

HeatSmart Tompkins

Cost, Comfort, Climate: Harnessing the Efficiency of Heat Pumps and Improving Home Energy Performance in Tompkins County

Matt Johnston, Program Director

What is Solar Tompkins?

- A non-profit community-based organization
- Promotes the rapid adoption of renewable energy through community education and providing trusted 3rd party support
- In 2013 and 2014, successfully tripled the amount of solar in Tompkins County

What is HeatSmart Tompkins?

- A program leading home-heating away from fossil fuels
- Focused on better building efficiency through insulation, air sealing, and highly efficient air- and ground-source heat pump systems

Our Goals This Year

- **Facilitating more than 100 homes in Tompkins County adopting these home energy efficiency measures**
- **Reducing fossil fuel use and mitigating regional and global climate change**
- **Creating local and regional jobs**
- **Stimulating ongoing growth of the home energy efficiency and heat pump markets**

A Proven Model

The program seeks to **eliminate the barriers to heat pump and energy efficiency adoption:**

1. Lack of Familiarity with Technologies



- A simple process
- Vetted technology and partners
- Best practice standards
- Educational outreach

2. Upfront Cost



- Lower-than-market pricing for participants
- Financing options

3. Customer Inertia



- Limited Time Offer

Why is the HeatSmart Program Needed?

- 75% of home energy use in Tompkins County goes toward home heating, cooling, and hot water
- Of this energy use, more than 70% is from fossil fuels
- Reducing fossil fuel use is essential to meeting Tompkins County's 80% greenhouse gas (GHG) emission reduction goal by 2050
- “The Upstate climate zone is generally the most cost-effective market for heat pumps due to lower equipment and labor costs, and the lowest winter electric costs.”

- NYSERDA, 2014

Why Will HeatSmart Work?

- **Compelling economics for making these home efficiency improvements**
 - Reductions in equipment cost
 - Incentives and tax credits available
 - Accessible financing
- **Strong homeowner interest**
 - Desire for clean comfortable heating and cooling solutions
 - Increased home marketability and value
 - Educated consumers believe environmental benefits extend beyond property lines, add value to the community at-large

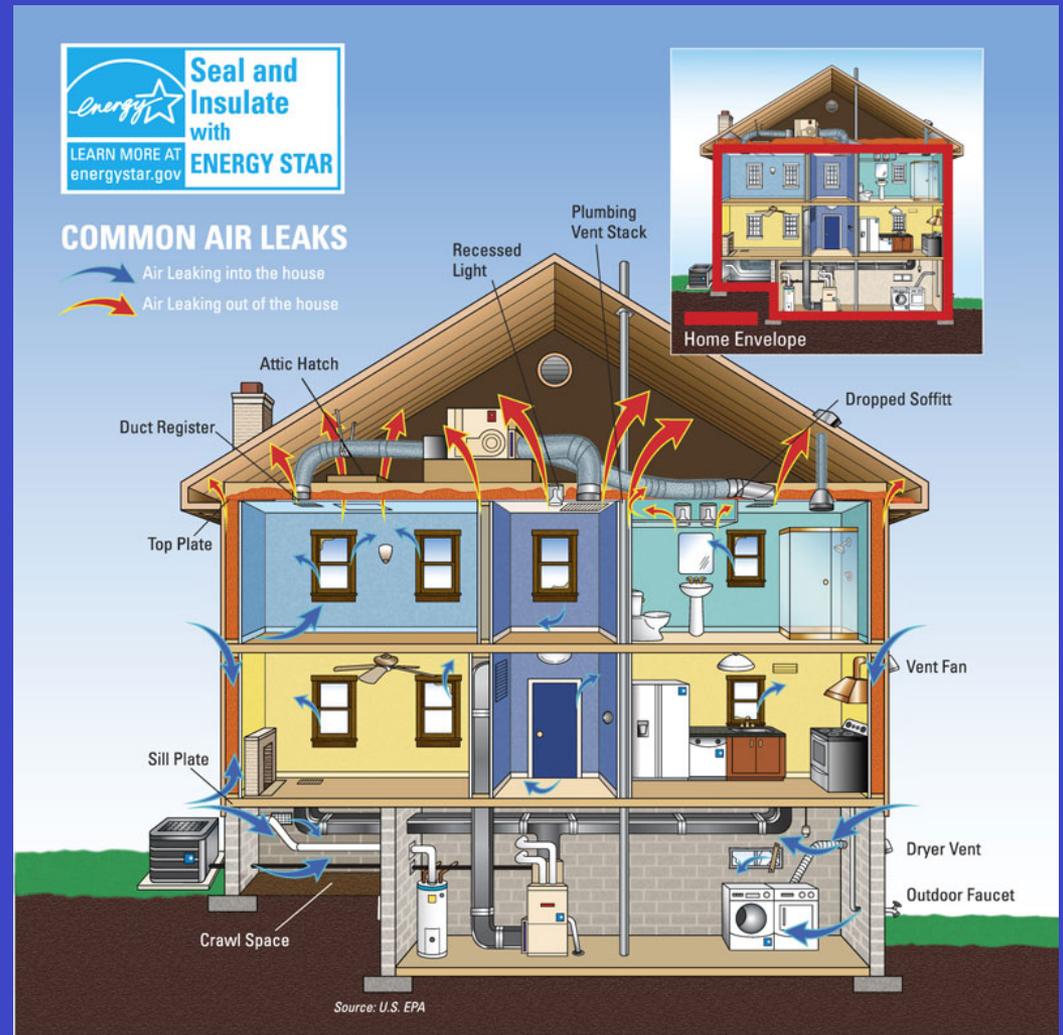
What Makes an Energy Efficient Home?



