Hazel Towers Data Integrator Notes

This site is a multi-family residence located in the New York City borough of the Bronx. Two CoastIntelligen generators provide electricity and heat is recovered from the engine to supplement domestic hot water loads. Unused heat recovery is dissipated through a dump cooler. Data for this site is collected by Connected Energy and provided to CDH Energy.

Raw Data File and 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 35 data points. One data file is uploaded on a nightly basis containing the previous day's 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. Due to the variability in some of the source data channels, the online database is best viewed on a daily or monthly interval.

The timestamp in the raw data files is in Eastern Local Time. This means it obeys the Standard to Daylight savings time 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 hourly data used in the Data Integrator system is formed by summing or averaging the 15-minute data found the in the CSV files. Hourly maximum data, (such as demand) are assigned by taking the maximum 15-minute value for each hourly period.

Table 1. Data Integrator Database Mapping

Integrated Data System Channel	Units of Measure	Raw Data Column Descriptions [label]	Raw Data Units	Calculation Formula
DG/CHP Generator Output	kWh/h	Engine Real Power [AG]	kW	$=[AG]*$ (15 minutes ÷ 60 minutes/hour)
DG/CHP Generator Output Demand	kW	Engine Real Power [AG]	kW	$=[AG]$
DG/CHP Generator Gas Input	cuft/h	Engine Cumul. Fuel Use [C]	cuft	$=[C]$
Total Facility Purchased Energy	kWh/h	Grid Power Cumul. [I]	kWh/h	$=[I]$
Total Facility Purchased Demand	kW	Grid Power Rate [J]	kW	$=[J]$
Other Facility Gas Use	cuft/h	N/A	N/A	$=0$
Total Facility Energy	kWh/h	Calculated	kWh/h	
Total Facility Demand	kW	Calculated	kW	
Useful Heat Recovery	Mbtu/h	Utilized Heat Recovery Rate [V]	Mbtu/h	$=[V]*$ (15 minutes ÷ 60 minutes/hour)
Unused Heat Recovery	Mbtu/h	Dump Clr. Heat Dump Rate [Q]	Mbtu/h	$=[Q]*$ (15 minutes ÷ 60 minutes/hour)
Status/Runtime of DG/CHP Generator	hours	Calculated	hours	
Ambient Temperature[1]	°F	N/A	°F	N/A
Total CHP Efficiency	% LHV	Calculated	N/A	
Electrical Efficiency	% LHV	Calculated	N/A	

[1] – Hourly Temperature from wunderground.com for the LaGuardia airport has been substituted for the ambient temperature from the rawdata.

The details for each individual data point are outlined below.

DG/CHP Generator Output (total kWh)

The data for Generator Output comes from a 15-minute sample of the generator demand. The column of origin for this data point is labeled "Engine Real Power" in the data files received from Connected Energy. The rate data is converted to energy, in kWh, for the interval and then summed into hourly data.

DG/CHP Generator Output Demand (peak kW)

The data for Generator Output Demand comes from a 15-minute sample of the generator demand. The column of origin for this data point is labeled "Engine Real Power" 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 gas flow. The column of origin for this data point is labeled "Engine Cumul. Fuel 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)
The data for Facility Purchased Energy comes from a 15-minute accumulator for the utility energy imported. The column of origin for this data point is labeled "Grid Power Cumul." 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.

Total Facility Purchased Demand (peak kW)
The data for Generator Output Demand comes from a 15-minute sample of the generator demand. The column of origin for this data point is labeled "Grid Power Rate" in the data files received from Connected Energy. The maximum for a given hour is assigned to the hourly database.

Other Facility Gas Use (cubic feet)
There is no suitable data available for this channel in the RAW CSV files.

Total Facility Energy (total kWh) and Total Facility Demand (peak kW)
These two data points are the sum of the DG/CHP Generator Output and Total Facility Purchased data points.

Useful Heat Recovery (total MBtu)
The Unused Heat Recovery comes from the 15-minute average for useful heat recovery. The column of origin for this data point is labeled "Utilized Heat Recovery Rate" in the data files received from Connected Energy. The rate data is converted to energy, in MBtus, for the interval and then summed into hourly data.

