CITY OF MONTPELIER
CAPITAL CITY OF VERMONT

City Manager's Weekly Report – 9/25/2015

UPCOMING MEETINGS …

- Monday, September 28th — Planning Commission Meeting, 5:30 P.M. in the City Council Chambers
- Tuesday, September 29th — Pedestrian Advisory Committee Meeting, 5:30 P.M. in the Memorial Room
- Thursday, October 1st — Community Fund Board Meeting, 4:00 P.M. in the City Council Chambers

  Tree Board Meeting, 5:30 P.M. in the Memorial Room

FOR YOUR CALENDARS …

- Tuesday, October 13th — Community Budget Forum #2, 6:30 P.M. in the Montpelier High School Cafeteria. (This forum will review all contributed and set key priorities for the City Council as they build future budgets abased on the collective values of city residents.)

ATTACHMENTS …

- District Heat Montpelier - Heating Season Review: 10-1-14 through 4-30-15
- "We Walk Week" Flyer

CITY MANAGER'S REPORT …

District Heat Montpelier

Next week District Heat Montpelier will switch back over to the State's Heat Plant from the City's furnace. The City Hall furnace is used in the summer to provide energy to the system for domestic hot water use. With the start of the heating season (October through April), we will switch back to the State Heat Plant. This week, the 2014-2015 Year End Reports were provided to each customer. These reports detailed both the overall system functioning, as well as an analysis of the individual building's performance. The City Hall example is provided here.

Legal

VCFA vs. City, Tax Appeal. – Motions for Summary Judgment were filed by both parties on June 15. Represented by Robert Fletcher.
Bettis/Powers vs. Bean – Motions being filed. Represented by Nancy Sheahan through VLCT.
Illuzzi vs. City, Law, Motyka, Renaud Bros. – Motions have been filed. Going into mediation. Represented by Constance Tryon Bell through VLCT.
Hallsmith Hearing is set for November 9, 2015.

WEEKLY UPDATES FROM DEPARTMENT HEADS …

None this week

TOPICS FOR UPCOMING CITY COUNCIL MEETINGS …

October 13	Public Budget Discussion 2 (MHS Cafeteria)
October 14	Debrief Public Forums Goal Discussion - TBD Budget Schedule ? Winter Parking Ordinance Discussion
October 28	Mowatt Site Visit Mowatt Necessity Hearing Goal Discussion – TBD Tentative: Zoning Update by PC
November 11	Budget Direction Parking Study Rec Transition Manager's 6-month Review
November 18	Goal Discussion – TBD Berlin Pond Charter Change

William J. Fraser
City Manager

City of Montpelier

District Heat Montpelier

Heating Season Review: October 1, 2014 through April 30, 2015

DISTRICT HEAT MONTPELIER

AN ENERGY INDEPENDENT DOWNTOWN

City of Montpelier vermont

June 29, 2015

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Summary

District Heat Montpelier (DHM) is the thermal utility operated by the City of Montpelier. DHM distributes thermal energy through a system of underground pipes to downtown Montpelier. For the source of heat, the City has contracted with the State of Vermont to receive energy in the wholesale form from the rebuilt central heat plant located at 120 State Street in Montpelier. Eighteen accounts, representing twenty-one buildings comprising 421,052 square feet of heated space have elected to receive heat from DHM.

The 2014-2015 Heating Season represented the first full season of operation of DHM. During the 212 days of the Heating Season, the system provided 100% availability; at no time was heat not delivered to customers of the system.

While the Heating Season was off to a mild start, with the month of October being 14% milder that the average of the previous fifteen Octobers, the season as a whole turned out to be one of the coldest of the previous fifteen heating seasons, with numerous new record lows being set. During the 59 period from January 1, 2015 through February 28, 2015 the outdoor air temperature rose above freezing for only two brief periods, with a minimum temperature of -23 ^{O}F being experienced during this period. In spite of the severity of the winter, all connected buildings maintained their desired level of heat at all times.

DHM delivered 14,625 million British Thermal Units (MMBTUs) of energy to its customers between October 1, 2014 and April 30, 2015. The delivered heat was comprised by 88.6% renewable, locally sourced biomass, and 11.4% conventional fuel oil.

If this heat was supplied by individual building furnaces it would require the consumption of an estimated 137,700 gallons of fuel oil.

Introduction

District Heat Montpelier (DHM), is the thermal utility operated by the City of Montpelier. The system was constructed in calendar year 2013. It consists of a set of parallel pipes which run underground in the downtown core of Montpelier. One of the pipes is a hot water supply pipe for building heating, whereas the other pipe returns a cooler water which results from the energy being extracted for building heating. The pipes come from the factory with high performance polyurethane foam insulation and have a high density polyethylene outer cover for protection. The new hot water district heating system has a subscribed customer base of an estimated 421,052 square feet of heated space. Figure 1 presents the piping used to distribute the thermal energy throughout the system.

Figure 1. District heat insulated thermal energy distribution pipe.

The constructed distribution system is comprised of 8,000 feet of pipe located in 4,000 feet of trench which runs through the core of downtown Montpelier. Over 900 welds connect the insulated pipe into a closed loop system for the supply and return of thermal energy to heat twenty-one buildings.

The route of the City's thermal energy distribution system runs from the central heat plant at 120 State Street to Taylor Street, north on Taylor Street, then east on State Street to Elm Street. The system continues north on Elm Street to Langdon Street,

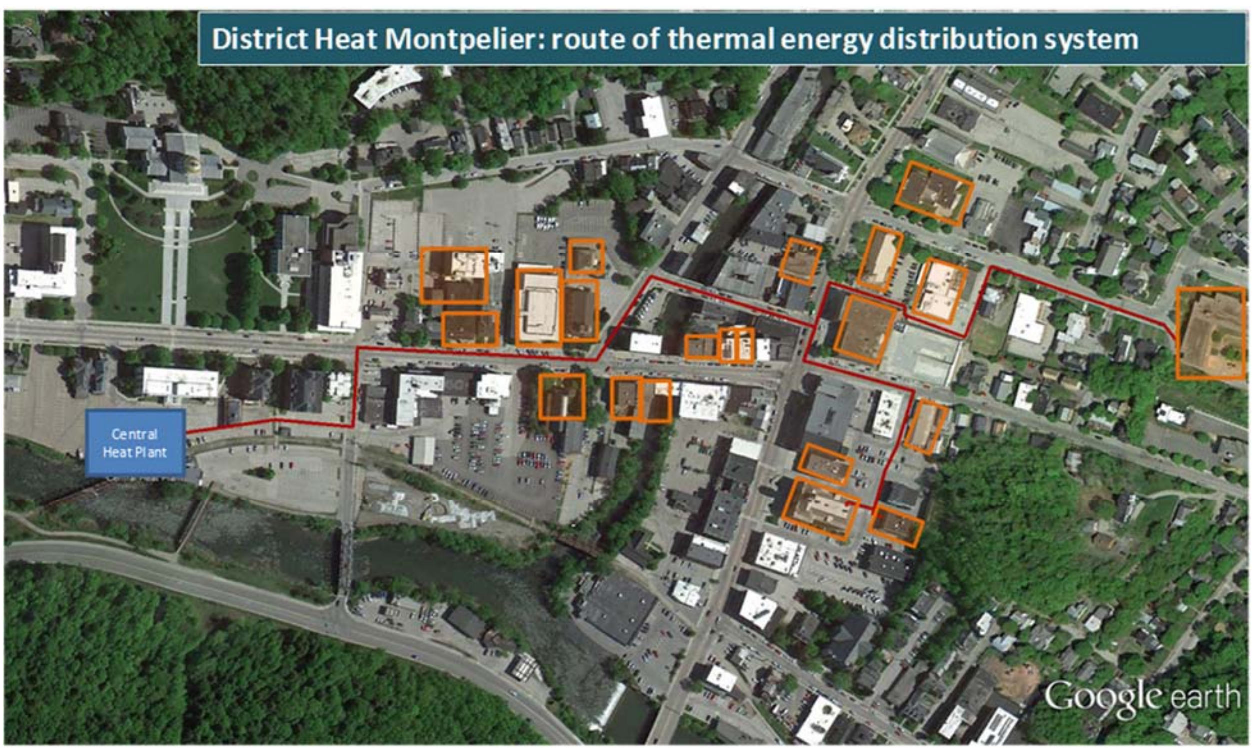


Figure 2. Routing of DHM's main underground piping.

where it crosses the North Branch River attached to the underside of the Langdon Street Bridge. At the intersection of Langdon and Main Streets, the route splits, with a branch heading north on Main Street then east to eventually terminate with service to Union Elementary School. The other branch turns south, then east providing service to the municipal complex of City Hall, Fire Station and Police Station. Figure 2 presents the routing of the underground piping and Table 1 lists the buildings served by DHM. All of these building have historically been heated with individual furnaces or boilers fueled by distillate fuel oil.

Of the twenty-one buildings, three are municipal buildings, one is an elementary school, another is a federal building, two are county buildings, two are churches, one is a library and eleven are privately owned commercial buildings made up of office buildings, retail space, restaurants and a cafe.

Table 1. Buildings Served by District Heat Montpelier

No. of Bldgs.	Address	Building Area, ft.^{2}
2	City Hall/Fire Station	43,466
1	Police Station	9,300
1	Union Elementary School	60,804
1	Federal GSA Building	50,996
1	Washington County Courthouse	9,800
1	Washington County Sheriff’s Office	6,845
2	89 State Street	37,419
1	52 State Street	8,217
1	46 State Street	12,730
1	27 State Street	11,519
1	15 State Street	8,682
1	17 State Street	7,191
1	118 Main Street	14,033
1	89 Main Street	71,718
1	15 East State Street	8,852
1	115 Main Street	13,037
1	64 State Street	15,866
1	23 School Street	13,495
1	135 Main Street	17,082
21	TOTALS	421,052

The source of the thermal energy which the City distributes is the State of Vermont’s (SOV’s) central heat plant located at 120 State Street (Figure 3). The SOV’s central heat was originally built in 1947. In 2013-2014 it was completely rebuilt. The new central heat plant is fitted with two 600 boiler horsepower - BHP - biomass boilers (20.1 MMBTUH each) and has the ability to accommodate a third boiler of equal size at a point in the future if desired.

The reconstructed heat plant has the capacity to support the current steam distribution system that serves state buildings of the Capitol Complex and the City of Montpelier’s new hot water thermal energy distribution system (DHM). Of the total 40.2 MMBTUH capacity of the central heat plant, 9.71 MMBTUH is allocated to the City for the district heat system, 23.9 MMBTUH to support SOV steam district heating system, and the remaining 6.59 MMBTUH available to support growth of either the City or State systems.

Figure 3. State of Vermont's central heat plant.

In addition the central heat plant has a 300 BHP light-oil fueled boiler for periods when the load on the system is not sufficient for efficient biomass boiler operation (primarily the first and last month of the heating season), periods of load instability or for backup operations.

Figure 4. Steam to Hot Water Heat Exchanger (SHWX) located in the City Room at the central heat plant.

For the next twenty years of heating seasons[1] the City has contracted for the supply of energy from the SOV's central heat plant. For the non-heating season, thermal energy is provided to the distribution system by the boilers located at City Hall. These boilers pre-dated DHM and were the boilers that originally provided heat for City Hall and the Fire Station. Through this combination of contracted energy from the SOV and operation of the boilers located in City Hall, DHM is now providing year-round thermal energy to the customers of DHM.

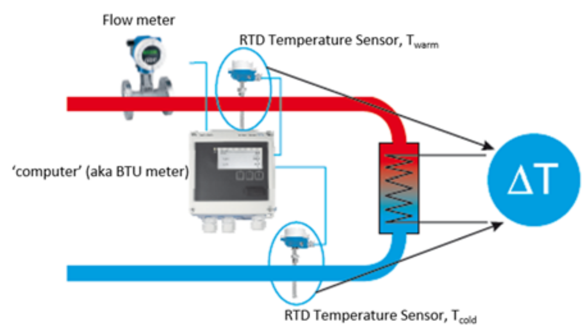


Figure 5. Components of a thermal metering system.

The thermal energy distributed is measured both by the SOV for the wholesale energy provided to DHM; and DHM measures the energy taken by each of its customers. The SOV measurement is the steam energy supplied to the City's steam to hot water heat exchanger (SHWX – Figure 4) located at the central heat plant and the heat content of the steam condensate returned to the central heat plant. The net of these two measurements is the energy taken by DHM to provide heat for distribution to its customers.

Figure 6. Photograph of typical thermal metering system installation.