Insulating and Air-Sealing Improvements

- No single measure can alone achieve an energy efficient home
- Requires a comprehensive approach to the building envelope
- But there is a mix of common improvements that can make a significant difference in most homes

- In the U.S., a majority of houses lack adequate insulation at key places
- If all leaks in a typical home were combined, they would be equivalent to having a window open every day of the year!
 - U.S. DOE, EnergyStar Program



Present State of Our Housing

- A quarter of upstate NY State homes are 75 years or older
- 42% of homes have no foundation insulation
- Almost 7% have no wall insulation



Insulation Offered in this Program:

- **Cellulose** – Loose in attic, dense-packed in walls or sealed cavities
 - Natural material
 - Does not provide an air or vapor barrier on its own
 - Moderate R-value



- **Spray Foam – Closed cell**
 - Synthetic plastic material that hardens
 - Provides both air-sealing and a vapor barrier
 - Blower agents can be HFC-based, Water-based, or 4th Gen- differ in GHG emission and R-value combination



Typical R-Value Targets

- **R-value is a measure of the resistance of a material to heat flow. The larger the R-value, the slower the heat moves across the boundary**
- Attic Flat: R-49
- Basement/Crawl Space Rim Joists: R-18
- Basement/Crawl Space Walls Above Grade: R-18
- Walls: R-20 to R-25

Insulation Not Allowed in this Program

- **Fiberglass**
 - Poor R-value
 - Can emit synthetic material called styrene--possibly carcinogenic
 - Can reduce lung function and cause inflammation in humans and animals



Health & Safety Aspects - Insulation and Air-Sealing

- Spray foam ventilation and re-occupancy requirements
- Compliance with building air flow requirements (natural or mechanical ventilation as needed)
- Proper handling of any hazardous existing insulation
 - Vermiculite in walls or attic, which often contains asbestos
 - Pure asbestos insulation often found in stovepipe insulation, and insulation tape on duct work

The Value of Insulated and Air-Sealed Homes

- Save energy and money on your utility bills
- Improve the interior environment of your home and eliminate common problems:
 - Better humidity control
 - Lower chance of ice dams on roofs
 - Reduced noise from outside
 - Less pollen, insect, and pest intrusion



Heating System Improvements

- ~20% of natural gas heating systems and ~29% of fuel oil heating systems are more than 20 years old
- More than 80% of the central AC systems (statewide) are not high efficiency
- Heat pumps are particularly attractive for homes using propane or oil – which are higher cost fuels burned in lower efficiency systems

Sizing of Heating Systems

- Heating systems are sized on a design day basis, which represents the temperature above which 99% of the hours of the year are
- For this program, we use a design day temperature of 0°F
- Heating system sizes are given in the unit of “tons”
- One ton is equal to 12,000 BTU per hour

What is a Heat Pump?

- Common electric-powered technology used in refrigerators, AC units
- Supplies warmth in winter, cooling in summer
- Effective at low temperatures common in our region
- Two basic types:
 - **Air-Source**: Moves heat from the outside air in winter
 - **Ground-Source**: Moves heat from underground in winter

