# Technical Memorandum

## EWPCF Alternative Fuels Receiving Facility Performance


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# 1 Introduction

As part of the Encina Wastewater Authority (EWA) energy and emissions strategic planning effort completed in 2011, a Fats, Oils, and Greases (FOG) program was identified for the Encina Water Pollution Control Facility (EWPCF). A design-build approach was selected for project delivery. In December 2013, EWA's Board of Directors awarded a contract to the J.R. Filanc Construction Company, Inc. (Filanc) / HDR, Inc. (HDR) design-build team for delivery of an Alternative Fuel Receiving Facility (AFRF). Construction of the AFRF was completed in April 2015, and was placed in service in May 2015 with regular deliveries of FOG.

Based on EWA's experience operating the AFRF over the past couple of years, biogas production has increased in the digesters being fed with FOG. This additional biogas is used primarily to fuel the heat dryer due to existing San Diego County Air Pollution Control District (APCD) permit limitations on the amount of biogas that can be used in the cogeneration engines. Thus, the AFRF project has allowed EWA to reduce the purchases of natural gas and advance toward the goal of becoming energy independent.

## 1.1 Background

Onsite electrical power production at the EWPCF is provided by four 750 KW cogeneration engines fueled by biogas, natural gas, or a mixture of the two. Historically, the amount of biogas produced by the EWPCF anaerobic digesters has been sufficient to reach the annual maximum threshold for use in the cogeneration engines that is determined by existing permits issued by the APCD. Surplus biogas can be used in the heat dryer to offset purchases of natural gas. Any excess biogas produced that cannot be utilized or stored is flared. Waste gas flare operations are also included in the APCD permit, but historically its use has been well under permit limitations.

The AFRF's goal is to feed FOG or other biofuel supplies to the digesters in a controlled manner so that the digesters will produce more biogas. The FOG should be fed at a consistent rate to avoid a digester upset and ensure that the extra digester gas produced can be beneficially used with minimal flaring and/or venting.

Through a competitive prequalification and bid process, EWA selected Liquid Environmental Solutions of California, LLC (LES) to be the preferred supplier of FOG and liquefied food waste for the AFRF. The agreement with LES, awarded in December 2013, was for an 8-year duration with the following key terms:

- Supply volume (gallons per week):
  - Years 1-6: minimum 50,000; maximum 80,000
  - Years 7-8: minimum 100,000; maximum 160,000
- Tipping Fee (per gallon):
  - Years 1-4: $0.045
  - Years 5-6: $0.040
  - Years 7-8: $0.035
- Capital Contribution Fee ($300,000 total), paid on July 31st of each year:
  - Years 1-4: $30,000 per year
  - Years 5-8: $45,000 per year

It was estimated at the time of the agreement that EWA would see $4.2 million in revenue ($1.9 million in tipping fees and $2.3 million in natural gas cost avoidance) over the 8-year agreement with LES, and the simple payback period would be approximately 5 years. It was assumed that the FOG would generate 13 cubic feet of biogas per gallon, which equates to 0.078 therms per gallon.

