ERM

**Energy Resource Management Construction Corp. LLC.**

www.energyresourcemanagement.us

**ENERGY REVIEW**

**1/1/2013**

# Alexandria VA

## Project Description

This single family home is located on a large lot  on in Alexandria VA


The home is approximately XXXXXX sf.

Its lot is 2.6 +/- acres and has its primary entrance off the main  street.

The home is wood framed with a brick exterior. Windows have been updated.

The grounds include the main house, a exterior pool, gardens and a separate house on the property.

The separate house is approximately 3000 sf and was formerly a garage that was converted to a residence.

The original house was built in 2000, but has been fully renovated more than 0 years ago.

## *ERM* Energy Review

This report is offered to our clients as a free introductory examination of a subject property in order to provide a starting point on its energy reduction and an eventual over-all Energy Design.

*ERM* has been an Energy Management Company for more that five years.

In that time we have overseen the energy study and upgrade of hundreds of homes and businesses in the greater DC area.

The *ERM* team of energy experts has been extremely successful in this short time in making our customers, safer and secure, more comfortable in their homes and businesses and reducing their energy consumption by as much as 65%.

The systems that *ERM* can include in our Energy Design are;

Energy Monitoring
Geothermal
Passive Solar
Active Solar
High Efficiency
Heating and Cooling Systems
Water Management
Water Recovery
Insulation
Weatherization
Lighting
Smart Technologies
Energy Evaluations (Audits)
Energy Modeling
Overall Energy & Construction Management

ENERGY STAR PARTNER

ENERGY HOUSE

## Purpose

It is the desire of the homeowners to reduce their overall Carbon Footprint on this property.

## What is a carbon footprint - definition

**A carbon footprint is defined as:** http://timeforchange.org/what-is-a-carbon-footprint-definition

The total amount of greenhouse gases produced to directly and indirectly support human activities, usually expressed in equivalent tons of carbon dioxide (CO2).

In other words: When you drive a car, the engine burns fuel which creates a certain amount of CO2, depending on its fuel consumption and the driving distance.
**(CO2 is the chemical symbol for carbon dioxide).**
When you heat your house with oil, gas or coal, then you also generate CO2. Even if you heat your house with electricity, the generation of the electrical power may also have emitted a certain amount of CO2. Even when you buy food and goods, the production of the food and goods also emitted some quantities of CO2. **Your carbon footprint is the sum of all emissions of CO2 (carbon dioxide),** which were induced by your activities in a given time frame. Usually a carbon footprint is calculated for the time period of a year.

*ERM* will be primarily focusing on the reduction of the Carbon Footprint on the subject home in Alexandria.

While the overall Carbon Footprint should include lifestyle and transportation the intention of the *ERM* work will be on the property.

Additional consideration can be given to the overall Carbon Footprint of the family if that is desired and the scope of our review is expanded.

## Purpose - Continued

The initial inquire of the homeowners was to consider using geothermal as a means of reducing the Carbon Footprint of the property.

While geothermal will significantly reduce the heating and cooling cost and less usage of fossil fuels for the property, the first step in any energy upgrade of a property has to be Weatherization.

If through Weatherization the demand of the home can be reduced then the size of the geothermal systems can also be reduced. Which will save the homeowners installation costs and operating costs over the next 20 to 30 years.

In a neighbors home, a savings was found through weatherization of $15,000.00 on equipment and drilling costs and another $10,000.00 in operating costs over the next 25 years through Weatherization.

Weatherization is truly the lowest hanging fruit on the tree of Energy Savings.

**Therefore the purpose of the Energy Review will be to apply all methods of energy reduction to the potential project which will be the very best way of achieving the homeowners purpose, to reduce the properties Carbon Footprint.**

## Exterior Review - No pictures were taken

The exterior of the home is in excellent condition.

Windows and doors are in well caulked and are properly weather-stripped and appear to all be in good working condition.

There are some exterior utility penetrations that could be resealed and made weather tight with insulating foam.

The home has a southeast exposure to the sun, which is very good for passive solar gain in the winter time. Not good for passive solar gain in the summer time without shading and proper window treatments.

There is a large lot associated with the property for which geothermal and potentially solar could be considered as renewable systems for the buildings heating, cooling and electrical usage.

## Interior Review - No pictures were taken

From the initial visit for this Energy Review only some of the areas were investigated for the properties proper energy systems and operation.

Those found and inspected were the utility rooms, the kitchen and family room crawl space, the garage and the basement.