Fitted at DHM customer locations is a thermal metering system that records the amount energy each building takes. The individual building metering systems are comprised of a flow meter to measure the flow of hot water the building control system commands for heating, the temperature of the supply water and the temperature of the return water after the energy necessary to the heat the building has been extracted by the building heat exchanger system. A "BTU" meter (specialized computer) receives the signals from these devices and calculates the energy taken by the building. The BTU meter is connected to a central computer via an Ethernet cable that runs with the underground piping and provides a

[1] A heating season is defined as the period October 1 of the current year through April 30 of the subsequent year. For example, the 2014-2015 heating season ran from October 1, 2014 through April 30, 2015. Reference to no-heating season is the period May 1 through September 30 of the subsequent year of the heating season. For the 2014-2015 heating season, the non-heating season would be the period May 1, 2015 through September 30, 2015.

detailed record of energy and related statistics to a central database to support thermal energy billing. Figure 5 provides a schematic of the components of the thermal metering system and Figure 6 is a photograph of a typical installation. It is of note that the distribution system water does not circulate through a building. Heat is extracted from the distribution system water by a building heat exchanger system, and it is that water that is circulated throughout a building for heating.

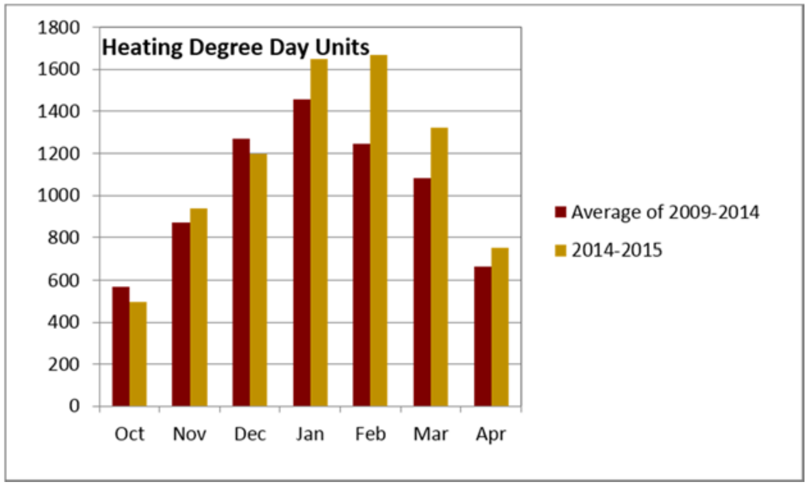


Figure 7. Comparison by month of HDDUs for 2014-2015 to the average of the previous five years

Operations

The 2013-2014heating season was the first year of operation of DHM. As the central heat plant was under construction for most of this period, DHM's operation was limited to the capacity that the existing

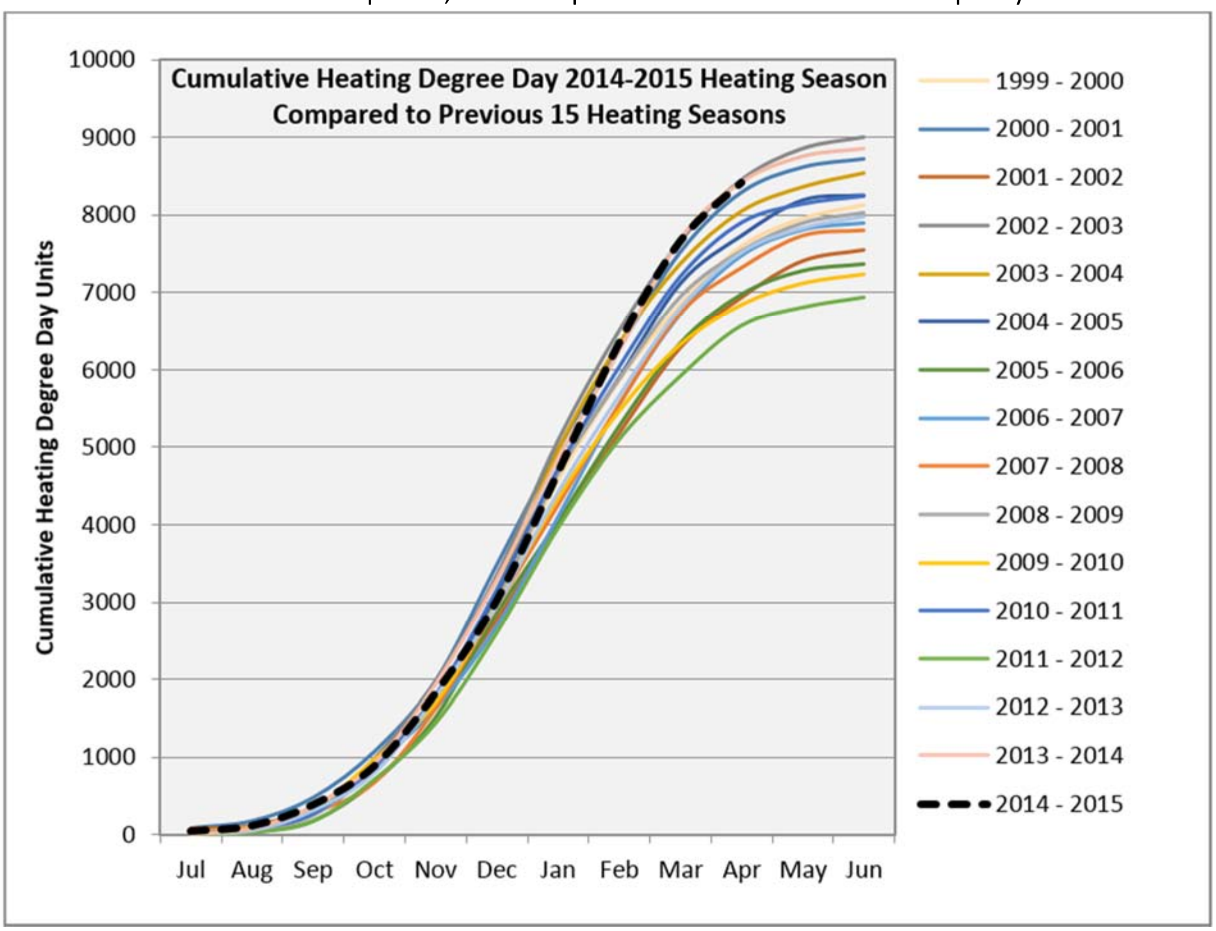


Figure 8 Cumulative Heating Degree Days for Current Heating Season (to date) and Previous fifteen

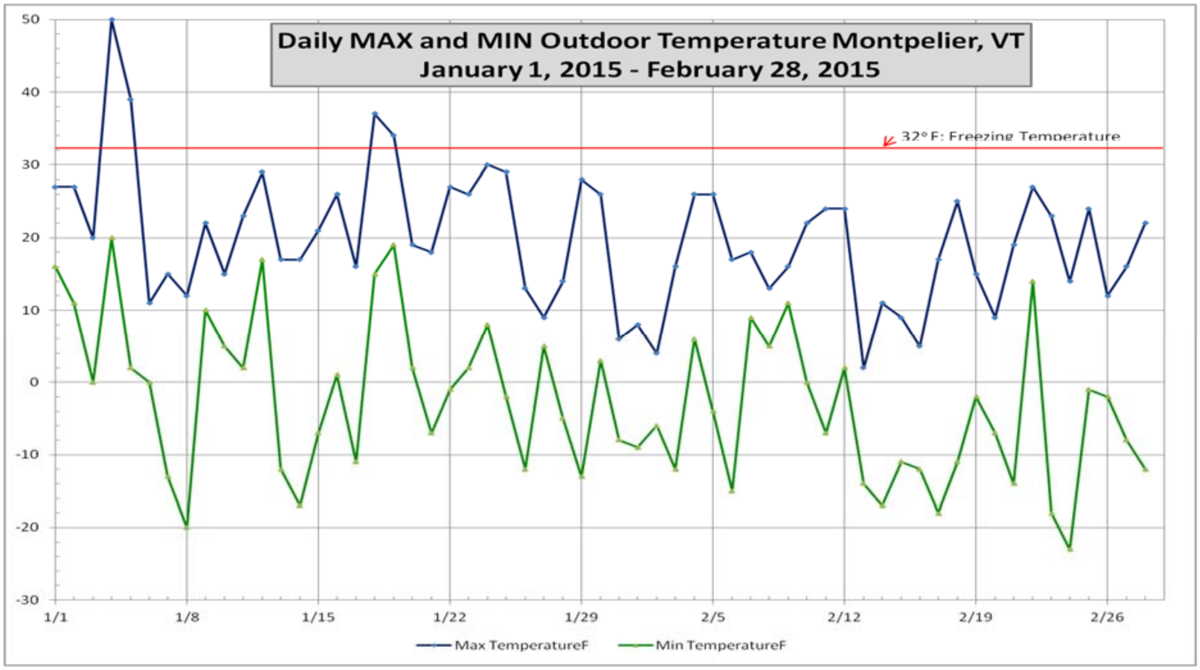


Figure 9 Daily Maximum and Minimum outdoor air temperature, January and February, 2015

conventional oil fired boilers at City Hall could carry. For the 2013-2014 season, DHM served six buildings, with two of the six buildings supplementing their heating needs with their historical heating systems. For the 2014-2015 heating season, all heating needs were supplied by the SOV's central heat plant.

The thermal energy provided by DHM is principally used for space heat, therefore the load is driven by the severity of the heating season. A common measure of heating load severity is the Heating Degree Day Unit (HDDU). HDDU is a unit of measurement equal to a difference of one degree between the mean (average) outdoor temperature on a certain day and a reference temperature. A common reference temperature is 65^{O}F. If the average outdoor temperature is 65^{O}F, the HDDUs is zero (65-65 = 0). If the average outdoor temperature were to be -3^{O}F, the HDDUs would be 68 (65-[-3] = 68)). Summing the daily HHDUs provides a running tally of the severity of the heating requirements for a heating season.

As the heating season progressed a total of sixteen of the eighteen accounts were receiving heat from DHM by the end of February 2015. This represented over 95% of the subscribed customers. By the end of the heating season, one of the two remaining accounts began receiving heat for a total load of 411,024 square feet (97.6% of the subscribed space). The remaining building is expected to be served in the 2015-2016 Heating Season.

The 2014-2015 heating season was off to a mild start. On a Heating Degree Day basis, October was 14% milder than the average of the previous fifteen Octobers, November was 8% colder than the respective average and December was 7% milder. However, as the calendar turned to 2015, winter came on strong with January 12% colder than the long term average and February 31% colder. Several cold weather records were broken during the first two months of 2015. For example, for the 59 day period from January 1 to February 28, 2015, the outdoor air temperature rose above the freezing temperature for only two brief periods; and the minimum temperature recorded during this period was -23^{o}F. The seasonal cumulative HDDU data are presented in Figure 7 and Figure 8, and time series of temperature for the 59 day period in Figure 9.

To meet the heating needs of the City and State connected load, the central heat plant fuel consumption included 6,302 tons of wood chips and 42,742 gallons of fuel oil between October 1, 2014 and April 30, 2015. Consumption of wood chips by month on a weight basis is presented in Table 2 and on an estimated heat input basis in Table 3:

Table 2.	SOV Central Heat Plant Total Fuel Consumption									
2014-2015 Heating Season										
	Boiler #1				Boiler #2				Boiler #3	
	Wood		#2 Oil		Wood		#2 Oil		#2 Oil	
Month	Tons	Hours	Gallons	Hours	Tons	Hours	Gallons	Hours	Gallons	Hours
October	61.5	87	966	23	92.26	135	0	0	16682	472
November	572.26	685	0	0	37	45	0	0	475	11
December	245.6	359	105	2	777.56	744	0	0	1315	32
January	736.97	663	0	0	824.41	744	0	0	2368	79
February	677.29	630	3532	42	795.07	580	0	0	2060	59
March	232.36	178	5758	70	735.8	684	0	0	594	12
April	0	0	0	0	514.1	561	0	0	8887	196

Table 3.	SOV Central Heat Plant Total Energy Production				
2014-2015 Heating Season					
	Boiler #1		Boiler #2		Boiler #3
	Wood	#2 Oil	Wood	#2 Oil	#2 Oil
Month	MMBTUs	MMBTUs	MMBTUs	MMBTUs	MMBTUs
October	461.3	133.3	692.0	0.0	2302.1
November	4292.0	0.0	277.5	0.0	65.6
December	1842.0	14.5	5831.7	0.0	181.5
January	5527.3	0.0	6183.1	0.0	326.8
February	5079.7	487.4	5963.0	0.0	284.3
March	1742.7	794.6	5518.5	0.0	82.0
April	0.0	0.0	3855.8	0.0	1226.4

Fuel oil is used for the specific functions: the total load is not enough to operate the biomass boilers efficiently; for load stabilization; or as a back-up heat source. In addition fuel oil is used to keep the backup boiler at the ready. This enables an immediate cut-over to the back-up boiler in the unlikely event of needing the back-up boiler to provide service.