Unused Heat Recovery (total MBtu)
The Unused Heat Recovery comes from the 15-minute average for dump cooler heat rate. The column of origin for this data point is labeled "Dump Clr. Heat Dump Rate" in the data files received from Connected Energy. The rate data is converted to energy, in MBtus, for the interval and then summed into hourly data.

Status/Runtime of DG/CHP Generator (hrs)
No status or runtime of the DG/CHP system is directly monitored. The operational runtime of the DG/CHP system is calculated from the power data. Each generator has a full loaded output of roughly 60 kW, or 15 kWh per 15-minute data record. The generator operating status is determined using the following ON/OFF threshold:

DG/CHP Operating Status	**Criteria**
ON	> 5 kWh (33% of nominal output for one engine) is produced in a 15-minute period
OFF	< 5 kWh (33% of nominal output for one engine) is produced in a 15-minute period

These status values are then summed for each 15-minute interval and then summed into hourly data for the online database.

Ambient Temperature (avg °F)
The Ambient Temperature comes from hourly sampled conditions at LaGuardia 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 (%),Electrical Efficiency (%)
The two system efficiencies are calculated using the hourly data in the Integrated Data System database.

The Total CHP Efficiency includes the useful heat recovery, and is based on the lower heating value (LHV) of natural gas for this site.

Equation 1. Formula for Total CHP Efficiency

$$EFF_{chp} = \frac{\left(WG \times 3.413 \frac{kWh}{\text{MBtu}}\right) + QHR}{FG \times 0.93 \frac{MBtu}{cu\ ft}}$$

Where:
EFF_{chp} = Total CHP Efficiency (%)
WG = DG/CHP Generator Output (total kWh)
QHR = Useful Heat Recovery (MBtu)
FG = DG/CHP Generator Gas Input (cubic feet)

The Electrical Efficiency does not include any heat recovery, and is also based on the lower heating value (LHV) of natural gas for this site.

Equation 2. Formula for Electrical Efficiency

$$EFF_{elec} = \frac{\left(WG \times 3.413 \frac{kWh}{\text{MBtu}}\right)}{FG \times 0.93 \frac{MBtu}{cu\ ft}}$$

Where:
EFF_{elec} = Total CHP Efficiency (%)
WG = DG/CHP Generator Output (total kWh)
FG = DG/CHP Generator Gas Input (cubic feet)

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 2. 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.

Table 3. Relational Checks for Hazel Towers

Evaluated Point	Criteria	Result
FG	WG > 0 and FG <= 0	DQ Level for FG set to 2
WG, WG_KW, SG	WG = 0 and WG_KW > 0	DQ Level for WG_KW, WG and SG set to 2

Notes: FG – DG/CHP Generator Gas Use
WG – DG/CHP Generator Output
WG_KW – DG/CHP Generator Output Demand
SG – Status/Runtime of 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.

Table 4. Range Checks for Hazel Towers

Data Point	Hourly Data Method	Upper Range Check	Lower Range Check
DG/CHP Generator Output	Sum	41 kWh	0 kWh
DG/CHP Generator Output Demand	Maximum	125 kW	0 kW
DG/CHP Generator Gas Use	Sum	500 cubic feet	0 cubic feet
Total Facility Purchased Energy	Sum	125 kWh	0 kWh
Total Facility Purchased Demand	Maximum	500 kW	0 kW
Other Facility Gas Use	Sum	N / A	N / A
Unused Heat Recovery	Sum	250 MBtu	0 MBtu
Useful Heat Recovery	Sum	250 MBtu	0 MBtu
Status/Runtime of DG/CHP Generator	Sum	0.5 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 some of the optional performance parameters.

Monitoring Notes

September 29, 2006

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

September 12, 2007

Based on feedback regarding the performance of this site, the useful heat recovery value recorded in the database has been altered. The original database included data from column 18 "Cumul. Cogen Heat Rec" which appears to represent the combination of the "useful" heat recovered to the DHW HX, and "unused" heat lost to the dump radiator. All data in the database has been updated for this correction.