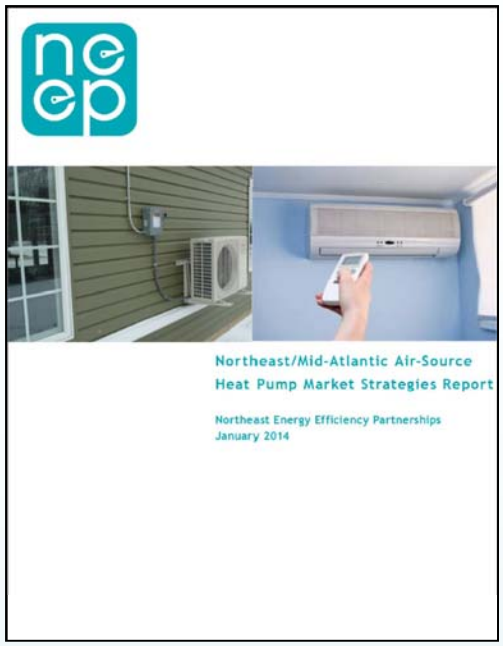
Northeast Energy Efficiency Partnerships



NORTHEAST/MID-ATLANTIC AIR-SOURCE HEAT PUMP STRATEGY REPORT PRESENTATION

PRESENTED BY

DAVID LIS

Director of Energy Efficiency Strategies

NORTHEAST ENERGY EFFICIENCY PARTNERSHIPS

THURSDAY JANUARY 16, 2014

Webinar Housekeeping

- No role call; Attendee list can be viewed on the sidebar
- All phone lines will be muted until Q&A section
- Technical support; Use the chat function on the side bar
- High level presentation; please refer to report for more detail or contact me directly

Presentation Agenda

- Genesis of Report (NEEP, 10 min.)
- Highlights from Market Assessment (SWA, 20 min.)
- Recommended Regional Market Strategies (NEEP) (20 min.)
- Next steps/Q&A (NEEP/SWA, 10 min.)

NORTHEAST ENERGY EFFICIENCY PARTNERSHIPS

"Accelerating Energy Efficiency"

MISSION

Accelerate the efficient use of energy in the Northeast and Mid-Atlantic Regions

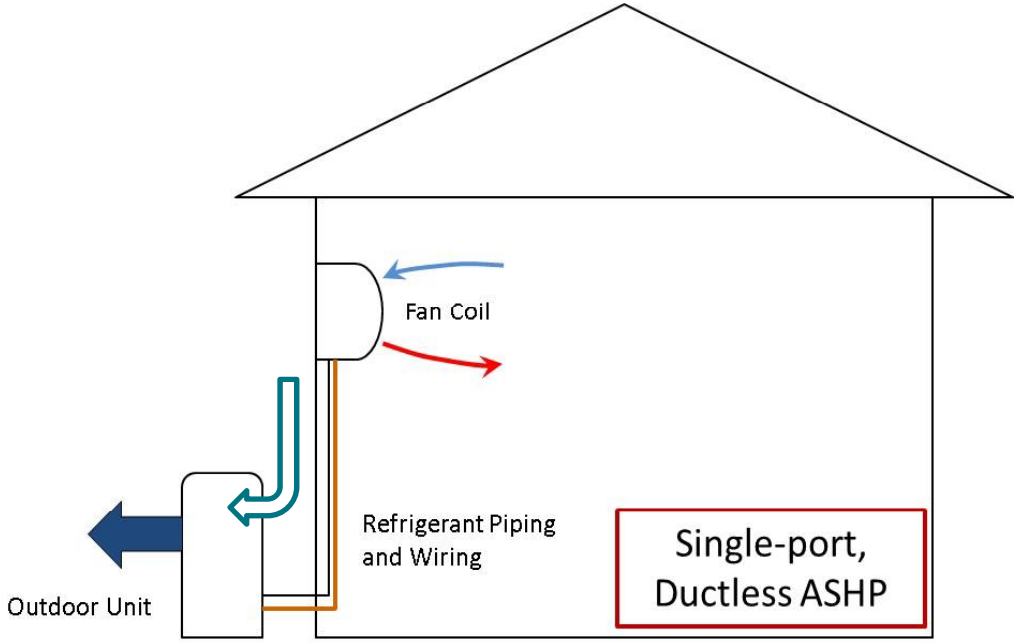
MARKET STRATEGIES TEAM

Developing and implementing Market Strategies to facilitate the transformation of priority product categories;

- Residential Lighting
- Business and Consumer Electronics
- Heat Pump Water Heaters
- Air-Source Heat Pumps

