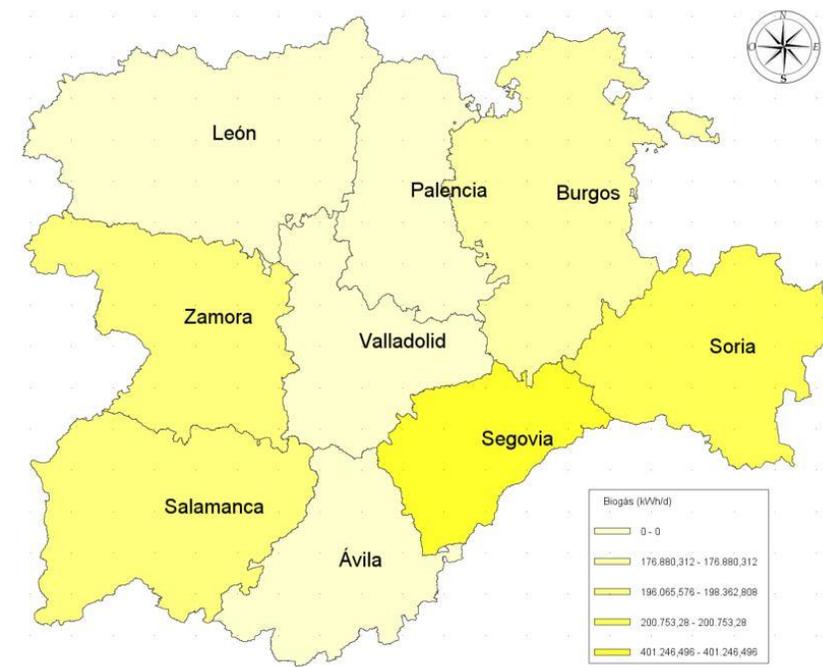
	Sows	Growers	Total livestock
Segovia	118.337	677.787	799.124
Soria	41.884	356.436	398.320
Salamanca	57.026	336.551	393.577
Zamora	30.567	358.452	389.019
Burgos	35.441	315.512	350.953

- Censo porcino
- Poder calorífico del biogás
- Producción biogás (LIFE SMART AgroMobility)



Biogás (kWh/d)

