Steven Winter Associates, Inc.
Building System Consultants

50 Washington Street
Norwalk, CT 06854

Telephone: (203) 857-0200
Telefax: (203) 852-0741
Web: www.swinter.com

June 26, 2014

Ethel Wood
285 Main Street
Germantown, NY 12526
Via email: lwkate@gmail.com

RE: Energy Audit of 321 Main Street Residence in Germantown, NY

Dear Ethel,

The following letter provides an overview of the audit findings at 321 Main Street in Germantown, NY from June 13th, 2014. This ~1,500 ft^2 home has not been occupied for some time and extensive renovations are being made to property. The primary goal of this home energy inspection was to prioritize a list of cost-effective recommendations to improve the overall efficiency of this 19th century home. This should lead to improved comfort and lower utility bills.

If you have any questions or concerns, please do not hesitate to contact me.

Best Regards,

Srikanth Puttagunta, P.E.
Steven Winter Design, a Division of Steven Winter Associates, Inc.

Steven Winter Associates, Inc.
Building System Consultants
50 Washington Street
Norwalk, CT 06854
Telephone: (203) 857-0200
Telefax: (203) 852-0741
Web: www.swinter.com

Section 1: Building Envelope

A general inspection of the building was made to determine what possibilities there are to insulate and air seal the building envelope during renovations. A variety of solutions are available, but the best solution will depend on the level of renovation that is occurring. Options for extensive and less intrusive energy conservation measures (ECMs) are discussed.

Basement

The stone foundation is 20+ inches thick. Ideally, this space would be insulated as the mechanical equipment will likely be located in the basement. Based on current conditions, this is not recommended without additional steps for water management. There are several locations where water intrusion can be observed.

There is likely no below grade exterior water barrier on the foundation, so insulating the interior side of the foundation could result in water being trapped in the foundation assembly and deteriorating the integrity of the structure over time due to freeze-thaw. Exterior insulation options would require excavation around the foundation, which is limited on the front and left side of the home due to the porch and driveway.

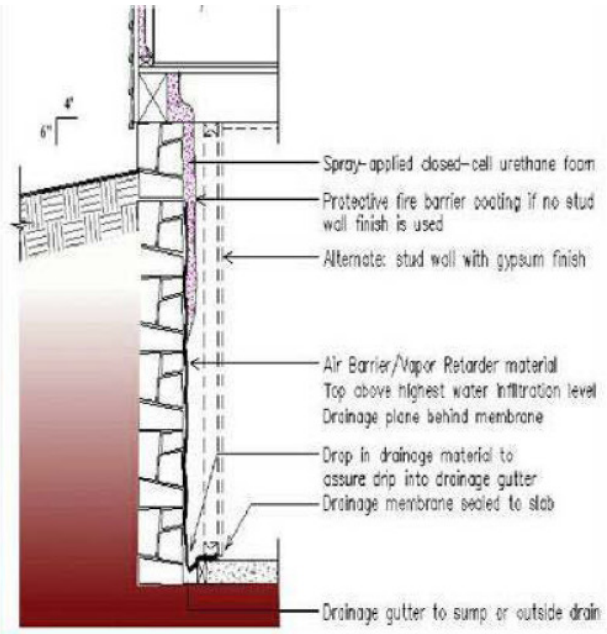
The crawlspace is also a stone foundation. There is plumbing that runs in this space as well, so concern of freezing needs to be addressed.

Steven Winter Associates, Inc. 50 Washington Street Telephone: (203) 857-0200
Building System Consultants Norwalk, CT 06854 Telefax: (203) 852-0741
Web: www.swinter.com

There is also a large pit near the crawlspace access panel that is filled with standing water. The specific purpose of this pit was not clear (may be old well), but it should be investigated and likely drained and/or sealed.

Recommended Approach: The first thing you should do is to try to reduce the amount of moisture in the basement. The work might include changing the grade around the house so that the soil slopes away from the foundation; installing a swale on the uphill side of your house, with the swale draining away from the foundation; and fixing roof gutters. The gutter drains need to extend far enough away (typically 4+ feet) from the building so water does not collect around the foundation exterior. Grading around the home should be properly sloped away from the home. The stairs to the basement on the rear of the home need to have a proper bulkhead door installed to prevent rain from coming down the stairs into the basement. Additional technical guidance on site water management is available here: http://epa.gov/indoorairplus/technical/moisture/1_1.html