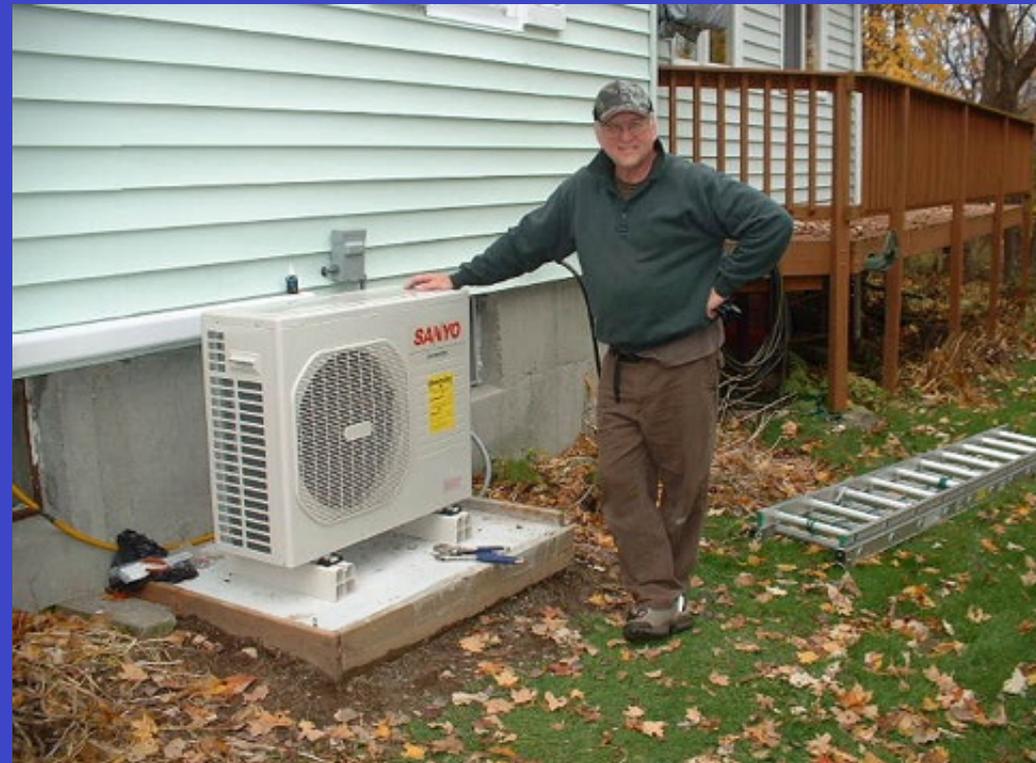


Heat Pump Efficiencies

- Achieve season-long efficiencies above 100%
 - Air-source heat pumps - 200+%
 - Ground-source systems - 300%
- In comparison, fossil fuel heaters range from 70-95% efficiency
- For GSHPs, one unit of electricity is used to provide 3 units of heat energy to the house
- Achieved by electrical energy running pumps and a compressor that extracts renewable heat from the ground and moves it into your home

Benefits of a Heat Pump System

- Low operating cost
- No on-site combustion
- Long life expectancy (15+ years)
- Low maintenance
- Can meet 100% of heating needs
- Low environmental impact



Air Source Heat Pumps (ASHPs)