Capacity and Energy

Two important terms associated with the delivery of thermal energy is Capacity, also known as Power, or Demand, and Energy. An understanding of these properties of delivering heat is important both for a technical understanding of system operations and for billing of service by DHM.

In physics, Energy is the ability to do work. As it relates to DHM, Energy is effectively the amount of fuel required to meet the heating needs of a building. As compared to a conventional heating system, Energy is analogous to the amount of fuel consumed to heat a building (absent the inefficiencies of combusting that fuel into the desired energy). The unit of measure used by DHM for Energy is *millions* of British Thermal Units[2] (millions of BTUs is expressed as MMBTUs).

Power, or Capacity is the amount of energy produced in a given amount of time. As Capacity is Energy per unit of time, DHM measures Capacity in British Thermal Units per Hour. For convenience the specific units are *thousands* of BTUs per hour and is represented as MBTUH.

The terms are important for billing as DHM has a two component rate structure: there is a Capacity Charge and an Energy Charge component to a customer's bill. For FY 2015 (which encompasses the 2014-2015 heating season), the Capacity Rate was set at $4.84/MBTUH and the Energy Rate was $8.82/MMBTU. A Capacity Charge is generally applied for each of the seven months of a Heating Season based on a contracted capacity provided in a Customer Agreement. An Energy Charge is provided for all energy recorded by the thermal metering system.

As an analog to a car, energy is the fuel in the tank and capacity is the size of the engine.

System Performance

Data collected for the heating season has been reviewed. The review has been for system-wide performance and the performance of individual buildings. System-wide performance is presented in this section, whereas building performance is summarized in an Appendix.

Figure 10. Photograph of steam limiting valves at the central heat plant.

The City of Montpelier has acquired 9.71 MMBTUH of capacity from the SOV to support the operation of DHM. A limiting valve is installed at the central heat plant which limits the steam provided to the SHWX (see Figure 10). Under the terms of the agreement between the City and the SOV, if the City desires additional capacity there are three options available; 1) to permanently acquire additional capacity from the SOV, 2) rent additional capacity for short period of time, or 3) provide the capacity by operating the boilers at City Hall. If option 3 is elected, there are hours of limitation of this option during the heating season.

Parallel to the issue of taking capacity from the central heat plant is the processing of that capacity through the SHWX to provide the

[2] A British Thermal Unit (BTU) is a unit of energy required to heat one pound of water one degree Fahrenheit (^{O}F). A pound of dry wood generally represents 8,500 BTUs; a gallon of fuel oil generally represents 138,000 BTUs.

thermal energy to the distribution system. The SHWX system is comprised of two heat exchanging units. Each unit has a rating of approximately 8 MMBTUH. While the system has the capability for both units to operate simultaneously, the current configuration is to operate one unit at a time. And while the units are rated at 8 MMBTUH, the units can operate over this design rating.

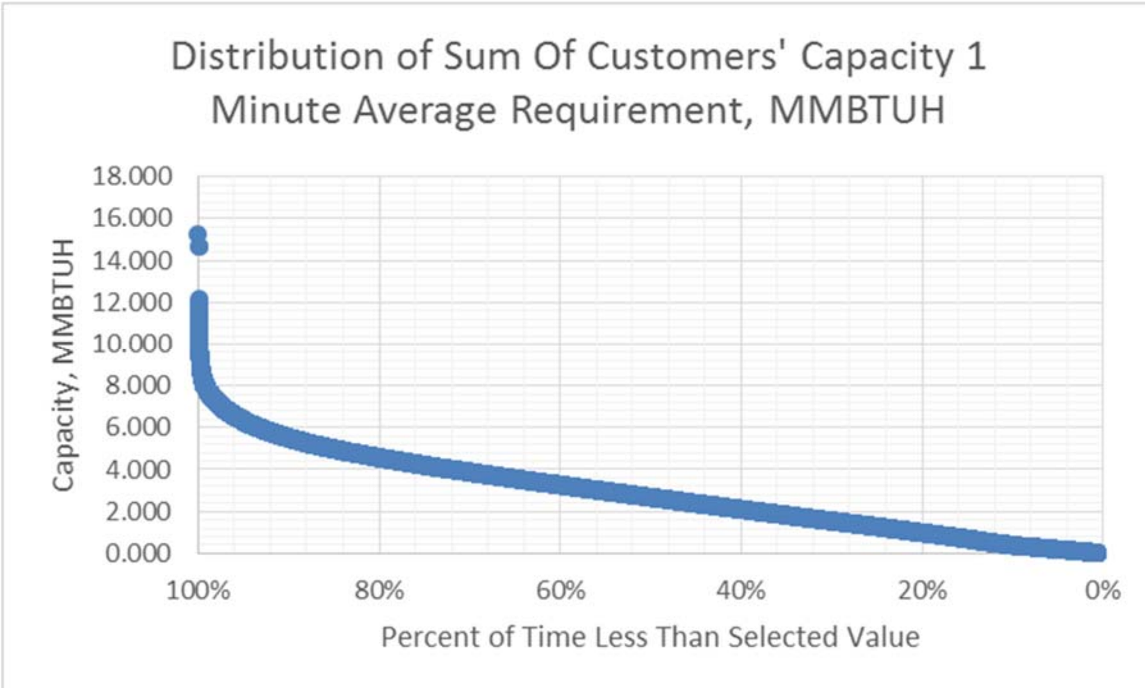


Figure 11. Distribution of total delivered Capacity (sum of customers) by DHM for the 2014-2015 Heating Season; 1-minute average.

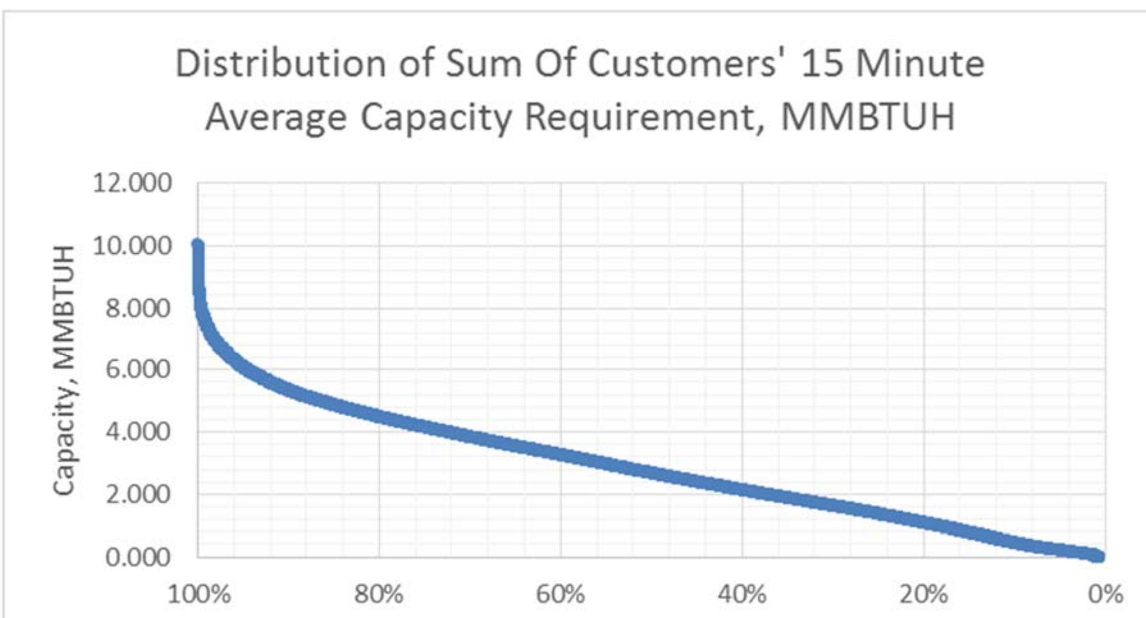


Figure 12. Distribution of total delivered Capacity (sum of customers) by DHM for the 2014-2015 Heating Season; 15-minute average.

The thermal metering system makes second by second readings of the monitored components. These data are stored as minutely averages with maximum/minimum daily statistics retained at the one-second resolution. For the heating season, a complete record of the thermal metering system is 212 days, or 5,088 hours or 305,280 minutes of time series data, plus the daily retained statistical information.

The total capacity supplied by DHM to its customers is the sum of the capacity recorded by the thermal meter at each building served. The distribution of these data are presented in Figures 11 and 12. Figure 11 are the data for a one minute averaging period and Figure 12 is for a fifteen minute averaging period. From this review the maximum 1-minute average Capacity delivered was 15.270 and a maximum 15-minute average capacity delivered to the sum of customers was 10. 069 MMBTUH

Based on the above load profiles, the maximum sum of supplied capacity exceeds DHM's allocation of the central heat plant by an estimated 0.1% of the time (an estimated 300 minutes over the course of the Heating Season). During these periods, system performance is degraded as the demand on the system is greater than the supplied capacity, as the controlling factor on capacity is the operational configuration of the SHWX. When these peak conditions exceed system-wide capacity the supply water temperature is reduced; as more energy is being taken out of the system than is provided to the system. This is evidenced

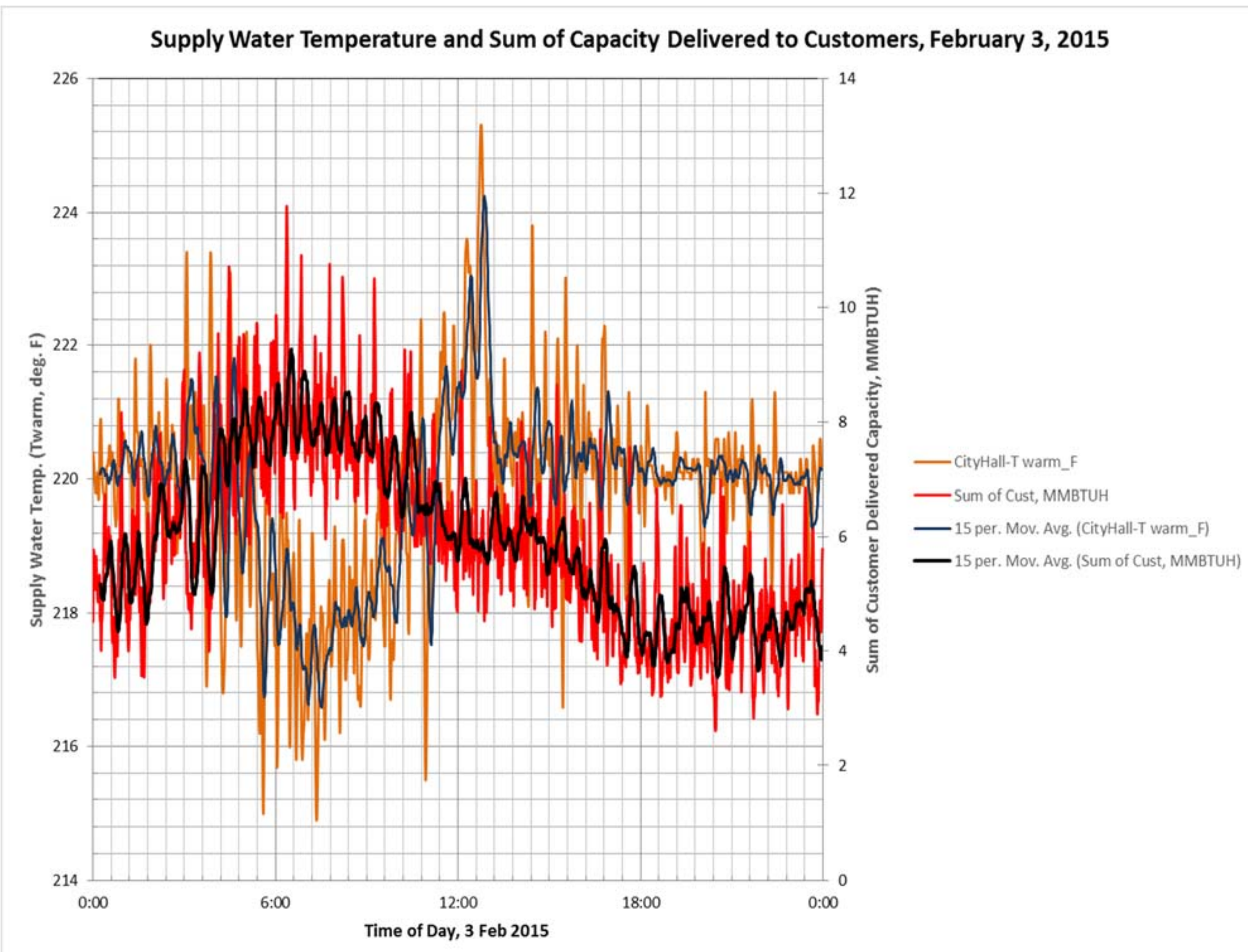


Figure 813. Data for February 3, 2015 presenting the Sum of Delivered capacity to DHM's customers and the Supply Water Temperature as measured at City Hall.

by the data presented in Figure 13, a time series plot of the supply water temperature as measured at City Hall and Sum of Capacity taken by the customers.

