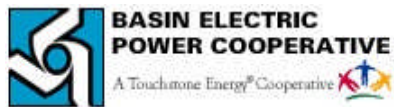


Deploying a Heat Pump Program



Hosted by  *Montana Electric Cooperatives' Association*



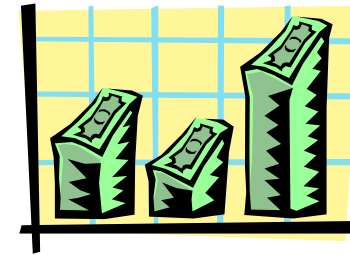
Identify critical inputs to DSM Success

- What are the costs?
- What are the benefits
- Importance of capturing program results at program design



Ways Utilities Calculate Program Value

- Cost Effectiveness Tests
 - Utility Cost Test
 - Participant Cost Test
 - Ratepayer Impact Test
 - Determining rebate levels



Total Resource Cost Test

- TRC = Benefits **(Avoided supply costs) / (Participant costs + Utility cost)**
 - The utility benefits- supply costs avoided (*generation, transmission and distribution, energy and operations and maintenance*) due to demand and energy savings achieved.
 - Participant costs -costs incurred by customers due to participation in the program.
 - Utility costs -the program's rebates, administrative costs, marketing costs and measurement and verification costs. The discount rate is a pre-determined figure, usually relatively low such as 5%.

Other Types of Cost Tests

- **Utility Cost Test (UC) = Benefits**
(Avoided supply costs) / (Utility costs + Rebate)
- **Rate Payer Impact Measure (RIM) Test = Benefits** *(Avoided supply costs) / (Utility costs + Rebate + Revenue loss)*
- **Participant Test= NPV of Benefits to Participants / NPV of the Participant Costs**
 - Benefits include:
 - Energy Savings
 - Costs include:
 - Equipment Premium
 - Less any Incentive Payments
 - Less any Maintenance Savings

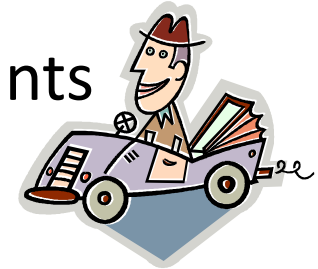
Comparing Marketing Tests vs. Economic Tests

- Sometimes consumer demand “trumps” economic analyses.
- Growing interest in minimizing environmental impacts/carbon emissions.
- Some customers are demanding more energy efficient choices and options, and willing to pay any “premium” associated with the green benefits.



Quantifying Impacts

- Free ridership rate is how many participants would have purchased energy efficient equipment without the program
- Free drivership rate is how many participants will install the rebated energy efficient equipment, outside the utility's service territory
- Non-Energy Benefits – additional benefits that result from the installation of energy efficiency measures such as:
 - Improved health/safety
 - Increased property values
 - Better “cash flow” due to energy savings

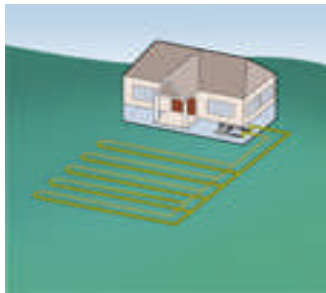


“Doing the Math”

