Design Review Committee Briefing #26

Subject: Phase II Upgrades Biogas Resource Recovery Options

Date: August 9, 2019

The Issue

The Design Review Committee (DRC) requested an analysis of potential biogas (i.e. gas produced from the anaerobic digestion process) resource recovery options. These options are being evaluated as they have an opportunity to reduce operational costs and/or provide a revenue source. In some cases, this cost offset can be greater than the capital and operating costs yielding a positive return on investment.

Background and Analysis

The alternatives considered as part of this biogas resource recovery development are described in the following list. These alternatives beneficially reuse digester gas produced by the anaerobic digesters at the treatment plant. In addition, process configurations are provided in the attached figures.

- **Alternative 1 – Cogeneration with Internal Combustion Engine:** This alternative involves the addition of a new 1,000-1,200 kW internal combustion cogeneration engine, and associated supporting ancillary equipment including: switchgear, waste heat radiator, heat recovery equipment, heat recovery silencer, controls, hot water circulation pumps and tie-in into the existing plant heat loop, and digester gas conditioning equipment. The internal combustion engine is operated from digester gas yielding both electricity and heat, both of which are recovered. The gas conditioning equipment consists of a hydrogen sulfide removal tank, moisture removal using a glycol chiller, gas compression, and siloxane removal tanks. Each of these constituents in the digester gas must be removed before the engine can safely use the digester gas as fuel. The engine and associated equipment will be installed indoors in a new dedicated cogeneration building. The gas conditioning equipment will be installed outdoors on a new concrete pad, adjacent to the new building. Figures 1 and 2 show the cogeneration process and gas conditioning process, respectively.
- **Alternative 2 – Biogas upgrade for injection into pipeline as renewable natural gas quality (RNG):** This alternative involves the addition of gas conditioning and upgrading equipment and the associated pipeline connection requirements to inject upgraded digester gas into the pipeline at natural gas quality. This alternative uses the same gas conditioning equipment as described in Alternative 1, with the additional step of removing carbon dioxide from the digester gas using a dual pass membrane system prior to delivering the gas to the pipeline. Discharge pressure from the membrane skid is adequate to inject into the local Intermountain pipeline, so a discharge compressor is not required. This alternative also includes the associated utility connection fees and a new pipeline buried along W. Railroad St. toward Northside Blvd. In addition, a thermal oxidizer is required to safely burn the tail gas (mostly carbon dioxide) wasted by the membrane skid package. The City would earn revenue from the sale of the gas to the pipeline and by partnering with an organization that purchases renewable identification numbers (RINs) as part of the Renewable Fuel Standard Program. Figure 3 shows the process flow diagram for producing RNG.
- **Alternative 3 – Biogas upgrade for use in vehicle fuel as compressed natural gas (CNG):** This alternative is similar to Alternative 2, with the following key differences:
  - Upgraded gas must be stored on site in ASME gas storage tubes and hauled regularly (typically daily) to a local CNG vehicle fueling center
  - Requires high pressure (3,600 psid) gas compressor for storage
  - No new pipeline or utility connection required

Figure 4 shows the process flow diagram for the CNG process.

Potential Consequences

The DRC should be aware of the potential consequences of each alternative that may not be readily apparent based on current development of the work at this time. The primary consequences from this evaluation are described in further detail below:

- Cogeneration systems (Alternative 1) tend to be relatively complex in relation to some typical components at wastewater treatment plants and have a learning curve to understand the intricacies of the intended operation, maintenance requirements, and for overall reliable operation. BC has generally found that while O&M for cogeneration and the associated gas conditioning equipment can be outsourced, it is beneficial for the plant to also have a cogeneration "champion" or two on staff to help over-see operation and troubleshoot the system when issues occur. Many times, these "champions" are current operators or maintenance staff that receive factory training after showing an interest in the cogeneration system. Some facilities will perform basic maintenance activities like change air filters, spark plugs, perform oil changes, and other relatively basic tasks.
- Due to the amount of equipment, controls, and coordination with either the utility or balancing product gas delivery with production, CNG/RNG facilities are generally more complex than a comparably sized cogeneration facility. The equipment includes compressors, pumps, blowers, media beds and tanks, automated valves, storage tanks, thermal oxidizer, and other items. Most vendors offer an O&M service which removes monitoring and scheduled maintenance and training of plant staff.
- Both RNG and CNG upgrading involves the City submitting to the United States Environmental Protection Agency (US EPA) to become a certified renewable fuel producer. Following the EPA's review/approval process, the injection of RNG into a pipeline or CNG for use in vehicle fuel generates RINs. RINs require an ongoing, annual third-party audit for verification. Sale of RINs can be either brokered or direct. The former approach requires less effort on the part of the City, because the broker locates buyers and handles the RIN transaction. However, the broker receives a cut of the revenue (approximately 10 to 15 percent). The latter approach requires the City to enter a direct contractual relationship with an Obligated Party for the purchase of the RINs produced. This requires more effort by the City, but the City receives the full value of the RINs. The benefit cost will assume a broker is utilized and, as such, a 15 percent broker fee will be accounted for in the cost analysis.
- A major component of evaluating the feasibility of converting digester gas to fleet vehicle fuel involves analyzing potential end users and availability of fleet vehicles to consume the product. Valley Regional Transit currently operates about 50 busses on CNG while Republic Services operates around 120 refuse haulers on CNG. The base business case evaluation will assume all of the CNG will be consumed by existing fleet vehicles such as Republic Services.

Recommendation

This briefing is intended to provide an overview of available biogas resource recovery approaches. A business case evaluation of these option will be presented for consideration at DRC Meeting #11.