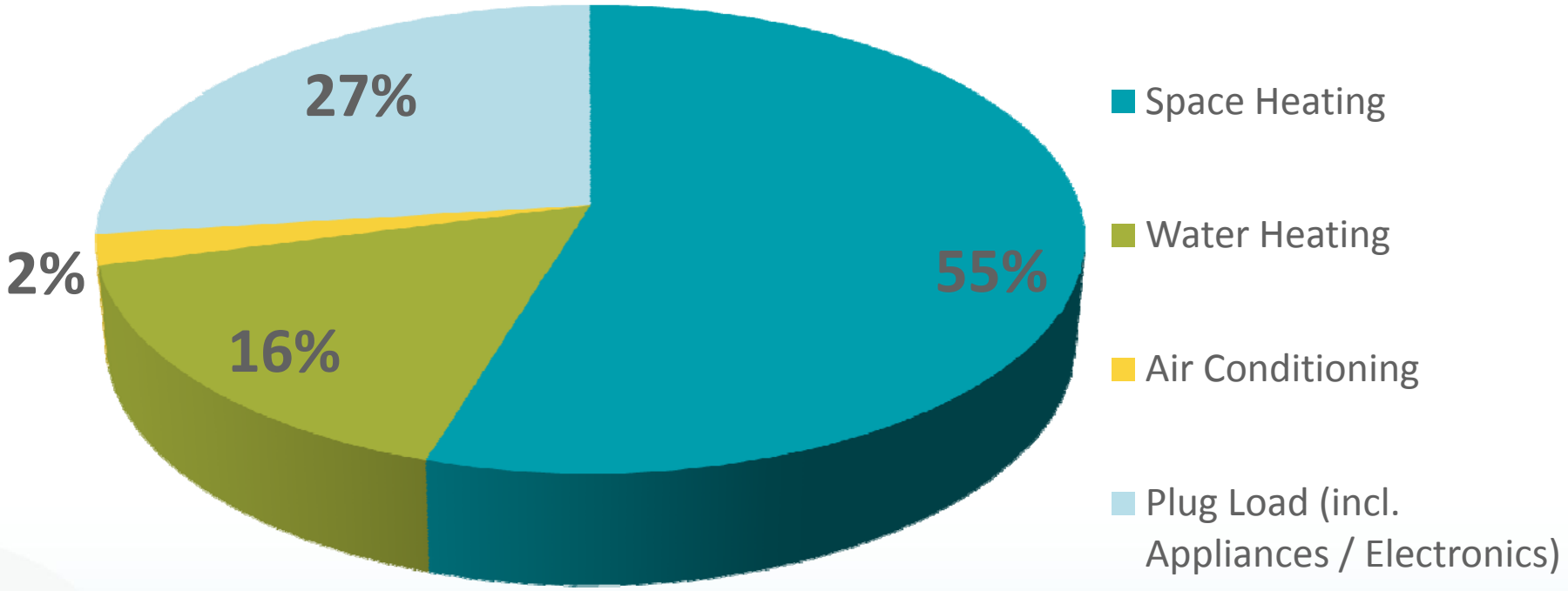
What are Air-Source Heat Pumps (ASHP)?

- Residential HVAC technology that uses electricity
- Transfer heat from outdoors to indoors (or vice versa) using a vapor compression cycle.
- Think of an air conditioner that can run in reverse during cold weather.
- Provide a combination of space heating and, in some instances, cooling to homes.



Why should we care about ASHPs in this region?

- Space Heating dominates residential energy consumption (site) in the Northeast



Source; 2009 EIA RECS

ASHPs don't do well in cold climates, right?

- Things have changed…Recent advances in technology (i.e. inverter-driven compressor motors) have made ASHPs a legitimate heating alternative in cold climates

How do we know they are performing?

- Body of evidence constantly growing (i.e. in-field monitoring)

