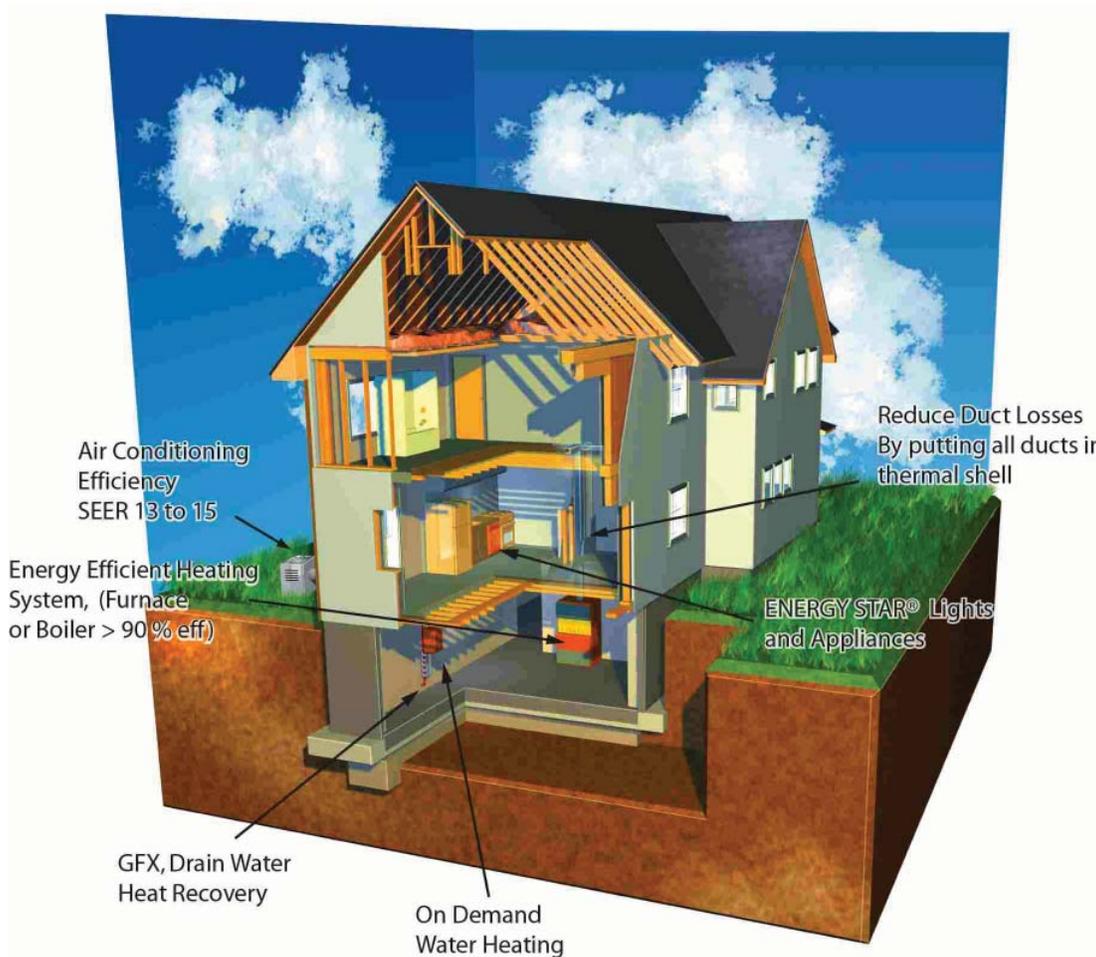


Economic High-Performance Design Options for Residential New Construction

Expect higher energy costs in the future and avoid them by investing in your new home's performance now.



Are you interested in building an energy-efficient new home with advanced building practices and the latest technologies? Rising energy costs make High Performance Design economical now and into the future.

The information presented in this brochure is a summary of the findings from a report entitled "Reference Design Guide for Highly Energy-Efficient Residential Construction"¹. The purpose of the research was to determine the least-cost path to achieving high levels of energy efficiency in single family detached residential new construction.

The following examples include low- or no-cost measures as well as high performance design elements that could be incorporated into your new construction project.

THERMAL SHELL

In the climate of New York State, the priority for decreasing residential energy consumption is to minimize heating and cooling loads through thermal performance improvements in the building shell. If done properly, this can account for a 50% decrease in space conditioning energy usage in an average home with minimal and cost-effective improvements in conventional practices. The primary practices to achieve this reduction follow.

