Home Energy Efficiency, Heat Pumps, and Community Mobilization
Solar Tompkins History

2013-2014  First solarize effort in just three townships
          109 solar PV & 37 solar thermal hot water
2014-2015  Full-county solarize effort (pop. ca 100,000)
          365 solar PV systems
2015-2016  First HeatSmart effort, full county
          12 GSHP
          32 ASHP (space conditioning)
          12 ASHP (domestic hot water)
          55 Building envelop improvements
2016-2017  Second HeatSmart effort- in progress
Community Mobilization

HeatSmart Public Meetings

Word of Mouth
Social Networks
Yard Signs
Pamphletting
Invited Talks
Solar 101

Website

Website Program Enrollment

Installer Chosen:
comprehensive vetting
competitive bid

Installer Assessments

Initial Contracts Signed

NYSERDA approval if GSHP

Enrollee Doesn’t Sign
Site not suitable
Finance or Personal Reason
Chooses another installer

Heat pump Systems Installed!

Results!!!
How to Make a Difference?

HeatSmart is a Grass roots campaign organized by local volunteers.

We are focused on solutions, not complaints!

Our goal is to remove barriers to the strength of individual action

- Generating confidence in a path forward
- Providing accessible information
- Lowering the costs
Confidence in a Path Forward

Moral assurance- the right thing to do
Economic assurance- cost effective, affordable
Super energy efficient with low operating costs
Personal experience assurance
  Improved comfort
  Air conditioning
  Zonal control

Begin with building shell efficiency: air sealing & insulation

Technical confidence in products
  Performance issues and reliability
  Demystifying heat pumps

Who is a reliable installer?
Providing Accessible Information

We consider ourselves, first and foremost, an educational effort

- 20 public meetings throughout the county (also via video online)
- We held 12 home tours of existing heat pump installations
- Fact sheets and testimonial videos online
- Links to other sites

Price comparisons of participating installers are posted

HeatSmart Best Practices are posted including:

- Required certifications and/or credentials
- Installation requirement details
- Allowable equipment and materials

Videos and links to Installers
Lowering the Costs

- Reducing soft costs - by generating leads, higher conversion rates
  1) The effort to pay-off ratio gets a lot of discussion with the installers
  2) Market is very down right now so it is sometimes challenging to recognize the boost

- Having multiple installers helps guarantee some price competition. Of our three slots, two are strongly biased in favor of local businesses and the third is open.

- We have seen other businesses in the area lower costs to compete.

- Our installers tell us the pricing is 15-20% lower than their normal pricing, but we have no market standard to judge that against
Save $\$$. Cheap Hot Water

CO$_2$ We Shrank Our Footprint. Zero

Honey, We Shrank Our Footprint.

HEATSMART TOMPKINS

Improve Comfort
- Warm in winter
- Cool in summer
- Cheap Hot Water
- Easy Control, Stable Temperature
- DRAFTS
- COLD SPOTS
Enrollment is done online at www.SolarTompkins.org
(paper enrollment forms also available here at meetings)

HeatSmart asks that enrollees initially pick ONE Installer Partner
- Pricing is already negotiated and public
- A majority of enrollees pick and contract with their first choice installer

If, after the first assessment, an enrollee desires a second evaluation,
they can ask the HeatSmart Program Director (that’s me) and I then
open a parallel lead
HeatSmart enrollment, rates through time

HeatSmart Enrollees 2017, # per week

Advertised date of enrollment closure

Extended enrollment closure

Preliminary enrollment mini-peak

Enrollees per week, #

How Did Enrollees First Hear About HeatSmart (n=160)?

- Friends & word-of-mouth
- Website: SolarTompkins.org
- Yard signs
- Solar Tompkins newsletter
- Other
- Facebook
- Newspaper feature articles
- Other news letter
- Newspaper advertisements
- Posters
- Newspaper opinion pieces
- Radio announcements
- Radio interviews
- Participating Installer newsletter
NYSEG ran the ‘Yes Community Solutions’ program concurrently with HeatSmart.

- HeatSmart is powered by word-of-mouth and local list-serves
- NYSEG’s Yes Home Solutions is all web-based interactions promoted by large customer mailings. Relatively little educational content.

2 of our 3 installer partners also participated with NYSEG

- Similar numbers of leads were generated by each program—no overlap at all!
- The installers expect a much higher conversion rate from HeatSmart leads
- The NYSEG leads are buying no heat pumps but are nonetheless resulting in some building shell work and other household efficiency measures
Origins of the Heat Pump Concept
The Unicorn Fish of Consciousness returns from the fifth dimension with the invention of renewable heating and cooling.
UF of C has adapted the traditional concept of duality in Yin-Yang energy centers to the cause of RH&C. The Yin&Yang spirals become wavy heat-exchanger coils!