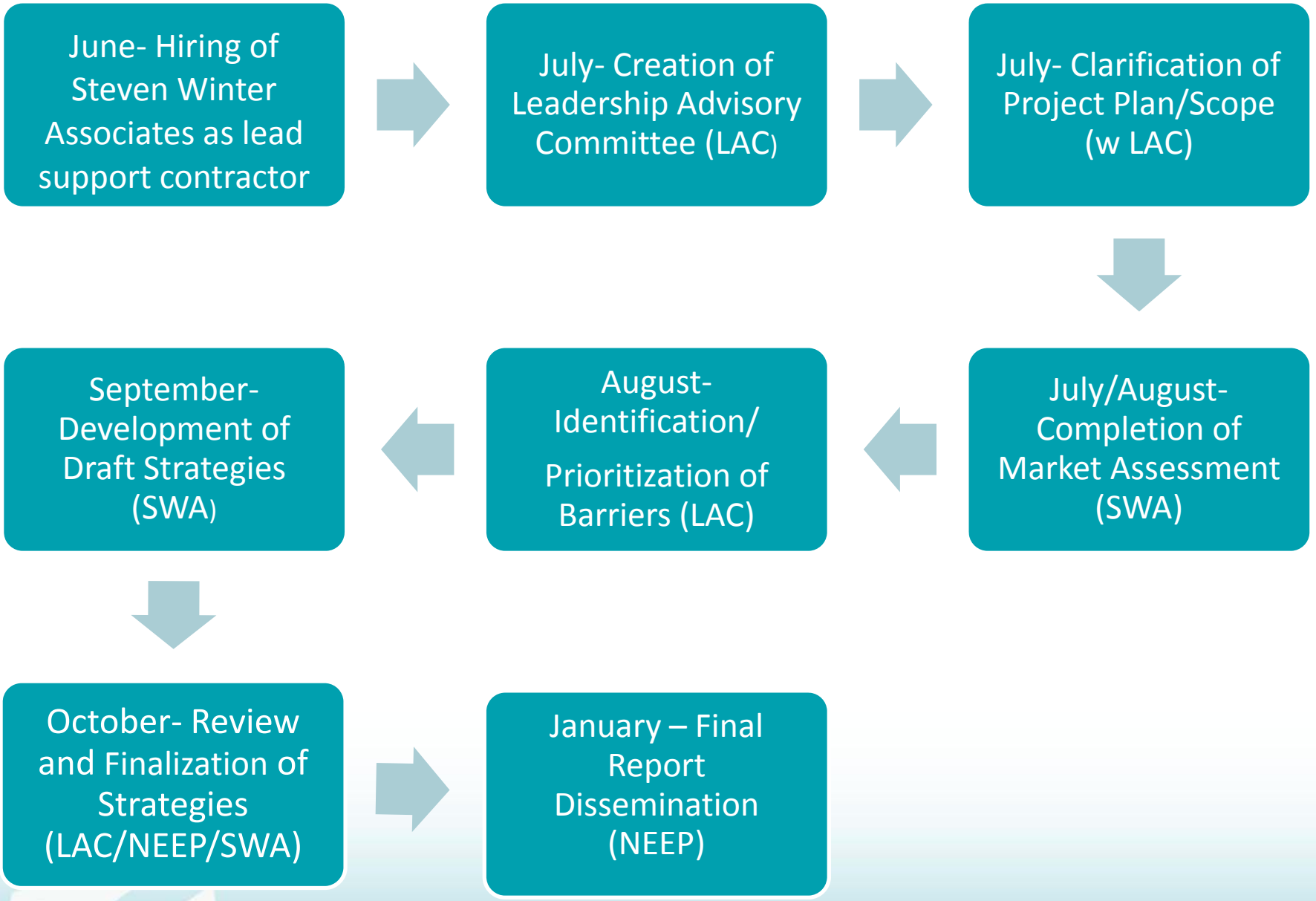
NEEP's Perspective

- NEEP views the expanded use of this particular technology in the region as a potential pathway to multiple outcomes:
  - Reduction in energy use, greenhouse gas emissions and costs associated with space heating
  - Effective solution for comprehensively meeting heating/cooling loads in low load homes (i.e. zero-net energy homes)

NEEP's Perspective

- Not wanting to repeat the same mistakes of other emerging technologies …Need for coordinated market growth strategies
- HURRY UP SLOWLY!

REPORT DEVELOPMENT PROCESS

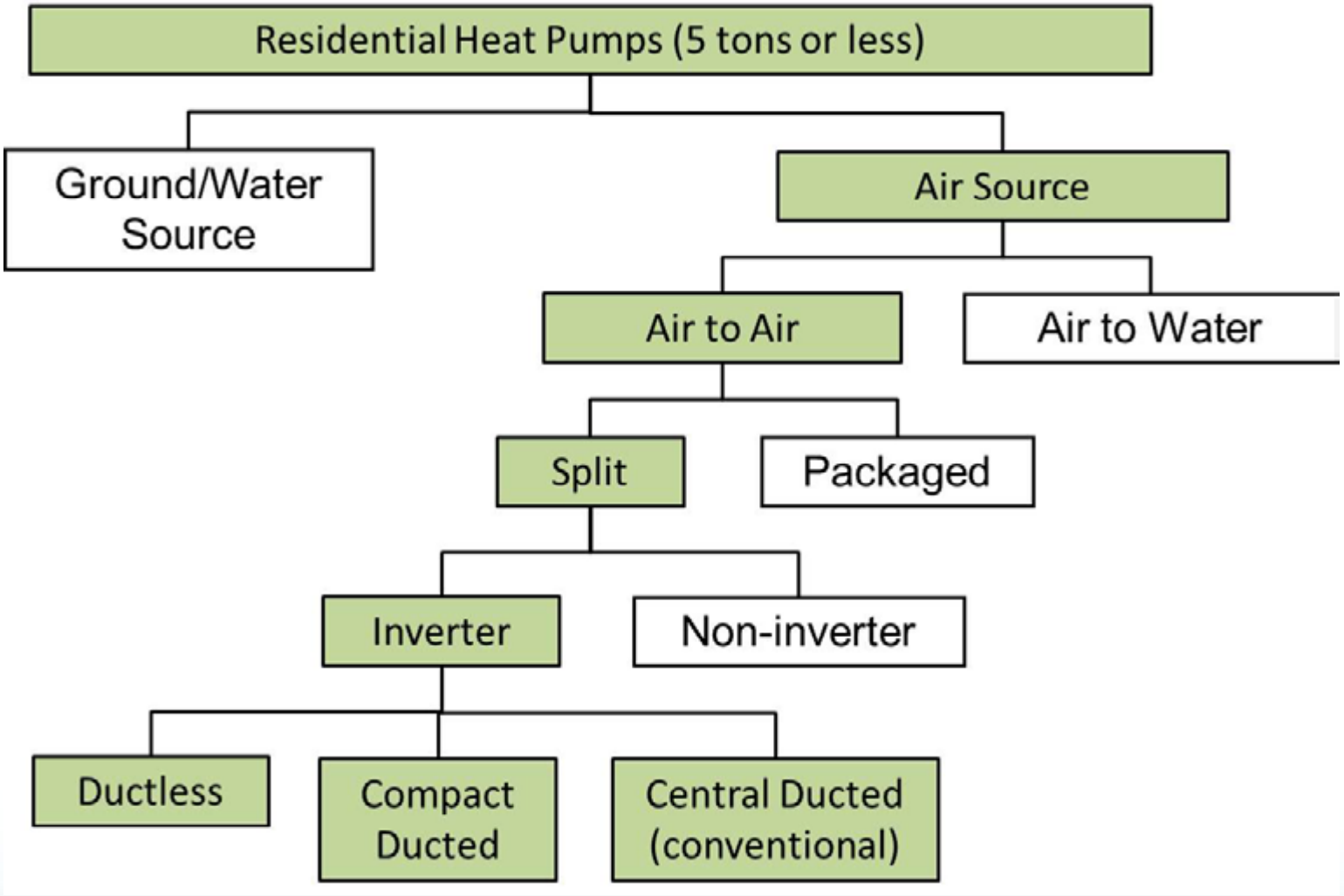


Leadership Advisory Committee (LAC) and Steven Winter Associates Team

HIGHLIGHTS/INSIGHTS OF MARKET ASSESSMENT

- Presented by Robb Aldrich, Team Lead from Steven Winter Associates (SWA)

Air-Source Heat Pump Family Tree



Equipment

Ducted, ductless, in between…

Studies & Potential Savings

- NW studies: DHP saves ~3,000 kWh/year displacing elec. resistance
- NE study: DHP saves ~2,500 kWh/year displacing elec. resistance.
- May cost ~50% to heat compared to oil and LP heating systems.
- Close to cost of natural gas?

