



**Biogas**  
**cogeneration in a Waster Treatment Plant**  
**Madrona (Segovia) in Spain**  
**Council of Segovia & EREN**  
Covenant EREN and Segovia Council

The process starts with the generation of sludge from the purification of wastewater. The sludge is dived in an anaerobic digester (HETAMIX). The digester system makes a heating of the sludge without oxygen, with a controlled injection of the generated biogas, and the pressure.

In the digester process takes part the digester, 3 exchanges-agitators, where the heating of the sludge is made by one hand through hot water with 60-80°C and by the other hand through the injection of biogas. The hot water is produced from two 525 kWt boilers adapted to work with mixed-burner biogas or fuel-oil. Because of the burner is not modulating, the only regulation is the switch-on and switch-off of the boiler-burner.

The generated biogas, once is cooled through a heating exchange system fed with water, is injected partially in the digester using a compressor (with another in stock). The remaining biogas is used for the heating boilers used to produce water during the digestion process. In order to get the adequate pressure of the biogas in the entrance to the boilers supply is used a fan (with another in stock).

The non consumed biogas from the boilers, is storage in a gasmeter with a capacity of 400 m<sup>3</sup>, where the pressure is 20 mbr. When the capacity of the gasmeter is 100%, automatically is burned in a torch.

All the generated electricity is consumed by the plant. There is no electricity connection to the net. Neither there is biogas generated connected to the grid.

This initiate comes because in the beginning of the waste Treatment System had any biogas use. Currently the annual saving thanks to the cogeneration with the biogas reach 35,638 € per year.

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Photo: EREN

## key data

|   |   |
|---|---|
| Start of Operation .....                  | <b>2003</b>                             |
| Start of Operation of EDAR.....           | <b>1996</b>                             |
| Type of corporation.....                  | <b>Council of Segovia &amp; EREN.</b>   |
| Amount of gas produced <sup>1</sup> ..... | <b>740,800 Nm<sup>3</sup>/ per year</b> |
| Investment costs .....                    | <b>214,160 €</b>                        |
| Equivalent population of WWTP.....        | <b>125 000 hab. eq.</b>                 |
| Population.....                           | <b>14 800 hab. eq</b>                   |
| WWTP flow .....                           | <b>4 400 m<sup>3</sup>/day</b>          |

## feedstock

|  |                      |
|--|----------------------|
| Sludge from a Water Treatment Plant..... | <b>14 234 kg/day</b> |
|--|----------------------|

<sup>1</sup> note: there is any equipment for register the quantity of produced biogas. The calculation is made with the consumption on the boilers and in the torch

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# Biogas Regions Shining Example



Origin: Directly from the Water Treatment Plant.

Any cost for the use of the sludge to produce biogas.

## production data

|  |   |
|--|---|
| Available area for the output of the biogas fertilizer .....           | <b>112 ha</b>   |
| Gas Flow.....  | <b>100 Nm<sup>3</sup>/h</b>   |
| Thermal power rating of the gas engine .....                           | <b>207 kW</b>   |
| Generated thermal energy.....  | <b>3 201 893 kWh per year</b>   |
| Utilisation of heat .....  | <b>For increase the heating temperature of the own process of the digester, in the Water Treatment Plant.</b> |
| Electric power rating of the gas engine .....                          | <b>2 x 500 kW</b>   |
| Generated electric energy .....  | <b>1 197 000 kWh per day</b>  |
| Power consumption (electricity) of the plant itself .....              | <b>171 000 kWh per year</b>   |
| Annual delivery of electricity to the (regional) electric grid company | <b>0 kWh per year</b>   |

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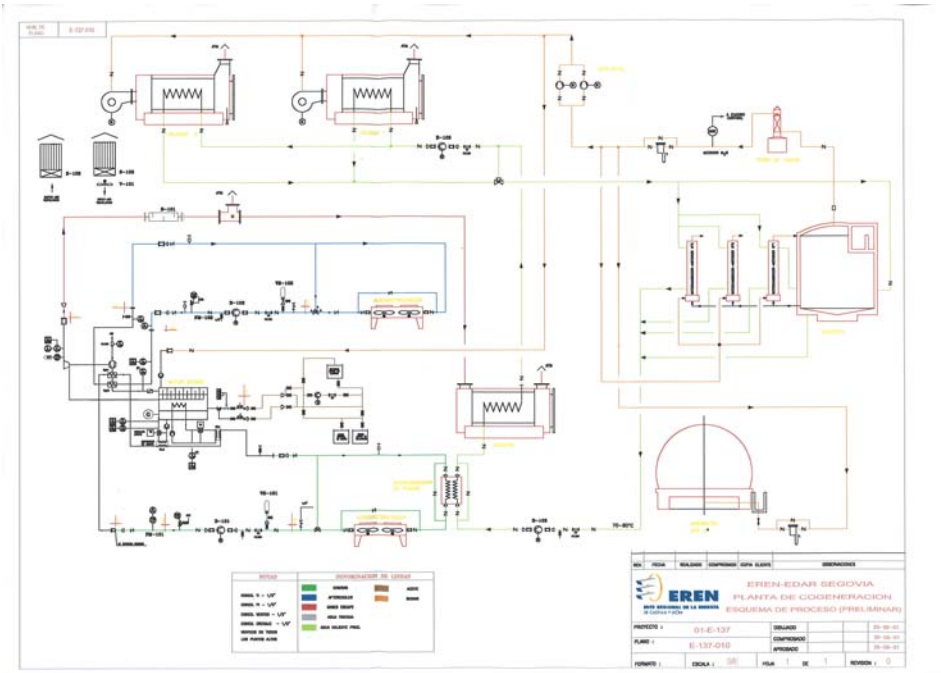


Photo: EREN

## technical plant description

|  |                            |
|--|----------------------------|
| Digester .....   | <b>3 000 m<sup>3</sup></b> |
| Gas storage tank .....                                     | <b>400 m<sup>3</sup></b>   |
| (double membrane)  |                            |
| Mixing vessel co-enzymes .....                             | <b>60 m<sup>3</sup></b>    |
| Residence time in the digester .....                       | <b>~ 30 days</b>           |
| Temperature of the anaerobic digestion (operational) ..... | <b>36.5-37.5 °C</b>        |
| Average expenditure of human labour .....                  | <b>2.5 hours per day</b>   |
| Total in the Waste Water Treatment Plant .....             | <b>14 hours per day</b>    |

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