To properly address water management and insulation for the basement and crawlspace, a dimple mat or membrane should be installed on the interior below-grade portions of the stone foundation that would allow water that makes it through the foundation to drain to the new drainage system in the basement floor that connects to a sump pit (with a sealed cover). This will require the existing partial basement slab to be removed. For the above-grade portions of the stone foundation in the basement and crawlspace, 2+ inches of closed cell spray foam insulation (ccSPF) can be applied directly to the interior of the foundation. This insulation should continue down over the wall membrane in the basement to the floor. The wall assembly should connect into a continuous vapor retarder for the basement and crawlspace floor to prevent moisture from wicking up through the ground into the home. A concrete slab should be poured over the floor membrane in the basement to protect the membrane from wear and tear. It would also be a good idea to install a stand-alone dehumidifier drained to a sump in the basement to remove any excess moisture.



Finally, there is an access panel to the crawlspace off of the porch shower area. This opening should either be sealed off or an insulated door with weatherstripping should be installed to minimize the air leakage that occurs at this opening

Alternative ECM approach: To avoid dealing with the basement water management at all, it may be possible to move the mechanical equipment to a small room to be configured in the screened-in porch renovation. Then water and hydronic heat plumbing would be placed in the floor bays of the basement and crawlspace ceiling. These would be wrapped with pipe insulation and then ccSPF would be applied to the basement ceiling to isolate the rest of the living space from the basement and to provide additional insulation to the plumbing. This is not an ideal solution, especially if you anticipate the home not being occupied for extended periods during the winter. In addition, access or replacement of plumbing is extremely difficult due to the ccSPF.

Last-resort approach: Mechanical system to be installed in the basement. The basement and crawlspace space should be heated by a hydronic baseboard to provide a minimum heating level of 50°F. This is extremely energy intensive, especially as the fuel source will be oil or propane. I would still strongly recommend the water management measures mentioned in the recommended approach to minimize the amount of moisture that enters the home.

Above-Grade Walls

The above-grade exterior walls are wood frame construction but appear to be uninsulated from the couple of locations where wall cavities were accessible during the inspection. No major evidence of water intrusion was observed other than around the chimney in the kitchen, which is a known issue

that is being dealt with already.

Recommended approach: It is recommended that the water management of the exterior siding be verified and fixed as needed (siding repair, caulking around windows, sealing of any penetrations, etc.). Then dense packed blown-in insulation (cellulose or fiberglass, R-3.6 to 4.3/in) can be applied to the wall cavities from the interior through small 2" holes.

Example of insulation being blown into a wall cavity from a smaller interior penetration.

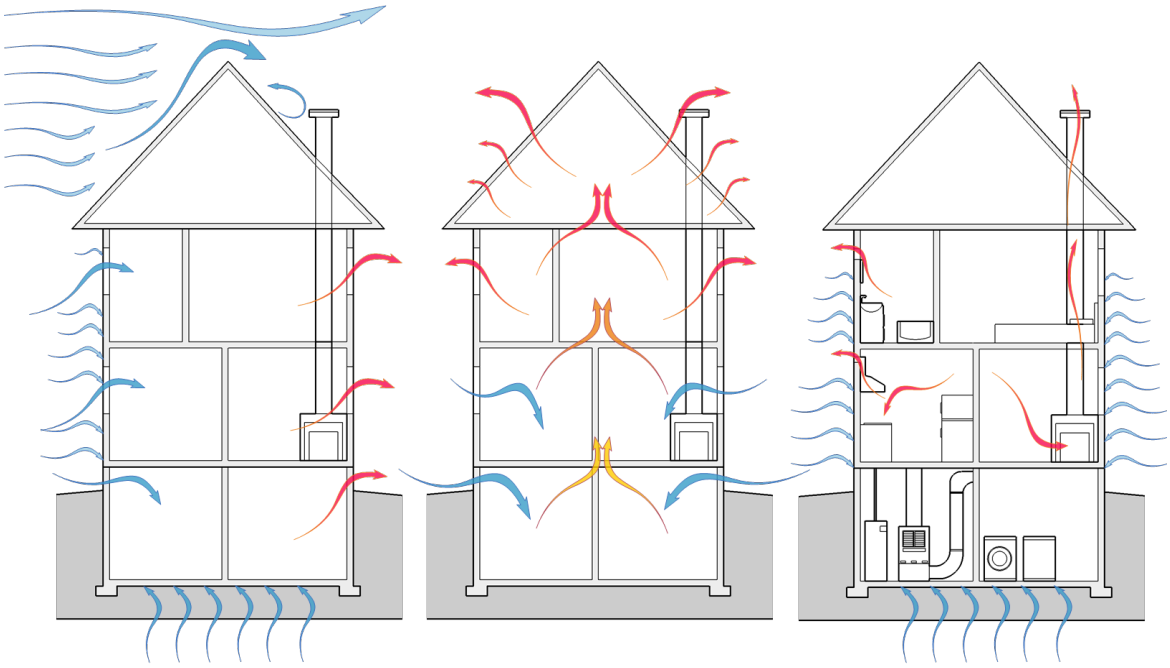
Additional options: If a larger expenditure is possible for the exterior walls, one thing to consider is removing the exterior siding, applying 1" of polyisocyanurate over structural sheathing (all seams between rigid insulation boards need to be sealed with manufacturer approved tapes), and install new siding. This layer of continuous insulation would provide additional air sealing and minimize the thermal bridging (good example/definition of thermal bridging: https://www.finehomebuilding.com/pages/thermal-bridging/) across the wood studs.