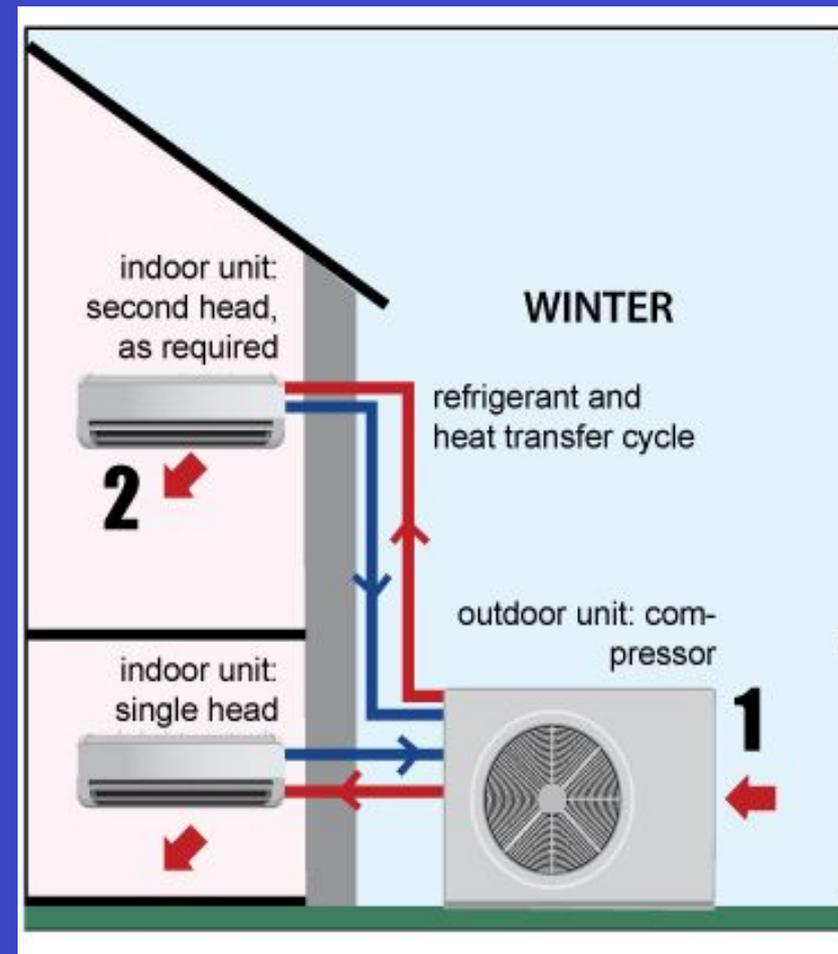
Types of ASHPs

- 1. Ducted ASHP system:** Ties into an existing distribution system
- 2. Ductless ASHP system:**
Individual interior wall-mounted units connected by small refrigerant lines to an outdoor compressor
 - Flexibility to heat the entire home or select rooms



How an ASHP Works

- Graphic shows a ductless system:
 - Compressor unit transfers heat from the air outside to the indoors
 - Efficiencies to 200+%
 - Units demonstrated to remain operational to temperatures down to at least -13°F



- Cold climate Hyper-heat models can handle upstate NY winters
- Advanced inverter-driven compressor technology allows heat capture in worst winter conditions
- Units defrost themselves by briefly reversing heat flow- this is included in their efficiency rating



ASHP Components

- Compressor
- Refrigerant cycle
- Transfer lines
- Mini split unit or ductwork
- Thermostat
- Remote control(s)



ASHPs for Domestic Hot Water Heating

- Domestic hot water can account for up to 22% of fossil fuel heating in NY State homes
- Replacement of your existing water heater with an ASHP hot water unit can be a big bang for your buck
- A good option if a whole home system is not feasible

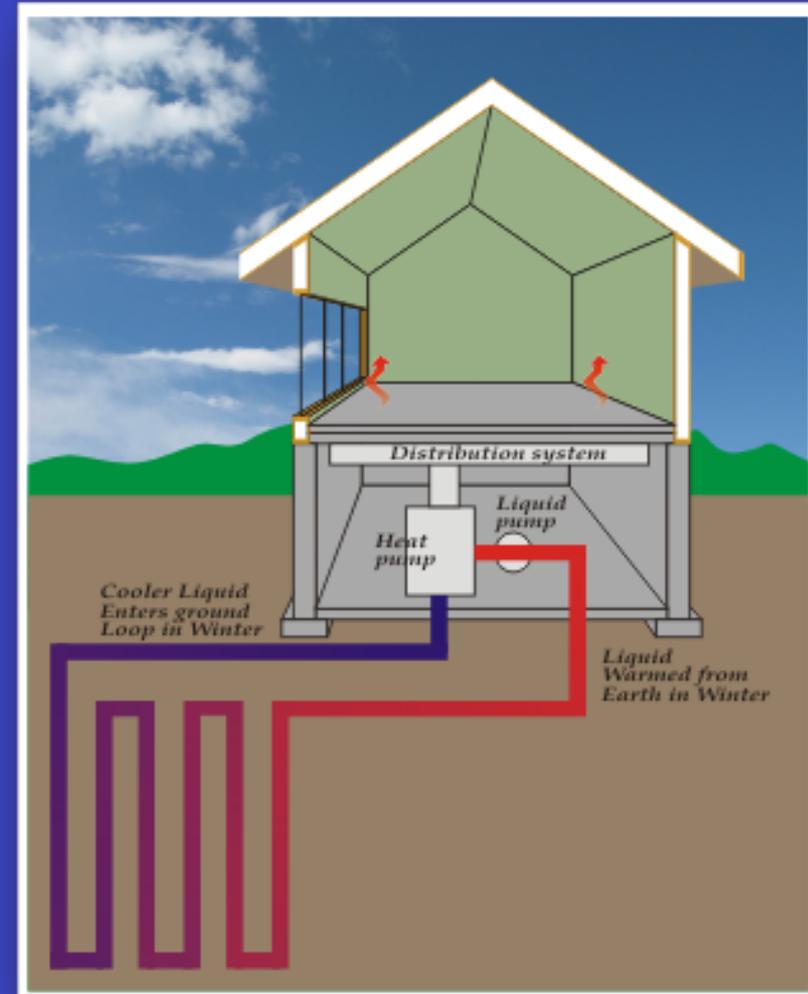


Ground-Source Geothermal Heat Pumps (GSHPs)

