D.T2.1.1 REASONS/CONDITIONS LEADING TO THE CHOICE OF THE 5 PILOTS

Czech Republic

16/07/2018

1. Objective of the task:

In DT2.3.1, the pilot locations were selected. The main objective of this deliverable (D.T.2.1.1) is to identify the leading reasons for selecting the pilot locations, in this case the WWTP in Prague.

The deliverable draws on four deliverables finalised in Work Package 1.

- D.T1.2.1: Base line analysis of the current situation in the targeted utility companies/ territories
- D.T1.2.2: Relevant models highlighting integration and combination of technologies
- D.T1.2.3: Guiding document to demonstrate the benefits of implementation of REEF 2W plants
- D.T1.4.1: Detailed description of the methodology and criteria for location suitability

The deliverable is divided into three parts. First, an overview is provided about the initial situation at Central Prague WWTP (PCWTP), including the technological setup and its suitability. This is followed by an overview of the planned technological upgrade in the context of Reef2 W and the benefits accruing from it. The last part analyses the leading conditions including socio-economic and institutional aspects that qualified the WWTP for selection in Reef2W

2. Initial Situation at the Pilot Site

Figure 1: Picture of the PCWTP (l.)

The waste water treatment plant (WWTP) serving as the Czech pilot site is situated on the northern part of Prague, on a riverine island adjacent. to residential areas. It has a capacity of 1 641 000 PE The PCWTP is a mechanical-biological system with a sludge production of about 75 000 t, which is further treated in a thermophilic anaerobic digestion.

Technological details of PCWTP

The PCWTP removes carbon containing water pollutants through biological treatment and partially ammonia nitrogen by oxidative denitrification. Phosphorus is removed through precipitation of Fe(III) salts. The technological line consists of several grit, flowing debris and sand catches; primary sedimentation tanks; activation tanks with fine-bubble aerators; rotating biological contactors and regeneration tanks of back-flow sludge. After thickening the excessive sludge it is mixed with primary sludge and pumped into tiered digestion tanks which are temperated to 55 °C. The digested sludge is then dried by centrifugation.

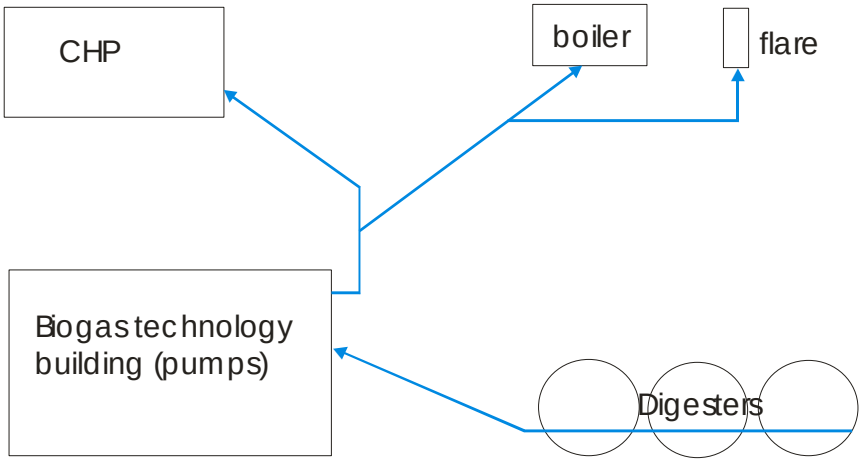
The WWTP in Prague is the largest biogas production site in Czech Republic. There is:

5 x 4380 m^3 digester (1stage)

5 x 4000 m^3 digester (2 stage)

5 x 6000 m^3 gas storage

3 x 0,95 + 2 x 1,25 MWel CHP



Veolia operates the PCWTP including the sludge line with AD thermophilic process. The biogas is now incinerated at the on-site CHP plant with an output of 5 MW of electricity (gas piston engines). Heat capture is limited, which renders the energy efficiency performance low.

