# Urban Horizons Gas Data

The microturbine system at the Urban Horizons site consists of a single Capstone C65 microturbine generator. Gas data for this system is measured using a dedicated Eldrige Product Inc. 8716 MPNH hot-wire anemometer gas meter, which reports gas flow via an analog 4-20 mA signal. The 4-20 mA signal is read by an Obvius A8812 Acqisuite, which scales the signal from 1 CFH @ 4 mA to 850 CFM @ 20 mA.

**Table 1. Gas Meter Scaling**

| Meter Output | Obvius Data Logger Scaling |
|---|---|
| 4 mA | 1 CFH |
| 20 mA | 850 CFH |
| Slope | 53.0625 |
| Offset | -211.25 |

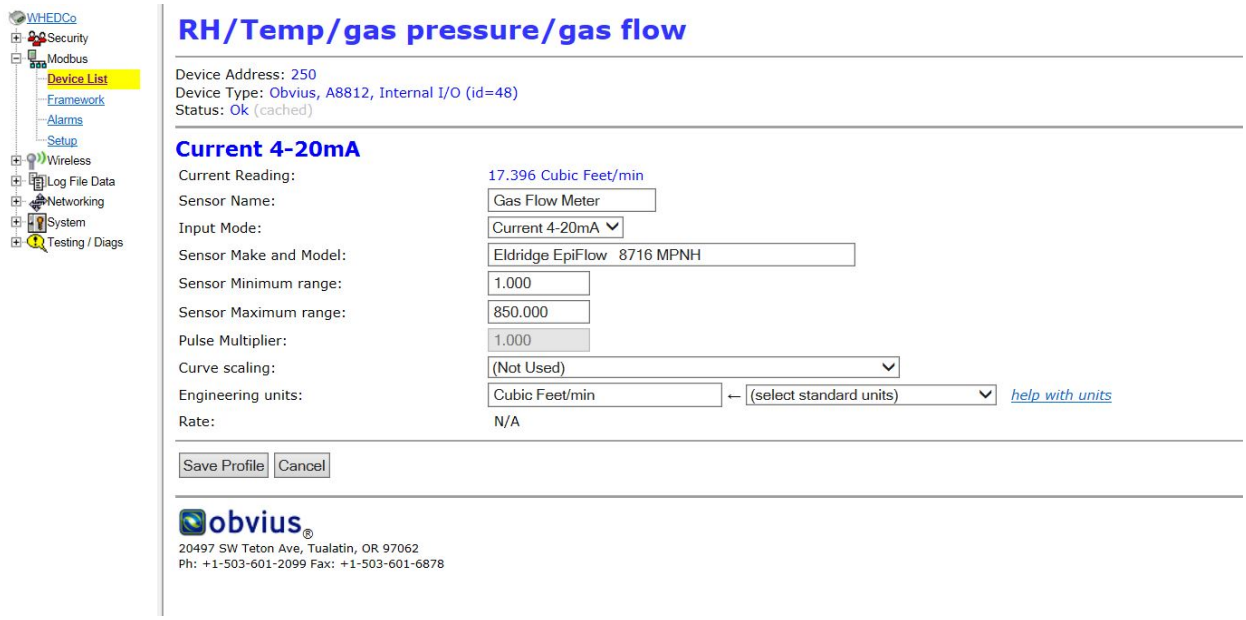


**Figure 1. Data Logger Configuration Screen – Gas Meter**

The data logger units are set to cubic feet per minute, not cubic feet per hour. This does not impact the scaling, only the display units on the data logger. The 17.396 reading indicates that the sensor is outputting 4.3089 mA, as computed below:

Meter Scaling Formula: Flow = Slope × mA + Offset

Solved for mA: mA = (Flow-Offset) ÷ Slope
mA = (17.396 – (-211.25)) ÷ 53.0625
mA = 4.3089

This indicates that the flow measured by the sensor at typical operation is very low. Ideally analog meters should be sized for the peak flow to occur near 18 mA, to allow for sufficient analog to digital conversion.

By virtue of being a hot-wire anemometer meter, the Eldrige Product Inc. 8716 MPNH is inherently temperature compensated. Temperature compensated means that variation in gas density due to pressure are directly measured by the sensor and corrected to standard conditions of 60°F. The 8716 MPNH is not pressure compensated. The meter specifications indicate that the impact of variation in pressure is negligible for ±20% variation of absolute calibration pressure.

