

**SUSTAINABLE PRACTICES  
FOR BUILDING OWNERS AND OCCUPANTS**

# **BUILDING ENERGY EFFICIENCY**

**HIGH EFFICIENCY FURNACES/BOILERS  
HEAT PUMPS  
LIGHTING  
ON DEMAND HOT WATER HEATERS  
HIGH EFFICIENCY APPLIANCES  
INTERNAL ENERGY MONITORING**

# High Efficiency Furnaces / Boilers



## Background:

Space heating is the largest energy expense in the average U.S. home and accounts for approximately 45% of energy bills.<sup>1</sup> Furnace efficiency is measured by the annual fuel utilization efficiency (AFUE).

## Concept:

Analyze benefits and savings of installing a high efficiency furnace.

## Did you know?

Upgrading a furnace from 56% to 90% efficiency will save a household an average of 1.5 tons of CO<sup>2</sup> per year.<sup>2</sup>

## Types of Furnaces:

	LOW EFFICIENCY	MID EFFICIENCY	HIGH EFFICIENCY
<b>Air Flow</b>	Natural draft	Exhaust fan	Condensing flue gases in second heat exchanger
<b>Ignition Source</b>	Continuous pilot light	Electronic ignition	Sealed combustion
<b>AFUE</b>	56%-70%	80%-83%	90%-98.5%

## Helpful Equations:

$$AFUE = \frac{\text{Annual Heat Output}}{\text{Total Annual Fossil Fuel Energy}}$$

$$\text{Percent Savings} = \frac{\text{New Efficiency} - \text{Existing Efficiency}}{\text{New Efficiency}} * 100\%$$

## Did you know?

If your existing furnace is 56% efficiency, you could save up to 43% on your annual heating bills. If your existing furnace is Mid Efficiency, it may be more cost effective to perform small updates such as installing a flue dampener.

<sup>1</sup> Energy Saver 101 Infographic: Home Heating; <sup>2,3</sup> Energy.gov Furnaces and Boilers  
Hyperlink: <https://greatercomfort.com/blog/heating-service/10-surprising-furnace-facts/>

# High Efficiency Furnaces / Boilers



TARGET GROUP	WHAT CAN I DO
<b>Developer, Landlord, Business Owners, Institutions</b> 	<ul style="list-style-type: none"> <li>In the market to replace an old furnace, or install one into a new build? Check out <a href="#">this link</a> for Consumer Report’s buying guide to furnaces.</li> <li>Want to learn more about efficiency ratings of furnaces and boilers? <a href="#">Click here</a></li> <li>Looking for tax credits? <a href="#">Click here</a></li> </ul>
<b>Homeowner</b> 	<ul style="list-style-type: none"> <li>Rochester Gas and Electric offers rebates for replacement of existing furnaces with high efficiency replacements. <a href="#">Click here</a> to learn more. <a href="#">Click here</a> for a specific "Residential Natural Gas Equipment Rebate Program.</li> <li>The City’s Emergency Assistance Repair Program provides financial assistance to eligible owner-occupants for furnace, hot water tank, and water line repair or replacement. <a href="#">Click here</a> and click “Grant Programs” to find out if you are eligible.</li> </ul>
<b>Landlord</b> 	<ul style="list-style-type: none"> <li>Are you or your tenants responsible for the heating bill? Replacing old furnaces will reduce your monthly bills.</li> </ul>
<b>Tenant</b> 	<ul style="list-style-type: none"> <li>Ask your landlord what type/efficiency furnace is heating your rental unit.</li> </ul>

## Did you know?

All furnaces contain these three components:

1. A burner (in gas furnaces) or a heating element (in electric furnaces) dictates how the heat is created;
2. A heat exchanger: separates combustion gas from breathable air;
3. A blower: sends the breathable air through the duct system in the house.

Hyperlinks: <https://www.consumerreports.org/cro/gas-furnaces/buying-guide>

<https://energy.gov/energysaver/furnaces-and-boilers>

[https://www.energystar.gov/about/federal\\_tax\\_credits](https://www.energystar.gov/about/federal_tax_credits)

<http://www.rge.com/UsageAndSafety/usingenergywisely/eeps/default.html>

<http://www.cityofrochester.gov/HomeRepairGrants/>

[http://www.rge.com/MediaLibrary/2/5/Content%20Management/Shared/UsageAndSafety/PDFs%20and%20Docs/Res\\_Nat\\_Gas\\_Rebate\\_Application.pdf](http://www.rge.com/MediaLibrary/2/5/Content%20Management/Shared/UsageAndSafety/PDFs%20and%20Docs/Res_Nat_Gas_Rebate_Application.pdf)