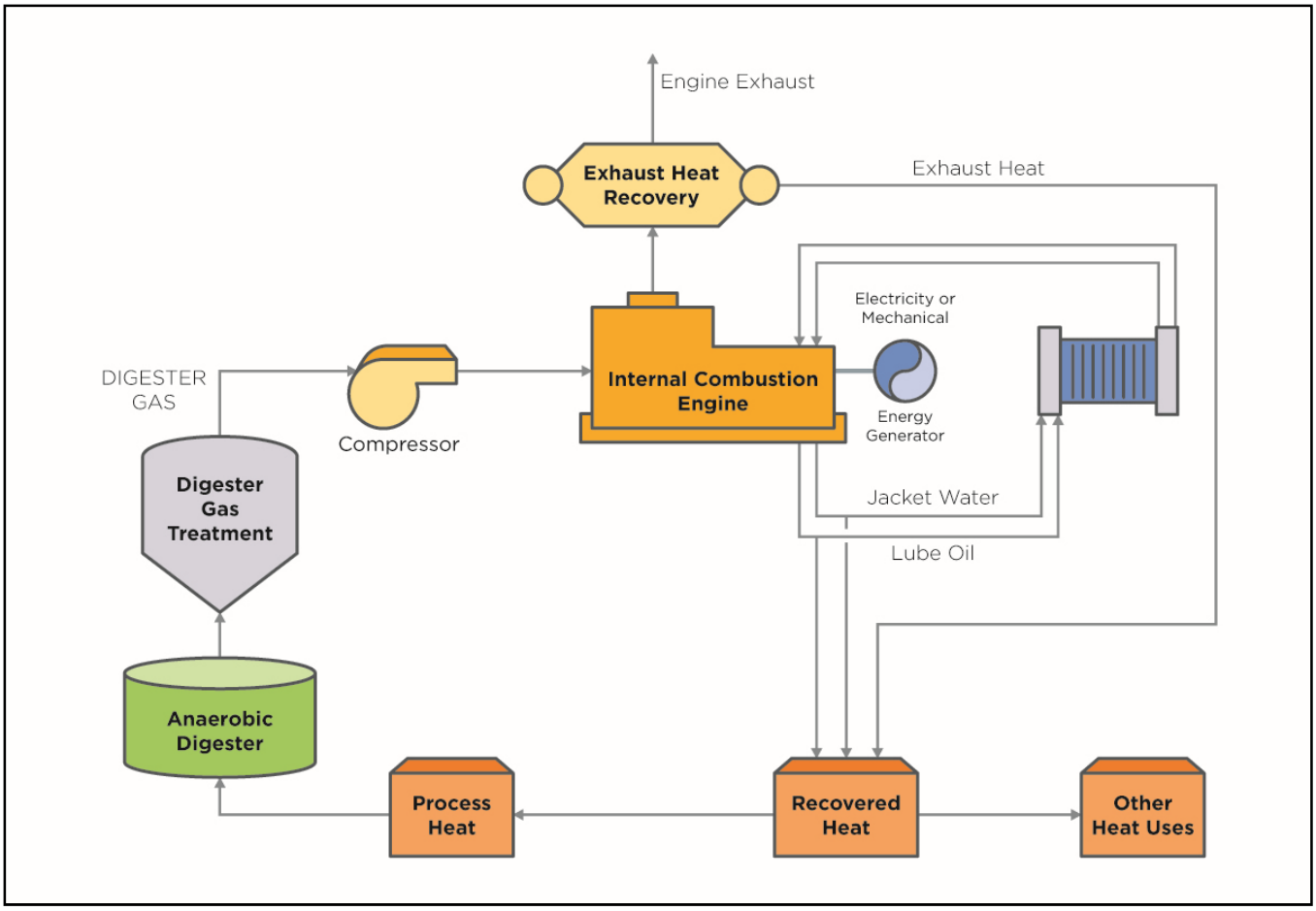

Figure 1. Cogeneration System (Alternative 1) Process Flow Diagram

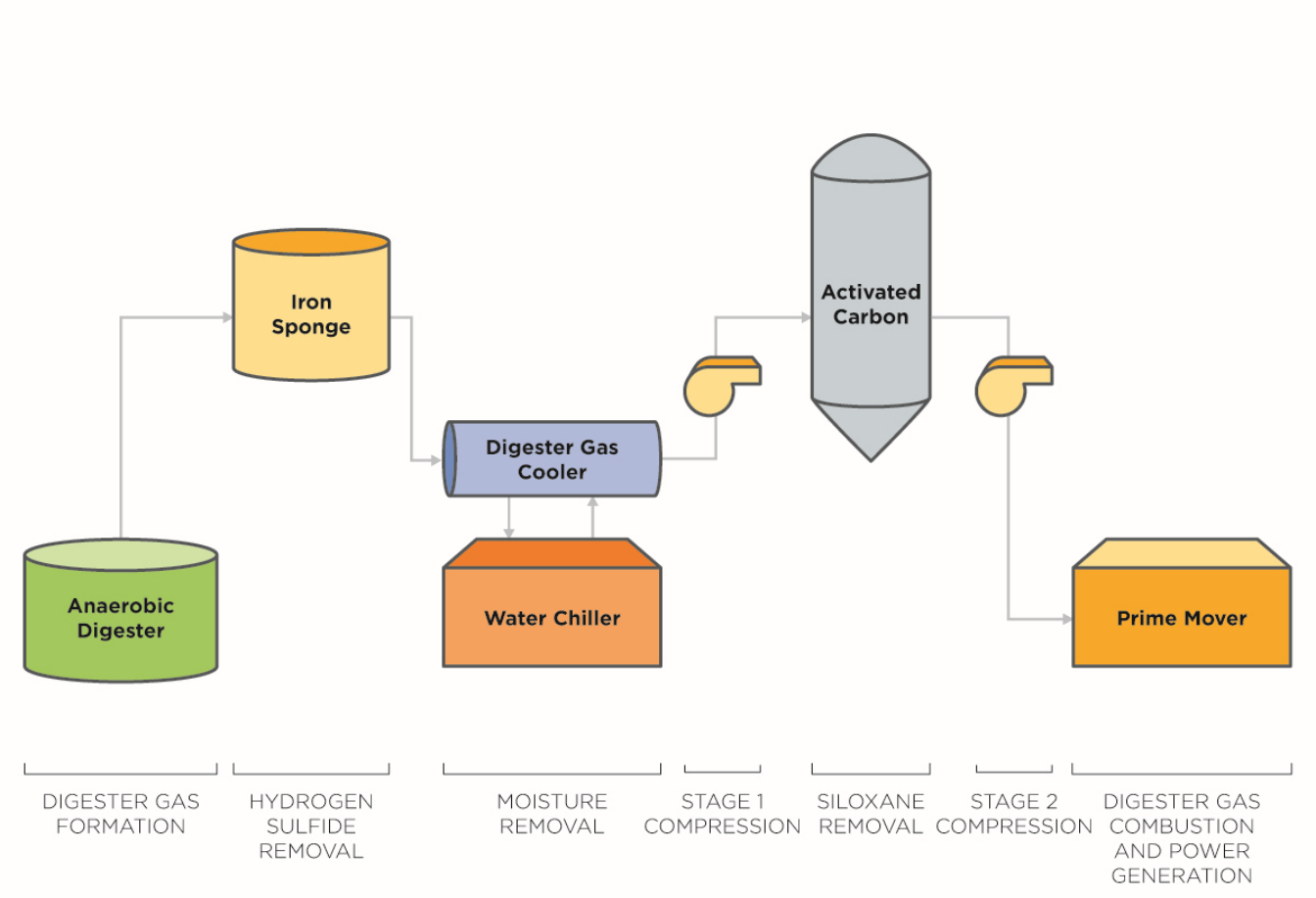