Segovia	401.246
Soria	200.753
Salamanca	198.363
Zamora	196.066
Burgos	176.880



## gvSIG

Capas vectoriales

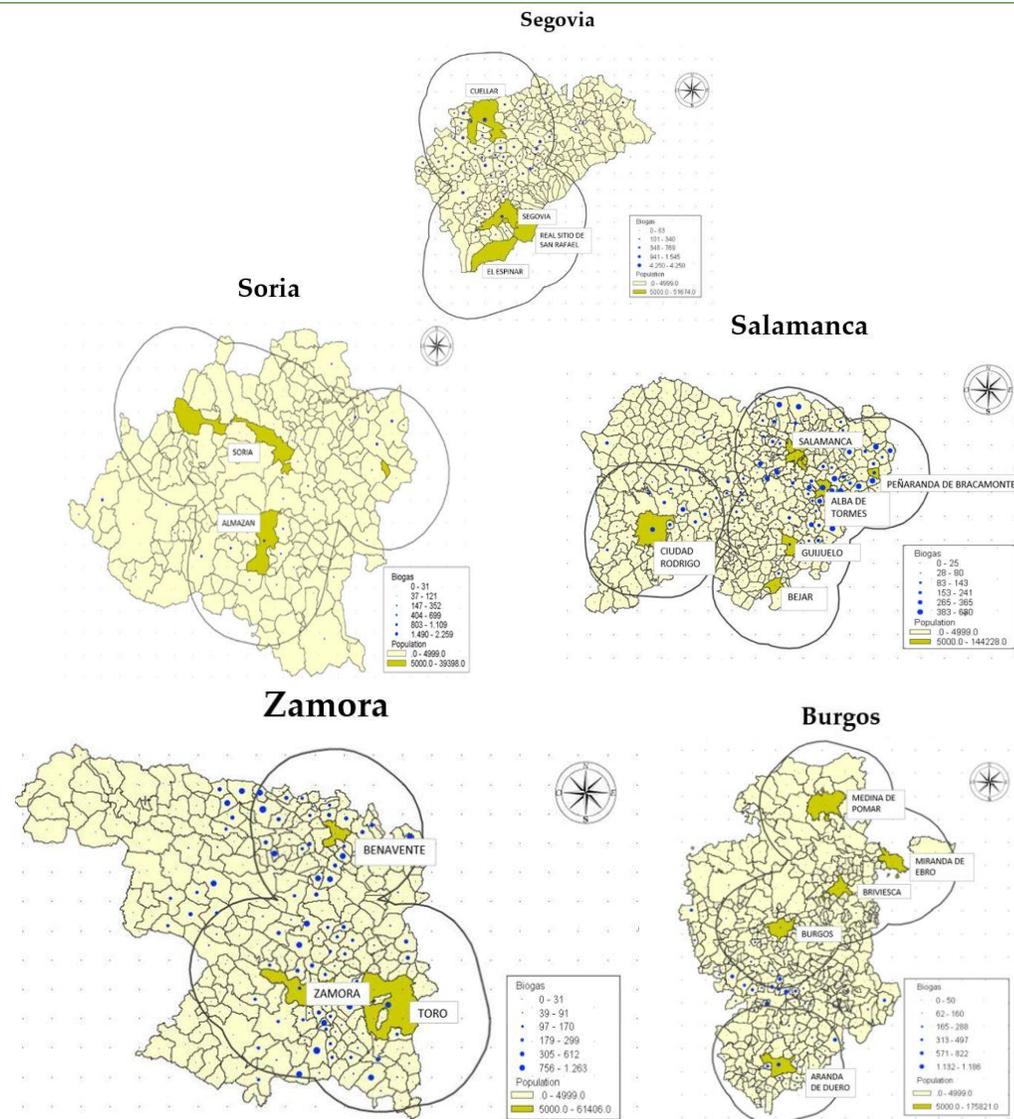
- Producción de biogás
- Censo poblacional

Selección

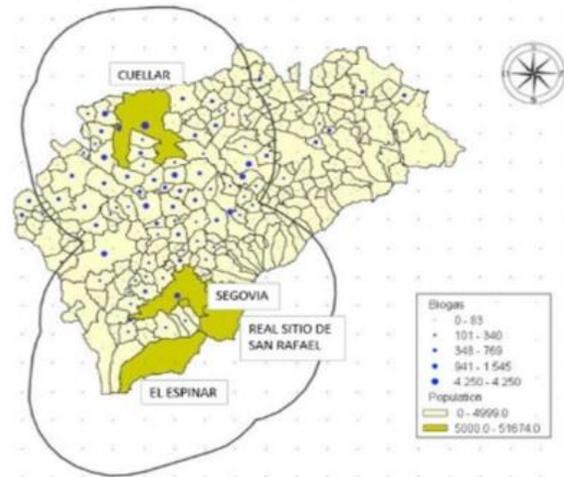
- Mayor producción de biogás
- Términos municipales

Áreas de influencia

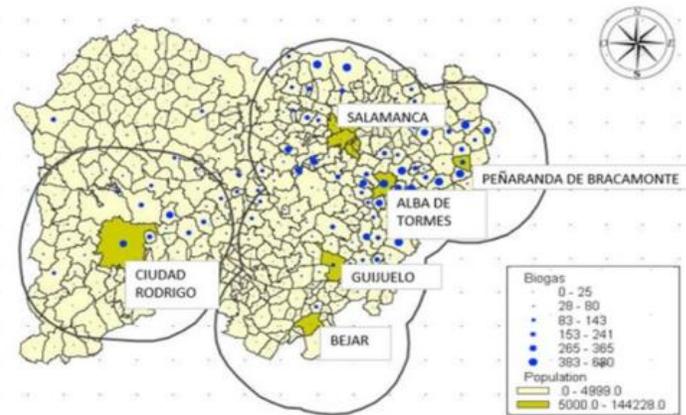
- Perimetrales a los términos municipales



