Shoprite Supermarket (Brooklyn, NY) Data Integrator Notes

Shop-Rite is a supermarket located in Brooklyn, NY. The facility has a 140 kW Hess engine running on natural gas. Heat is recovered from the engine by a jacket water loop as well as an exhaust HX. The useful heat recovery loads are the Yazaki absorption chiller and a desiccant dryer. The Yazaki chiller, in series with an electric chiller, provides chilled water for refrigerant subcooling. The chilled water loop also removes heat from the intercooler on the engine. 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 90 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 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 Shoprite data is summarized in Table 1. Due to the variability in some of the source data channels, the online database is best viewed on a daily or monthly interval.

Table 1. Data Integrator Database Mapping

Integrated Data System Channel	Units of Measure	Raw Data Column Descriptions [col][1]	Raw Data Units	Calculation Formula
DG/CHP Generator Output	kWh/int	Generator Total Energy Product [BW]	kWh	$=[BW]$
DG/CHP Generator Output Demand	KW/int	Generator Power, Total [BX]	kW	$=[BX]$
DG/CHP Generator Gas Input	cuft/int	Natural Gas to Engine Cumul [C]	cuft	$=[C]$
Total Facility Purchased Energy	kWh/int	N/A	N/A	N/A
Total Facility Purchased Demand	KW	N/A	N/A	N/A
Other Facility Gas Use	cuft/int	N/A	N/A	N/A
Total Facility Energy	kWh/int	Calculated		
Total Facility Demand	kW	Calculated		
Useful Heat Recovery	MBtu/int	Total Heat Used Rate [AC]	MBtu/h	$=[AC]$* 15 minutes/int ÷ 60 minutes/hour
Unused Heat Recovery	MBtu/int	Dump Cooler Heat Dump Rate [AD]	MBtu/h	$=[AD]$* 15 minutes/int ÷ 60 minutes/hour
Status/Runtime of DG/CHP Generator	Hours/int	Calculated		
Ambient Temperature	°F	Outdoor Ambient Temp [L]	°F	$=[L]$
Total CHP Efficiency	% LHV	Calculated	N/A	
Electrical Efficiency	% LHV	Calculated	N/A	

[1] – The Raw Data Column Description is from the Connected Energy CSV files. The corresponding column id (i.e., A,B,C…) is given in square brackets and shown in the calculation formulas.
Int - interval

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 "Generator Total Energy Product" 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 "Generator Power, Total" 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 "Natural Gas to Engine Cumul" 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 two data points are the sum of the DG/CHP Generator Output and Total Facility Purchased data points. Since the Total Facility Purchased data points are not available, this channel cannot be calculated.

Unused Heat Recovery (total MBtu/h)
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 Cooler 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.

Useful Heat Recovery (total MBtu/h)
The Unused Heat Recovery comes from a 15-minute average for the utilized heat recovery rate. The column of origin for this data point is labeled "Total Heat Used 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)
The engine is defined as being fully on for a 15-minute interval if the engine power output is greater than 1 kW for the period (the fully-loaded capacity is approximately 75 kW). The status is given a value of 0.25 if the generator output is above 1 kW and the status is assigned 0.0 if it is below for each of the three generators. 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 a 15-minute average for outdoor temperature. The column of origin for this data point is labeled "Outdoor Ambient Temp" in the data files received from Connected Energy. The 15-minute average temperature is averaged into hourly data for 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 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 4C Foods

Evaluated Point	Criteria	Result
FG	WG > 5 and FG <= 0	DQ Level for FG set to 2

Notes: FG – DG/CHP Generator Gas Use
WG – DG/CHP Generator Output

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 4C Foods

Data Point	Hourly Data Method	Upper Range Check	Lower Range Check
DG/CHP Generator Output	Sum	20 kWh	0 kWh
DG/CHP Generator Output Demand	Maximum	80 kW	0 kW
DG/CHP Generator Gas Use	Sum	1,300 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	250 MBtu	0 MBtu
Useful Heat Recovery	Sum	250 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

September 3, 2007

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

November 28, 2007

CDH finishes reviewing data and notified Connected Energy of several data issues. The data issues are addressed on this date and the data from this day forward is now reliable. Data prior to this date will not be shown in the online database.