- **Simplified Building Shape**

Keeping the shape of the building simple improves performance at negative cost, since it's also less expensive to build. Avoid cantilevers and complicated roof lines, in particular, and avoid creating north facing roof valleys. Be sure to create a continuous thermal envelope.

- **Orientation**

Site the house on the lot where it has access to southern light and is sheltered from prevailing winds. Ideally, the long axis of the home should be oriented east and west. Place rooms of most occupancy on the south side with stairs, bathrooms, and storage areas on the north.

- **Foundation**

New York State code requires basement walls to be insulated. Insulated Concrete Forms (ICFs) are a great choice for foundation walls because they are the least expensive to achieve an R-22.5 insulation value.

- **Walls**

The most cost-effective approach to achieving an energy-efficient wall structure using relatively conventional approaches, is to apply 2" of rigid foam continuous exterior insulation, regardless of framing method or cavity insulation type.

Advanced framing, or optimum value engineering (OVE) framing, as it is also known, involves the reduction of framing members by going from 16" to 24" on-center spacing, as well as other techniques, and uses approximately 30% less lumber. This should lessen labor costs and framing time as well as allowing for higher levels of insulation and reduced thermal bridging.

- **Windows**

Windows are the building's weakest link in its thermal shell, as well as being one of the most expensive building components. Glazing should be used wisely to frame for views and maximized on the south side to harvest passive gains in the winter. Size overhangs to reduce summer overheating. New York State code requires a U-value of .35, and most window brands have common units in stock in the range of U 0.29 to U 0.33, with some as low as U-0.18 (Lower U-values are better).



Ideally, the Solar Heat Gain Coefficient (SHGC) should be specified for windows of different orientations. The SHGC is a measure of how well a window absorbs or reflects heat from the sun. The lower the coefficient, the better the window is at blocking the sun's heat. Windows should be specified with low (<.4) SHGC on west-facing orientations in particular to reduce summer over-heating, and higher SHGC should be specified on south-facing windows.

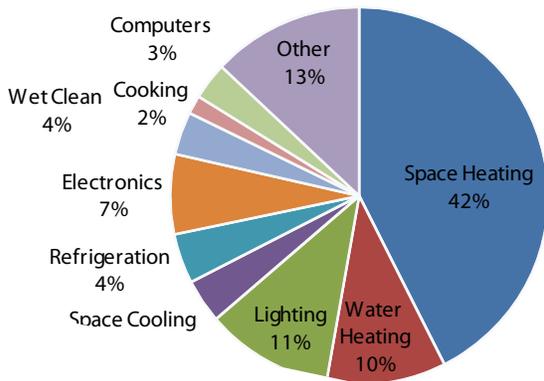
- **Ceiling insulation**

Ceiling insulation is important for both flat attic surfaces as well as vaulted ceilings. Increasing insulation from R-35 to R-60 in the attic and from R-30 to R-38 in vaulted ceilings provides measurable savings at modest incremental costs.

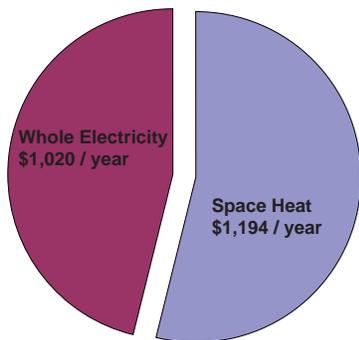
- **Infiltration**

The importance of good air sealing at the time of construction (pre-drywall) cannot be overemphasized. The best time to inspect for and repair potential leaks is just before insulation is installed to enable identification of the leak source. While homeowners can and will make changes in their households, it is difficult and expensive to make changes to the thermal shell after initial construction. Meticulous attention to sealing, caulking, and foaming all shell penetrations and verifying performance with a blower door is "best practice."

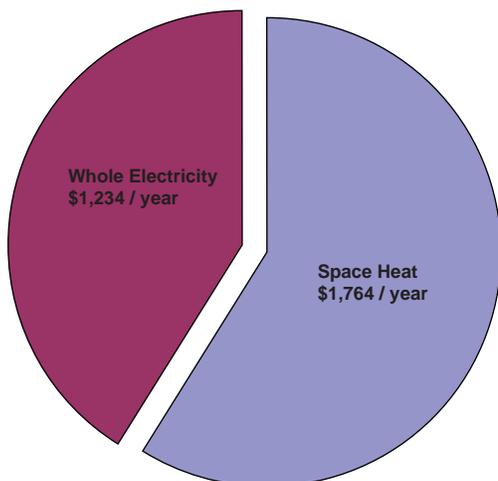
New York State Estimated Residential Energy End Use Expenditures