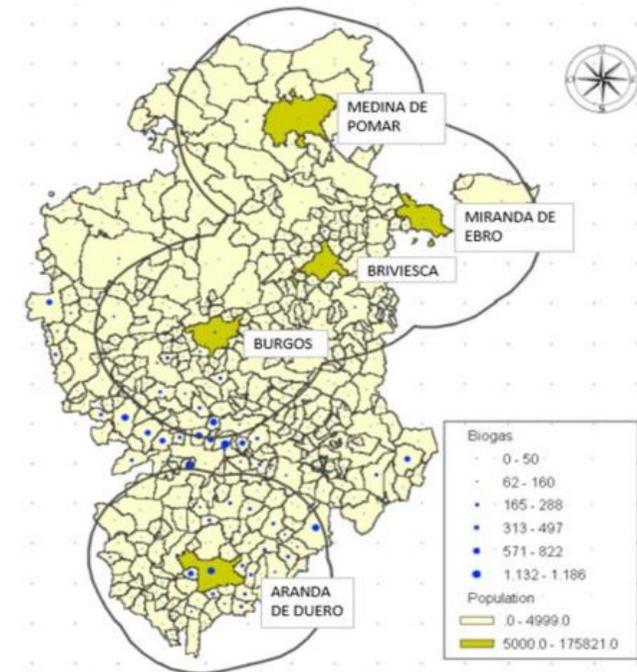
## Segovia



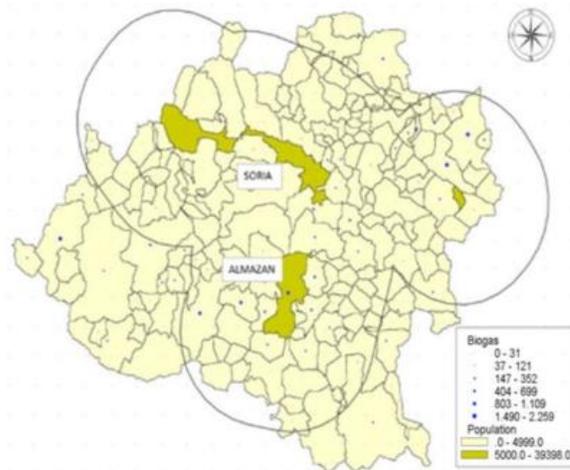
## Salamanca



## Burgos



## Soria

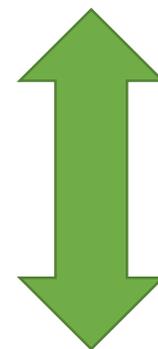


## Zamora



Energía cubierta	Ingresos	CO <sub>2</sub> evitado
Cuéllar: 209,2 %	Venta biogás:	52.339,54 t
Almazán: 92,2 %	8.627.396,55 €	
Alba de Tormes: 80,1 %	CO <sub>2</sub> : 1.958.022,16 €	
Peñaranda de Bracamonte: 50,8 %		