## Section F General Specifications

| | |
|---|---|
| Linear signal output | 0–5 VDC & 4–20 mA |
| Relay Output | Two 1-amp, user-selectable alarm functions |
| Signal Interface | RS232 & RS485 Modbus RTU |
| Accuracy including linearity (Ref.: 21°C): | ± (1% of Reading + (0.5% + .02%/°C of Full Scale)) |
| Repeatability | ± 0.2% of Full Scale |
| Sensor response time | 1 second (time constant per step change) |
| Turn down ratio | 100:1 (15 SCFM/FT² minimum Reading) |
| Electronics temperature range | -40–85°C (-40–185°F) |
| Gas temperature range | 0–200°C (32–392°F) *Consult factory for extended range.* |
| Gas temperature effect | 0.02% /°C |
| Gas pressure effect | Negligible over ±20% of absolute calibration pressure |
| Pressure rating maximum: | |
| Inline flowmeters | 500 PSI Std., >500 special |
| Insertion flowmeters (*See note below*) | |
| .500" OD | 125 PSI Std., >125 special |
| .750" OD | 55 PSI Std., >55 special |
| 1.000" OD | 30 PSI Std., >30 special |
| Transmitter power requirements | 5 Watts or less |
| RAM Back-up | Lithium Battery, 2.5–3.5v, >10 years |
| Wetted materials: | 316SS, including sensor |
| Standard temperature & pressure (STP) | 70° F & 29.92" Hg<br>(Air .075 lb/cubic foot) |
| NIST traceable calibration | Standard |
| Approvals | |
| MPNH Series — | For use in Ordinary (Non-Hazardous) area locations:<br>Type 4X, IP66 |

Figure 2. Eldrige Product Inc. 8716 MPNH Specifications

Assuming the meter is calibrated for standard condition of 14.7 psia, the ±20% value indicates the meter should be accurate at delivered gas pressures up to 2.94 psig[1]. If the gas pressure is substantially higher

[1] 14.7 psi × 20% = 2.94 psi.

than this level, then the meter should be factory calibrated for the actual gas pressure, or an ideal gas law correction can be applied.

**Question #1: What is the calibration pressure for the meter?**

**Question #2: What is the gas pressure where the meter is located?**

The data logger has a channel for gas pressure, but no data has ever been observed on that channel. This data could be used to adjust the gas flow reading if the sensor is located in the same section of piping (at the same pressure) as the gas meter.
The gas data collected to date has shown a high degree of linearity with power production. This indicates that the meter is providing a reading that is related to the actual gas use of the microturbine, but requires some adjustment (either pressure based or otherwise). The gas data also shows distinct periods variation inside the overall linear trend, with some areas higher or lower than others.

**Question #3: Do these distinct time periods correspond to any site changes on the gas system (e.g. gas booster pressure adjustment, etc).**