It for the day of February 3, 2015. The maximum outdoor temperature on February 3 was 2^{O}F; the low was -12^{O}F -- a new record low for the date -- resulting in 70 Heating Degree Day Units. The one-minute average Sum of Capacity delivered to customers peaked at 11.765 MMBTUH at the minute starting at 6:22 AM; the 15-minute average peaked at 9.262 MMBTUH with the minute starting at 6:17:00 AM and ending at 6:31:59 AM.

An examination of the chart concludes, as the Sum of the Delivered Capacity exceeds 8 MMBTUH, the supply water temperature begins to drop. As the Sum of Delivered Capacity continues to increase, the supply water temperature continues to decrease. It is not until the peaks and begins to decrease does the supply water temperature begin to increase. It is only when the Sum of Capacity decreases to below 8 MMBTUH is the supply water temperature able to control to its design value.

Over the course of the heating season DH sold 14,624.910 MMBTUs of thermal energy to its customers. Figure 14 presents the distribution of this energy both daily and monthly and relates it the HDDUs recorded.

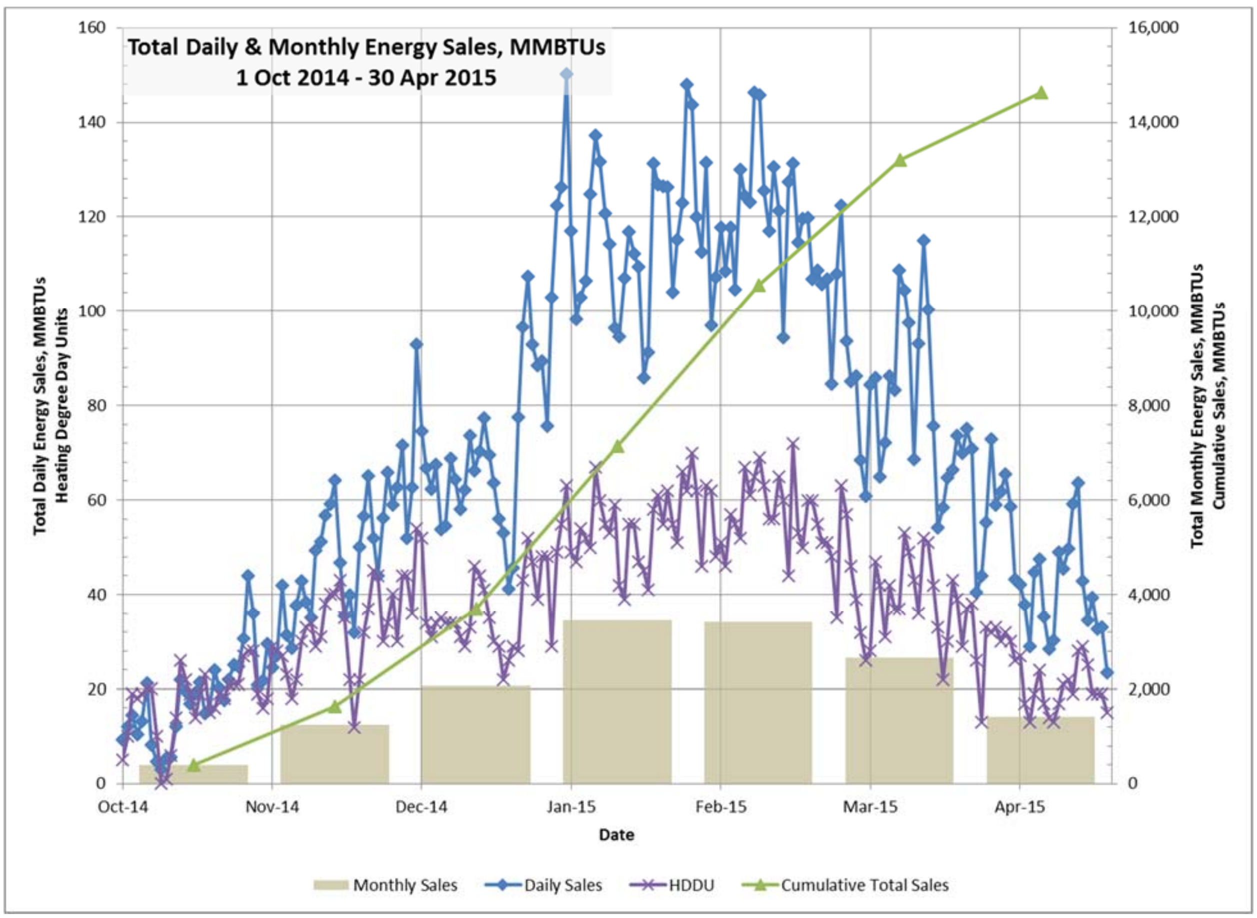


Figure 14. Seasonal energy supplied and heating degree day units; Daily and Monthly data.

Appendix – A

Explanation of Customer Data Reviews provided in Appendix B

[Note: Appendix B contains a set of standard data summaries for each customer that took energy from District Heat Montpelier (DHM) during the 2014-2015 Heating Season.

This appendix provides an overview and explanation of the information presented in Appendix B – Customer Data.]

Common name of building to which service is provided

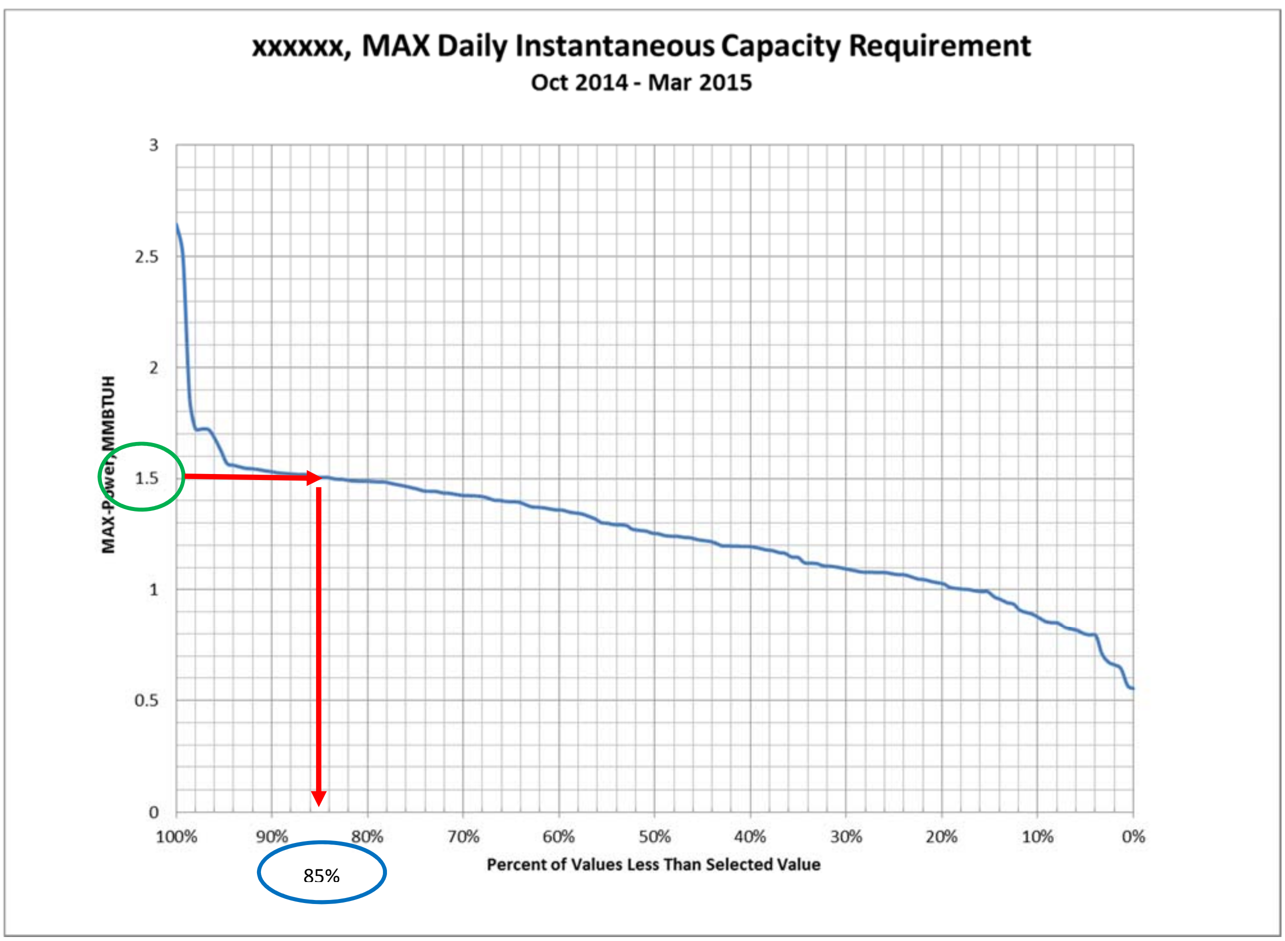
Building name
Street address
Tax Parcel ID number
The amount of finished area in square feet listed in the tax record

A photo of the building served

Customer Agreement Initial Capacity:	*The 'Initial Capacity' which the customer has contracted for in their Customer Agreement*
Date of first energy take from system:	*The date of which service commenced for the 2014-2015 Heating Season*
Data completeness:	*The percent of data available. The thermal metering system retains a record for every minute of operation. Therefore there are 305,280 records in a complete Heating Season. For example, if "Data completeness" is 50%, the review id based upon 152,640 records.*
Instantaneous maximum demand:	*The thermal metering systems samples at a one-second interval and retains certain statistics in addition to the one-minute records. One of those statistics is the "Instantaneous maximum demand" for each day of operation. This is the instantaneous maximum capacity demand of a day. The data presented is the value of the capacity called for, and the date, hour, minute and second which the demand was placed on the system.*
Maximum 1-minute average demand:	*The magnitude, and date, hour and minute of the "Maximum 1-minute average demand" or capacity which the building's control system called for from DHM.*
Maximum 15 minute running average demand:	*The magnitude, and date, hour and minute of the "Maximum 15-minute average demand" or capacity which the building's control system called for from DHM.*
Capacity at 99.8-Percentile 1-minute average:	*The capacity that was not exceeded 99.8% of the time; that is the capacity called for was equal to less than this value 99.8% of the time based on the one-minute average data. Conversely, this value was exceeded 0.20% of the time, approximately 10 hours at 100% data completeness.*
Capacity at 99.8-Precentile 15-minute average:	*The capacity that was not exceeded 99.8% of the time; that is the capacity called for was equal to less than this value 99.8% of the time based on the fifteen-minute average data. Conversely, this value was exceeded 0.20% of the time, approximately 10 hours at 100% data completeness.*
Percentile at Contracted Capacity, 1-minute average:	*The percentile of the data distribution of the "Initial Capacity" as found in the Customer Agreement based on the one-minute average. One hundred minute the value provided would be a measure of the percent of time the "Initial Capacity" is exceeded.*
Percentile at Contracted Capacity, 15-minute average:	*The percentile of the data distribution of the "Initial Capacity" as found in the Customer Agreement based on the fifteen-minute average. One hundred minute the value provided would be a measure of the percent of time the "Initial Capacity" is exceeded.*
Max 1 Minute average Tcold, ^{O}F:	*The maximum one-minute average return water temperature recorded.*
Percent of recordings where Tcold exceeds 170 ^{O}F, 1-minute average:	*The percent of time the one-minute average return water temperature from the building exceeded the 170^{O}F return water criteria.*
Max 15 Minute average Tcold, ^{O}F:	*The maximum fifteen-minute average return water temperature recorded.*
Percent of recordings where Tcold exceeds 170 ^{O}F, 15-minute average:	*The percent of time the fifteen-minute average return water temperature from the building exceeded the 17^{0}OF return water criteria.*

Energy take by month, MMBTUs		*A summary of the energy supplied to the customer by month of the Heating Season. The units are in Millions of British Thermal Units MMBTUs) taken by the building.*
October		
November		
December		
January		
February		
March		
April		
Total energy take during Heating Season, MMBTUs:		*A summation of the total energy taken for the Heating Season*
Estimated equivalent gallons of fuel oil:		*A conversion of the thermal energy taken by the building to an estimate of what that would equal in gallons of fuel* oil.