This is a great opportunity to study the phase changes of the refrigerant. It flows from the tail as a liquid (yellow) into the outside heat exchanger where it gradually evaporates to gas (red) thus storing the potential energy of latent heat. UF of C is the compressor. The hot gas leaves through his horn into the inside heat exchanger where it condenses back to liquid releasing its stored energy as heat.
Pros and Cons of Heating with ASHPs

ASHP Pros

- Minimal Infrastructure:
  - Ductless versions have no extra ‘heat distribution’ costs
  - Multiple inside units are all individually controlled
  - Very small ‘footprint’ for equipment and no digging
  - Always provide heating and air-conditioning as well

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
- Seasonal energy Efficiency only 250%, lower than for GSHP
Pros and Cons of Heating with GSHPs

GSHP Pros
- Highest seasonally-averaged energy efficiency (350 to 400%)
- Takes advantage of existing heat distribution systems
- NYSERDA incentive of $1,500 / ton (now has official approval)
- Heating capacity not affected by outside air temperature
- Ground-loop system lasts 50 years or more, pumps/compressors indoors

GSHP Cons
- Substantial adder costs can arise:
  ✓ Vertical loop field drilling, property remediation
  ✓ Heat distribution upgrades (e.g. adapting hydronic systems)
- Land area requirements greater, more ground disturbance
**HeatSmart Timeline**

<table>
<thead>
<tr>
<th>Year</th>
<th>Month</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>Nov</td>
<td>Installer Selection</td>
</tr>
<tr>
<td></td>
<td>Dec</td>
<td>Enrollment</td>
</tr>
<tr>
<td></td>
<td>Jan</td>
<td>HeatSmart Tour</td>
</tr>
<tr>
<td></td>
<td>Feb</td>
<td>Public Meetings</td>
</tr>
<tr>
<td></td>
<td>Mar</td>
<td>Assessment and Contract</td>
</tr>
<tr>
<td></td>
<td>Apr</td>
<td>Ext.</td>
</tr>
<tr>
<td></td>
<td>May</td>
<td>HeatSmart Tour</td>
</tr>
<tr>
<td></td>
<td>June</td>
<td>Ext.</td>
</tr>
<tr>
<td></td>
<td>Jul</td>
<td>Ext.</td>
</tr>
<tr>
<td></td>
<td>Aug</td>
<td>Installations</td>
</tr>
<tr>
<td></td>
<td>Sept</td>
<td>Installations</td>
</tr>
<tr>
<td></td>
<td>Oct</td>
<td>Installations</td>
</tr>
<tr>
<td></td>
<td>Nov</td>
<td>Installations</td>
</tr>
<tr>
<td></td>
<td>Dec</td>
<td>Installations</td>
</tr>
<tr>
<td>2017</td>
<td>Jan</td>
<td>Installations</td>
</tr>
<tr>
<td></td>
<td>Feb</td>
<td>Installations</td>
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<tr>
<td></td>
<td>Mar</td>
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<td>2018</td>
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<tr>
<td></td>
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<td>Installations</td>
</tr>
<tr>
<td></td>
<td>Jan</td>
<td>Installations</td>
</tr>
</tbody>
</table>

**HeatSmart is Here**

- (get oriented, meet the installers)
- (enroll online at SolarTompkins.org)
- (see equipment in action & learn about installation experiences)
Heat Pumps have the LOWEST OPERATING COSTS!

This analysis assumes a 3-ton design temperature heating need:

<table>
<thead>
<tr>
<th>Heating Mode</th>
<th>Annual Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas ($0.96/Mcuf t)</td>
<td>$888</td>
</tr>
<tr>
<td>Heating Oil ($2.59/gallon)</td>
<td>$1800</td>
</tr>
<tr>
<td>Propane ($2.23/gallon)</td>
<td>$2676</td>
</tr>
<tr>
<td>Electric resistance heater ($0.088/kWh)</td>
<td>$1981</td>
</tr>
<tr>
<td>ASHP ($0.088/kWh)</td>
<td>$760 *** runner up ***</td>
</tr>
<tr>
<td>GSHP ($0.088/kWh)</td>
<td>$565 *** the winner ***</td>
</tr>
</tbody>
</table>
This analysis assumes the same 3-ton design temperature heating need:

<table>
<thead>
<tr>
<th>Old heating mode</th>
<th>Metric tons CO2 (per year)</th>
<th>% of footprint left after switch to:</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASHP</td>
<td>GSHP</td>
<td></td>
</tr>
<tr>
<td>Gas</td>
<td>5.08</td>
<td>46%</td>
</tr>
<tr>
<td>Heating Oil</td>
<td>7.11</td>
<td>33%</td>
</tr>
<tr>
<td>Propane</td>
<td>5.93</td>
<td>40%</td>
</tr>
</tbody>
</table>

These large reductions in carbon footprint going from fossil fuel to a heat pump, even when just buying electricity from NYSEG, are due to both the super-high efficiency of the heat pumps and the fact that in our region the grid electricity is over half from low-carbon sources like hydro-electric.