2006 Total Annual Energy Costs for New York State Average Residential Size Home



2011 Projected Total Annual Energy Costs for New York State Average Size Residential Home



Pie charts data source: NYSERDA

MECHANICAL SYSTEMS

Heating, Ventilating, and Air Conditioning (HVAC) equipment should be designed appropriately for the specific building. When a building's shell is air-tight and well insulated, the heating and cooling loads are considerably reduced. This allows for use of smaller, less expensive HVAC equipment. Size HVAC equipment according to the calculated heat loss or gain of your building, not general rules of thumb.

- **Water Heating**

You can save 44% of water-heating energy use by going from a standard 40 gallon natural gas water heater, to a high-efficiency tankless on-demand water heater. Solar water heating is also a cost-effective opportunity, especially with rising fuel prices.

- **Mechanical Ventilation**

Advanced air sealing must go hand in hand with mechanical ventilation, or by solving one problem you may be creating several more. Mechanical ventilation is typically achieved through one of three means. The most efficient and effective approach is a fully-ducted, energy-recovery ventilation (ERV) or heat recovery ventilation (HRV) system. The least expensive approach is exhaust-only ventilation, achieved by putting upgraded household fans, such as bath fans, or timers to ensure a specified amount of air exchange is occurring. Efficiency gains are enhanced by specifying an ERV or HRV system that uses electrically commutated motors (ECMs) to operate the fans.

- **Heating System Efficiency**

Heating is the largest energy expense in many New York State homes. The energy code requires 78-80% boiler and furnace efficiencies, but many manufacturers sell units with efficiencies up to 94%.

EFFICIENCY PACKAGES

Building a new home presents many choices. The level of energy efficiency and what your budget allows for energy options are just some of those choices. In order to help you decide how far you should go with the energy components of your home, presented are packages of improvements along with their estimated costs, savings, and "cash flow", assuming they are financed as part of your mortgage. Cash flow is the difference between the energy savings generated from a package of improvements and the increase in mortgage costs to pay for those improvements. If cash flow is positive, that means that those energy improvements (financed as part of the mortgage) more than pays for themselves. Over time, your mortgage payments stay fixed while energy prices will continue to rise, making your cash flow position grow even more

Cost-Effective Energy Efficiency Packages for Residential New Construction

Performance Measure	Incremental Annual Cost	Annual Energy Mortgage Costs	Annual Savings	Cash Flow	Annual Cash Flow in 5 yrs.
Package 1					
Above grade wall 2" foam	\$2,500.00				
Ducts within thermal envelope	\$ -				
Window orientation - southern exposure maximized	\$ -				
Advanced framing w/grade 1 installation of insulation	\$ -				
Total Package 1	\$2,500.00	(\$179.87)	\$766.00	\$586.13	\$774
Package 2					
ICF foundation walls	\$3,000.00				
Total Package 1 + 2	\$5,500.00	(\$396.70)	\$853.00	\$457.30	\$603
Package 3					
Triple pane windows (north side)	\$4,100.00				
R-60 Attic	\$900.00				
Total Package 1 + 2 + 3	\$10,500.00	(\$755.43)	\$905.00	\$149.57	\$197
Package 4					
On demand water heater	\$500.00				
Programmable thermostat	\$20.00				
Reduced air leakage not including whole house; ventilation .5 to .35	\$300.00				
Total Package 1 + 2 + 3 + 4	\$11,320.00	(\$814.43)	\$1,167.00	\$352.57	\$465
Package 5					
Air infiltration improved from .35 to .15 include whole house; ventilation via HRV	\$2,700.00				
Total Packages 1 - 5	\$14,020.00	(\$1,008.68)	\$1,115.00	\$106.32	\$140

Recommended sources of information:

- New York State Energy Research and Development Authority (www.nyserda.org)
- The New York Energy Smart Program (www.getenergysmart.org)
- New York State, Department of State, Division of Code Enforcement and Administration Field Guide to Residential New Construction" (www.dos.state.ny.us/code/energycode/residential.htm)
- Energy and Environmental Building Association (www.eeba.org)
- Building Science Corporation, "Builders Guide to Cold Climates" (www.buildingscience.com)
- "Residential Windows: A Guide to New Technologies and Energy Performance Book," third edition, Carmody/Selkowitz/Arasteh/Heschong
- Efficient Window Collaborative (<http://www.efficientwindows.org>)