Attic

The largest culprit to building leakage tends to be the roof. By air sealing the attic, drafts are reduced. In addition to reducing the physical air leaks in the ceiling plane, by sealing the top of the home, the stack effect (heat rising) is minimized. A reduction in the stack effect (exfiltration) results in a lower neutral pressure plane in the home, which reduces the driving pressures that cause air leakage in exterior walls (infiltration).

Steven Winter Associates, Inc. 50 Washington Street Telephone: (203) 857-0200
Building System Consultants Norwalk, CT 06854 Telefax: (203) 852-0741
Web: www.swinter.com

Air Flow in Buildings



Wind Driven Air Flow **Stack Effect** **Mechanical Equipment**

The vented attic is in decent condition for an existing home. The upper attic area has fiberglass batts installed between the ceiling joists, but the batt insulation has deteriorated and is likely providing little thermal value currently. There is also evidence of rodent droppings. The lower attic area appears to be uninsulated, but a good portion is covered by a platform that wasn't removed to verify insulation levels beneath. As previously mentioned, there is some water intrusion around the chimney that needs to be addressed.

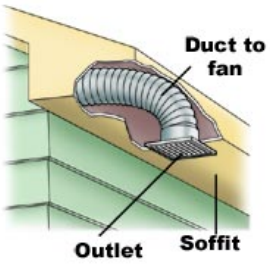
Recommendation if insulating at the ceiling: If the ceiling is not vaulted, all existing batt insulation should be removed. Then the overall insulation level in the attic should be 11+ inches of blown cellulose or fiberglass, which would result in a R-38+ to the ceiling plane. To do this in your attic, a couple things would need to be done.

- Ideally, with a vented attic, the most important feature is to ensure that the ceiling plane is air sealed. The existing insulation should be pulled up and a critical air seal of all penetrations, framing, and seams in the ceiling plane with spray polyurethane foam be performed. For your project, it may make more economical to just do spot air sealing around the light housings, exhaust fan housings, and any plumbing penetrations. Confirm that all recessed light housings are ICAT (Insulation-Contact-Air-Tight) rated. If not, an enclosure will need to be installed over the housing prior to air sealing and insulating. [see

Steven Winter Associates, Inc. 50 Washington Street Telephone: (203) 857-0200
Building System Consultants Norwalk, CT 06854 Telefax: (203) 852-0741
Web: www.swinter.com

example image below on left]

- Next, baffles need to be added to the bays in which soffit vents are located. Then either fiberglass batts or spray polyurethane foam should be inserted at the transition to the soffit to prevent any blown insulation from blocking the flow of air from the soffit through the baffle to the attic space above the insulation. [see example image below in upper right] Make sure that any exhaust fans that are ducted out through the soffit are actually hard ducted through the soffit to the outside and not just ducted to the interior of the soffit vent area.



- The attic platform is not being used for storage, so I would recommend just removing the platforms and insulating the attic. If a walkway is still desired, a pathway could be made along the wall with an insulation dam [see example below in lower right image]. Insulation would need to be blown under the platform as well.

Examples of ceiling plane critical air seal, baffles installed at soffit vents, and insulation dam for additional blown insulation.

Recommendation if vaulting ceilings and insulating at the roof deck: There was discussion of vaulting all the ceilings where possible. In this case, it is recommended to use ccSPF against the roof deck to the full depth of the rafter and then cover with drywall to provide a fire rated assembly.

