Greenpark Care Center Data Integrator Notes

This site is a health care facility located in Brooklyn, NY. The site has two Tecogen 75 kW generators for generating power and recovering heat. Heat is recovered from the engines for use in the building. The data at this site is just for the engines and there is no data about heat recovery use in the facility or facility power. Data for this site is collected by Connected Energy and provided to CDH Energy.

Data Point Details

The data at this site is provided by Connected Energy in the form of comma-separated value (CSV) files. There is one file for each day containing 15-minute timestep data for 120 data points. One data file is uploaded on a nightly basis containing the previous days data. From these 15-minute values, the hourly database is formed. It is unclear whether the 15-minute data is sampled or averaged across the interval. The details for each individual data point are outlined below.

The timestamp in the raw data files is in Eastern Local Time. This means it obeys the Standard to Daylight savings times rules for the Eastern timezone. For display purposes, we convert the timestamp from Local Time to Eastern Standard Time for all graphical figures on the website. This means that during the Daylight Savings Time period from the first Sunday in April until the last Sunday in October the monitored data plots, CSV output and standardized PDF reports are in Eastern Standard Time and do not obey Daylight Savings time rules. Presenting data in Standard Time throughout the year is common practice for graphical time series plotting because it eliminates skipping an hour in April and duplicating an hour in October.

The site is divided into two monitoring units: one for generator 1 and the other for generator 2.

Greenpark Care Center Engine 1

DG/CHP Generator Output (total kWh)
The data for Generator Output comes from a 15-minute accumulator for the power produced by the engine. The column of origin for this data point is labeled “Eng 1 Cumul. Energy Produced” in the data files received from Connected Energy. The difference between consecutive records is assigned as the energy produced by the engine for that interval. This 15-minute energy data is then summed into hourly data.

DG/CHP Generator Output Demand (peak kW)
The data for Generator Output comes from a 15-minute average for the generator demand. The column of origin for this data point is labeled “Eng 1 Power, Actual” in the data files received from Connected Energy. The maximum for a given hour is assigned to the hourly database.

DG/CHP Generator Gas Input (cubic feet)
The data for Generator Gas Input comes from a 15-minute accumulator for biogas flow. The column of origin for this data point is the first column labeled “Engine #1 Cumul Gas Use” in the data files received from Connected Energy. The difference between consecutive records is

assigned as the gas consumed by the engine for that interval. This 15-minute gas data is then summed into hourly data.

Total Facility Purchased Energy (total kWh)
There is no information for this data channel available from the Connected Energy data.

Total Facility Purchased Demand (peak kW)
There is no information for this data channel available from the Connected Energy data.

Other Facility Gas Use (cubic feet)
There is no information for this data channel available from the Connected Energy data.

Total Facility Energy (total kWh) and Total Facility Demand (peak kW)
These data points cannot be calculated because of a lack of data for the Total Facility Purchased Energy/Demand channels.

Unused Heat Recovery (total MBtu/h)
There is no information for this data channel available from the Connected Energy data.

Useful Heat Recovery (total MBtu/h)
The Unused Heat Recovery comes from a 15-minute accumulator for the utilized heat recovery rate. The column of origin for this data point is labeled "Eng 1 Cumul. Heat Recovered**"** in the data files received from Connected Energy. The difference between consecutive records is assigned as the heat recovered by the engine for that interval, in MBtus. This 15-minute recovery data is then summed into hourly data.

Status/Runtime of DG/CHP Generator (hrs)
The Runtime of the Generator comes from a 15-minute accumulator for the total engine operating hours. The column of origin for this data point is labeled "Eng 1 Total Operating Hours**"** in the data files received from Connected Energy. The difference between consecutive records is assigned as the runtime of the engine for that interval, in minutes. This 15-minute runtime data is then summed into hourly data.

Ambient Temperature (avg °F)
The Ambient Temperature comes from hourly sampled conditions at JFK International Airport available at http://www.wunderground.com. The hourly data from the weather underground (which is often recorded at irregular time intervals) is assigned to the closest hour for the Ambient Temperature in the online database.

Total CHP Efficiency (%)
The Total CHP Efficiency is calculated from the online hourly database as the sum of the Useful Heat Recovery and the DG/CHP Generator Output, converted from kWh to MBtus, divided by the DG/CHP Generator Gas Input. The gas input is converted to MBtus using the Lower Heating Value (LHV) of the fuel which is 0.930 MBtu/cubic foot (Natural Gas).