The first provides a distribution of the maximum daily instantaneous capacity that the building called for during the Heating season. The way the chart is read is that on the horizontal axis is the percent of readings equal to or less than then the selected value on the vertical axis. For example in the chart displayed, 85% of the time daily maximum instantaneous capacity demanded by the building was 1.5 MMBTUH or less.



The second chart is all the one-minute average capacity values recorded for every minute that the building was connected to the district heat system from October 1, 2014 through April 30, 2015. The horizontal axes is the percent of recorded one-minute average values that are equal or less than the selected value of Capacity, which is presented on the vertical axes. Each data appoint represents a one-minute average of capacity taken by the building.

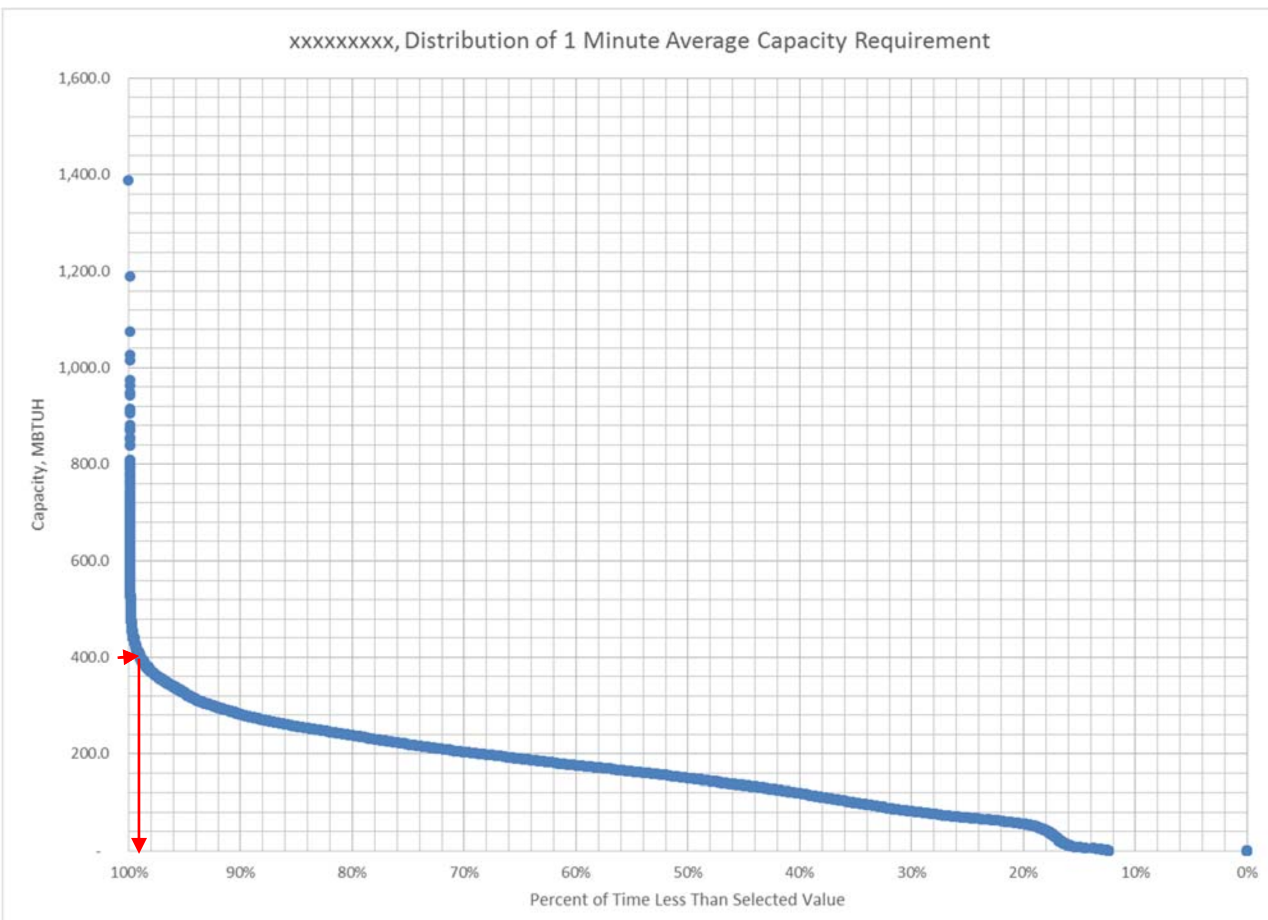
From this chart the amount of time that the capacity taken by a building exceeds a certain value can be determined. This can be done as follows: locate the capacity value of interest on the vertical axes, follow that value until it interests with the distribution line, than read down to the horizontal axes. This yields the percent of time capacity was equal to or less than the selected value. The Percent of time which it exceeds the value is determined by subtracting this value from 100. This yields the percent of time the value is exceeded. In the following example this building requires a capacity of 400 MBTUH or less 99% of the time. Conversely, the building took a capacity greater than 400 MBTUH 1% of the time (i. e., [100 – 1] = 99). To determine the time in minutes that the building took a capacity greater than 400 MBTUH use the following formula:

= (percent of time greater that value/100)*(305,280)*(percent data completeness/100)

For this example, the selected value is 400 MBTUH and it has been determined as presented above, the percent of time where the capacity demand was greater than this value was 1%. For this example, the data completeness is 99.8%.

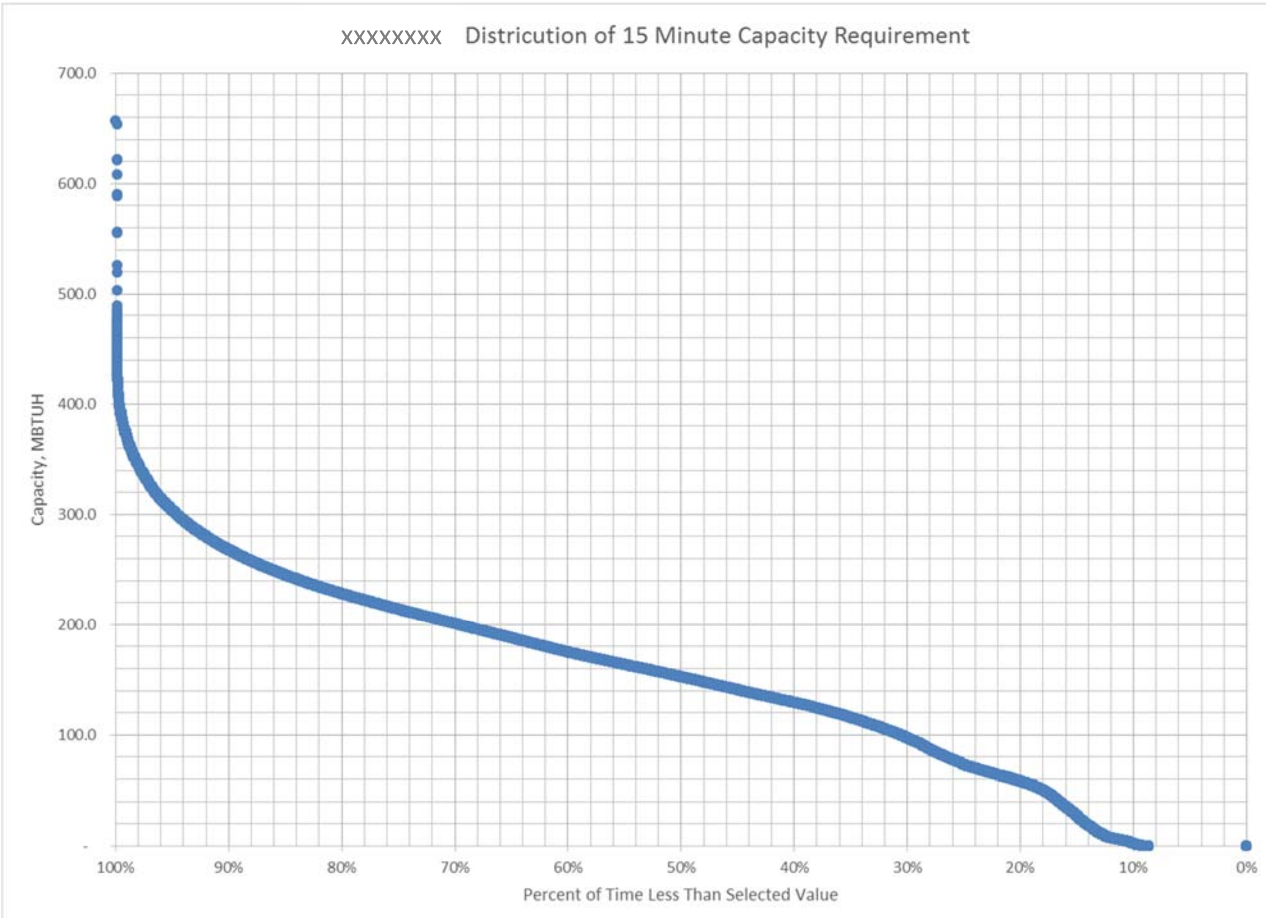
=(1/100)*(305.280)*(99.8/100)

= 3,047 minutes



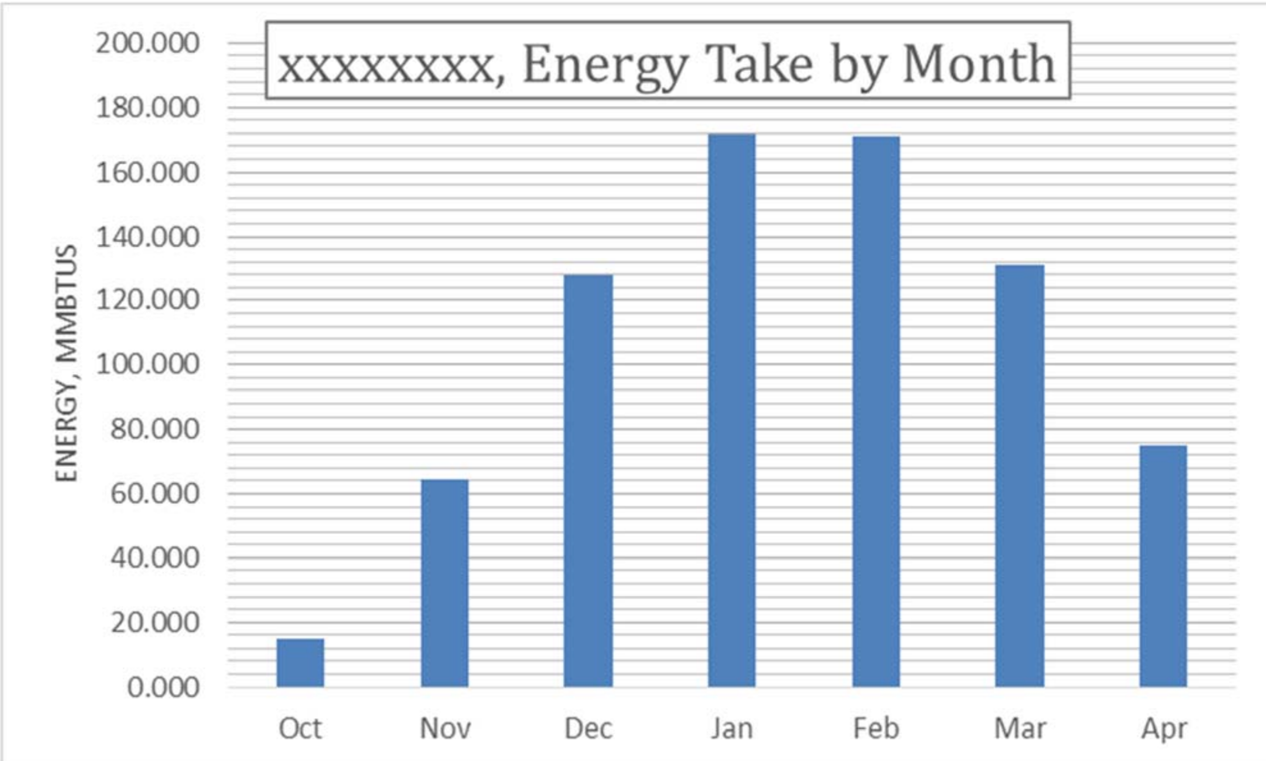
The third chart is the same as the second chart except that the data are a fifteen-minute average rather than a one-minute average. The explanation of the chart and the use of the data are the same. The difference being that the any conclusions reached represent a longer period of time, that of fifteen minutes.