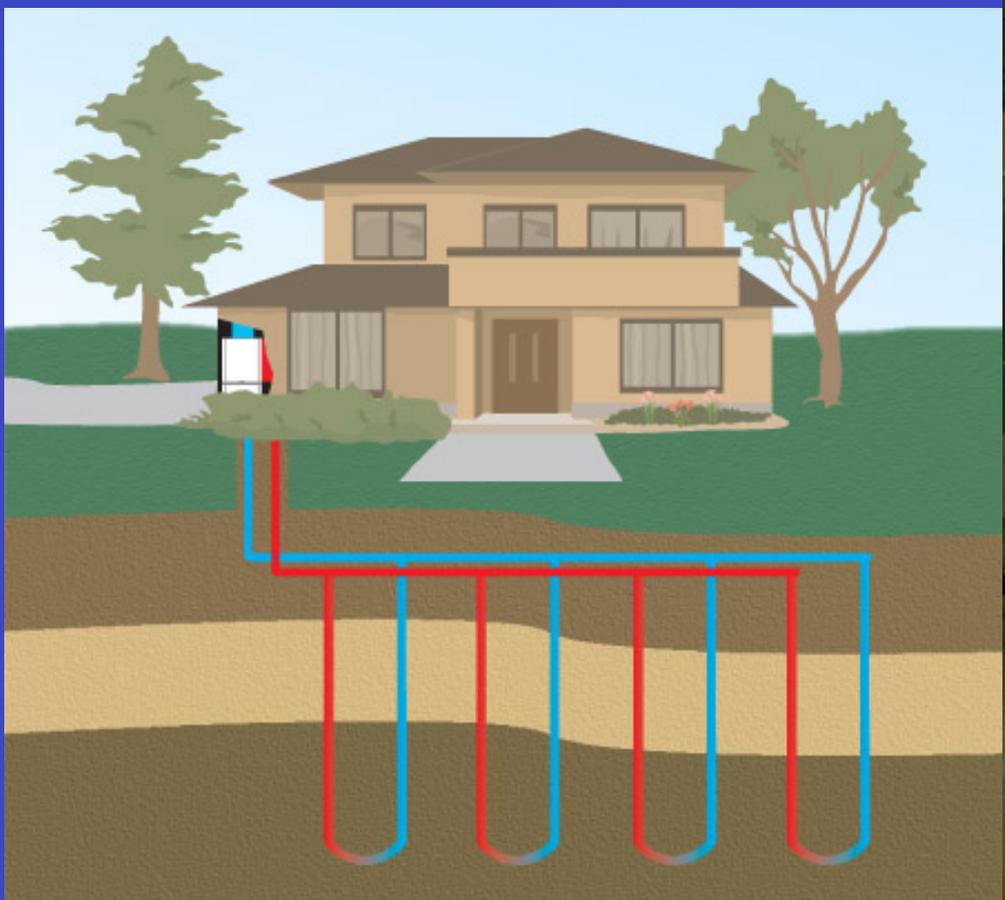


How a GSHP System Works

- The ground provides a relatively constant temperature for efficient year-round heat transfer
- GSHPs move water through closed pipes in the ground and couple with a home's HVAC distribution system