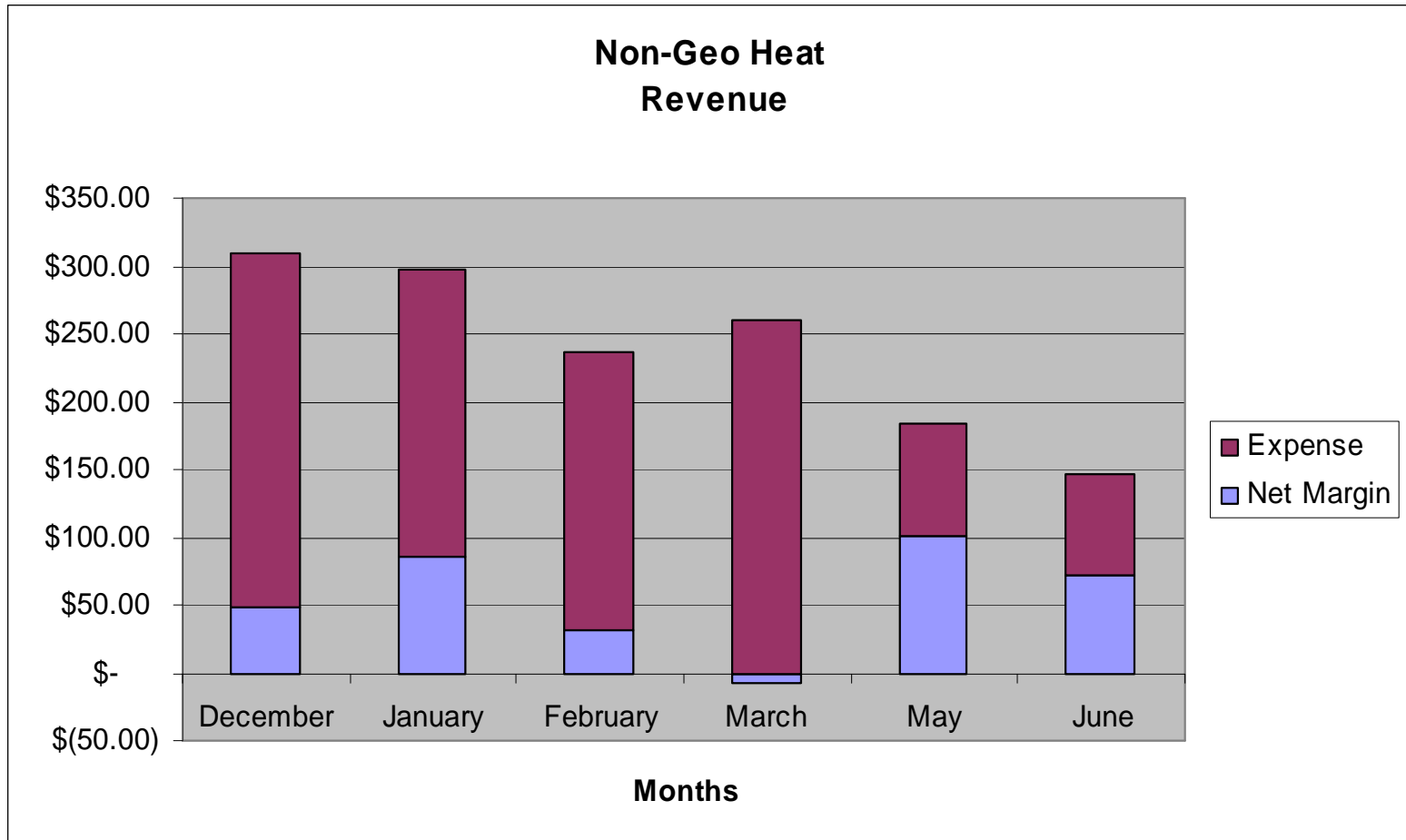
- Determining the critical
 - Market Size
 - Market Potential
 - Estimated Installation Costs
 - Estimated Energy Savings
 - Energy (kWh) and demand (kW)