Prague: anaerobic digestion of WWTP sludge

Biogas production (Nm^3/year)	18 066 974
Electricity production (kWh/year)	32 029 000
Plant self sufficiency	75 %
Biogas for other purposes (Nm^3/year) (now burned on flares without purpose)	1 150 000

Methane content of raw biogas	61 %

The PCWTP is producing ca 75 000 t per year of dry aerobic digested sludge for further processing - primarily composting and direct agricultural use.

3. Technological Upgrade

The REEF 2W technology at PCWTP encompasses a biogas upgrading to biomethane. The unit will be situated on the property of the WWTP Prague close to the digesters and the current biogas utilisation (CHP). Now the building permission proceedings are being carryied out and completion of the facility is planned for the first half of 2019.

After a detailed case study there was a decision over whether to choose PSA and membrane technology. PSA has a higher price, but lower operation cost. Membrane technology offers lower investment cost and higher operation costs. Due to priorities set within the project, the membrane biogas upgrading method was selected.

The technology consists of a membrane biogas upgrading unit and a compressed biomethane (bioCNG) vehicle filling station.

The biogas upgrading unit is connected to the existing raw biogas transport pipeline (pipeline from digester to CHP). It contains a unit for additional special biogas pre-treatment (removal of H_2S), gas drying and cooling unit, a compressor unit with filtration, a membrane separation unit, and a pressure control device for further distribution. The membrane separation unit is situated in a standard ISO20 container (width = 2.438 m, lengh = 6.058 m, height = 2.2348 m). Or another one according to the technology supplier). The container is mounted at the level of the terrain on the concrete blocks.

The filling station for vehicles contains a compressor, gas drying device, and a balancing pressure container - covering its own dispenser stand with the payment terminal (with the assumption of an automatic unmanned operation).

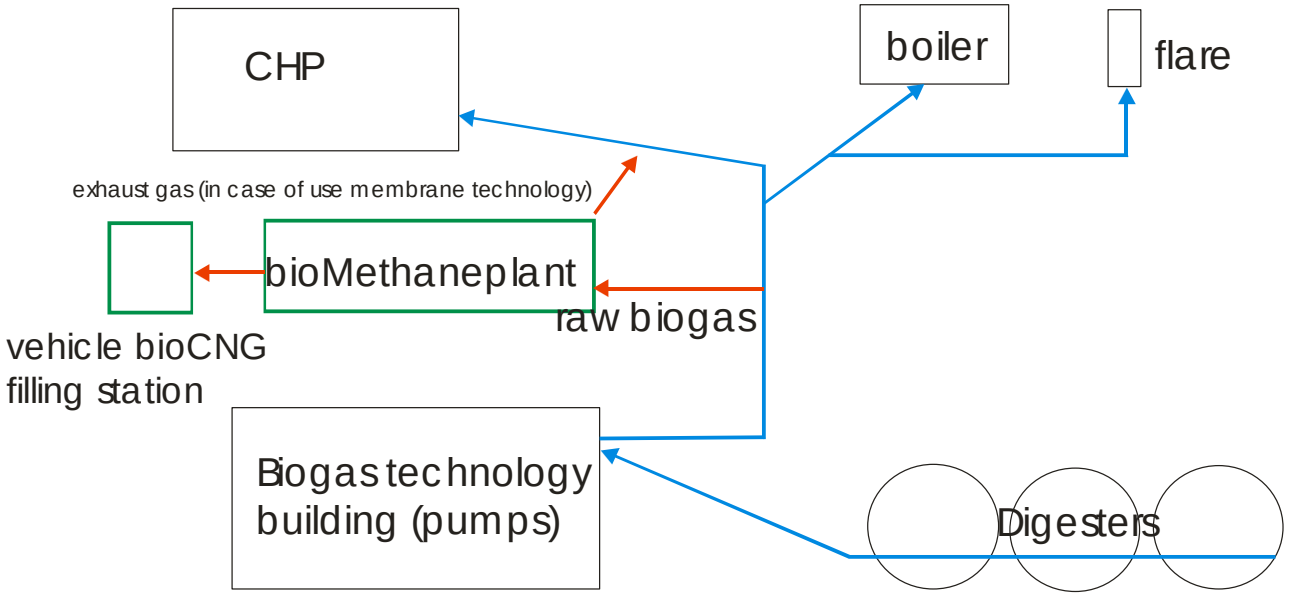
For compressed gas filling, stations for motor vehicles, TDG G 304 02 of the Czech Gas Association is available, which specifies the conditions for the location, execution, testing and operation of CNG fast-moving stations for motor vehicles if the inlet pressure does not exceed 0.03 MPa, the compressor does not exceed 20.3/h and the compressor internal volume does not exceed 0.5 m3.