# Heat Pumps



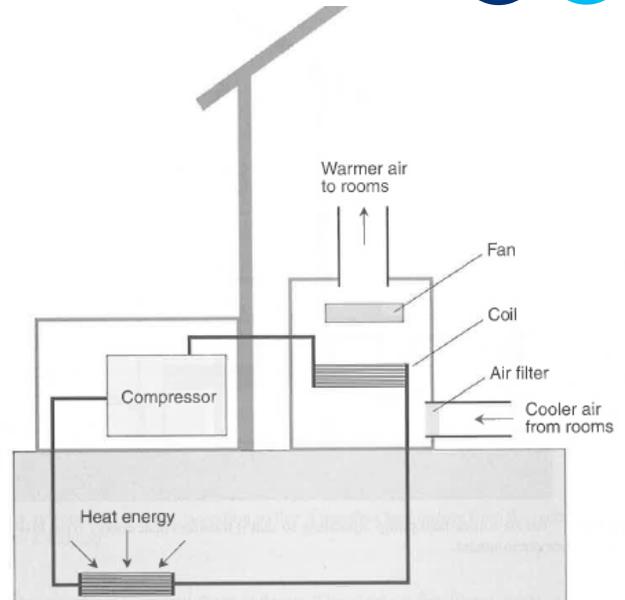
## Background:

There are two main types of heat pumps. One is known as an air source heat pump and the other is a geothermal or ground source heat pump. Both use similar concepts to transfer heating or cooling from the outdoor environment to the indoor environment and are very efficient at doing so.

Ground-source heat pumps have low operating costs, low environmental impact and a long life expectancy. Air-source heat pumps have technologically improved in recent years, making them effective options for providing heating in cold climates. NYSERDA currently offers several rebate programs for both ground-source and air-source heat pumps.

## Concept:

The outdoor environment is used as a heat source in the winter and a heat sink in the summer. A heat pump system typically has two coils on a loop. Coils are where the exchange of heat between the environment and a liquid (likely a refrigerant) will take place. See figures below for a depiction of the different types of heat pumps.



**Ground-Source Heat Pump Loop**

### **Did you know?**

Each year, about 80,000 geothermal units are installed in the U.S. (geothermal energy is used in all 50 U.S. states today, with great potential for near-term market growth and savings) and 27,000 in Sweden. In Finland, a geothermal heat pump was the most common heating system choice for new detached houses between 2006 and 2011 with market share exceeding 40%.

### **Did you know?**

Heating/cooling equipment is defined by how well it supplies heating/cooling compared to the energy required to operate the system. This parameter is known as the Coefficient of Performance (COP). Heat pumps typically have a COP greater than 1, meaning it supplies more useful heat (heat that is used to condition a space and not lost to the environment) than the energy it requires to operate.

Photo Credit: Gibilsco, Stan. Alternative Energy Demystified, 2nd Edition.  
Source: <https://www1.eere.energy.gov/geothermal/pdfs/40665.pdf>

# Heat Pumps



TARGET GROUP	WHAT CAN I DO
<p><b>All members of the Rochester community</b></p> 	<ul style="list-style-type: none"><li>• If you do install a heat pump system, or currently are operating one, consider the type of refrigerant you are using. Avoid certain refrigerants such as CFC (chlorofluorocarbon) based refrigerants which are known to degrade the ozone layer and contribute to climate change. Refer to <a href="#">LEED's Refrigerant Management credits</a> for further guidance.</li><li>• Purchase ENERGY STAR certified heat pumps for efficient units.</li><li>• Consult NYSERDA for resources such as approved designers and installers.</li><li>• Research rebate/grant programs such as <a href="#">NYSERDA's Ground Source Heat Pump Rebate</a> which allows customers to use NYSERDA approved designers/installers to obtain rebates on system installations for residential, commercial, institutions and industrial customers. <a href="#">NYSERDA's Air Source Heat Pump Rebate</a> applies only to residential units currently.</li></ul>

Hyperlinks: LEED Refrigerant Management Credits: <https://www.usgbc.org/credits/ea7>

NYSERDA Ground Source Heat Pump Manual: <https://portal.nyserderda.ny.gov/servlet/servlet.FileDownload?file=00Pt0000002xy5ZEAO>

NYSERDA Air Source Heat Pump Manual: <https://portal.nyserderda.ny.gov/servlet/servlet.FileDownload?file=00Pt0000002gtL7EAI>

# Lighting



## Background:

Lighting is one of the most important technologies that people benefit from every day. In 2012, the lighting industry created new standards. Read about them [here](#).