Hatches to the attic areas were not opened and inspected during this visit. Heating and cooling delivery systems were not all identified for a complete review of their efficiency and operation. Some assumptions were made.

**Attics**

Insulation in the attic on the third floor found insufficient roof insulation (R19) was obvious. Given the date of the last major renovation of the property it is not surprising that the insulation is less than todays standard for Energy Star recommendation (R49). It is assumed that since this was the only attic area inspected that this insulation level is what exists throughout the homes attic areas. (More in Recommendations Section)

**Utility Rooms**

In the three utility rooms that were inspected insufficient insulation and sealing was evident. In the area between the for framing that could be observed in these utility areas the rim joists were only stuffed with fiberglass insulation. Property air sealing and insulation should be done on all those areas that are accessible for being upgraded. (More in Recommendations Section)

Air infiltration from improper air sealing of rim joist areas can account for approximately 15% of outside air penetration into the home making areas warmer or colder in extreme temperatures.

**Crawl Space**

In the area under the back of the kitchen and the stair ways to the upper floors there was a large crawl space that was not weatherized at all. A large amount of air was felt at its hatch entrance even before the hatch was removed.

Upon inspection a number of spider webs were observed in the crawl space which is a very good indication of air leakage and bug entrance into the house. Spiders find these areas for food sources and are a great indication of a problem in that area. (More in Recommendations Section)

## Interior Review - No pictures were taken - Continued

**Garage**

The garage was not found to be conditioned space. While insulated, some of the common walls with the home did not seem to be sealed and in some cases was missing insulation.

Weather-stripping on the doors while present seemed in need of adjustment or replacement as light was evident around the door from the inside of the space.

**Wall Insulation**

Was not inspected as access to any unfinished areas were not found in this inspection that would enable us to comment.

**Heating and Cooling (More in Recommendations Section)**

19 Tons - Natural gas fired hot air systems are being used as this time for heating. This system has an AFUE (Annual Fuel Utilization Efficiency) of approximately 80% .

Electric heat pumps are being used for the cooling. Their efficiency is projected to be a 12 seer rating.

Mini Split systems are used to supplement the heating and cooling in the exercise rooms and the wine cellar.

**Fireplaces**

Fireplaces were not inspected during this visit to the property.

**Hot Water**

Hot water supply was provided by direct vent gas systems which are a very good method of heating the hot water for the home. Specifics on those units were not recorded. (More in Recommendations Section)

Only one location was found for the water heating for the home and that was on the east end of the property behind the office study area. Some hot water pipes were observed as not insulated.

**Ducts (More in Recommendations Section)**

Metal ducts and registers, supply the home with conditioned air. While the ducting system was not inspected for this Energy Review ducts were observed in the crawl space as not insulated and not sealed with mastic.

## Interior Review - No pictures were taken - Continued

Ducting in this type of system can range in inefficiency from 20 to 40%. As at the time of the homes renovation duct insulation and sealing were not part of the code at that time.

**Thermostats**
While there are a number of zones in the house to regulate the heating and cooling and a few of the thermostats had been upgraded to wifi accessibility they are all programmable and seem to be in good working condition.

**Smart Technologies (More in Recommendations Section)**
No smart technologies were observed in the home to monitor the overall energy usage of the building, the air quality or moisture.

A security system does exist.

**Passive solar**
While the house is washed with sun throughout the day due to its orientation no passive solar shades or awnings were observed in the windows.

South facing windows did not seem to have extended overhangs to shield the sun penetration in the summer months.

Those windows on the south side did not seem to carry any different solar films from those on the north side of the home. Not a practice that would have been done in the era of this homes last renovation.

No thermal massing for passive solar heating was observed in any other part of the home other than the kitchen where solar is allowed into the space through a number of skylights which will result in heat absorption by the floor tile and the mass of the stone on the counters.

This will help make the space warmer in the winter but may over heat the space in the summer months making the cooling zone in this part of the house work harder and cost more.

(More in Recommendations Section)

## Interior Review - No pictures were taken - Continued

### Utility Penetrations

Areas in the kitchen and bathrooms, utility rooms and non conditioned spaces were not inspected at this time but should be considered for proper sealing. (More in Recommendations Section)

### Utilities

The utility usage for the property was not provided at the time of our visit but should be reviewed. This would include, gas, electric water and sewage bills for the past year.

### Plans for the House

No complete set of plans were available for the property at the time of our visit. These plans should be collected from the renovation architect for review. These plans need to include the plumbing and electrical diagrams as well as the heating and cooling layouts.