Steven Winter Associates, Inc. 50 Washington Street Telephone: (203) 857-0200
Building System Consultants Norwalk, CT 06854 Telefax: (203) 852-0741
Web: www.swinter.com

Example of roof deck being insulated with ccSPD. In this case, drywall was still being placed at the ceiling plane so the ccSPF extends beyond the rafters and is covered by an intumescent paint rather than drywall for fire protection.

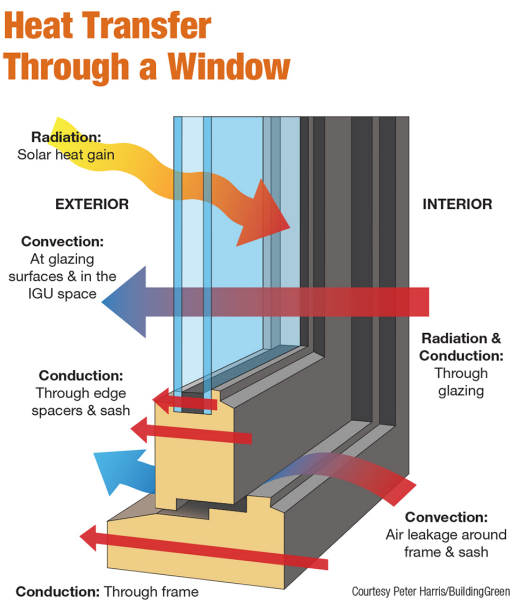
Chimneys

Another significant leakage point is fireplaces. The previous mechanical systems for the home seems to be a wood stove in the basement that would radiate heat up through the home. There is a chimney that runs against the side wall of the basement and along the asphalt driveway side of the home. It does not appear that this chimney will be used for any purpose, so you may want to consider sealing this chimney up.

The chimney in the kitchen needs to be repaired or replaced. If not desired for aesthetical purposes, you may want to consider eliminating this chimney all together. If the chimney is replaced, the interior opening should have a weather tight door closure to minimize air movement. Open chimneys act as a natural flue for conditioned air to exist the home, which wastes energy and impacts comfort.

Windows

Many of the windows throughout the home are single pane windows with storms. While I can't make the claim that these windows will be cost effective to replace purely on reduced energy bills (despite what some window manufacturers will market), updating the windows to double pane windows will improve comfort and reduce the amount of heating and cooling that is required. By replacing the single pane windows, you will be able to better air seal around the window rough openings, you will reduce the amount of conductive, convective, and thermal radiation heat transfer through the windows, and can better control solar heat gain (low-e coating) for the summer time.



Storm windows are feasible when cost is the determining factor. Exterior storm low-e windows: http://energy.gov/energysaver/projects/savings-project-install-exterior-storm-windows-low-e-coating. According to the U. S. Department of Energy, storm windows are not a good insulating factor, but they can help reduce air leakage. Still, exterior storms use a tiny "weep hole" to allow moisture to escape, which may slightly compromise the efficiency of the exterior storm window. If you plan on keeping this home for a long time, I would recommend updating the windows to double pane windows. But I would first address the other recommendations in this report first and see how the home responds and then make the determination to replace the windows or install exterior low-e storms.

Screened-In-Porch Reconstruction

If the screened-in-porch is torn down and rebuilt as conditioned living space, it will have to be built to current building code which is the Energy Conservation Construction Code of New York State 2010, which is comparable to the 2009 International Energy Conservation Code (IECC). Table 402.1(1) provides the prescriptive insulation and fenestration requirements by component for the building envelope (walls, floor, roof, windows, etc.). Columbia County falls under IECC Climate Zone 5.

Ceiling R-value	38
Wood Frame Wall R-value	21 or 15+5
Mass Wall R-Value	13/17
Floor R-Value	30
Basement Wall R-Value	10/13
Slab R-Value, Depth	10, 2 ft
Crawlspace Wall R-Value	10/13
Fenestration U-Factor	0.35
Skylight U-Factor	0.60
Glazed Fenestration SHGC	Not Required

This will require the above-grade exterior walls to either be 2x6 wood framing to allow R-21 wall cavity insulation or exterior rigid insulation will need to be applied over 2x4 wood framing. There is a portion of the lower wall that is CMU block due to variations in the grade around the screened-in-porch. This CMU block will need to be insulated either on the interior or exterior. If insulated on the exterior, it should be covered by a suitable flashing to protect the insulation from damage and to maintain the water drainage plane. It may make more sense architecturally to insulate the CMU block on the interior, as the concrete slab will require 2" of extruded polystyrene (XPS) to be applied on top of the existing slab and either a floating concrete slab or floating plywood floor

would installed over the insulation.