The necessary space for the bioCNG vehicle filling station is approximately 12 x 8 m.

4. Expected Benefits

The biomethane plant will use currently unused biogas. It therefore raises the efficiency of energy use of theWWTP in Prague. The biomethane can be used as bioCNG in vehicle fuel (primary use), or as biomethane injected to the public natural gas grid (now considered as future variant of development, public natural gas grid is not easily accessible on the site).

The installation of the biogas upgrading unit causes only minor consequences to the WWTP site in terms of the space it used up. The installed technology has a small spatial footprintand is situated in standard containers. Only a small part of the produced biogas (now not used) will be upgraded.



The biogas upgrading unit will operate with 250 Nm^3/hour of raw biogas. Biomethane production will be 160 Nm^3/hour. This meansthat 2500 kg of bioCNG per day will be produced. This translates into 1370 kWh of green energy produced from currently unused biogas.

As a first biomethane project in Czech Republic, there is great opportunity to gain full operational experience with biomethane production technology which will build the basis for follow-uprenewable energy projects led by Veolia

Sales of bioCNG will achieve approx. 21 mio. CZK per year (840.000 EUR) in revenues. The price of bioCNG is comparable to common CNG price.

The biomethane plant can positively affect the energy efficiency of PCWTP and reduce air pollution generated by public transport.

By daily production, 15 – 100 vehicles (buses, cars) can be filled at filling station. The plant is not big, but it is the first bioCNG plant in Prague and (now also Czech Republic) and there is big potential of positive publicity for both renewable energy use and city of Prague.

About 2300 t of CO2 emission per year can be saved.

5. Key Selection Criteria

Location:

The Prague WTTP is one of the largest and the most modern wastewater treatment plants in Europe. It is located close to urban areas of Prague and very close to the public transport hub Prague-Dejvice which is used by a large fleet of public buses. The WWTP area itself offers sufficient space for accommodating the new bioCNG facility, which itself has a small spatial footprint.

Human resources:

At WWTP Prague there is experienced staff and laboratory background available for the biomethane project.

Energy Surplus: Currently, some of the produced biogas at WWTP Prague is not used, there is significant overproduction of biogas which is burned by flare. This sustainable surplus biogas enables the installation of the biomethane plant. Yet only a fraction of the biogas will be converted into biomethane, but in the future, there is the possibility to expand the biomethane unit and use more biogas to upgrading than CHP.

Suitability of technological Setup

Without certain minimum technological setup in place undertaking a comprehensive upgrading of wastewater-to-energy technologies is impossible. At the Prague WWTP, many of the technological pre-conditions exist that allow establishing and testing Reef2W solutions and many aspects revolving around integrated infrastructures and streams of the solid waste and wastewater systems.

Grid injection

The biomethane can be used as bioCNG in the transport sector (primary use), or as biomethane injected to the public natural gas grid (now considered as future variant of development). Also, given the close proximity of the WWTP to residential areas, there is potential demand for supplying excess heat via the district heating network.

Biomethane injection to the grid is technically possible (the grid is located in close distanceto the WWTP site) but there are several problems with piping because of issues relating to land ownership which prolonged permission procedures.

Public Perception:

The plant is the first bioCNG plant in Prague (now also in Czech Republic) and there is big potential for gaining positive publicity for both the city of Prague and Veolia. Biogas production at the Prague WWTP has a poor image due to challenges with frequent odour, noise caused by the CHP and anaerobic sludge production. This intervention can contribute to changing perceptions of WWTPs, from being a “public pain” to a provider of multiple benefits (including energy security and a healthy environment).