Providing a portion of the necessary heat (Displacement) …Cost comparison

Displacing Electric Resistance:

Electricity Savings	3,000 kWh, $0.153/kWh	$459

Displacing Oil:

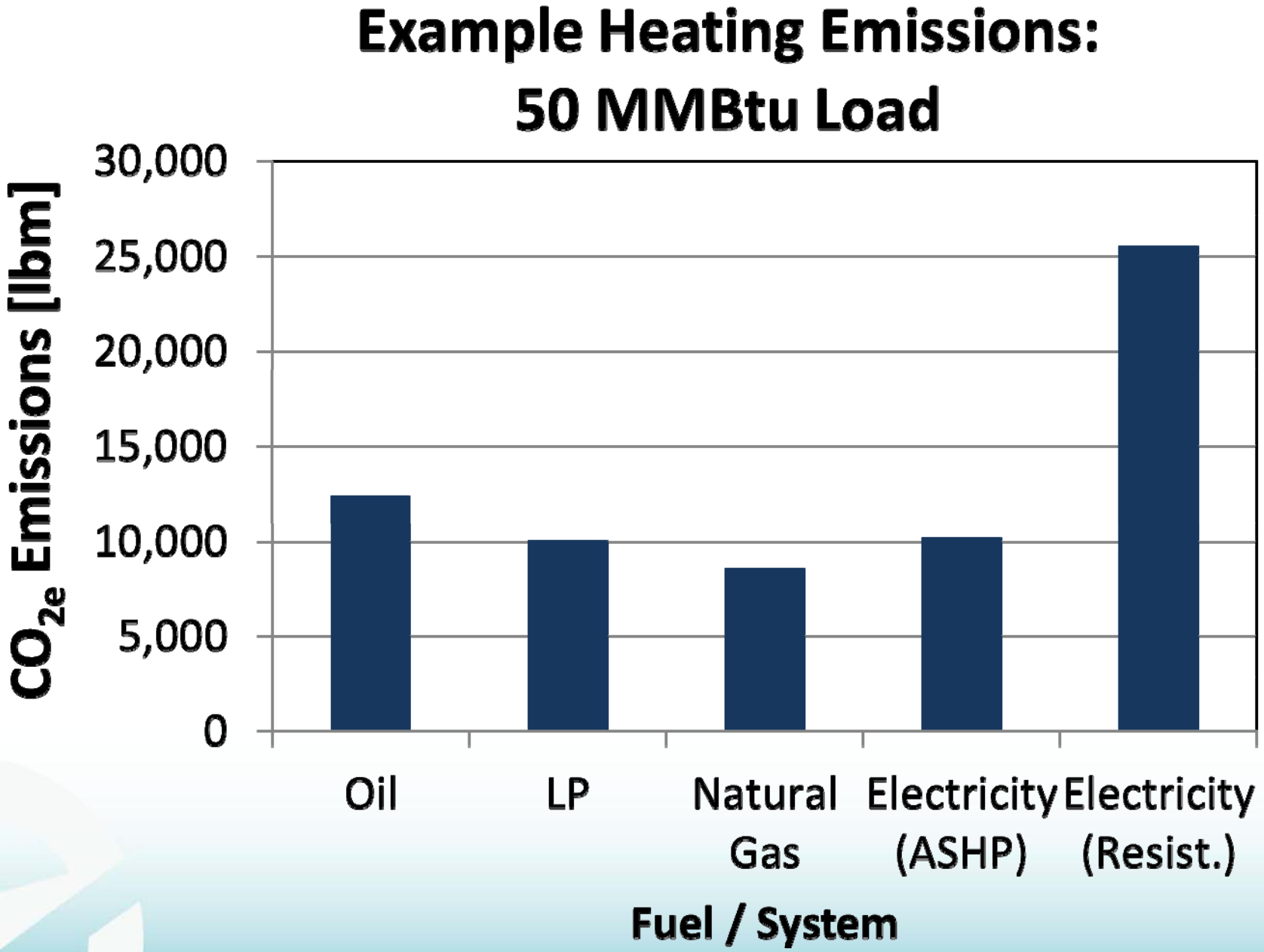
Oil Savings	164 gallons, $3.87/gal	$633
Added Electricity	2,000 kWh	$306
	Net Annual Savings:	$327