With the longer period of time, the peak value will typically be less and the distribution will be a little ‘smoother’ line. Following is the fifteen-minute average data for the above one-minute average data.



The fourth chart present the monthly energy take of the building during the Heating Season. Energy is expressed in millions of British Thermal Units (MMBTUs).

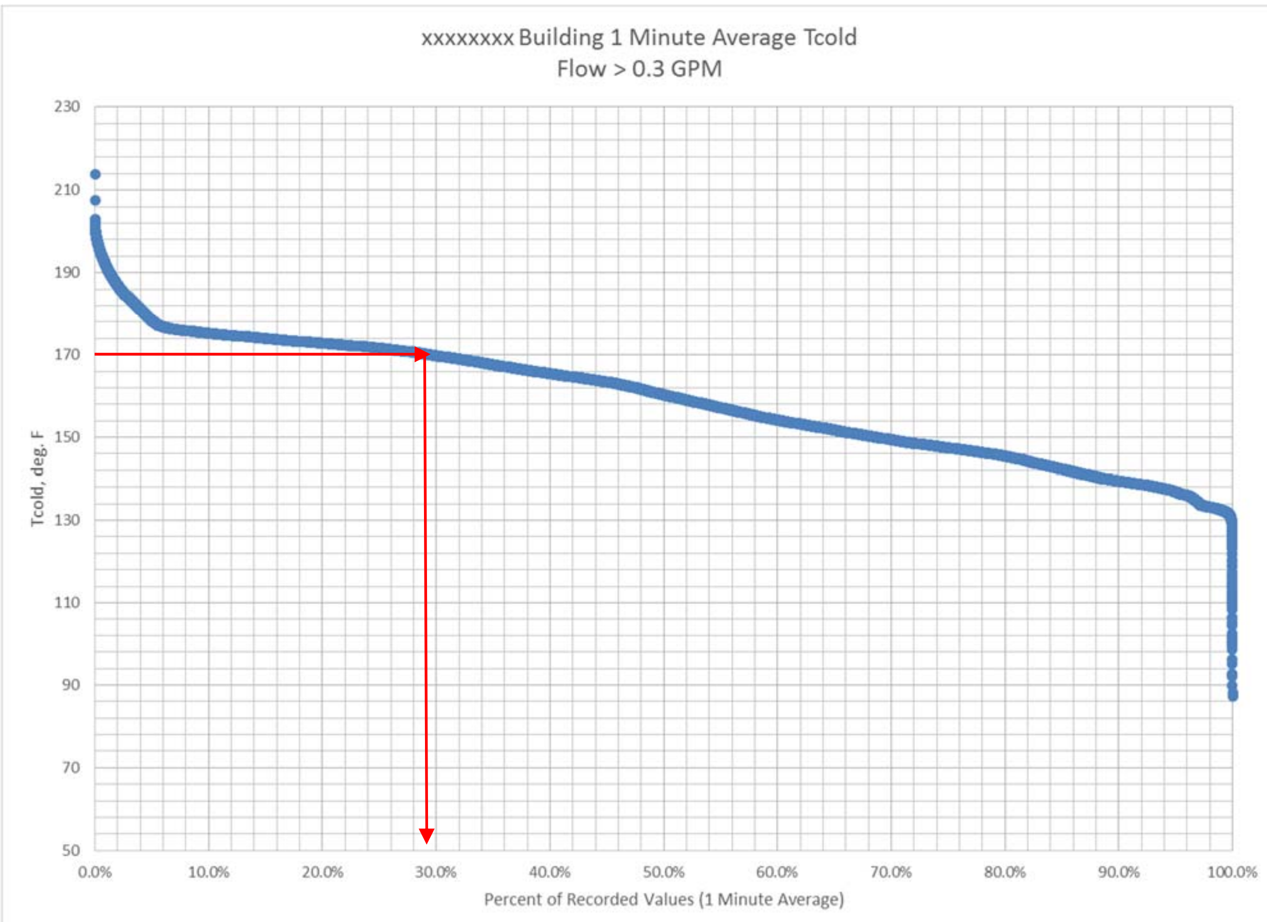
A British Thermal Unit (BTU) is a common unit of energy. It represents the energy required to heat one pound of water one degree Fahrenheit (^{O}F). A pound of dry wood generally represents 8,500 BTUs; a gallon of fuel oil generally represents 138,000 BTUs before they are combusted. The amount delivered energy by these fuels depends on the efficiency of the device (furnace of boiler) used to convert the fuel to energy. With the district heat system the energy is deliver to the building, not fuel which needs to be combusted.



The fifth chart is the distribution of the data for the one-minute average temperature of the return water (T_{cold}). This is the temperature of the water returned to the distribution system after a building's heating system has extracted the energy it needs from the supply water. The temperature of the water returned to the distribution system affects the overall efficiency of the district heating system, the cooler the water, the more efficient operations will be.

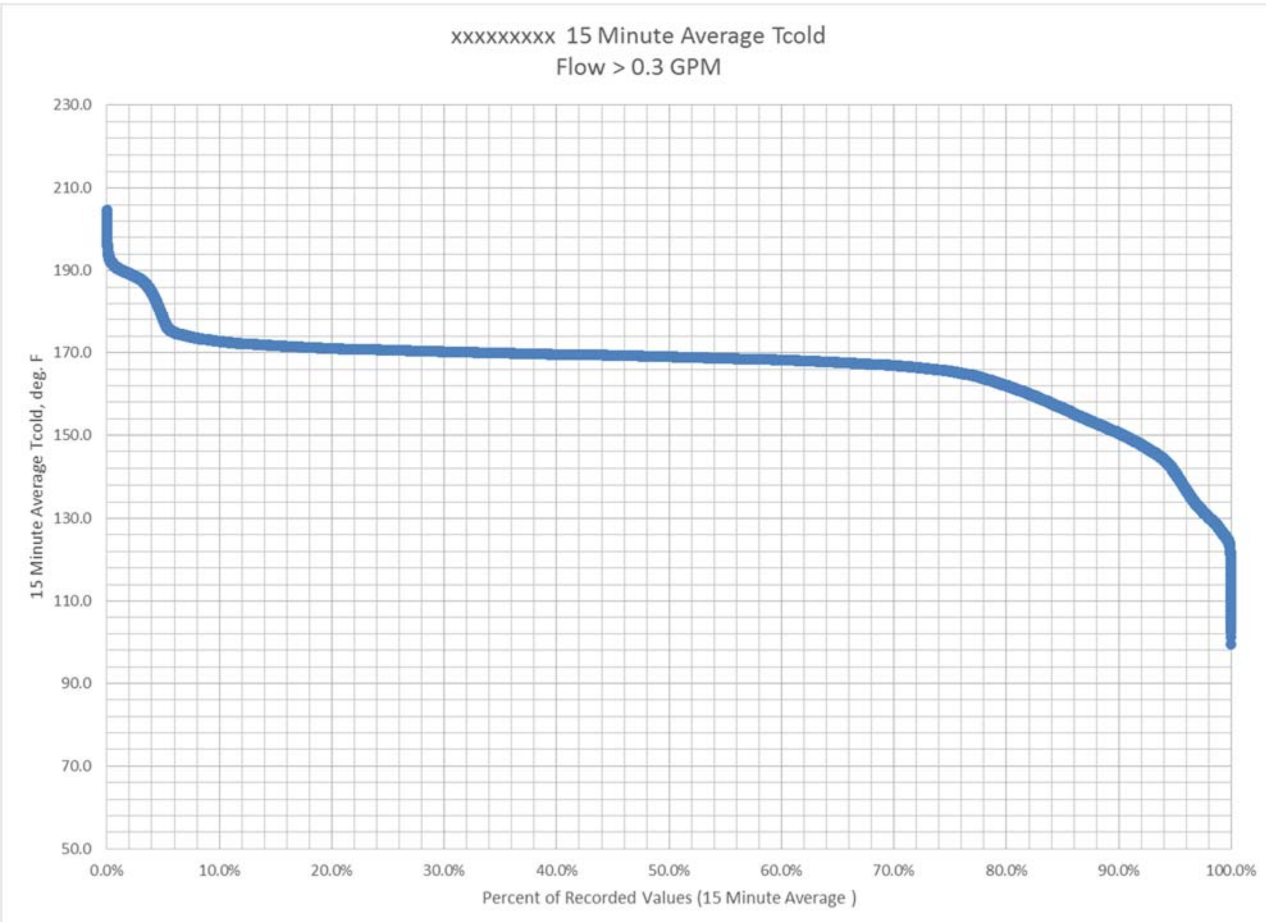
The data are presented for when the flow through the building's heat exchanger system is greater than 0.3 gallons per minute. This was done to ensure that there was adequate flow through the system and the return water temperature was representative of building system heat extraction performance.

The vertical axes is the value of the return water temperature in degrees Fahrenheit. The horizontal axes is the percent of recorded values that would be equal to or less than a selected value. In this example, the return water temperature is greater than 170 ^{O}F 29.7% of the recorded data.



The sixth chart is the same as the fifth chart except that the data are the fifteen-minute average of the return water, rather than the one-minute average. The explanation of the chart and the use of the data are the same. The difference being that the any conclusions reached represent a longer period of time, that of fifteen minutes.

With the longer period of time, the peak value will typically be less and the distribution will be a little ‘smoother’ line. Following is the fifteen-minute average data for the above one-minute average data.



Appendix – B

Customer Data

City Hall/Fire Station

City Hall/Fire Station
39 Main Street
Parcel ID: 095-039405
Finished area: 43,466 ft.2

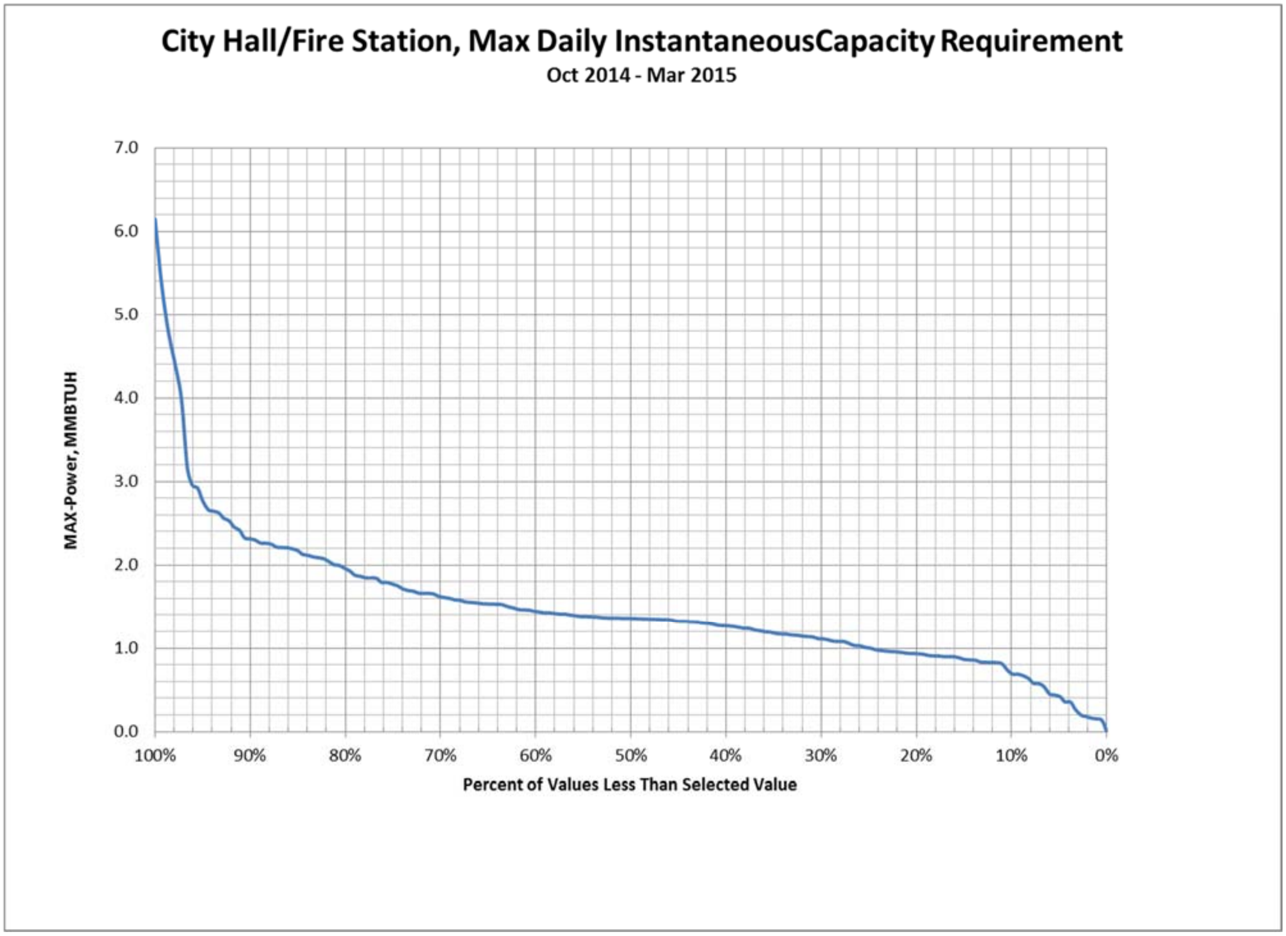
Customer Agreement Initial Capacity:	1,140 MBTUH
Date of first energy take from system:	October 1, 2014
Data completeness:	99.98%
Instantaneous maximum demand:	6,147 MBTUH recorded 24 February 2015 at 09:46:09
Maximum 1-minute average demand:	5,884 MBTUH recorded 24 February 2015 from 09:46:00 to 09:46:59
Maximum 15 minute running average demand:	3,320.2 MBTUH recorded 24 February 2015 from 09:45:00 to 09:59:59
Capacity at 99.8-Percentile 1-minute average:	1,966 MBTUH
Capacity at 99.8-Precentile 15-minute average:	1,071 MBTUH
Percentile at Contracted Capacity, 1-minute average:	98.30%
Percentile at Contracted Capacity, 15-minute average:	99.90%
Max 1 Minute Average Tcold ^{O}F:	201.8
Percent of recordings where Tcold exceeds 170 ^{O}F, 1-minute average:	59.11%
Max 15 Minute average Tcold, ^{O}F:	197.6
Percent of recordings where Tcold exceeds 170 ^{O}F, 15-minute average:	59.11%