## Concept:

Because lighting benefits almost every facet of America's infrastructure today, it is critical to better understand and incorporate the latest, most optimal and energy efficient lighting technology whenever and wherever possible.

## Helpful Information:

For more information on how to select an Energy Star certified build for application into your house, click [here](#).



*LED Light Bulbs (Department of Energy)*

### Did you know?

LED's are considered directional lights. This means that instead of emitting light in all directions, light is emitted in a specific direction, increasing the efficiency by focusing light emitted at specific angles.

TYPES OF LIGHTING	EFFICIENCIES*	TYPICAL LIFESPAN	ADDITIONAL INFORMATION
<b>Incandescent</b>	1.5-2.5%	1,200 hours	Emission of light is caused by heating the filament.
<b>Compact Fluorescent (CFL)</b>	7-10%	8,000 hours	Take longer and more energy to reach full brightness. Once operating, CFL's use ~70% less electricity than incandescents.
<b>Light Emitting Diode (LED)</b>	~85%	25,000 hours	Require very low voltage source, easily applied into solar energy generation systems.

*\*Efficiencies presented represent the percentage of energy that is converted into lighting. The remainder is lost as heat.*

### Did you know?

You can save approximately \$6 in energy costs each year if you replace one 100W incandescent light bulb with an Energy Star rated CFL.

*\*Savings based on usage of 2 hours per day at 11 cents per kilowatt hour.*

Hyperlinks: <https://energy.gov/energysaver/new-lighting-standards-began-2012>  
[https://www.energystar.gov/products/choose\\_a\\_light](https://www.energystar.gov/products/choose_a_light)  
 Sources: <https://greenbuildingelements.com/2014/02/12/guest-post-7-benefits-using-led-bulbs/>  
 Photo Credit: <https://energy.gov/energysaver/led-lighting>

# Lighting



TARGET GROUP	WHAT CAN I DO
<b>All members of the Rochester Community</b> 	<ul style="list-style-type: none"> <li>Energy Star offers a variety of rebates for energy efficient lighting. <a href="#">Click here</a> to see if you qualify.</li> </ul>
<b>Developer (Non-newbuild), Landlord, Business Owners, Tenants, Institutions</b> 	<ul style="list-style-type: none"> <li>Rochester Gas and Electric has a current rebate program for multi-family energy efficiency. Click <a href="#">here</a> to learn more.</li> </ul>
<b>Developer, Landlord, Business Owners, Institutions</b> 	<ul style="list-style-type: none"> <li>Where feasible, consider using occupancy sensors. To learn more, assess your current energy use and potential savings, <a href="#">click here</a>.</li> </ul>
<b>Landlord</b> 	<ul style="list-style-type: none"> <li><a href="#">Click here</a> to learn more about RG&amp;E's current multi-family energy efficiency program. Qualifying properties can receive free installation of energy-efficient products.</li> </ul>
<b>Developer</b> 	<ul style="list-style-type: none"> <li>The City of Rochester's code outline Lighting regulations in Section 120-170. <a href="#">Click here</a> to read more.</li> </ul>
<b>Tenant</b> 	<ul style="list-style-type: none"> <li>Replace incandescent light bulbs with Energy Star LED bulbs.</li> <li>Consider installation of motion sensors and timers to control lighting.</li> <li>Confirm if a sub meter has been installed for your rental unit</li> <li>Determine if you are paying for electricity directly to the utility or to the landlord.</li> <li>Discuss lightbulb replacement options with your landlord.</li> </ul>

Hyperlinks:[https://energy.gov/savings/search?f%5B0%5D=im\\_field\\_rebate\\_state%3A860101](https://energy.gov/savings/search?f%5B0%5D=im_field_rebate_state%3A860101)  
<http://rge.com/UsageAndSafety/usingenergywisely/eeps/multifamily.html>  
<http://www.wernermin.com/assets/files/PDF/green/Sensors-EnergyTips.pdf>  
[http://www.rge.com/MediaLibrary/2/5/Content%20Management/Shared/UsageAndSafety/PDFs%20and%20Docs/MultiFamily\\_Overview\\_Free\\_Measures.pdf](http://www.rge.com/MediaLibrary/2/5/Content%20Management/Shared/UsageAndSafety/PDFs%20and%20Docs/MultiFamily_Overview_Free_Measures.pdf)  
<http://www.ecode360.com/8682809#8682767>

# On Demand Hot Water Heaters



## Background:

Hot water heaters are appliances that heat water above its initial temperature for uses around the home. Typical uses include cleaning, bathing and cooking.

## Concept:

Tankless water heaters, also referred to as on-demand or Instantaneous water heaters, provide hot water on a demand based basis -only heating the water when a water fixture is turned on. For a comparison of all types of water heaters, [click here](#).