## *ERM* Team of Energy Experts - Projected for this Project

*ERM* - Energy Management Company -
http://ermcc.com/ www.energyhouse.us

Green Nation Energy LLC - Energy Evaluations
http://greennationenergy.com

Air Cool & Heat - HVAC Geothermal Contractor
duboise@verizon.net

Northern Virginia Drilling - Geothermal Well Driller
http://nvdinc.com/

Transcend Home Theater - Smart Technologies
dan@ththeater.com

Building Performance Retrofitters LLC - Sealing and Insulation
http://www.bpretrofitters.com/

Other companies based on competitive bid and need for services.

## Energy Recommendations

## Energy Evaluation (Audit)

This is the first place to start on the process of lowering the Carbon Footprint of the Alexandria property.

**Green Nation Energy LLC** will be hired to provide a full BPI Certified Energy Evaluation on the property - **http://greennationenergy.com**

### Health & Safety

This study will check all the systems of the home to make sure they are working properly and safely, like stoves, hot water tanks, furnaces, water devises and the homes ducting systems.

A combustion check will be done on all gas appliances to make sure they are operating properly.

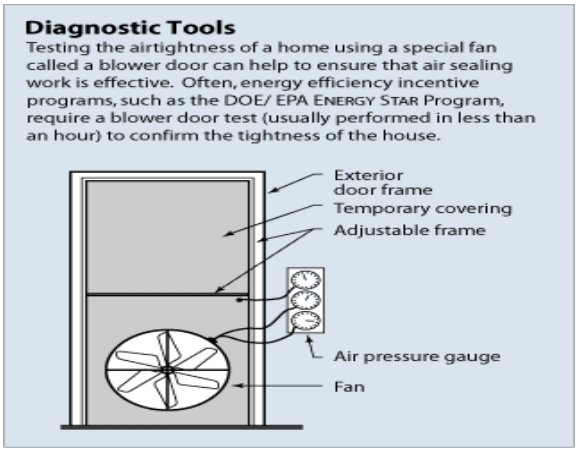
## *ERM* - Alexandria VA

# Energy Recommendations

## Energy Evaluation (Audit) - Continued

### Diagnostic Testing

**Blower Door** - used to determine air leakage in the home




Reducing energy consumption due to air leakage

Avoiding moisture condensation problems

Avoiding uncomfortable drafts caused by cold air leaking in from the outdoors

Making sure that the home's air quality is not too contaminated by indoor air pollution

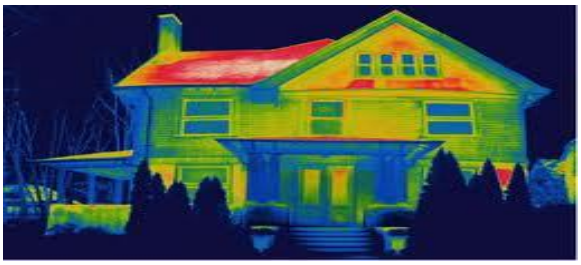
**Blower Door - How it Works**

A blower door is a powerful fan that mounts into the frame of an exterior door. The fan pulls air out of the house, lowering the air pressure inside. The higher outside air measure the amount of air pulled out of the house by the fan

On this home due to its size multiple blower doors will be required.

**Thermal Imaging**

Making the invisible visible is a useful first step in finding the air infiltration sources in the home.

By using the blower door and drawing in air from the outside the air infiltration sites in the home are sometimes obvious just to the touch. But they become more obvious when using a Thermal Imaging gun which will pick up the changes in temperature from the outside air as it comes in through the gaps in the envelope.

Pictures of this air leakage is taken and recorded and provide the Energy Evaluator a road map on how to reduce air infiltration into the home.

# Energy Recommendations

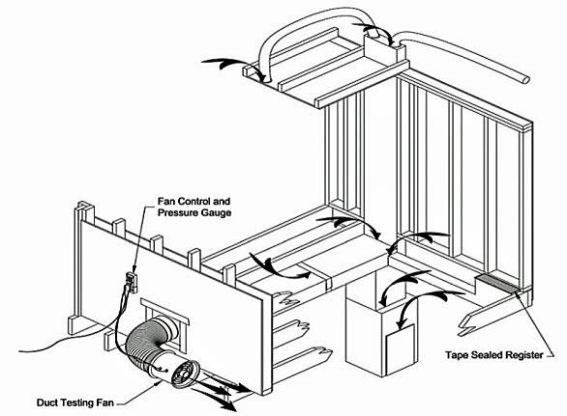
## Energy Evaluation (Audit) - Continued

### Diagnostic Testing - Continued

**Duct Testing - Duct Blaster or Pressure Pan**

Testing ducts for leakage is probably one of the most important functions we can provide. Duct leaks can account for almost half of your cooling/heating loads.