## 1.2 Objectives

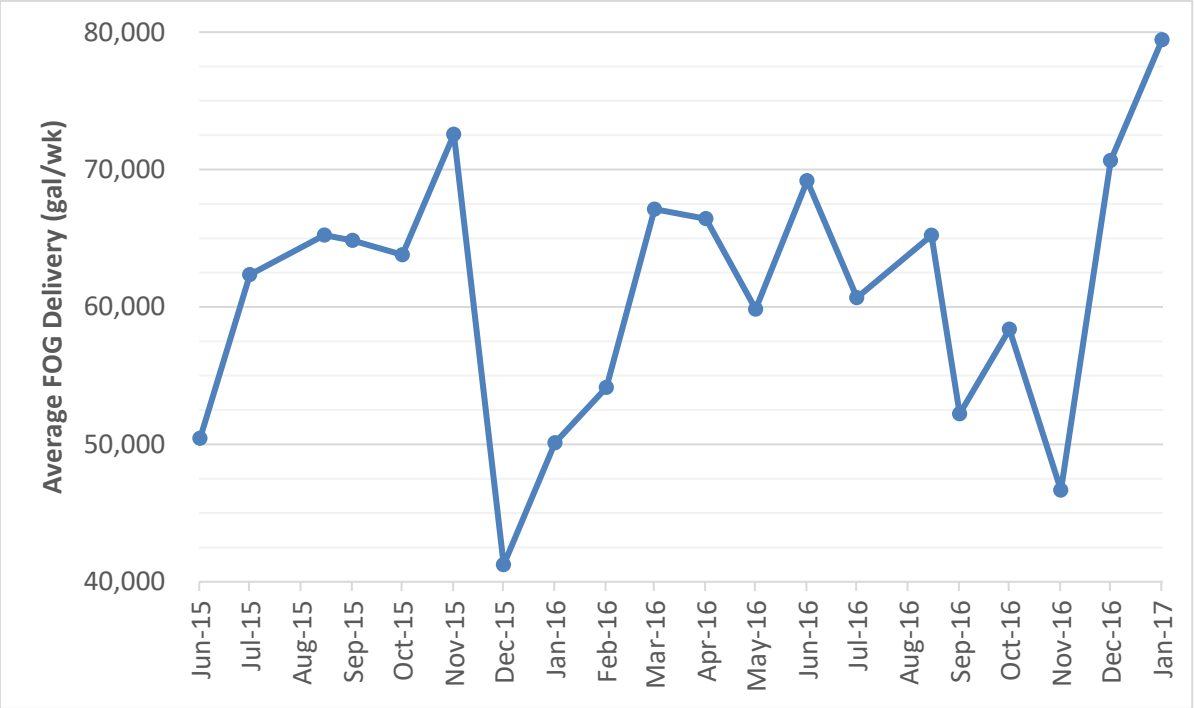
The purpose of this technical memorandum (TM) is to analyze the biogas production relative to the addition of FOG to assess the performance of the AFRF project. This TM will also present a simple payback analysis for the AFRF project by comparing capital and operating costs to the value of the increased biogas gas production, as well as revenue from tipping fees.

# 2 AFRF Performance

## 2.1 FOG Deliveries

EWA began introducing FOG into Digester 6 in May 2015, and reached the minimum 50,000 gallons per week rate by June 2015. Later in the year this was expanded to include Digester No. 5 and FOG is currently distributed evenly to both digesters at a steady rate. Typically, deliveries are made by LES vehicles Monday through Saturday, with no deliveries on Sunday. The average weekly FOG deliveries are shown in Figure 1 for the period June 2015 through January 2017, with an overall average of 61,022 gallons/week during this time.