Heating a Whole House...Cost Comparison

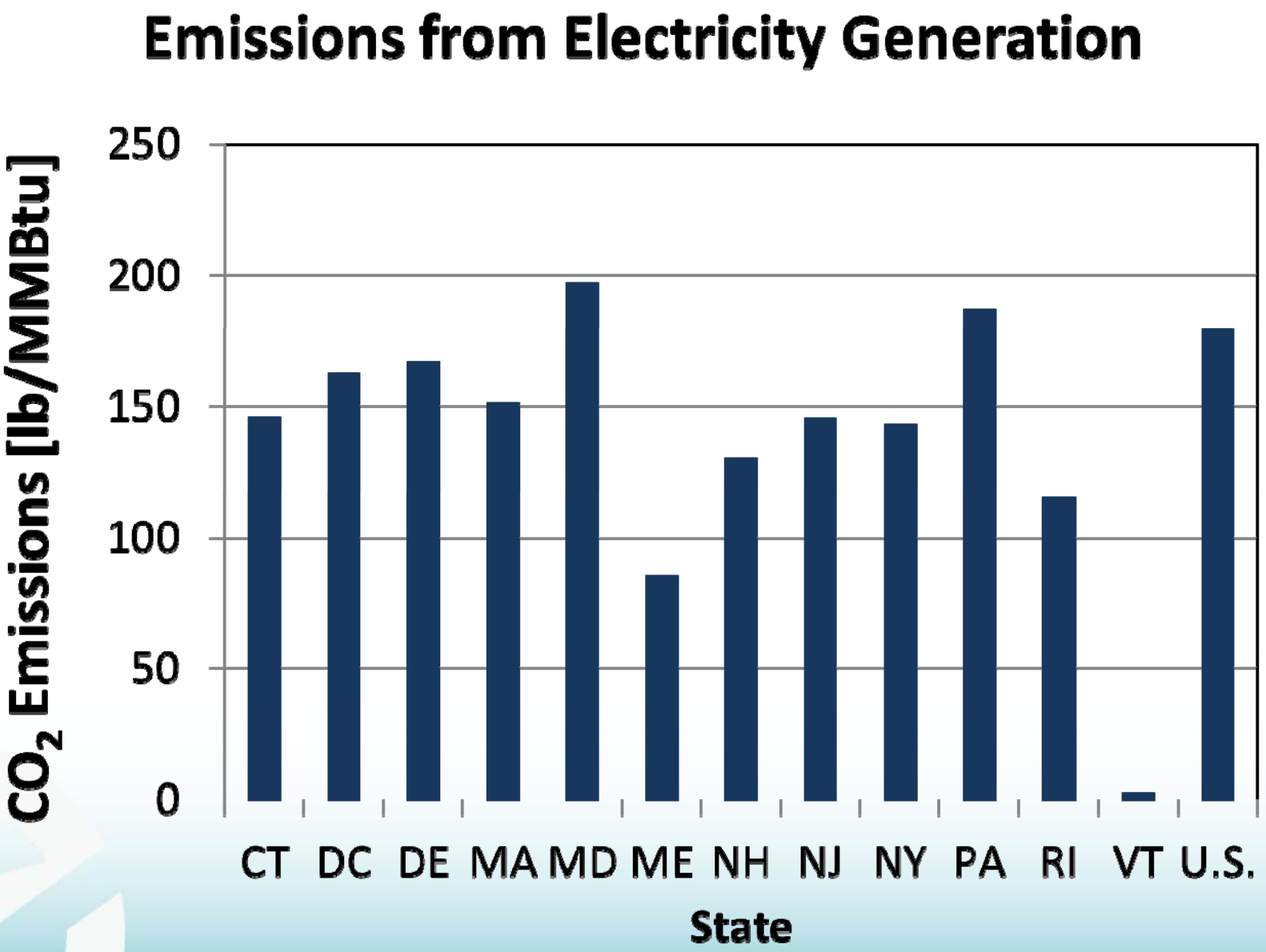
Fuel	Oil	LP	Natural Gas	Electricity (ASHP)	Electricity (Resist.)
Seasonal Eff/COP	80%	90%	90%	2.5	100%
Fuel Cost	$3.87 per gallon	$3.00 per gallon	$1.15 per therm	$0.15 per kWh	$0.15 per kWh

Example Home Type	Annual Heating Load	Approximate Annual Operating Cost*				
Large, inefficient	100 MMBtu	$3,710	$3,880	$1,506	$1,794	$4,484
Average NE Home	50 MMBtu	$1,855	$1,940	$753	$897	$2,242
New, code-compliant	25 MMBtu	$927	$970	$376	$448	$1,121
Very efficient	10 MMBtu	$371	$388	$151	$179	$448