Figure 2. Gas Conditioning System Process Flow Diagram

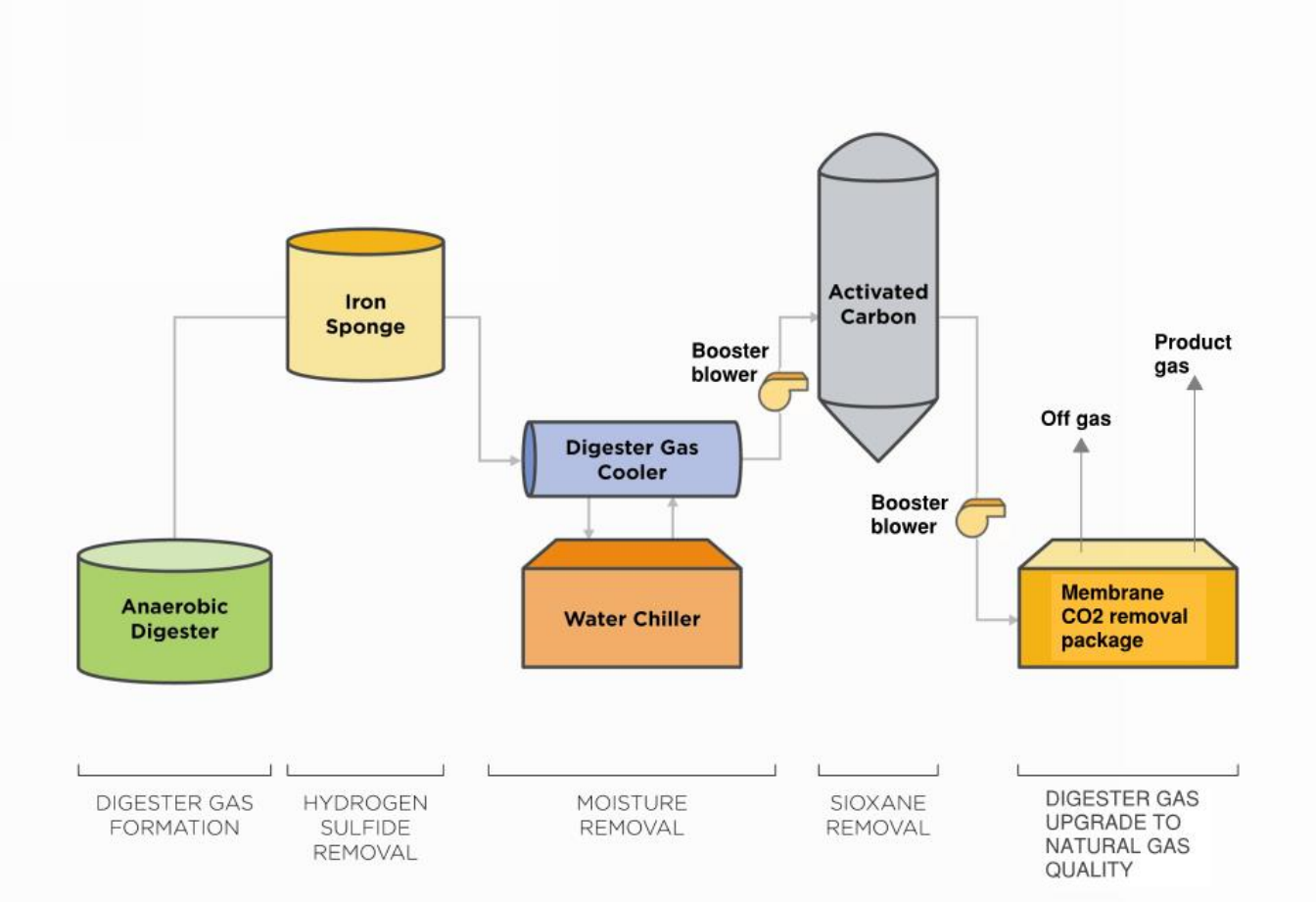

Figure 3. Renewable Natural Gas (Alternative 2) Process Flow Diagram

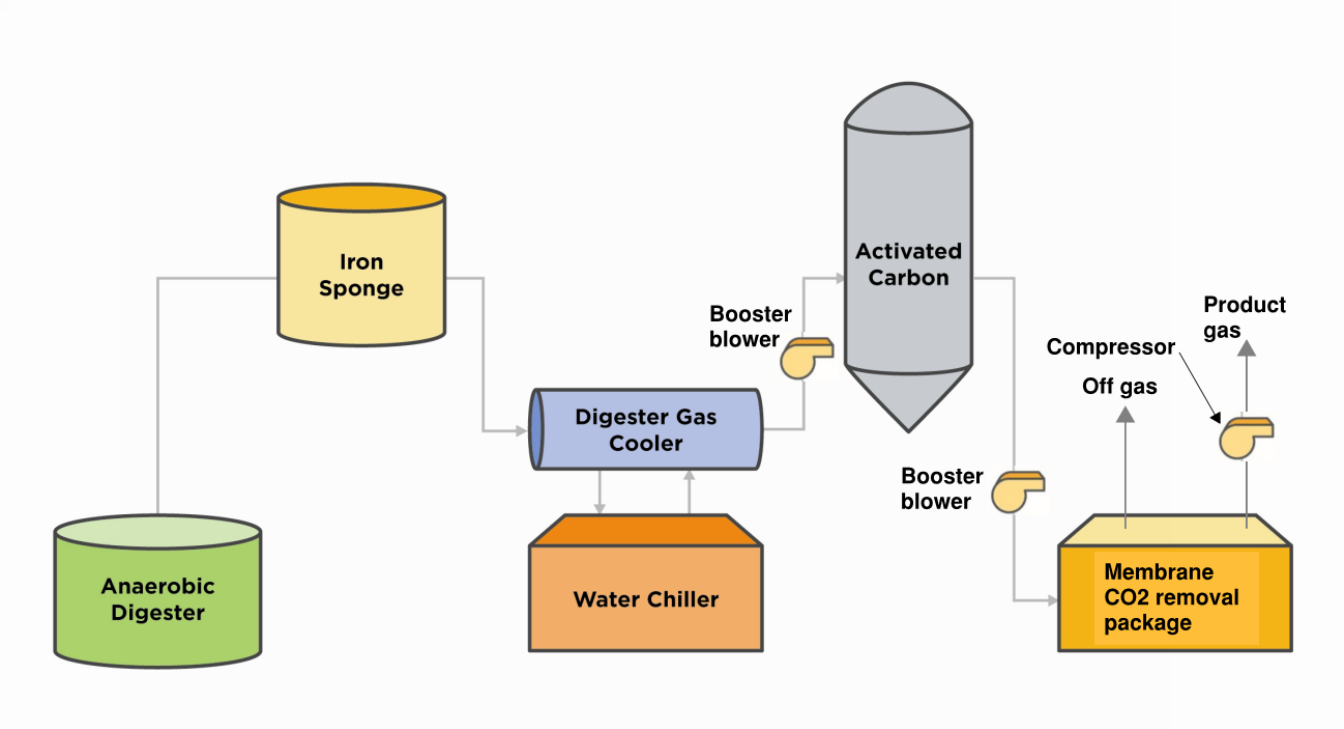

Figure 4. Compressed Natural Gas (Alternative 3) Process Flow Diagram