**Figure 1: Average Weekly FOG Deliveries**

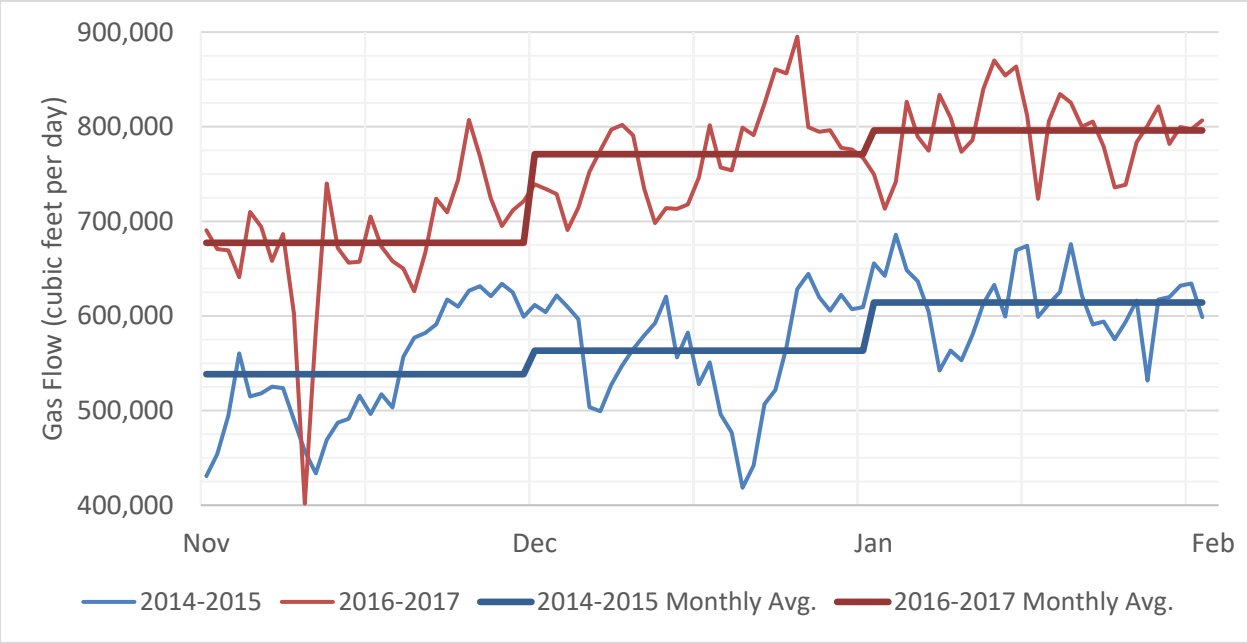



In 2017, LES has been supplying the maximum contracted volume of 80,000 gallons per week of FOG, and it is assumed that deliveries will continue at this level. Recently LES has expressed interest in increasing FOG deliveries above their contractual limit, and EWA is considering this request.

## 2.2 Digester Gas Production

Biogas production data from Digester Nos. 5 and 6 was analyzed to estimate the increase in biogas due to the addition of FOG. Figure 2 compares the gas flow data from November 2014 to January 2015, before the AFRF was operating, and November 2016 to January 2017, after the AFRF was operating.

**Figure 2: Combined Digester Nos. 5 and 6 Gas Production pre- and post-AFRF**




Comparison of these two periods shows a 31 percent increase in gas production. Note that overall EWPCF flows were similar for both three-month periods (21.4 mgd before AFRF vs. 22.7 mgd after AFRF). Numerical data on gas production is presented in Table 1.

**Table 1: Biogas Production pre- and post-AFRF**

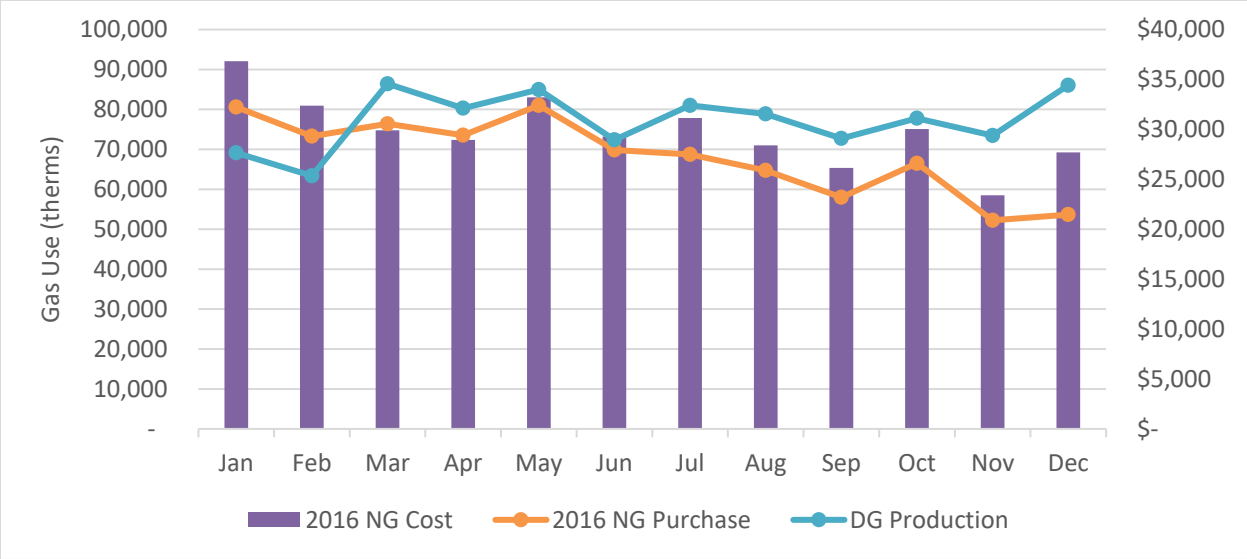
| Daily Average Gas Flows (cu. ft) | Dig. 5 2014-15 | Dig. 5 2016-17 | Dig. 6 2014-15 | Dig. 6 2016-17 | Combined 2014-15 | Combined 2015-16 | % Increase |
|---|---|---|---|---|---|---|---|
| November | 7,755,106 | 9,392,562 | 8,399,147 | 10,926,717 | 16,154,253 | 20,319,279 | 26% |
| December | 8,234,142 | 10,989,333 | 9,228,054 | 12,909,843 | 17,462,196 | 23,899,176 | 37% |
| January | 8,958,095 | 11,162,371 | 10,082,852 | 13,514,933 | 19,040,947 | 24,677,304 | 30% |
| **TOTAL** | **24,947,343** | **31,544,266** | **27,710,053** | **37,351,493** | **52,657,396** | **68,895,759** | **31%** |