Electrical Efficiency (%)
The Electrical Efficiency is calculated from the online hourly database as the DG/CHP Generator Output, converted from kWh to MBtus, divided by the DG/CHP Generator Gas Input. The gas input is converted to MBtus using the Lower Heating Value (LHV) of the fuel which is 0.930 MBtu/cubic foot (Natural Gas).

Greenpark Care Center Engine 2

DG/CHP Generator Output (total kWh)
The data for Generator Output comes from a 15-minute accumulator for the power produced by the engine. The column of origin for this data point is labeled "Eng 2 Cumul. Energy Prod" in the data files received from Connected Energy. The difference between consecutive records is assigned as the energy produced by the engine for that interval. This 15-minute energy data is then summed into hourly data.

DG/CHP Generator Output Demand (peak kW)
The data for Generator Output comes from a 15-minute average for the generator demand. The column of origin for this data point is labeled "Eng 2 Power, Actual" in the data files received from Connected Energy. The maximum for a given hour is assigned to the hourly database.

DG/CHP Generator Gas Input (cubic feet)
The data for Generator Gas Input comes from a 15-minute accumulator for biogas flow. The column of origin for this data point is the first column labeled "Engine #2 Cumul Gas Use" in the data files received from Connected Energy. The difference between consecutive records is assigned as the gas consumed by the engine for that interval. This 15-minute gas data is then summed into hourly data.

Total Facility Purchased Energy (total kWh)
There is no information for this data channel available from the Connected Energy data.

Total Facility Purchased Demand (peak kW)
There is no information for this data channel available from the Connected Energy data.

Other Facility Gas Use (cubic feet)
There is no information for this data channel available from the Connected Energy data.

Total Facility Energy (total kWh) and Total Facility Demand (peak kW)
These data points cannot be calculated because of a lack of data for the Total Facility Purchased Energy/Demand channels.

Unused Heat Recovery (total MBtu/h)
There is no information for this data channel available from the Connected Energy data.

Useful Heat Recovery (total MBtu/h)
The Unused Heat Recovery comes from a 15-minute accumulator for the utilized heat recovery rate. The column of origin for this data point is labeled "Eng 2 Cumul. Heat Recovered**"** in the

data files received from Connected Energy. The difference between consecutive records is assigned as the heat recovered by the engine for that interval, in MBtus. This 15-minute recovery data is then summed into hourly data.

Status/Runtime of DG/CHP Generator (hrs)
The Runtime of the Generator comes from a 15-minute accumulator for the total engine operating hours. The column of origin for this data point is labeled "Eng 2 Total Operating Hours**"** in the data files received from Connected Energy. The difference between consecutive records is assigned as the runtime of the engine for that interval, in minutes. This 15-minute runtime data is then summed into hourly data.

Ambient Temperature (avg °F)
The Ambient Temperature comes from hourly sampled conditions at JFK International Airport available at http://www.wunderground.com. The hourly data from the weather underground (which is often recorded at irregular time intervals) is assigned to the closest hour for the Ambient Temperature in the online database.

Total CHP Efficiency (%)
The Total CHP Efficiency is calculated from the online hourly database as the sum of the Useful Heat Recovery and the DG/CHP Generator Output, converted from kWh to MBtus, divided by the DG/CHP Generator Gas Input. The gas input is converted to MBtus using the Lower Heating Value (LHV) of the fuel which is 0.930 MBtu/cubic foot (Natural Gas).

Electrical Efficiency (%)
The Electrical Efficiency is calculated from the online hourly database as the DG/CHP Generator Output, converted from kWh to MBtus, divided by the DG/CHP Generator Gas Input. The gas input is converted to MBtus using the Lower Heating Value (LHV) of the fuel which is 0.930 MBtu/cubic foot (Natural Gas).

Data Quality Checks

The Data Quality Checks consist of three levels of verification: does the data exist, does the data pass reasonable range checking and does the data pass relational checks. The methodology for applying the data quality begins by creating a contiguous database. This is necessary to maintain compatibility between the many sites on the server. Next, the data received for this site is fit into the database, in this case we are using 15-minute data. For any period where there is data, the data quality level is set to 3 for "Passes Relational Checks". We then work backwards to identify data that does not meet Relational and/or Range Checking.