Duct leakage is much more subtle than leaks in water pipes but it it is not something to be ignored. Duct leakage can not only reduce the effectiveness of your heating & cooling systems but can also lead to comfort complaints, moisture buildups, mold and bad air being circulated threw a house.




**Duct Testing - How it Works**

A Duct Blaster can be connected to a residential duct system at a large return-air grille or near the furnace. Once the duct system has been pressurized or depressurized to 25 Pascal's, the air flow of the fan gives an indication of the duct system's leakiness.
A pressure pan is used to measure the leakage at individual ducts while the blower door is running. If there is no leakage, the pressure pan will show a reading of 0 Pascals. If the duct is totally open to the outside, the reading can be as high as 50 pascals, the same as that for the blower door.

### Utility Bill Analysis

As a means of determining the energy consumption of the property being studied all of the utility bills for the past year should be reviewed

- Gas - For cooking and heating systems.
- Electric - Supplemental heating, cooling, appliances, devices and lighting.
- Water - For drinking, cooking, washing, water closets and irrigation.
- Sewage - For waste and run-off
- Cable Television - For television viewing, internet, phone.

### Appliance, Devise, Lighting Inspection & Inventory

The Energy Evaluation team will take a full inventory of all the appliances, devises and lighting in the home.

This will determine the efficiency of those items in order to project any energy savings that may found from their upgrade.

# Energy Recommendations

## Energy Evaluation (Audit) - Continued

### Full Home Inspection

At the start of the Energy Evaluation process the Evaluator and their team interview the homeowner to learn about the goals and expectations are for the potential energy upgrade of the property.

In addition, comfort issues are identified with the homeowner that may have noticed in their day to day living in the home. These are all noted and then focused on for explanation and offered solutions from the Evaluation.

A complete inspection is then done on the interior and the exterior of the home which includes all the heating and cooling systems, hot water systems, delivery systems, thermostats, windows and doors, insulation and sealing.

A complete report of all the findings of the Energy Evaluation is provided to the home owner in about two weeks after the inspections are concluded.

It is expected for the Alexandria  property two days would be needed for a complete Energy Evaluation of the primary residence. Not including any out-buildings.

## Weatherization

Is the most cost effective way of reducing the Carbon Footprint of any home or business.

Weatherization is truly the lowest hanging fruit on the energy savings tree.

From the information provided by the Energy Evaluation the home will be made more air tight and efficient which will have results in all aspects of the energy upgrade of the property.

The reduction of energy demand in heating and cooling or in electrical usage will result in lesser equipment needed. Which will result in lower costs for equipment purchased and installed as well less operating costs of that equipment life span.

Typical home weatherization sources of air leaks.

Home Evaluation will determine actual.

SOURCES OF AIR LEAKS

# Energy Recommendations

## Weatherization - Continued

### Sealing and Caulking

No area will be proposed for additional air sealing or caulking that is not easily accessed in this process for this house.

It is not projected that a renovation will be done to the house because of its excellent condition. But areas that are unfinished or accessible air sealing and caulking will be proposed.

At the time of the homes last renovation air sealing foam was not available.

Air sealing foam would be used in all areas that are identified and are accessible for the sealing of air infiltration.

### Insulation

The Energy Evaluation will review all insulation in the home. The recommendations from that inspection will be projected in the Work Detail that results from the Evaluation.

## Heating & Cooling

The current demand and usage of the heating and cooling systems in the Alexandria property is 19 tons. It is currently provided by gas heat and electric heat pumps.

### Geothermal

Geothermal should be considered for the homes heating and cooling systems. This alternative energy source uses the earths consistent temperature to provide a base temperature that can be brought into your home to save money.

Drilling Loop

Ground Loop

## Heating & Cooling - Continued

### Geothermal

"Geo exchange systems are the most energy-efficient, environmentally clean and cost-effective space conditioning system available today."

U.S. EPA

A 30% federal tax credit is available for the installation of Geothermal. for the homeowner. There is no limit to the credit and the credit is in effect until 2016.