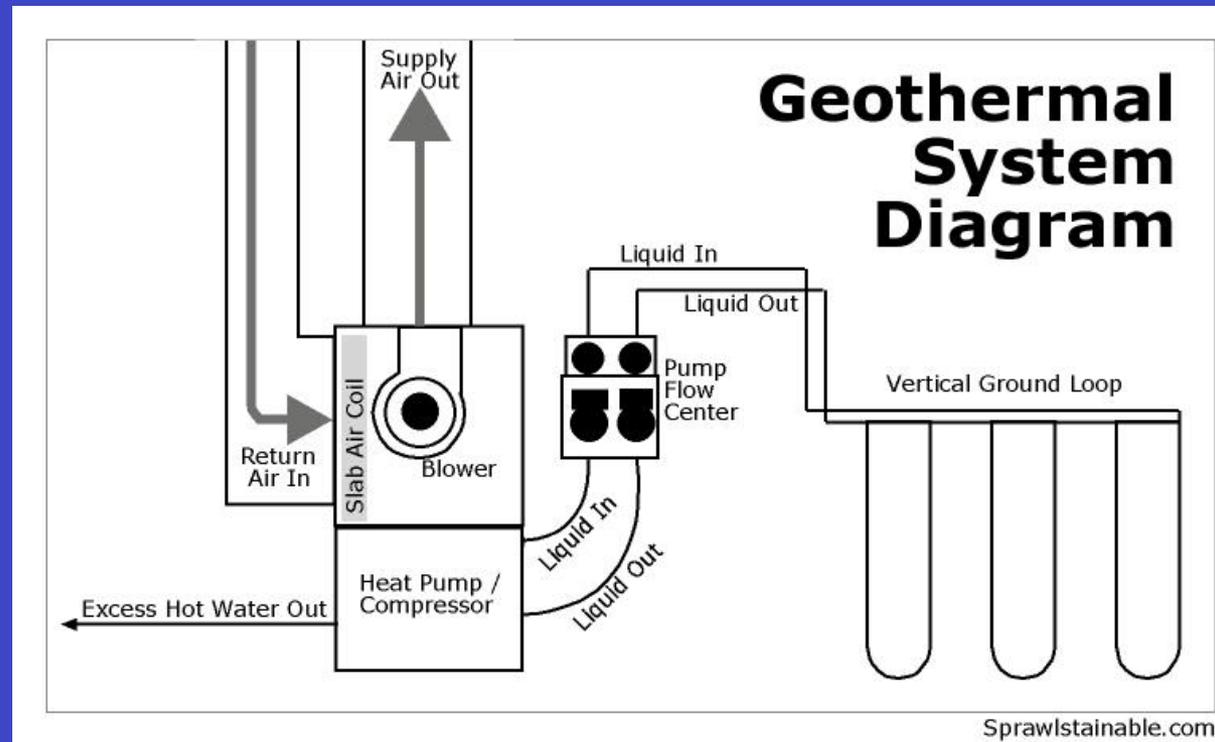


GSHP Components



GSHP Components

- Water-based ground loop
- Heat Pump
- Compressor
- Distribution system interface
- Desuperheater
- Thermostat



Size of an Average GSHP Loopfield



Vertical 4-ton System
Ground Disturbance:

Roughly 20' x 20'

Horizontal 4-ton System
Ground Disturbance:

Roughly 33' x 250'