Energy take by month, MMBTUs

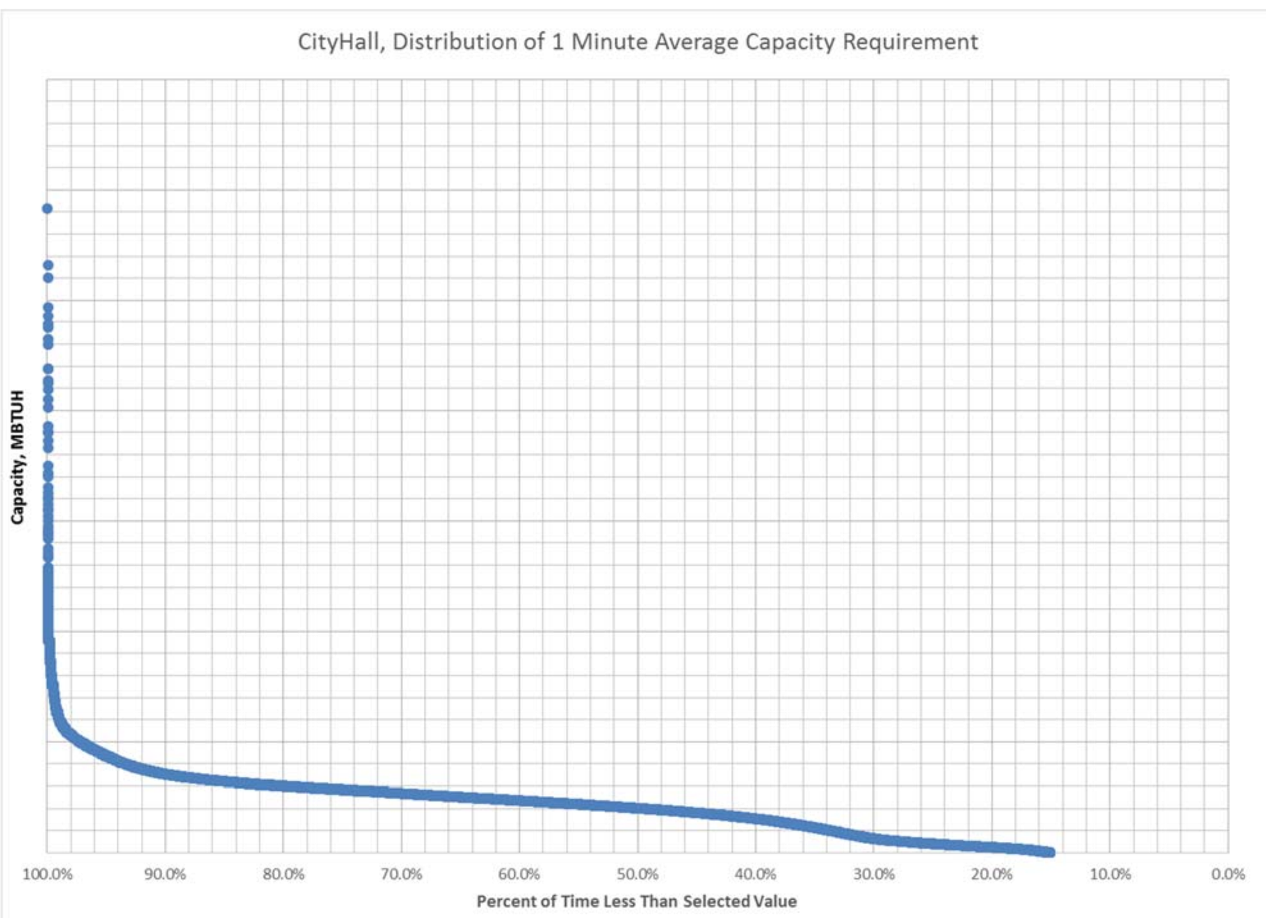
October	87.210
November	254.726
December	343.635
January	477.747
February	460.881
March	359.546
April	157.841

Total energy take during Heating Season, MMBTUs:	2,141.6
Estimated equivalent gallons of fuel oil:	20,154

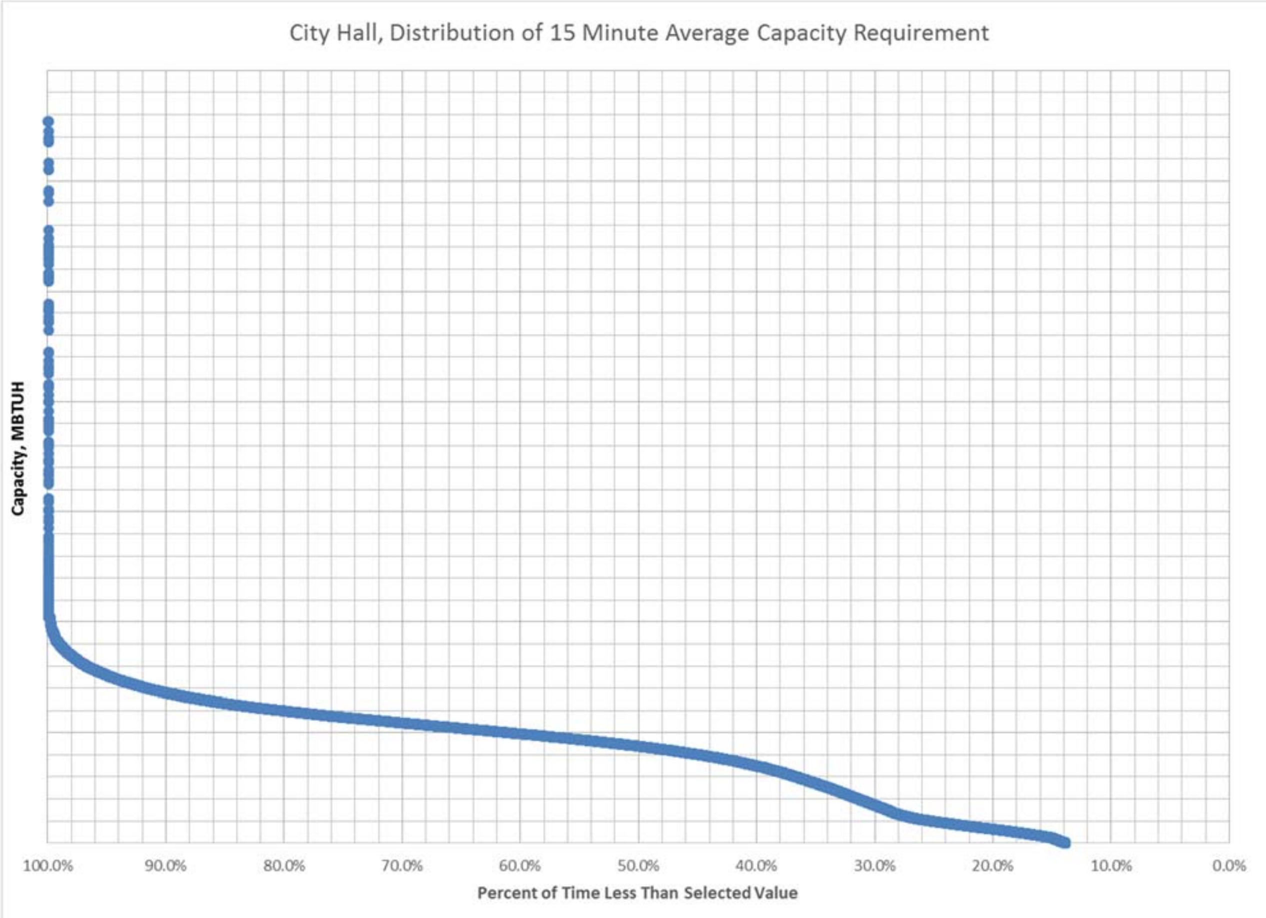
Note: In the following charts negative values represent the time when the boilers in City Hall are the source of heat for the distribution system.