Using Economic and Cost Effectiveness Tests

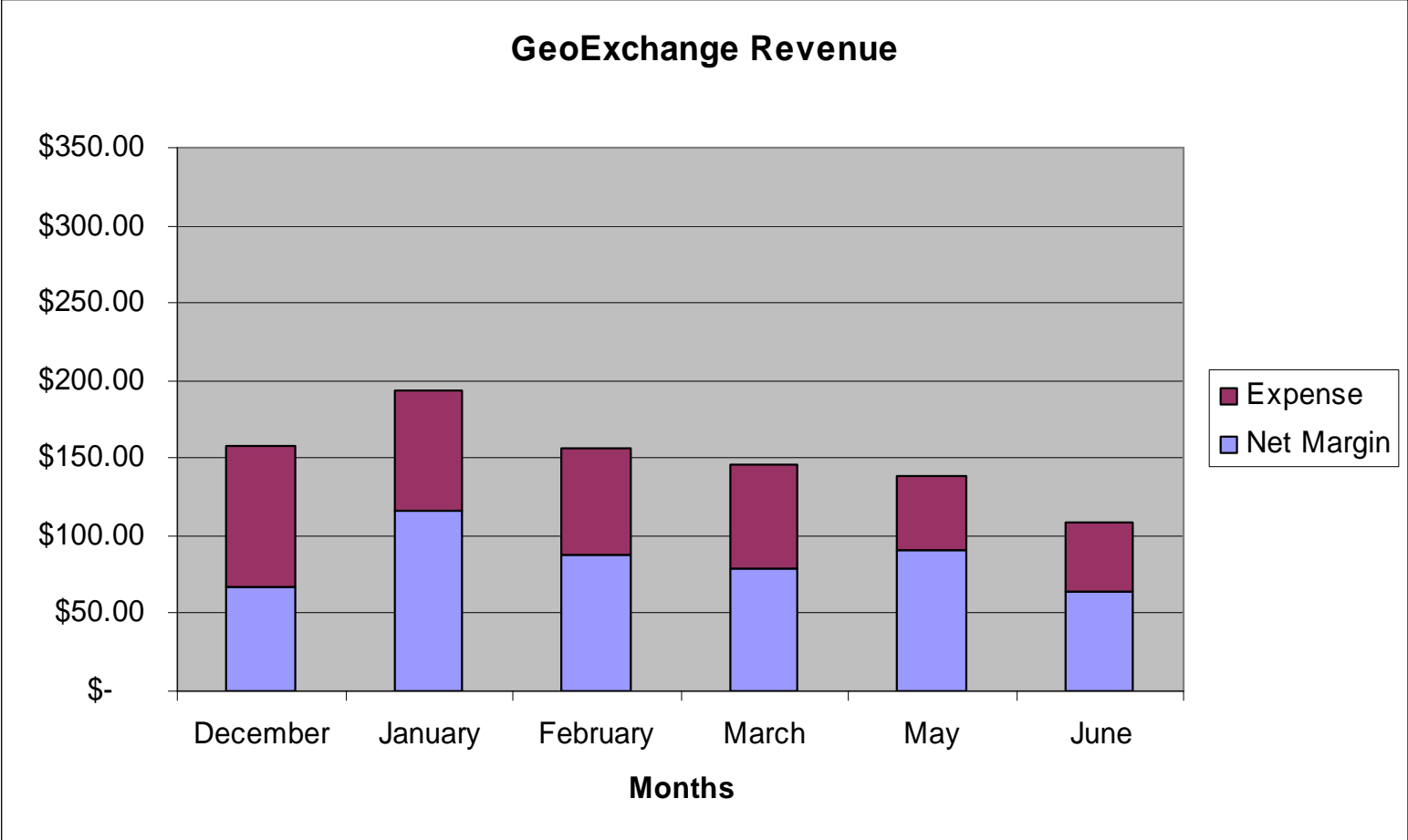
Example of Quantifying the Market for Geothermal Heat Pumps



Non-Geo Heat Revenue



GeoExchange Revenue



Overview of the Geothermal Heat Pump Calculators

- In MS Excel Format
- Two separate worksheets
 - Residential Perspective
 - Utility Perspective
- Requires users to provide critical information
- Analysis computes summary of benefits
- Assumptions may be changed as necessary
- Same process can be used for any type of heat pump analysis

Residential Heat Pump Calculator- Customer Perspective

- Helps customers compare geothermal heat pumps against alternative heating and cooling equipment
- Customers need to provide the following information:
 - System size for the geothermal heat pump
 - Annual heating costs for both systems
 - Annual cooling costs for both systems

[Residential Geo Cost Calculator-final.xls](#)

Customer Calculator Screen Shot- Introduction Page

USING THE RESIDENTIAL GEOTHERMAL HEAT PUMP CALCULATOR

This calculator is designed to help residential customers compared geothermal heat pump systems, sometimes called ground source heat pumps, to a variety of alternative heating and cooling systems.

To use this calculator, you will need the following information:

1. System size in tons
2. Annual heating costs for the two systems you are comparing
3. Annual cooling costs for the two systems you are comparing.

Annual heating and cooling costs are available from a variety of website calculators. The heating and cooling calculators developed by Washington State University for the Western Area Power Administration are provides this information based on regional data; however, any number of calculators can provide you with information you need to use this calculator.