## Sizing Criteria:

**Size:** The size of a water heater is based on the purposes for which hot water is used (i.e., showering, washing dishes, washing clothes, etc.) multiplied by the number of times hot water is used in one hour for each purpose. [Click here](#) to learn more, or use a spreadsheet similar to the example given below to calculate your total peak hour demand.

**Fuel Type:** Ensure that the type of water heater you are looking at will be compatible with your fuel source. [Click here](#) to learn more.

**Energy Efficiency:** Calculate your water heater's energy efficiency using an energy factor (EF). The energy factor is based on the ratio of hot water produced to the fuel consumed. A higher energy factor directly relates to the efficiency of the water heater. [Click here](#) to learn more.

**Costs:** Check on the installation and maintenance costs associated with the types of systems under consideration. Once all costs are determined, payback time can be estimated. [Click here](#) to learn more.

### Did you know?

The average household spends between \$400 and \$600 on water heating each year. Water heating is most likely the 2nd largest expense for your home. On average it accounts for 14-18% of your utility bills.

USE	AVERAGE GALLONS OF HOT WATER PER USAGE		TIME USED PER HOUR		TOTAL GALLONS USED IN 1 HOUR
Shower	Ex: 10 gal/shower*	X	2	=	20
Hand Washing	1	X	4	=	4
Shaving	2	X	1	=	2
Dishwashing (hand)	4	X	1	=	4
			<b>Total Peak Hour Demand</b>	<b>=</b>	<b>30</b>

\* Red text designates example calculation. Not reflective of personalized application.

Hyperlinks: <https://energy.gov/articles/new-infographic-and-projects-keep-your-energy-bills-out-hot-water>  
<https://energy.gov/energysaver/sizing-new-water-heater>  
<https://energy.gov/energysaver/selecting-new-water-heater>  
<https://energy.gov/energysaver/estimating-costs-and-efficiency-storage-demand-and-heat-pump-water-heater>

# On Demand Hot Water Heaters



TARGET GROUP	WHAT CAN I DO
<p><b>All members of the Rochester Community</b></p> 	<ul style="list-style-type: none"> <li>• Calculate how much installing an On-Demand hot water heater can save your home, development or community building by using the process outlined on the previous page.</li> <li>• For additional ways to save on water heating bills, reference “High Efficiency Appliances” and “Efficient Fixtures”.</li> </ul>
<p><b>Homeowner</b></p> 	<ul style="list-style-type: none"> <li>• There is a current tax credit for a solar water heater installation. Through 2019, a taxpayer may claim a 30% credit for the installation of a solar water heater in their residence. <a href="#">Click here</a> to learn more or <a href="#">click here</a> to apply.</li> </ul>

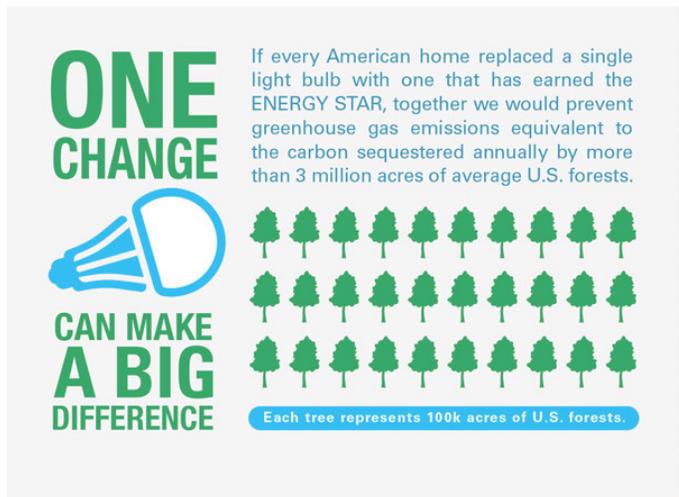
Hyperlinks: <https://energy.gov/savings/residential-renewable-energy-tax-credit>  
[https://www.energystar.gov/about/federal\\_tax\\_credits](https://www.energystar.gov/about/federal_tax_credits)

# High Efficiency Appliances



## Background:

Energy Star is a U.S. Environmental Protection Agency (EPA) voluntary program that helps businesses and individuals save money and protect the climate through superior energy efficiency. To date, homeowners, business developers, institutions and members of communities have saved over \$297 million in utility bills and avoided CO2 emissions of 2.1 billion tons.



*Energy Star Infographic*

## *Did you know?*

ENERGY STAR has been instrumental in helping consumers and businesses save energy and reduce GHGs. ENERGY STAR benefits have grown steadily over time, nearly tripling in the last decade.

