

---

## Green power from landfill gas with low methane content

Jörgen Held<sup>1</sup>, Ole Elmo<sup>2</sup> and Azhar Shah<sup>2</sup>

<sup>1</sup> Baltic Energy Innovation Centre, Skarpskyttev. 10D, 226 42 Lund, SWEDEN

<sup>2</sup> Deponigas ApS, Esby Strandvej 1, 8420 Knebel, DENMARK

---

### 1. Background

In Sweden, there is a ban to landfill organic material since 1 January 2005. As the landfill gas production decreases, due to no new organic material being added, and the methane content drops below about 40%, the energy content of the landfill gas is insufficient to drive conventional gas engines that work according to the Otto principle (spark ignition)

In Denmark, Deponigas ApS, has developed a new technology, based on the Diesel principle, where landfill gas with methane contents down to 10-15% is sucked into the engine and a small proportion of diesel is used as pilot fuel for the ignition. An important aspect of dual fuel technology due to fluctuating methane content is the reliable operation results achieved. This is important for remote control operation mode. In Sweden, there is an interest to use a renewable fuel as pilot fuel for the ignition, e.g. RME (rapeseed methyl ester), HVO (hydrogenated vegetable oils) and pyrolysis oil.

### 2. Pre-study

The Regional Council of Skåne granted Baltic Energy Innovation Centre funding to perform a pre-study of dual fuel engines for green power production from landfill gas with low and varying methane content under Swedish conditions. The project partners are NSR AB, Avfall Sverige and Deponigas ApS, Denmark.

### 3. Objectives

The three main objectives of the project are as follows:

- 1) Perform a feasibility study in which dual fuel engines with landfill gas with low (<40%) and varying methane content, and a renewable pilot fuel are investigated under Swedish conditions.
- 2) Organize a study tour to some of the landfills in Denmark, where Deponigas ApS is operating dual fuel engines.
- 3) Prepare an application for public co-funding, related to lab scale engine tests at Lund University with model gas and a renewable fuel as pilot fuel, and a pilot installation at one of NSR AB:s landfills in Skåne, Sweden.



*Figure 1. Dual fuel engine at Hedeland, Denmark, using landfill gas as main fuel and diesel as pilot fuel.*

*Photo: Jörgen Held*

#### 4. Research questions

From an economic and environmental point of view, it is of important to minimise the share of expensive pilot fuel and optimise the power output originating from the landfill gas. Deponigas ApS is currently operating 9 dual fuel engines at different landfill sites in Denmark. Their experience is that roughly 10-15% of the energy input originates from the pilot fuel. However, none of these engines are equipped with a common rail injection system. For engines without a common rail injection system, the lower limiting factor of the amount of pilot fuel injected into the engine, seems to be related to the need for cooling of the injectors and to achieve a good combustion.

A common rail injection system gives a better control of the combustion, and it is expected that the amount of pilot fuel can be further decreased.

The lab scale tests, foreseen in the next step of the project, will be used to span the operational window regarding the share of pilot fuel needed for stable operation. Different renewable fuels as pilot fuel will be tested.

Another aspect, in the pursue of minimizing the share of pilot fuel, is the size of the engine. The bigger the engine, the less share of pilot fuel is needed. This implies that it could be beneficial to operate an engine twice as big, half of the time compared to an engine running continuously.

A third consideration is the use of pyrolysis oil as pilot fuel. Pyrolysis oil is not a well-defined fuel, and the heating value is lower than that of RME or HVO.

#### 5. Discussion

There are many closed landfills in Europe and elsewhere, where methane emissions

are released to the atmosphere. Even with passive bio-covers, release of small amounts of harmful methane emissions is expected. In this case the dual fuel technology opens a possibility to continue extract methane, despite decreasing methane content in the landfill gas, and use it for green power production for the benefit of the environment.

The EU Methane Strategy [1] emphasizes the need for improved waste management and actions to minimise methane emissions, and the interest in solutions, such as dual fuel engines, is expected to increase.

#### 6. Acknowledgement

The public co-funding by the Regional Council of Skåne is highly appreciated.

#### 7. References

- [1] COM(2020) 663. European Commission. [https://ec.europa.eu/energy/sites/ener/files/eu\\_methane\\_strategy.pdf](https://ec.europa.eu/energy/sites/ener/files/eu_methane_strategy.pdf)  
Accessed 23 February 2022.