***Once you have your information available, you are ready to use this calculator.
Advance to the Residential Cost Calc Worksheet***

Step 1: Installation Cost Comparison

Input data in the green shaded cells; the other fields are automatically calculated				
STEP 1. INSTALLATION COST COMPARISON			With Duct Work	
	Alternative	Geothermal Heat Pump	GHP w Duct Tune Up	GHP with Duct Work
Number of Tons	3	3	3	3
System Installation Cost	\$3,498.00	\$5,459.60	\$6,059.60	\$11,210.60
Lifetime Loop Lease Costs (if any)	\$0.00	\$0.00	\$0.00	\$0.00
Total Costs	\$3,498.00	\$5,459.60	\$6,059.60	\$11,210.60
Installation Benefits				
Tax Credits (if any)	\$0.00	\$0.00	\$0.00	\$0.00
Rebates (if any)	\$0.00	\$0.00	\$0.00	\$0.00
Net Installation Costs	\$3,498.00	\$5,459.60	\$0.00	\$0.00
System Cost Premium	\$1,961.60		\$2,561.60	\$7,712.60

Step 2: Energy Cost Comparison

STEP 2.

ENERGY COST COMPARISON

Click on following link for heating calculator

<http://energyexperts.org/CalculatorsTools/AirConditioningCostCalculator.aspx>

Click on following link for cooling calculator

<http://energyexperts.org/CalculatorsTools/HeatingCostCalculator.aspx>

Follow instructions and copy the heating and cooling costs in the shaded green cells

Customers can use any variety of energy programs to compare systems.

Additional Sources of Information

- **Geothermal costs based on housing type:**
 - <http://www.earthcomfort.com/costcalculator.html>
 - http://www.waterfurnace.com/savings_calculator.aspx
- **Comparisons of energy costs by region for standard equipment and geothermal heat pumps**
 - http://www.sbgeothermal.com/energy_use_calc.htm
 - <http://www.useelectric.com/calculators.asp>
 - <http://www.southern-dist.com/tools.html>
 - <http://www.hvacopcost.com/>
- **Fuel price comparisons**
http://ces.ca.uky.edu/energy/calculators/fuel_price_comparison/index.htm#

Customer Inputs for Energy Cost Comparisons

Annual Energy Costs			
Type	Alternative	Geothermal Heat Pump	Difference
Annual Heating Costs	\$1,077.65	\$649.78	\$427.87
Annual Cooling Costs	\$389.32	\$227.99	\$161.33
Total Annual Heating and Cooling	\$1,466.97	\$877.77	\$589.20

Summary Results

SUMMARY OF BENEFITS FOR GEOTHERMAL HEAT PUMP SYSTEMS		With Duct Tune	With Duct Work
Initial cost difference	\$1,961.60	\$2,561.60	\$7,712.60
Life cycle savings	\$7,342.73	\$7,342.73	\$7,342.73
Net life cycle savings (life cycle savings - additional cost)	\$5,381.13	\$4,781.13	(\$369.87)
Simple payback of additional cost (years)	3.33	2.92	-0.42

Residential Heat Pump Calculator- Utility Perspective

Residential Geothermal Heat Pump Calculator Savings Based on Engineering Assumptions			
Step 1: Determine Costs			
Electric Costs		Program Costs per Installation	
Customer Electric Rate (cost per kWh)	\$0.12	Administration	\$0.00
Utility Costs		Loop Lease	\$0.00
Wholesale power per kWh	0.05	Rebates/ton	\$150.00
Coincident Peak Demand per KW	\$12.00	Number of tons installed	30
Step 2: Determine Number of Installations		Revenue from financing/installation	\$0.00
Estimated Number of Installations	10		
Net Effects from Geothermal Heat Pump Installations			
Customer revenue from kWh sales	\$10,630.02		
Increased kWh sales cost	(\$4,429.17)		
Avoided kW Cost	\$187.20		
"Net Effect"	\$6,388.04		
Revenue from Financing (loop leases, loans)	\$0.00		
Total Net Effect	\$6,388.04		
Utility Program Costs			
Net Revenue Effects	\$6,388.04		
Administration	\$0.00		
Loop Lease	\$0.00		
Rebates	\$4,500.00		
Total Program Costs	\$4,500.00		
TOTAL REVENUE	\$6,388.04		
TOTAL COSTS	\$4,500.00		
NET GAIN/LOSS	\$1,888.04		
Savings Analysis			
	Alternative HVAC System	Geothermal Heat Pump	Savings
kWh consumption	8,642.86	97,226.32	88,583.46
kW consumption	33.00	17.4	15.60
Customer Revenue	\$1,037.14	\$11,667.16	\$10,630.02
Utility Cost- kWh	\$432.14	\$4,861.32	(\$4,429.17)
Utility Cost -kW	\$396.00	\$208.80	\$187.20
Net Revenue to Utility	\$1,865.29	\$16,737.27	\$6,388.04
ADDITIONAL ANALYSIS- CALCULATING CARBON EMISSION SAVINGS			
Estimated kWh savings	88,583.46		
Carbon Equivalent Calculator	E:\http://www.usctgateway.gov/		
Click on this link and follow the directions			
Example:			
This is equivalent to one of the following:		kWh	Metric Tons of Carbon
		442,917.32	279
60	Passenger cars not driven for one year		
50	Passenger cars and light trucks not driven for one year		
31,777	Gallons of gasoline		
649	Barrels of oil		
3.74	Tanker trucks filled with gasoline		
36	Household electricity use for one year (number of households)		