## *Did you know?*

Energy use in homes, buildings, and industry account for two thirds of greenhouse gas emissions in the United States.<sup>1</sup> An Energy Star-certified washing machine uses 70 percent less energy and 75 percent less water than the standard washing machine of 1997.

Sources: <sup>1</sup>EPA's INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990 – 2010; <sup>2</sup>[https://www.energystar.gov/about/origins\\_mission](https://www.energystar.gov/about/origins_mission)  
[https://www.energystar.gov/products/24\\_hours\\_saving\\_energy\\_earth\\_day\\_infographic](https://www.energystar.gov/products/24_hours_saving_energy_earth_day_infographic)

# High Efficiency Appliances



TARGET GROUP	WHAT CAN I DO
<b>All members of the Rochester Community</b> 	<ul style="list-style-type: none"> <li>Reduce your overall energy use, bills and environmental impacts by installing or upgrading your appliances to Energy Star rated appliances.</li> </ul>
<b>Developer, Landlord, Business Owners, Institutions</b> 	<ul style="list-style-type: none"> <li>Install high efficiency appliances in your buildings.</li> </ul>
<b>Homeowner</b> 	<ul style="list-style-type: none"> <li>Select high efficiency appliances for use in your home.</li> </ul>
<b>Landlord</b> 	<ul style="list-style-type: none"> <li>Consider the use/benefit of using high efficiency appliances.</li> <li>Select high efficiency appliances for use in your building.</li> </ul>
<b>Tenant</b> 	<ul style="list-style-type: none"> <li>Inquire into the types of appliances that exist in apartments.</li> </ul>

# Internal Energy Monitoring



## Background:

Residential homes typically have a singular electric service and natural gas service meter. Commercial scale apartment buildings also have metered utility service, but often do not provide individual unit metering to allow an individual tenant to understand their energy usage.

**Concept:** In order to reduce one's energy usage, one must better understand what activities contribute to the highest energy consumption.

## Wi-Fi Enabled Thermostats:

Thermostats can now be hooked up to Wi-Fi, which enables:

1. Remote temperature control in the home
2. The qualifying of participation in programs that decrease energy demand during peak demand hours in the summer by allowing the utility to adjust home energy usage. Credits can be made on the utility bill each time the utility adjusts energy usage

*The starting price for Wi-Fi enabled thermostats is approximately \$200.*

RG&E is offering a "Smart Savings Reward" for consumers who agree to install a Wi-Fi connected thermostat. For more information on the program, [click here](#), or to read the frequently asked questions, [click here](#).



## ***Did you know?***

For the cost of \$20 to \$30, the energy usage of individual appliances can be measured with usage monitors, which can be plugged into a traditional wall socket.

## ***Did you know?***

Rochester Gas & Electric (RG&E) is currently offering up to an \$50 rebate to upgrade an existing thermostat to a Wi-Fi enabled thermostat. [Click here](#) for more information.

Hyperlinks: <https://enrollmythermostat.com/smartsavingsroch/>  
<https://enrollmythermostat.com/smartsavingsroch/faq/>  
<http://www.rge.com/usageandsafety/usingenergywisely/eeeps/default.html>

# Internal Energy Monitoring



TARGET GROUP	WHAT CAN I DO
<b>Developer, Landlord, Business Owners, Institutions</b> 	<ul style="list-style-type: none"> <li>In cases where tenants are charged a monthly flat rate for utilities, provide tenants with a history of their past electricity and natural gas usage data in order to allow tenants to better understand their energy usage data and incentivize them to reduce their energy consumption.</li> <li>Be aware that rating systems such as Enterprise Green Communities provide points for individual unit electricity monitoring (<a href="#">read about it here</a>).</li> </ul>
<b>Homeowner</b> 	<ul style="list-style-type: none"> <li>Purchase a \$20 to \$30 individual energy usage monitor and take note of any appliances that need an energy efficiency upgrade.</li> <li>Enroll in the Wi-Fi Connected Thermostat program. See if you qualify by <a href="#">clicking here</a>.</li> <li>If you have natural gas service from RG&amp;E and use it for heating and/or cooling, look into a Wi-Fi enabled thermostat.</li> </ul>
<b>Tenant</b> 	<ul style="list-style-type: none"> <li>Ask for copies of monthly utility bills if you do not have access to them.</li> <li>Use individual energy usage monitors to alert landlords of faulty appliances.</li> </ul>

Hyperlinks: <http://www.enterprisecommunity.org/solutions-and-innovation/green-communities/criteria>  
<https://enrollmythermostat.com/smartsavingsroch/>