Example of insulation over existing slab and floating plywood floor.

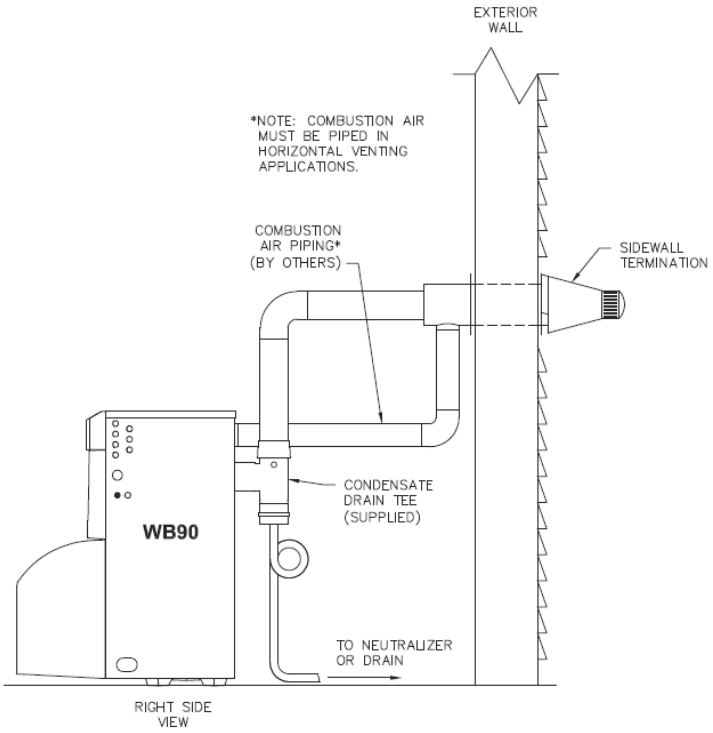
Again, depending on the desired ceiling configuration, it may make most sense to use ccSPF at the roof deck and vault the space to increase the volume of the additional bedroom.

Section 2: Mechanical Systems

The whole house needs new mechanical system for heating, cooling, hot water, and ventilation. There are two options for locating the mechanicals. The first is in the basement. The other option would be in a small mechanical closet that would need to be incorporated in the redesign of the screened-in-porch. The focus of this report will be based on the mechanicals being located in the basement, but if you decide to go with a mechanical closet in the screened-in-porch area, we can discuss details.

The primary heat source for the home with be a high-efficiency boiler that feeds hydronic baseboard heaters. The condition of the existing oil tank is poor and will likely need to be replaced with a new tank. Alternatively, the home could be heated with propane. This would require a large tank be located outside away from the home. Specific sizing of the propane tank would be made by the installing contractor, but this is one option to consider if you want to eliminate oil from the premises (and as the kitchen will already be converted to propane). In all likely hood, simply replacing the oil tank and going with an oil boiler will be the cheapest alternative. I would recommend the Peerless Series WB90 Oil Boiler with Indirect Water Tank or equivalent 90% AFUE oil boiler. The boiler should be direct vented rather than natural draft (chimney). The WB90 boiler is also designed to allow combustion air to be piped directly to the appliance from outside the building (sealed combustion). To do this, an optional Combustion Air Inlet Kit is available. The WB90 vent & air inlet may be sidewall vented with a concentric vent termination specified by the manufacturer. This will reduce the number of penetrations in the building structure. This sidewall termination needs to be high enough on the exterior wall to not be restricted by snow buildup.

Steven Winter Associates, Inc. 50 Washington Street Telephone: (203) 857-0200
Building System Consultants Norwalk, CT 06854 Telefax: (203) 852-0741
Web: www.swinter.com