- Helps utilities calculate effects of residential geothermal installations in service territories
- Requires utility to provide the following information:
 - *Engineering assumptions*
 - Default compares a geothermal heat pump to a 78% Efficiency furnace and 10.8 EER air conditioner
 - *Residential retail kilowatt hour rates*
 - *Wholesale kilowatt hour and peak demand charges*



Utility Calculator Screen Shot- Introduction Page

RESIDENTIAL GEOTHERMAL HEAT PUMP CALCULATOR- UTILITY PERSPECTIVE

USING THE Residential Geothermal Heat Pump Calculator - Utility Perspective

This calculator is designed to help **utilities** calculate the effects of residential geothermal heat pump installations in their service territory.

To use this calculator, you will need the following information:

1. Engineering assumptions to compare an alternative heating and cooling system with a geothermal heat pump system.
2. Residential kWh retail rates
3. Wholesale kilowatt hour charges and peak demand charges

The calculator's default is to compare a standard (78%) gas furnace and 10.8 EER Air Conditioner with a geothermal heat pump.

This information can be altered based on individual utility conditions, by changing the values in the **green** shaded cells in the spreadsheet.

Once you have this information available, you are ready to use this calculator.

Advance to the Cost Analysis Worksheet

Step 1: Determine Costs

Residential Geothermal Heat Pump Calculator Savings Based on Engineering Assumptions			
Step 1: Determine Costs			
Electric Costs		Program Costs per Installation	
Customer Electric Rate (cost per kWh)	\$0.06	Administration	\$0.00
Utility Costs		Loop Lease	\$0.00
Wholesale power per kWh	0.02	Rebates/ton	\$100.00
Coincident Peak Demand per kW	\$10.00	#Tons Installed	50

[Residential_GHP_Calculator-Utility_Perspective-final.xls](#)

Step 2: Determine Number of Installations

Step 2: Determine Number of Installations

Estimated Number of Installations	50
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Net Effects from Geothermal Heat Pump Installations

<i>Net Effects from Geothermal Heat Pump Installations</i>	
Customer revenue from kWh sales	\$26,575.04
Increased kWh sales cost	(\$8,858.35)
Avoided kWh Cost	\$780.00
"Net Effect"	\$18,496.69
Utility Program Costs	
Net Revenue Effects	\$18,496.69
Administration	\$0.00
Loop Lease	\$0.00
Rebates	\$5,000.00
Total Program Costs	\$5,000.00
TOTAL REVENUE	\$18,496.69
TOTAL COSTS	\$5,000.00
NET GAIN/LOSS	\$13,496.69

Life Cycle Cost Estimate for 1 ENERGY STAR Qualified Air Source Heat Pump(s)

This simple energy savings calculator was developed by the U.S. EPA and U.S. DOE and is provided for estimating purposes only. Actual energy savings may vary based on use and other factors. For a more sophisticated estimate, use the ENERGY STAR HVAC Investor software or a bin-hour tool.

Enter your own values in the gray boxes or use our default values.