The next step is to apply the relational checks. Relational checks attempt to identify data which is uncorroborated by the rest of the data set. For instance, data received indicating a DG/CHP Generator output when the gas use is zero is suspect. For data failing a relational check, the data quality level is set to 2 for "Data Passes Range Checks" or 1 for "Data Exists".

The last step is evaluating the range checks. The range checks consist of reasonable high and low values based on facility and DG/CHP Generator information. Data that falls outside the defined range for the database value has its data quality level set to 1 for "Data Exists."

It is necessary to work backwards when applying data quality checks to insure that data gets set to the lowest applicable data quality level. It is possible for data to pass the relational check and fail the range check and such data will be set to a data quality level of 1 for "Data Exists."

Table 1. Data Quality Definitions

Data Quality Levels	Description	Definition
3	Passes Relational Checking	This data passes Range Checks and Relational Checks. This is the highest quality data in the data set.
2	Passes Range Checks	This data passes the Range Checks but is uncorroborated by Relational Checks with other values.
1	Data Exists	This data does not pass Range Checks. This data is found to be suspect based on the facility and/or CHP equipment sizing.
0	Data Does Not Exist	This data is a placeholder for maintaining a contiguous database only.

Details on the Range and Relational Checks are found below.

Relational Checks

These checks are applied to the 15-minute data before it is converted to hourly data. If any of the 15-minute data points fails the relational check, the data for the entire hour is marked as failed. When there is a failure to obtain new data, the data set repeats the old value. We can identify this bad data through a relational check for repeating data on selected portions of the data set, which represent unique pieces of equipment. The data points labeled "Eng 1 O2 Sensor" through "Eng 2 Throttle" represent two pieces of equipment: the ones for with engine 1 in the name are one pieces and engine 2 is the other. We are using a threshold of 95% repeating values because some values reset to zero during the repeating periods.

Table 2. Relational Checks for Greenpark Care Center

Evaluated Point	Criteria	Result
FG	WG > 5 and FG <= 0	DQ Level for FG set to 2
WG_KW	WG > 5 and WG_KW = 0	DQ Level for WG_KW set to 2
QHR	CHP Efficiency (LHV) > 100 %	DQ Level for QHR set to 2
WG, WG_KW, QHR, SG	95% of channels "Eng 1 O2 Sensor" through "Eng 2 Throttle" for the given generator repeat previous values	DQ Level for WG, WG_KW, QHR and SG set to 1

Notes: FG – DG/CHP Generator Gas Use
WG – DG/CHP Generator Output
WG_KW – DG/CHP Generator Output Demand
QHR – Total Useful Heat Recovery
SG – Status/Runtime of the DG/CHP Generator

Range Checks

These checks are applied to the 15-minute data before it is converted to hourly data. If any of the 15-minute data points fails the range check, the data for the entire hour is marked as failed. The same ranges are used for both of the engines.

Table 3. Range Checks for Greenpark Care Center

Data Point	Hourly Data Method	Upper Range Check	Lower Range Check
DG/CHP Generator Output	Sum	21.25 kWh	0 kWh
DG/CHP Generator Output Demand	Maximum	85 kW	0 kW
DG/CHP Generator Gas Use	Sum	350 cubic feet	0 cubic feet
Total Facility Purchased Energy	Sum	N/A	N/A
Total Facility Purchased Demand	Maximum	N/A	N/A
Other Facility Gas Use	Sum	N/A	N/A
Unused Heat Recovery	Sum	N/A	N/A
Useful Heat Recovery	Sum	125 MBtu	0 MBtu
Status/Runtime of DG/CHP Generator	Sum	0.25 hrs	0 hrs
Ambient Temperature	Average	130°F	-30°F

Notes: Data failing the Range Check has the data quality level set to 1 for "Data Exists"

ASERTTI Protocol Adherence

This site adheres fully to the ASERTTI Long-Term Monitoring Protocol. Data is provided in 15-minute intervals satisfying the protocol. In addition, this site also has most of the optional performance parameters.

Monitoring Notes

December 20, 2006

CDH begins receiving daily file uploads from Connected Energy for this site.

January 12, 2007

CDH finishes reviewing data. The heat recovery data appears too high. Periodically, the CHP Efficiency calculated from the heat recovery will exceed 100% LHV. As of January 12, a relational check is being used to lower the data quality level of these periods by marking the heat recovery as failing relational checks.

This issue has been communicated to Connected Energy.