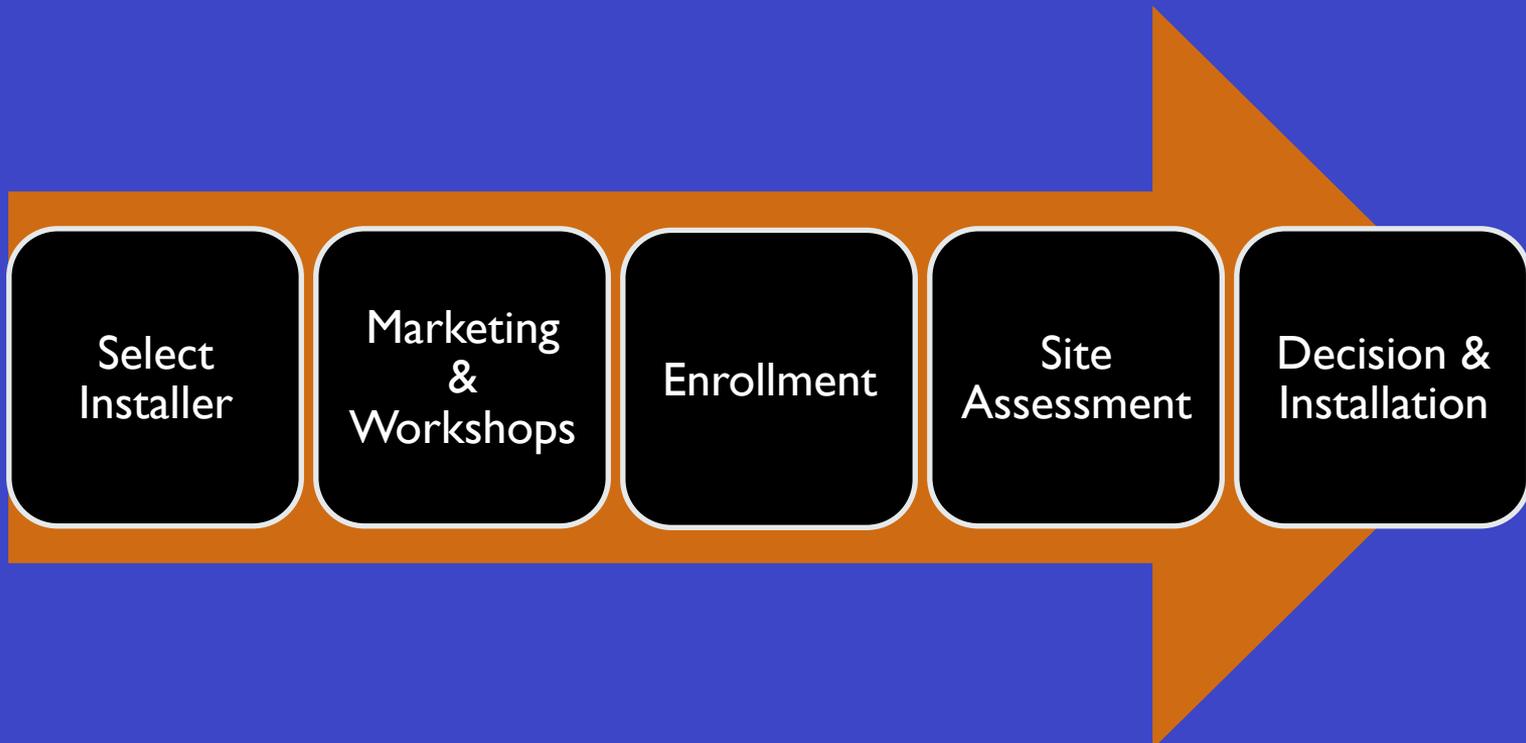


Adopting a Home Energy Efficiency Package



How the HeatSmart Program Helps You

- HeatSmart structure and process predicated on the successful Solarize model



Installer Partners Selected by Competitive RFP Process

- **Halco**: Offering insulation/air sealing, ASHP, GSHP systems
- **NP Environmental/Upstate Spray Foam**: A team offering insulation/air sealing, ASHP, GSHP systems
- **Zerodraft**: Offering insulation/air sealing, ASHP systems



Comfort Today. Energy for Tomorrow.

NP environmental™
The Leader in Geothermal

Upstate
Spray Foam Insulation

315 822-5238



HeatSmart- What to Expect After Enrolling

- Site Assessment/Preliminary Envelope Assessment
 - Will inform you of insulation needs/ options
 - Will help size a heat pump system
 - Will provide a set of proposals



Elements of a Site Assessment

- Includes inspection of the house - measures dimensions, inspects current insulation and distribution system, infrared imaging, and blower door test to inventory air leaks
- For accuracy of heat load calculation, customers provide to installers their previous year's utility data



Presentation of Proposals

- Installer Partner presents at least two options for a mix of insulation, air-sealing, and heating system combinations
- All proposals based on the fixed, better-than-market pricing negotiated by HeatSmart Tompkins
- Proposals will include description of all available incentives and details of financing options

Below-Market Pricing

- On average, Installer Partners are offering ~ 20% below market rate
- Pricing categories have been standardized across installers for ease of comparison
- Pricing is fixed for each Installer Partner, publicly available

“Adder” Cost Pricing

- Examples:
 - Removal of existing attic or basement insulation
 - Post GSHP-installation landscaping beyond basic leveling, reseeding/strawing and removal of large rocks
 - An updated thermostat with extended home heat system monitoring ability
 - Low GHG spray foam/blower agent for insulation/air-sealing work in the home

HeatSmart asks that you initially pick ONE Installer Partner

- Pricing is already negotiated and public so it eliminates the need for multiple bids
- Below market prices achieved through soft cost reduction
- Approximately 95% of customers pick and contract with one installer

Incentives for Adopting a Home Energy Efficiency Package

- **State - NYSERDA**

- Families above 80% county Median Income: 10% grant up to \$3,000, and NYSERDA low-interest loan available (*NYSERDA Home Performance*)
- Families below 80% of county median income: 50% grant up to \$5,000, and NYSERDA low interest loan available (*NYSERDA Assisted Home Performance*)
- Families below 60% state median income: 100% grant for selected measures (*EmPower NY Program*)

Incentives for Adopting a Home Energy Efficiency Package

- **Federal**
 - ENERGY STAR-certified geothermal heat pump systems eligible for 30% federal tax credit
- Installer Partners pursue required state and federal paperwork to assist customers



Financing for a Home Energy Efficiency Package

- Unsecured Loans
 - NYSERDA 3.49% for 5-15 years up to \$25,000
 - Home Improvement Loans 6-7% for 10 years up to \$30,000
- Secured Loans
 - Home Equity Lines or Loans – 3.5-4.5% for 20 years up to 85% of home valuation minus mortgage
- Other products available through Installer Partners from regional and national banks

HeatSmart Case Study Example #1

- Average 2,000 square foot house with a heat load of 4 tons
- Current fuel is propane, costs \$3,310/year
- Preliminary site assessment resulted in proposal for:
 - Cellulose insulation on attic flat
 - Spray foam in basement, down 4 feet of wall and on rim joists (for moisture/thermal barrier)
 - After these improvements, a 3 ton horizontal GSHP system to meet the new home heat load

HeatSmart Case Study Example #1- Cost Breakdown

- Total Costs
 - \$3,564 - 14 inches cellulose in attic
 - \$1,050 - 3 inches insulation for rim joist
 - \$1,960 - 3 inches closed cell spray foam on basement walls
 - \$19,500 - Horizontal GSHP system (3 tons)
 - \$26,074 = Project Sticker Price (Before Incentives)**
- Unit costs on HeatSmart fixed price sheet, are available online, and will be shared with customers in their proposals