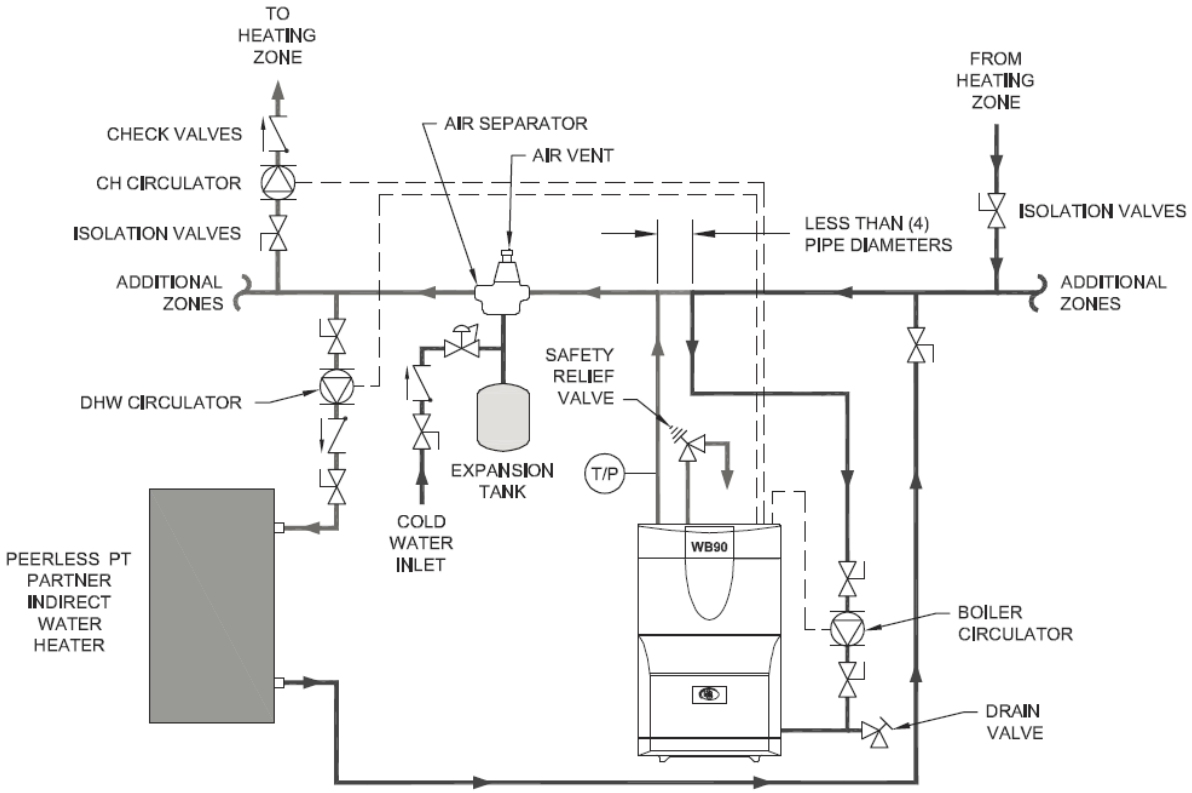


The hydronic baseboards come in a variety of styles, but two examples are provided below (a traditional style on the left and a more modern European style on the right). The specific layout and location of the baseboards will have to be further evaluated once the floor plan updates have been finalized, but hydronic baseboard heat is anticipated to service the main floor area..

This oil boiler would also provide domestic hot water to the home through the heating of an indirect tank off of the boiler. A schematic plumbing layout is provided below.

.

Steven Winter Associates, Inc. 50 Washington Street Telephone: (203) 857-0200
Building System Consultants Norwalk, CT 06854 Telefax: (203) 852-0741
Web: www.swinter.com



For the upstairs bedroom suite and the screened-in-porch bedroom, an alternative mechanical system is being proposed to provide both heating and cooling to these spaces. This system is referred to a mini-split air-source heat pumps. Newer versions of the technology by various manufacturers (Fujitsu, Mitsubishi, Daikin, etc.) are able to provide heating down to -15°F outdoor temperature. I am recommended that two Fujitsu Extra Low Temp Heating Mini-Split (AOU15RLS2H outdoor unit with ASU15RLS2 indoor wall mounted unit) be installed, one in each bedroom. The indoor unit would be a wall mounted unit. A drain line will need to be installed to remove condensate from the unit during cooling mood. If the aesthetics of the wall mounted units are not desireable, a slim concealed ducted unit option is available.

.

Steven Winter Associates, Inc. 50 Washington Street Telephone: (203) 857-0200
Building System Consultants Norwalk, CT 06854 Telefax: (203) 852-0741
Web: www.swinter.com

Bathrooms to have ENERGY STAR qualified exhaust fans: Panasonic WhisperGreen FV-08VKM3 (these have motion sensors to activate, so you don't have to rely on the occupants to remember to turn on the fan during showers.

Kitchen should have an ENERGY STAR qualified exhaust fan (rated for 100-300 cfm) that is ducted to the outside to minimize indoor air pollutants from the range and oven burners: Air King has numerous options that could work.