## 2.3 Natural Gas Purchases

The heat content of natural gas is higher than that of biogas. Natural gas is approximately 1,000 Btu/CF while biogas produced at the EWPCF is approximately 600 Btu/CF (i.e., the methane content of the biogas is approximately 60 percent). Therefore, about 1.67 CF of biogas is required to produce the same energy value as 1.0 CF of natural gas.

Figure 3 compares the use and cost of natural gas to the use of biogas (converted to therms for comparison purposes) at the EWPCF for the year 2016. This reflects a declining trend in the latter half of 2016 in natural gas purchases, corresponding to sustained biogas production. In addition to AFRF performance, this decline in natural gas use may also be related to other energy efficiency improvements at the EWPCF because natural gas is also used to fuel the cogeneration engines (e.g., Aeration Basin Nos. 1 and 2 were placed back in service as of June 2016 with new diffuser systems).

**Figure 3: EWPCF Natural Gas Purchases vs. Digester Gas Production**




## 2.4 Energy Intensity of FOG

A full calendar year comparison of digester gas production for 2014 (pre-AFRF) to that for 2016 (post-AFRF) shows an increase of 29%. This is comparable to the 31% increase identified using a 3-month period comparison in Section 2.1 above. By using 2014 as a baseline year and adjusting for EWPCF annual average daily flow (AADF), it was determined that each gallon of FOG received at the AFRF produces an average of approximately 10,425 BTU (or 0.104 therms).