HeatSmart Case Study Example #1- Final Cost

= \$19,567 Final Project Cost After 30% Federal Tax Credit and 10% NYSERDA Incentive

With 3.49% 10 year Financing:

- \$262/month is the total financed and operating cost for insulation and horizontal GSHP system
- \$276/month average payment for current propane heating
- Result is \$14/month savings immediately with no upfront cost

HeatSmart Case Study Example #1- Savings Details

- At end of 10-year loan, the cost goes down to just \$68 for supplying monthly electricity!
- **\$14,300 = Home Energy System Savings Over 15 years (constant dollars)**
- Significant GHG emissions savings even with grid electricity
 - ✓ 5,790 kg CO₂ savings from avoided propane use
 - ✓ 1,380 kg CO₂ emissions from increased electricity use
 - ✓ **Net 74% GHG savings total per year**



With solar or working with an ESCO, a carbon neutral home is possible!

HeatSmart Case Study Example #2

- Same 2,000 square foot house with a heat load of 4 tons
- Same propane heating bill, costs \$3,310/year
- Preliminary site assessment resulted in proposal for same insulation packages now with an ASHP system:
 - Cellulose insulation on attic flat
 - Spray foam in basement, down 4 feet of wall and on rim joists (for moisture/thermal barrier)
 - After these improvements, a 3.75 ton ductless ASHP system to meet the new home heat load

HeatSmart Case Study Example #2- Explanation

Why a larger ASHP (3.75 tons) than GSHP (3 tons) for the same house?

- ASHP lose capacity as the temperature of outside air falls
- HeatSmart Tompkins requires the sizing of ASHP units to take this into account to meet 100% of home heating needs
- Geothermal systems rely on ground temperature which is more constant throughout the winter
- Results in a larger ASHP system being needed as compared to a GSHP system

HeatSmart Case Study Example #2- Final Cost

- Total Costs

 - \$5,917 - Same insulation package

 - \$10,050 - Ductless ASHP system (3.75 tons)

 - **\$15,967 Final Project Cost After 10% NYSERDA Incentive**

 - *(Currently no 30% Federal Tax Credit for ASHPs)*

With 3.49% 10 year Financing:

- \$251/month is the total financed and operating cost for insulation and ductless ASHP system

 - \$276/month average payment for current propane heating

- Result is \$25/month savings immediately with no upfront cost

HeatSmart Case Study Example #2- Savings Details

- At end of 10-year loan, the cost goes down to just \$93 for supplying monthly electricity!
 - **\$15,261 = Home Energy System Savings Over 15 years (constant dollars)**
 - ✓ Significant GHG savings even with grid electricity
 - ✓ **Net 64% GHG savings total per year**
-  *With solar or working with an ESCO, a carbon neutral home is possible!*

Pros and Cons of Heating with ASHPs

- **ASHP Pros**
 - Minimal Infrastructure:
 - ✓ No extra 'heat distribution' costs
 - ✓ Very small 'footprint' for equipment
 - ✓ No property digging required
 - Few adders costs affect final price
- **ASHP Cons**
 - Heat distribution can be limited by number of inside units
 - Outdoor compressors exposed to the elements
 - Max BTU output declines at very low temperatures
 - CoP slightly lower than for GSHP systems

Pros and Cons of Heating with GSHPs

- **GSHP Pros**

- Highest efficiency for seasonally-averaged operation
- Utilizes existing heat distribution systems
- 30% federal tax-credit reduces final project cost
- No 'oversizing' of system to meet coldest-day demand
- Ground-loops last 50+ years, pumps/compressors indoors

- **GSHP Cons**

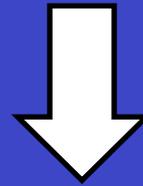
- Requires more land area
- Adder costs can arise:
 - ✓ Vertical loop field drilling, property remediation
 - ✓ Heat distribution upgrades (e.g. adapting to hydronic systems)
- Price rises sharply if ineligible for 30% tax credit

Moving Forward with HeatSmart

- Get HeatSmart by learning about the technologies through these presentations, on community tours
- Speak with us and our Installer Partners
- Review fixed pricing offered through the program
- Consider access to state and federal incentives as well as financing options

Learn more at: SolarTompkins.org

Enrolling in the HeatSmart Tompkins Program



www.solartompkins.org/heatsmart-enrollment.html



**Upstate
Spray Foam Insulation**

315 822-5238



Comfort Today. Energy for Tomorrow.

Thank You