### Benefits of Geothermal

Proven technology
Millions of units have been installed world-wide
Most energy-efficient and environmentally friendly HVAC systems available
Eligible for federal tax credits and state incentives
Geothermal Heat Pumps keep your entire house comfortable year-round
System can be used to provide free hot water
No outdoor units
Longer system life
No fossil fuel
No site emissions

**A Picture of Water Furnace Equipment - Just an Example**

The use of geothermal heat pumps save energy but do require electrical power from the grid to make them work.

Off-set electrical production is possible to make the use of geothermal carbon neutral.

## Solar - Offset to Electrical Usage

Solar photovoltaics should be considered as a way to off-set the fossil fuel usage - while limited relative to other heating and cooling systems - for geothermal.

If the homeowner determines that they wish to make the heating and cooling a net zero carbon usage finding a way to produce electrical power on site could be explored.

**Net Metering**

Which exists in the state of Virginia, allows you to offset your purchase of electricity with your own generated electricity, essentially making your meter on your house run backward. Your utility will then only bill you the monthly customer charge and the net amount of electricity you use from its power grid.

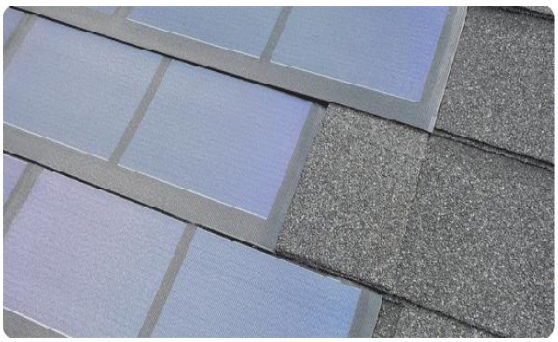
Net Metering in Virginia will not allow the utility to pay you for more electricity than you consume, so proper sizing of your needs for a photovoltaic system is important.

**How Solar Photovoltaics Work**

Sunshine is converted into electricity by using solar panels (also called photovoltaics or PV panels) that produce direct current (DC) when exposed to sunlight. Our homes and workplaces use AC, or alternating current. A device called an inverter converts the DC electricity generated by the PV array to AC electricity that is usable in your home.

**Power Shingle**

Solar that's designed to fit you.
Your style. Your home. Your roof.
No bulky panels or heavy frames,
just a solar roof that's stylish enough
for the front of your home,
with the energy to power it.



http://www.uni-solar.com/products/residential-products/powershingle-2/

## Solar Hot Water

As part of the suggested Geothermal system, one of the added benefits is the over production of heat that comes from the ground loop in the system.

This extra heat can be transferred into holding tanks for hot water which is a free frindge benefit of Geothermal. Excess heat if not used and stored is just recycled back into the ground loop.

**Adding Solar Hot Water**

With the W Braddock Rd home having a good gas fire hot water system for their domestic use and the addition of geothermal hot water heating costs can be lowered.

The addition of Solar Hot Water Panels can not only improve the savings but the solar panels can be used to heat the pool or other hot water needs.

**Solar Federal Tax Credit**

There is a 30% federal tax credit available for solar PV and Hot Water. One condition on the tax credit is that it cannot be applied for if solar is used for pool or hot tub heating.

## Whole House Energy Modeling

As a means of better determining the heating and cooling load of the current home and to project what the reduced heating and cooling load will be when additional Weatherization work is done, ERM will provide a Whole House Energy Model of the Alexandria home.

This modeling is a service that *ERM* provides before it does any work on a property so it can determine the actual mechanical loads of the property now and projected. Often, from the findings of the Energy Evaluation and the agree course of action determined by the homeowner substantial reductions do occur.

## Whole House Energy Modeling - Continued

The reductions of the mechanical loads from the tightening of the house will have impact on the Geothermal and Solar applications for the projects.

For example, on one of our current geothermal projects we have been able to take the well drilling from four boaring holes to just two which will mean a reduction in not only the drilling cost but also a reduction in the cost of the geothermal equipment being installed.

Given the standard live expectancy of geothermal is 50% longer just on the equipment side the savings are substantial on its installation but its operation as well.

Whole House Modeling is also our best tool in determining the payback and return on investment for each of our projects. **This service is done free for homeowner once a contract is signed with *ERM*.**

## Smart Technologies

It is accepted that 50% of all energy savings comes from changed learned behavior.


## Needed from the client

Copy of one utility bill for Electric, Water, Gas, Television, Other
Site Plan if available
Floor Plans if available

## Thank You

We appreciate the opportunity to submit this Energy Review of your home.