Get electricity from solar or wind and you approach zero carbon!
Considering the same 3-ton heating need of the previous examples, what is the full cost of switching heating modes compared to costs of continuing to heat with the furnace? Heat pump system cost $12,550.

<table>
<thead>
<tr>
<th>Original Fuel</th>
<th>Old Furnace Monthly cost</th>
<th>New Heatpump Monthly Cost (operation)</th>
<th>Heatpump Total Costs (operation &amp; payments)</th>
<th>Change in year1 Monthly Budget</th>
<th>Savings over 15 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>heating oil</td>
<td>$ 150</td>
<td>$ 66</td>
<td>$ 196</td>
<td>$ (46)</td>
<td>$ 240</td>
</tr>
<tr>
<td>propane</td>
<td>$ 224</td>
<td>$ 66</td>
<td>$ 196</td>
<td>$ 28</td>
<td>$ 13,919</td>
</tr>
</tbody>
</table>

This example assumes the use of single-zone ASHP (best ton/$) and a 10 year loan at 4.5% interest.
Considering the same 3-ton heating need of the previous examples, what is the full cost of switching heating modes compared to costs of continuing to heat with the furnace? GSHP system costs $21,300, but we expect a NYSERDA incentive of $4,500 ($1500/ton) bringing it down to $16,800.

<table>
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<th>Original Fuel</th>
<th>Old Furnace Monthly cost</th>
<th>New Heatpump Monthly Cost (operation)</th>
<th>Heatpump Total Costs (operation &amp; payments)</th>
<th>Change in year1 Monthly Budget</th>
<th>Savings over 15 years</th>
<th>Savings over 25 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>heating oil</td>
<td>$150</td>
<td>$47</td>
<td>$221</td>
<td>$(71)</td>
<td>$(1,488)</td>
<td>$10,886</td>
</tr>
<tr>
<td>propane</td>
<td>$224</td>
<td>$47</td>
<td>$221</td>
<td>3</td>
<td>$12,192</td>
<td>$33,422</td>
</tr>
</tbody>
</table>

**Cost of replacement furnace**

<table>
<thead>
<tr>
<th>Original Fuel</th>
<th>Old Furnace Monthly cost</th>
<th>New Heatpump Monthly Cost (operation)</th>
<th>Heatpump Total Costs (operation &amp; payments)</th>
<th>Change in year1 Monthly Budget</th>
<th>Savings over 15 years</th>
<th>Savings over 25 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>heating oil</td>
<td>$7,500</td>
<td>$117</td>
<td>$7</td>
<td>$7,756</td>
<td>$20,131</td>
<td></td>
</tr>
<tr>
<td>propane</td>
<td>$3,600</td>
<td>$148</td>
<td>$50</td>
<td>$17,738</td>
<td>$38,969</td>
<td></td>
</tr>
</tbody>
</table>

This example assumes the use of single-zone ASHP (best ton/$) and a 10 year loan at 4.5% interest.
Acknowledgements

HeatSmart Board Members (all volunteer)

Current Board
- Brian Eden
- Martin Hatch
- Matthew Johnston
- Melissa Kemp
- Roxanne Marino
- Gay Nicholson
- Julie Schroeder
- Tom Seaney
- Mark Witmer
- Charles Woodcock

Past Board
- Karim Beers
- Linda Mizer
- Leslie Schill
- Marie McRae
- County
- Katie Borgella
- Social Ventures
- Sara Hess

Many Volunteers who help our programs succeed!

The Park Foundation and all our Individual Sponsors
Questions?
Everything Has a Footprint
Graphic shows a ‘ductless minisplit’

- Compressor unit facilitates transfer of heat from the air outside to the indoors using recirculating refrigerants

- Seasonal Efficiencies to 250+% 

- ASHP offered through HeatSmart guaranteed operating range down to -13°F and function down to -19°F.

This capacity is a modern development of cutting edge ASHP technology.
GSHP Components

The compressor and hot and cold heat exchangers are all in one casing that goes in the basement.

Water mixed with 5% safe, food-grade glycol circulates between the basement and the buried loopfield capturing heat (in winter) or depositing heat (summer air conditioning) in the ground.
Size of an Average GSHP Loopfield

Horizontal 4-ton System
Ground Disturbance:
Roughly 33’ x 250’

Vertical 4-ton System
Ground Disturbance
Roughly 20’ x 20’