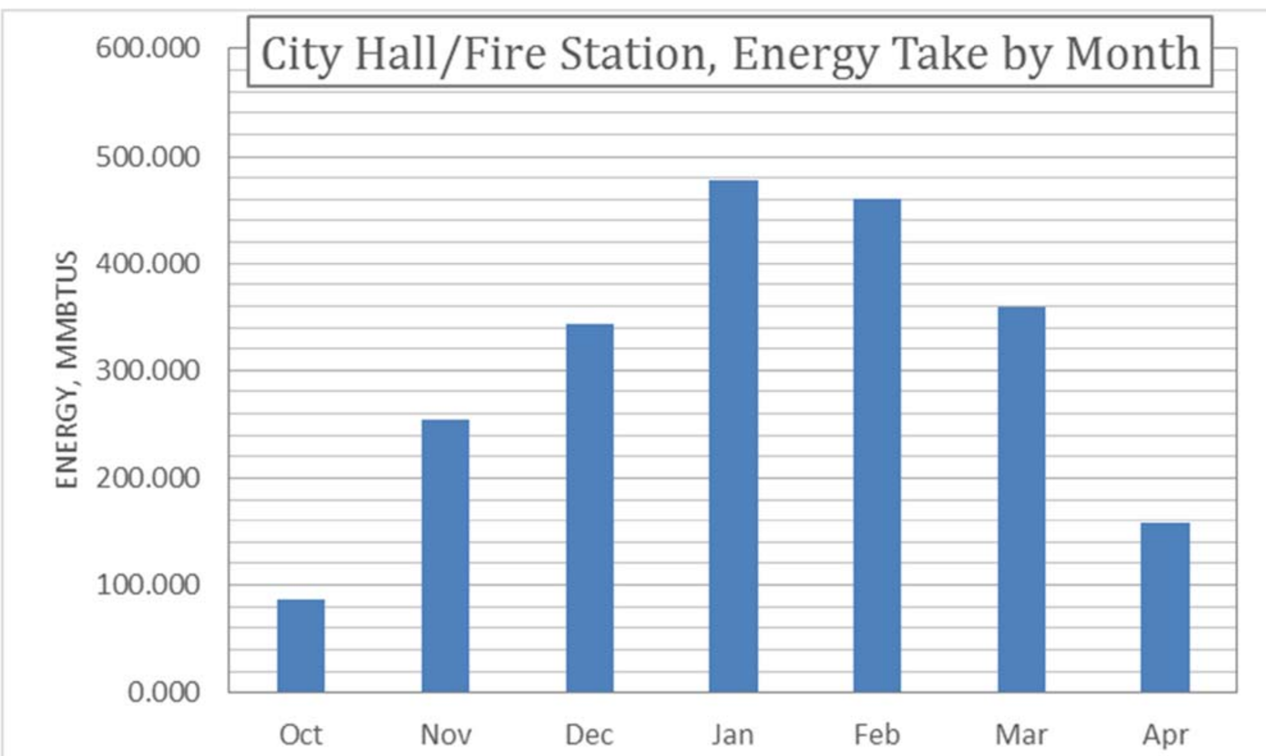


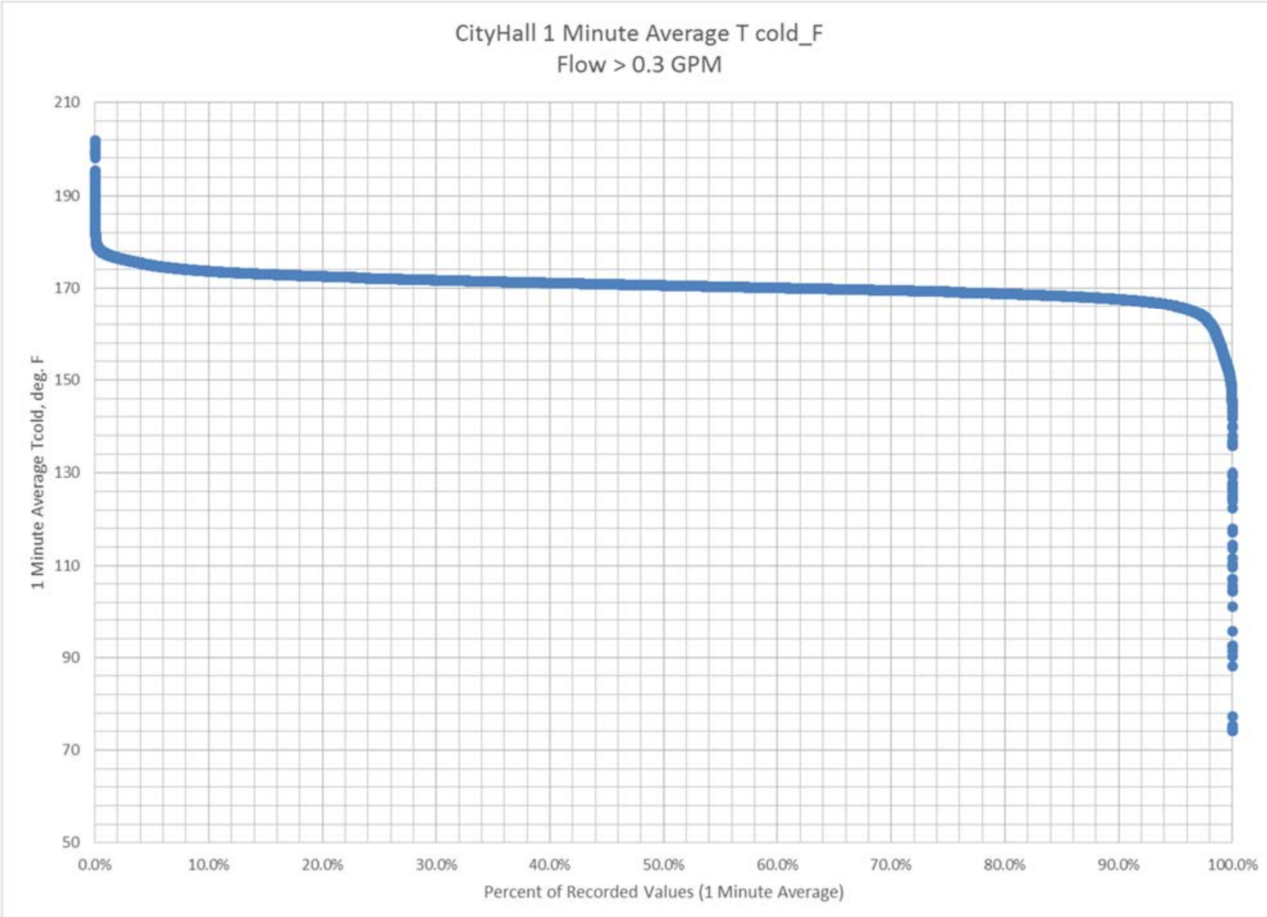
City Hall/Fire Station, Max Daily InstantaneousCapacity Requirement
Oct 2014 - Mar 2015
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
MAX-Power, MMBTUH
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Percent of Values Less Than Selected Value

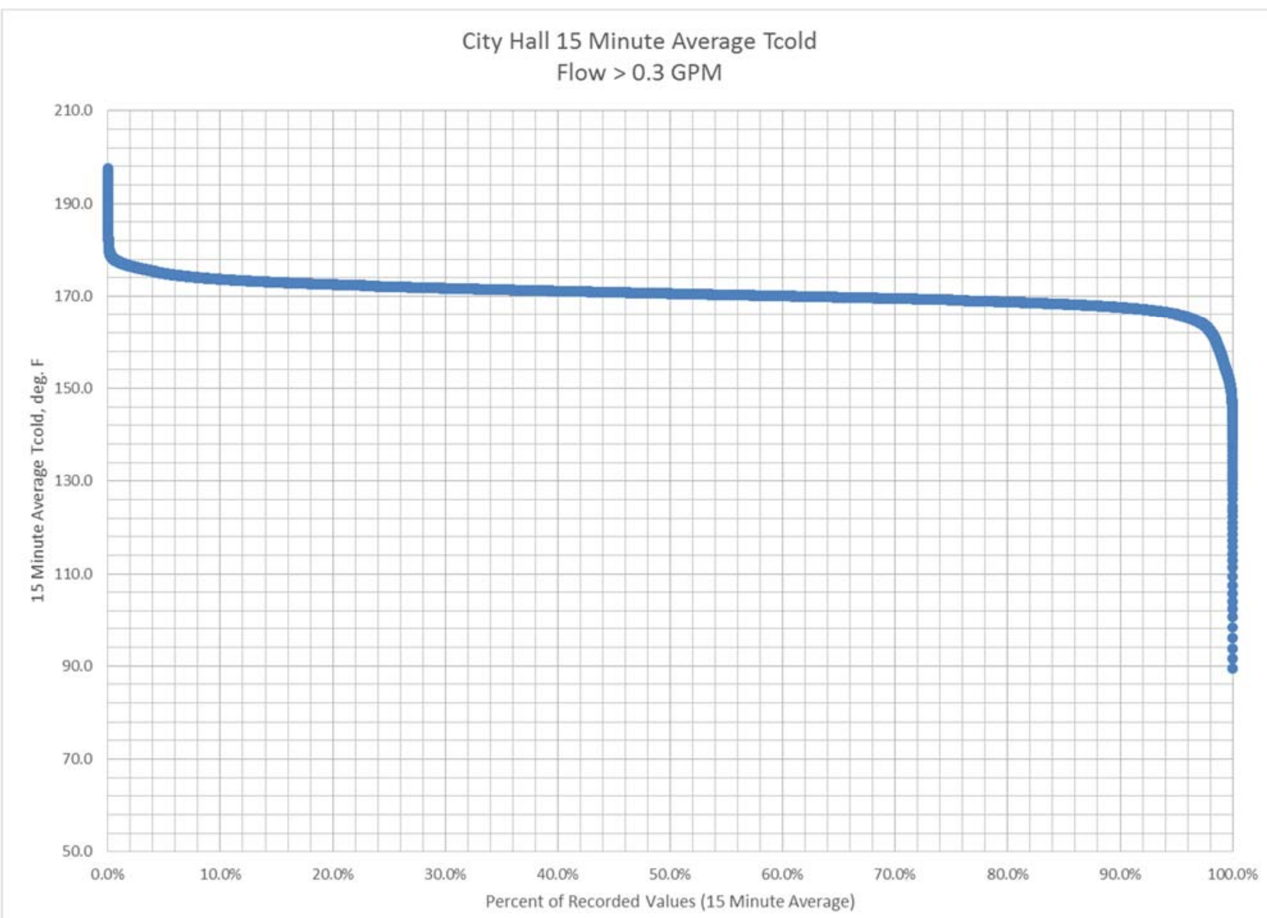


CityHall, Distribution of 1 Minute Average Capacity Requirement
Capacity, MBTUH
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
Percent of Time Less Than Selected Value


City Hall, Distribution of 15 Minute Average Capacity Requirement
Capacity, MBTUH
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
Percent of Time Less Than Selected Value


City Hall/Fire Station, Energy Take by Month
ENERGY, MMBTUS
600.000
500.000
400.000
300.000
200.000
100.000
0.000
Oct
Nov
Dec
Jan
Feb
Mar
Apr


CityHall 1 Minute Average T cold_F
Flow > 0.3 GPM
1 Minute Average Tcold, deg. F
210
190
170
150
130
110
90
70
50
0.0%
10.0%
20.0%
30.0%
40.0%
50.0%
60.0%
70.0%
80.0%
90.0%
100.0%
Percent of Recorded Values (1 Minute Average)


City Hall 15 Minute Average Tcold
Flow > 0.3 GPM
15 Minute Average Tcold, deg. F
210.0
190.0
170.0
150.0
130.0
110.0
90.0
70.0
50.0
0.0%
10.0%
20.0%
30.0%
40.0%
50.0%
60.0%
70.0%
80.0%
90.0%
100.0%
Percent of Recorded Values (15 Minute Average)

Montpelier Pedestrian Advisory Committee Presents

We Walk Week

OCTOBER 3-10

3 Saturday

1:00-2:30 PM

Forest Trails Less Traveled

Harris Webster

National Life Building

Join Harris for a moderately difficult walk through some of Montpelier's less traveled trails.

4:00-8:00 PM

ArtFest 2015

Unique venues all over downtown Montpelier exhibit the large and diverse artistic talent of Central Vermont. Sponsored by Montpelier Alive!

more info on website: www.montpelier-vt.org/group/409/Pedestrian-Committee.html

4 Sunday

1:00-3:00 PM

Tales of Hubbard Park

Joanne Garton

Frog Pond, top of Parkway Street

Hubbard Park is the forested gem of Vermont's capital city, but it wasn't always such an urban hideaway. Learn how the city now cares for its downtown forest and manages for its future,

3:00-5:00 PM

Green Mount Cemetery

Patrick Healey

Route 2/Lower State Street, Hubbard Chapel/vault building

History, granite carvings, and questions about cemeteries that you were afraid to ask will be discussed.

5 Monday

1:00-2:00 PM

Industrial Past

Manuel Garcia

109 State Street, Pavilion Building

Manuel Garcia lived on River Street in Montpelier when there were many commercial and industrial establishments along the Winooski River.

6:30-7:30 PM

Trees of Montpelier

John Snell, Montpelier Tree Board

39 Main St., City Hall

See and learn about trees around town. You are welcome to come to either or both walks, as they will be somewhat different. Both walks, about a mile in length, will focus on the "urban forest" of the city. Also Tuesday at noon!

6 Tuesday

NOON

Trees of Montpelier

39 Main St., City Hall

Similar, but different, from Monday's walk!

2:00 PM

Trash Tramps

Anne Ferguson

Senior Center

Tramp around picking up trash. Bags provided, bring gloves.

7 Wednesday

NOON-1:00 PM

Architecture of Downtown Montpelier

Barb Conrey

39 Main St., City Hall

Walk through town with this well-known, local architect and professor to learn about the rich history of architectural styles we walk by every day.

8 Thursday

12:45-2:00 PM

Walking with Harris

Harris Webster

58 Barre St., Montpelier Senior Activities Center Office

Harris will share some of his favorite spots—some of which you may never have walked to—as well as some of the gems of the city. Rain or shine.

9 Friday

NOON

Walk with a Cop

Mike Philbrick

Police Station

Walk with one of Montpelier's finest! Learn what he sees and how he views his job and share with him what is important to you about law enforcement in Montpelier. All are welcome.

10 Saturday

8:00-9:00 AM

Statehouse Trail to Hubbard Park

Tom Aloisi

Court Street parking lot east of Statehouse

This hidden gem starts at the statehouse and climbs the steep hill to Hubbard Park Tower. (dog friendly, rain date Sunday, October 11)

7:00PM

Owl Banding

NBNC staff

North Branch Nature Center

Every fall migrating pint-sized Saw-whet Owls filter through Vermont. View these common, yet seldom-seen, birds. Follow signs from parking lot to the banding station and be sure to dress warmly and bring a flashlight.

Notes

Use your smartphone to learn more!

AMERICORPS VISTA