Carbon Comparison



Associated Carbon Emission impacts do vary by state



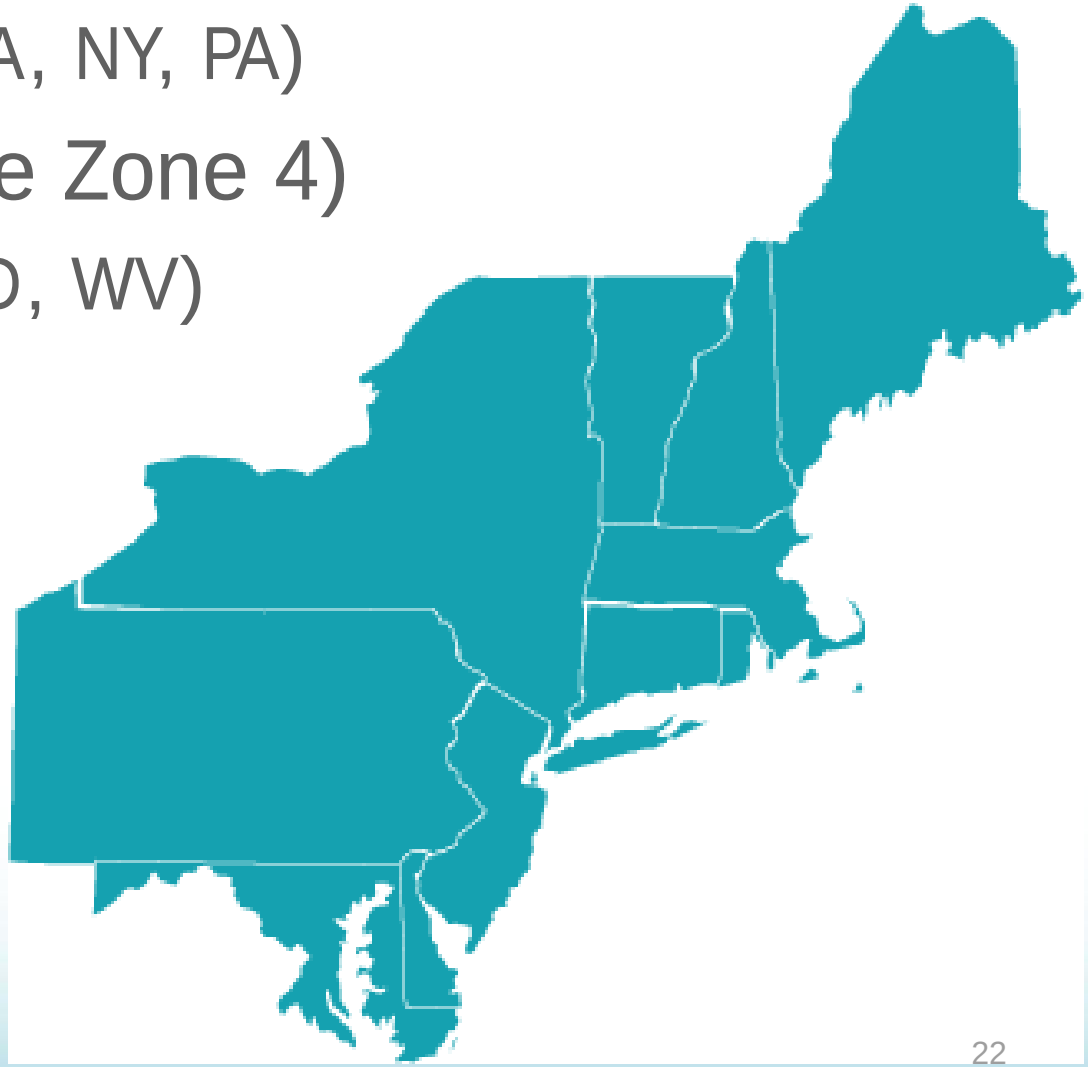
Synergy with Renewables

Electric Demand Effects

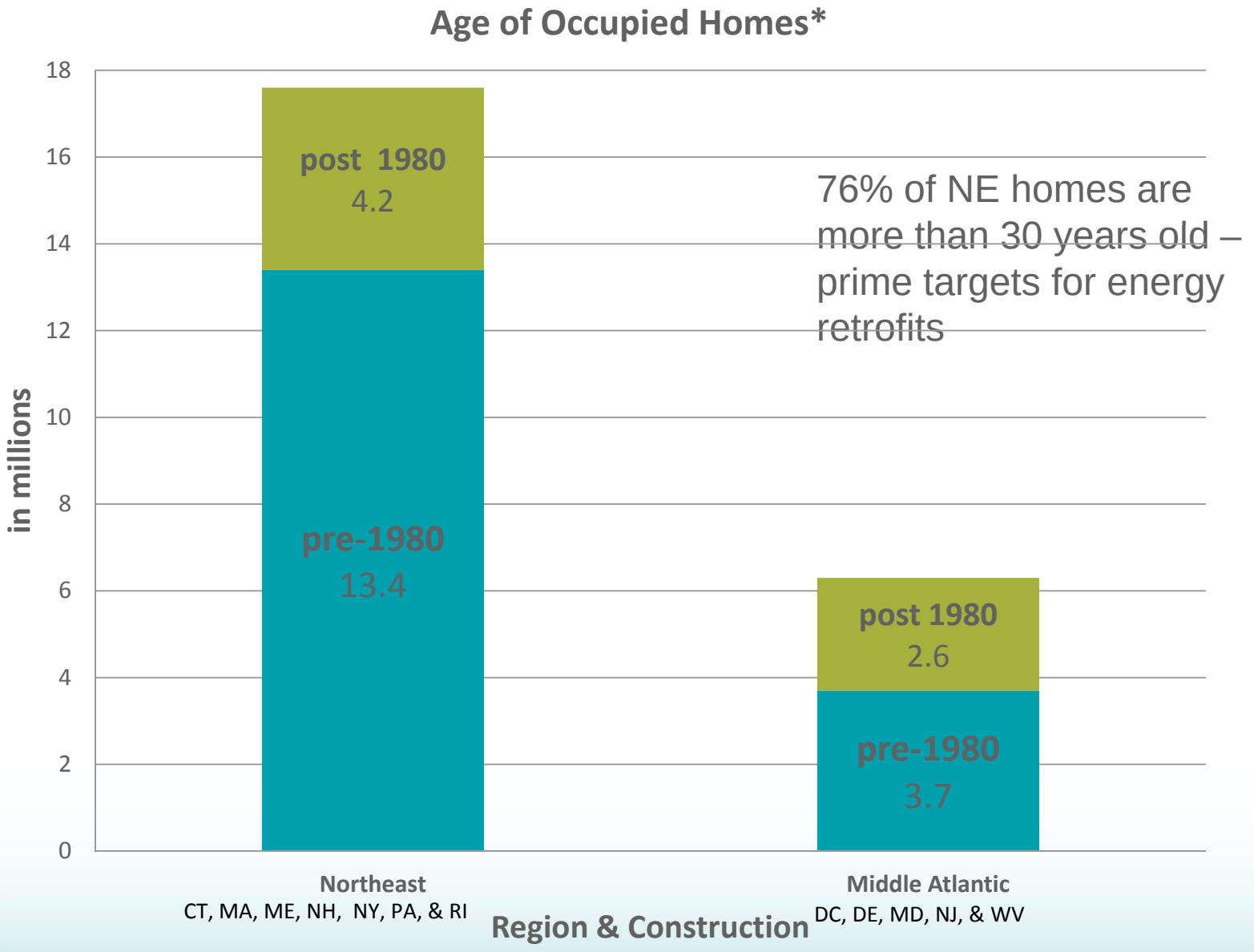
- KEMA study calculates winter on-peak impacts
  - e.g. 0.024 kW/kBtu/h for Boston. On average each 2-ton heat pump (displacing resistance) reduces winter on-peak demand by 0.58 kW. ~1,700 HPs result in 1 MW reduction
- Shifting from oil will increase demand.
  - e.g. 0.016 kW/kBtu/h, e.g. 0.38 kW for a 2-ton HP.
  - ~2,600 HPs result in 1 MW of on-peak demand.