Precio del gas: 0,03 €/año  
Coste CO<sub>2</sub>: 37,41 €/t



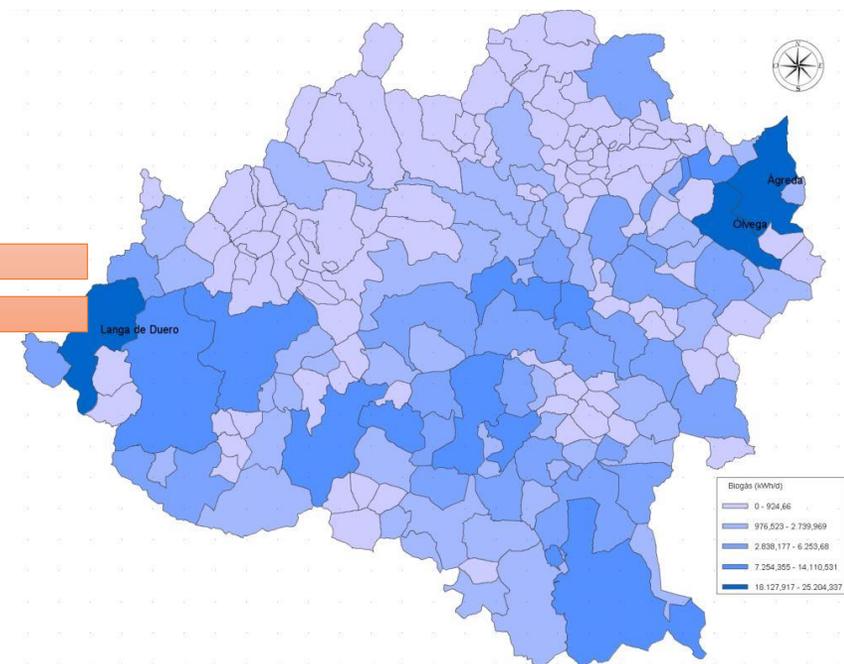
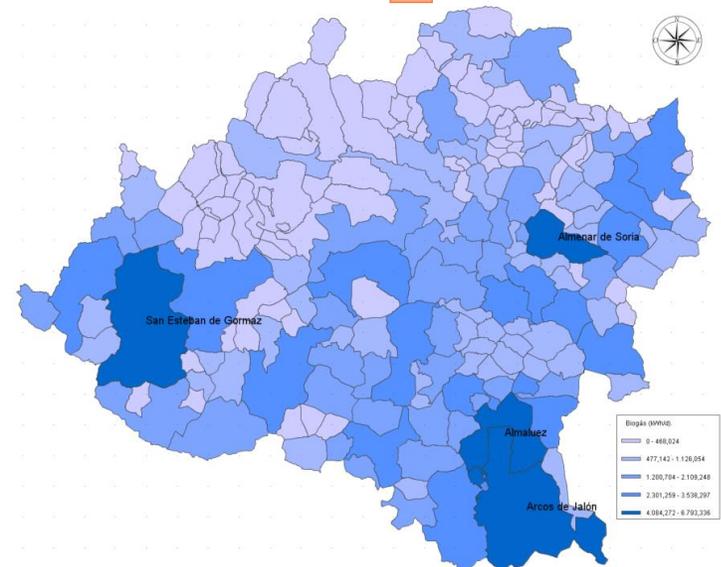
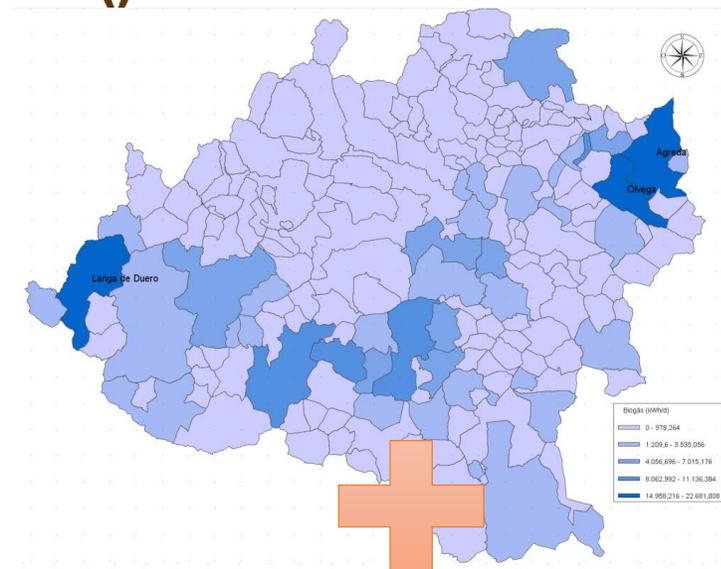
Precio del gas: 0,06 €/año  
Coste CO<sub>2</sub>: 59,58 €/t

## Ingresos

Venta biogás:  
17.254.793,10 €  
CO<sub>2</sub>: 3.118.389,74 €

# ¿Y si se hace codigestión?

## Soria



### Ganado porcino

- Poder calorífico: 6,3 kWh/m<sup>3</sup>

### Cultivos

- 1.000 kg/ha y disponibilidad del 15%
- Factor de producción: 0,3 m<sup>3</sup>/kg

	Ganado	Cultivos	Total
	54,6 %	45,4 %	100 %
kWh/d	200.753	166.865	367.649

- Posibilidad de escalado industrial.
- Alto potencial de biomasa y energético en Castilla y León.
- Producción de energía por medio de un sistema de bajo coste.
- Se cubre buena parte de la demanda energética de varios municipios.
- Reemplazo de combustibles fósiles por combustibles de origen renovable.
- Reducción de emisiones de Gases de Efecto Invernadero.
- Creación de puestos de trabajo.



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