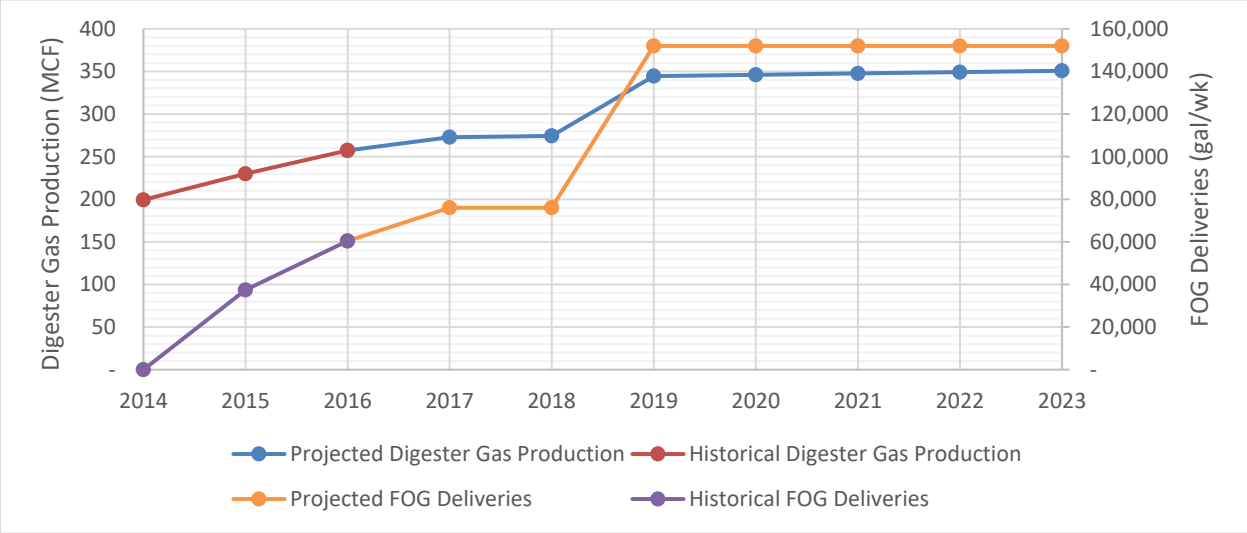
# 3 AFRF Return on Investment

## 3.1 Projected AFRF Performance

A projection of annual biogas production at the EWPCF was developed based on the AFRF performance to date and the following assumptions:

- For 2017-2018, FOG deliveries by LES at 95% of the current maximum delivery rate of 80,000 gallons per week. Starting in 2019, FOG deliveries by LES at 95% of the future maximum rate of 160,000 gallons per week.
- Each gallon of FOG delivered is assumed to produce 0.104 therms. Biogas production increases due to FOG is assumed to be independent of biogas production associated with changes to influent flows and loads.
- Wastewater flows to the EWPCF are projected to increase from 20.9 mgd in 2016 (AADF) to 22.2 mgd in 2023 based on a 0.74% annual population growth rate in EWA's service area.

**Figure 4: Historical and Projected EWPCF Biogas Production (2014-2023)**




## 3.2 Cost Analysis

The final capital cost for the AFRF project is shown in Table 2 below.

**Table 2: AFRF Project Capital Cost**

| Item | Cost |
|---|---|
| Design-Build Contract (Filanc) | $ 2,250,036 |
| Approved Change Orders (Filanc) [1] | $ 192,364 |
| Capital Contribution by LES | $ (300,000) |
| SDG&E Rebate Check | $ (150,000) |
| **TOTAL** | **$ 1,992,400** |

**Note:**

1. The total amount for the five approved change orders was $226,169; however, approximately $33,805 of this amount was associated with Dryer Safety work and is therefore excluded from the AFRF project cost.

An updated payback analysis was performed incorporating the following:

- Actual capital costs of the project. The base contract amount was allocated to 2014, and the change orders less the SDG&E rebate were allocated to 2015. The LES capital recovery fee was spread out over the 8-year contract duration.
- Operating costs were estimated based on actuals, but appeared to be relatively close to those estimated during the AFRF project planning analysis.
- Revenues from the LES tipping fees.
- Offset of natural gas purchases based on the increased biogas production attributable to the AFRF project, in accordance with the projections provided above. Actual annual average rates for natural gas (i.e., burnertip rates) were used for 2015 and 2016, while the utility's projected rates (as of May 2017) were used for 2017-2019. For 2020 and beyond, rates were assumed to hold steady at the 2019 annual average rate.

As shown in Figure 5 below, payback is estimated to occur within approximately 4 years after AFRF operations started. The total estimated revenue (from tipping fees and capital recovery) and natural gas cost avoidance over the 8-year period of the LES agreement is $4.1 million (2016 dollars), with the increased digester gas production accounting for roughly 50 percent. The balance after accounting for project capital and operating expenses is a net positive $1.54 million after the 8-year period.

**Figure 5: AFRF Payback Analysis**