Our Northeast and Mid-Atlantic Regions

- Northeast (Climate Zones 5 and 6)
  - RECS (ME, NH, VT, MA, NY, PA)
- Mid-Atlantic (Climate Zone 4)
  - RECS (NJ, DE, DC, MD, WV)



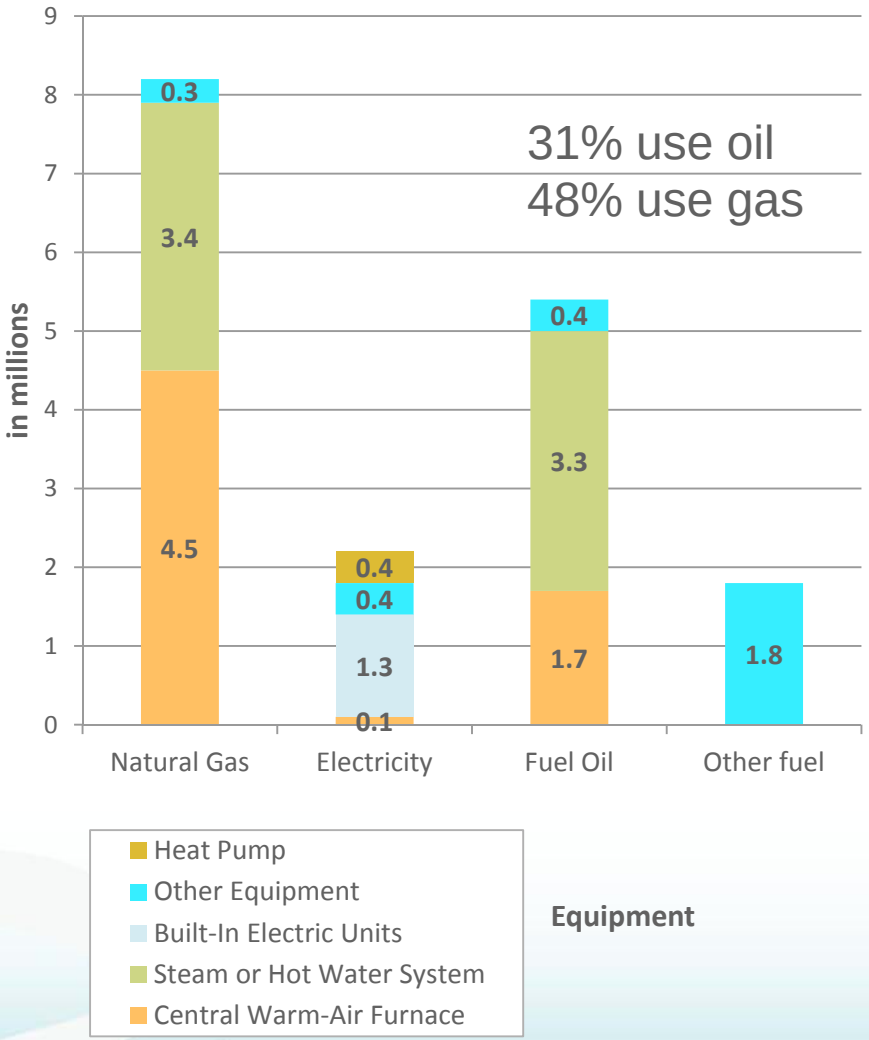
Region's Housing Market



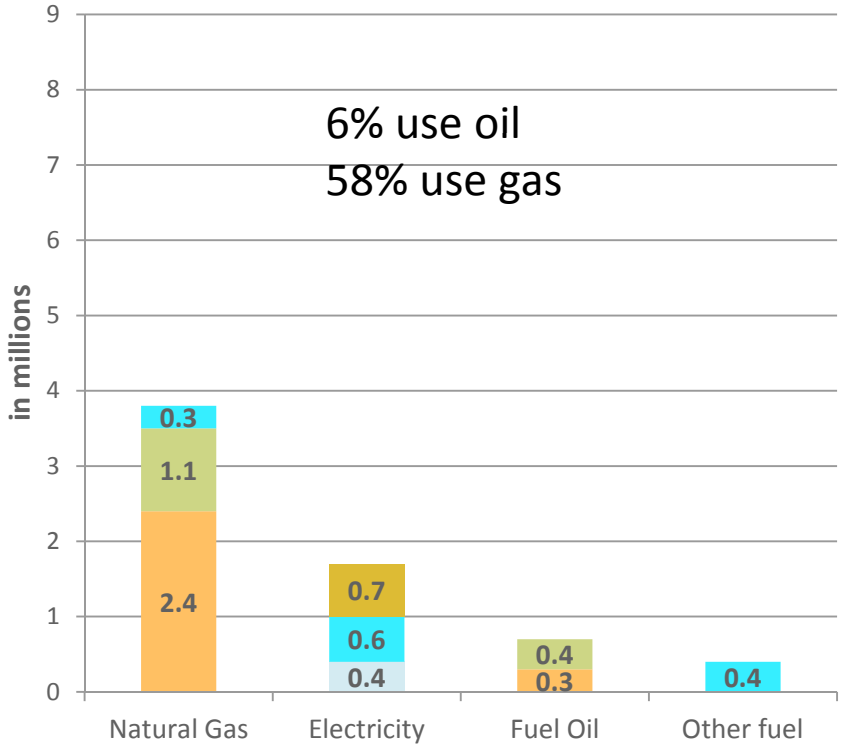
*2009 EIA RECS Data; Includes occupied homes in the following