Number of units	1	
Electric Rate (\$/kWh)	\$0.113	
	City	
Choose your city from the drop-down menu	DC-Washington	
	ENERGY STAR Qualified Unit	Conventional Unit
Initial Cost per Unit (estimated retail price)	\$6,700	\$5,700
Heating Seasonal Performance Factor (HSPF) rating	8.2	7.7
Seasonal Energy Efficiency Ratio (SEER) rating	15	13
Heat Pump Capacity (Btu/hr)	36,000	36,000
Use with programmable thermostat (Yes/No)	Yes	No

Annual and Life Cycle Costs and Savings for 1 Air Source Heat Pump(s)

	1 ENERGY STAR Qualified Units	1 Conventional Units	Savings with ENERGY STAR
Annual Operating Costs*			
Energy cost	\$1,158	\$1,498	\$339
Energy consumption (kWh)	10,279	13,291	3,012
Maintenance cost	\$0	\$0	\$0
Total	\$1,158	\$1,498	\$339
Life Cycle Costs*			
Operating costs (energy and maintenance)	\$10,873	\$14,058	\$3,186
Energy costs	\$10,873	\$14,058	\$3,186
Maintenance costs	\$0	\$0	\$0
Purchase price for 1 unit(s)	\$6,700	\$5,700	-\$1,000
Total	\$17,573	\$19,758	\$2,186
	Simple payback of initial additional cost (years) [†]		2.9

* Annual costs exclude the initial purchase price. All costs, except initial cost, are discounted over the products' lifetime using a real discount rate of 4%. See "Assumptions" to change factors including the discount rate.

† A simple payback period of zero years means that the payback is immediate.

Summary of Benefits for 1 Air Source Heat Pump(s)

Initial cost difference	\$1,000
Life cycle savings	\$3,186
Net life cycle savings (life cycle savings - additional cost)	\$2,186
Simple payback of additional cost (years)	2.9
Life cycle energy saved (kWh)	36,141
Life cycle air pollution reduction (lbs of CO ₂)	55,657
Air pollution reduction equivalence (number of cars removed from the road for a year)	5
Air pollution reduction equivalence (acres of forest)	6
Savings as a percent of retail price	33%

Calculating Carbon Emissions

- The Greenhouse Gas Equivalencies Calculator is designed to translate greenhouse gas (GHG) reductions from (e.g., metric tons of carbon dioxide equivalent) into terms that are easier to understand (e.g., equivalent number of cars not driven for one year).

<http://www.usctcgateway.net/tool/>

Carbon Emissions Example

- Example using estimated carbon emission savings from 1,000,000 kWh
- 1,000,000 kWh = 632 metric tons

1,000,000 kWh savings are equivalent to:	
137	Passenger cars not driven for one year- reducing from the highways
OR	
71,982	Gallons of gasoline (using less gas)
OR	
16,205	Number of tree seedlings grown for 10 years (planting trees)

Carbon Calculators

- Estimates calculated from the following website:
www.epa.gov/cleanenergy/energy-resources/calculator.html
http://oaspub.epa.gov/powpro/ept_pack.charts
- Carbon Emission Reduction Estimates calculated from the following website:
www.epa.gov/cleanenergy/energy-resources/calculator.html
- Carbon Fuel Mix Calculations from the following website:
http://oaspub.epa.gov/powpro/ept_pack.charts

Tax Credit Update

- Tax credits that were previously effective for 2009, have been extended to 2010 as well.
- Tax credit has been raised from 10% to 30%.
- Tax credits that were for a specific dollar amount, have been converted to 30% of cost.
- Maximum credit has been raised from \$500 to \$1500 for the two years (2009–2010).
- Some improvements such as geothermal heat pumps, solar water heaters, and solar panels are not subject to the \$1,500 maximum.

Program Resources

The following organizations are able to provide more detailed information about both the costs and benefits of purchasing and installing a GHP system:

- DOE Geothermal Technologies Program
- Geo-Heat Center
- Geothermal Heat Pump Consortium
- International Ground Source Heat Pump Association (IGHSHA)
- U.S. Department of Energy – *Energy Efficiency and Renewable Energy, How To Buy and Efficient Ground Source Heat Pump*
- ENERGY STAR®, *Geothermal Heat Pump Systems*
- American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE)
- Air-conditioning and Refrigeration Institute

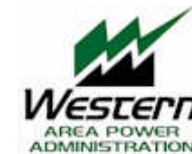
Demand-Side Management Technology Workshop:

All About Heat Pumps - Air Source, Geothermal and Dual Fuel

Sponsored by

*Basin Electric Power Cooperative
with Western Area Power Administration*

August 11-12, 2009
Great Falls, MT



Hosted by  *Montana Electric
Cooperatives' Association*