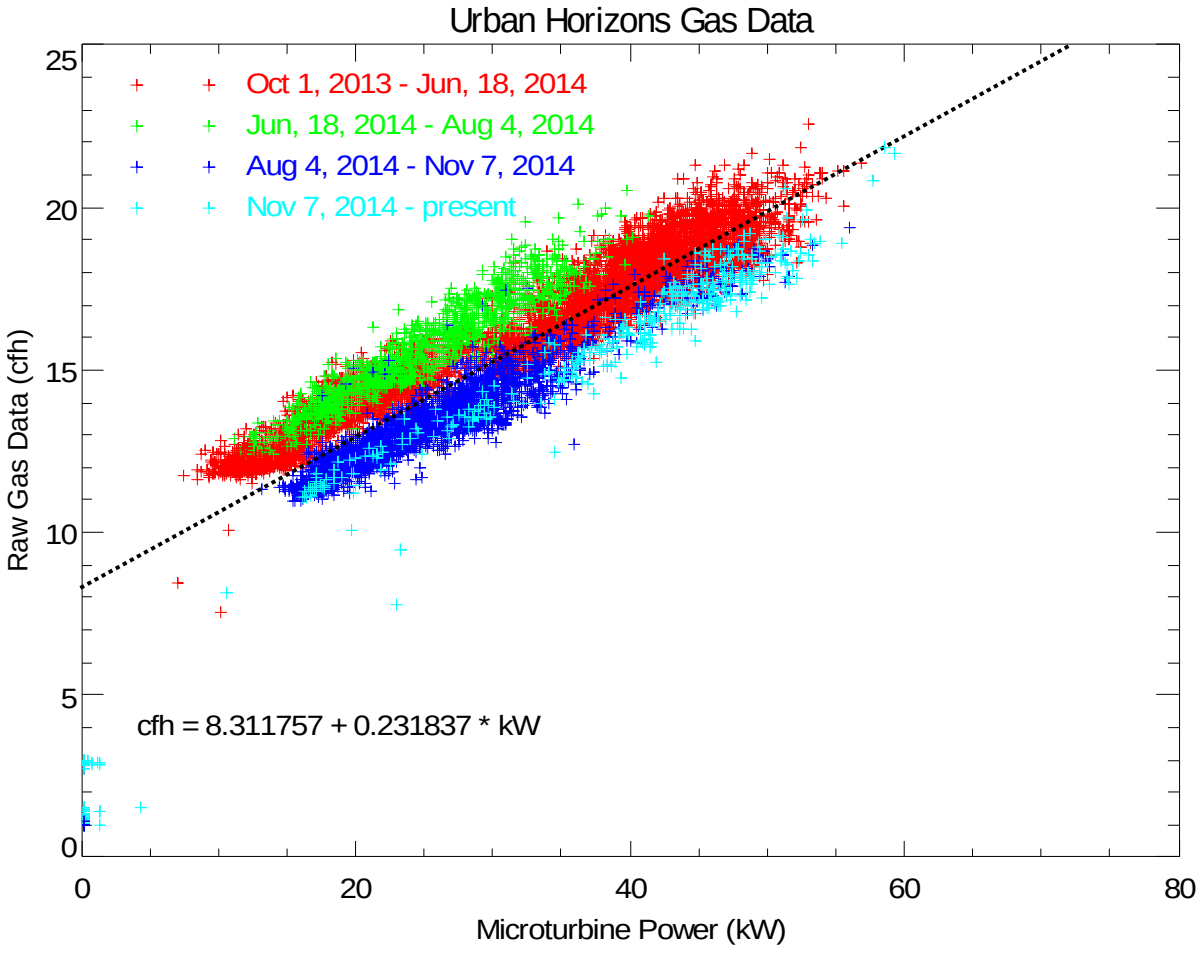


Figure 3. Measured Raw Gas Data Variation Power Output

Finally, an attempt to turn the measured gas data into a reasonable gas consumption was developed. The specifications for the C65 microturbine indicate a gas flow rate of 842 MBtu/h at a full load power of 65 kW. This gas flow rate corresponds to approximately 815 CFH when a heat content of natural gas of 1,032 Btu/CF is applied.

**Table 2. Performance Ratings**

| Parameter | C65 CARB & Low NOx | All Other C65 |
|---|---|---|
| **Net Power Output** | 65 (+0/-3) kW net | 65 (+0/-2) kW net |
| **Net Efficiency (LHV)** | 28 (± 2)% | 29 (± 2)% |
| **Nominal Net Heat Rate (LHV)** | 12,900 kJ /kWh (12,200 Btu /kWh) | 12,400 kJ /kWh (11,800 Btu /kWh) |
| **Nominal Generator Heat Rate (LHV)** | 12,100 kJ /kWh (11,400 Btu /kWh) | 11,600 kJ /kWh (11,000 Btu /kWh) |
| **Nominal Steady State Fuel Flow (HHV)** Notes (1) and (2) | 919,000 kJ/hr (871,000 Btu/hr) | 888,000 kJ/hr (842,000 BTU/hr) |

Figure 4. Capstone C65 Ratings

Using this nominal gas flow rate of 815 CFH @ 65 kW, and the linear trend indicated in Figure 3, a correction factor for the existing gas use was estimated.

Table 2. Gas Data Correction Factor Calculation

| System Power (kW) | Rated Gas Use (Based on Rating) (CFH) | Observed Gas Use (Based on Trend) (CFH) | Correction Ratio (Rated to Measured) |
|---|---|---|---|
| 65 kW | 815 CFH | 23.38 CFH | 815÷23.38 = 34.8 |

This multiplier of **34.8** was applied to all gas data prior to being loaded into the NYSERDA website. This correction factor is only an estimate, based on the analysis above. Further investigation (including field evaluation of the installed gas meter, observations of system power and gas pressures) are required to determine the root cause of the gas data issue.