categories: single family attached & detached, apartment buildings,

Primary Heating Fuel

Northeast Homes
CT, MA, ME, NH, NY, PA, & RI*



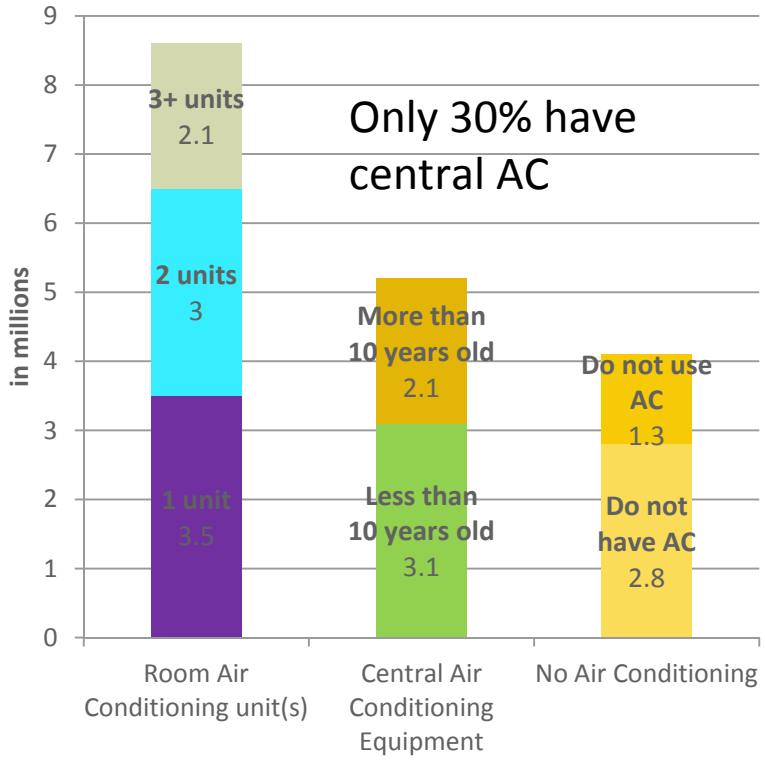
Middle Atlantic Homes
DC, DE, MD, WV, & NJ*



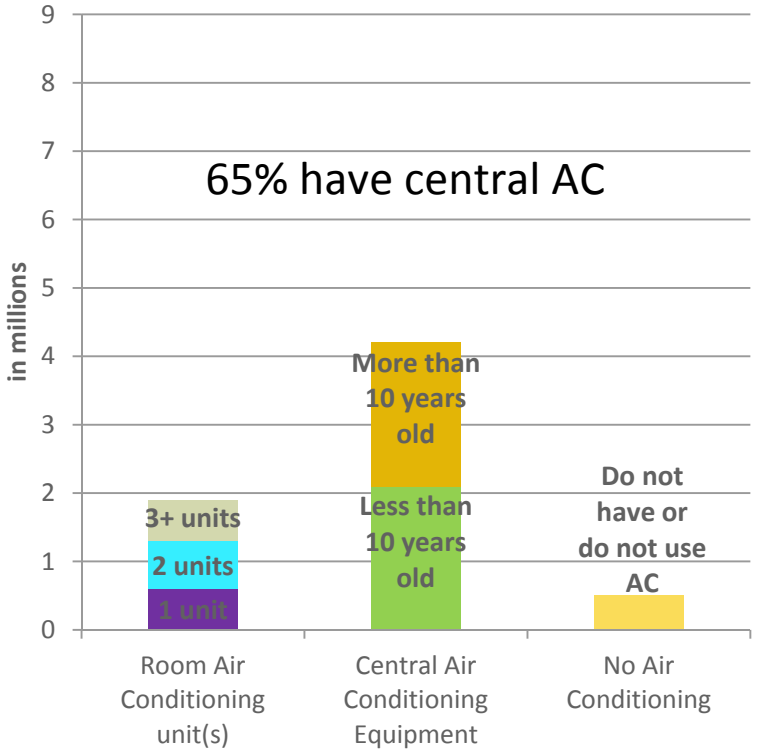
*2009 EIA RECS Data; Includes occupied single family attached & detached, apartment buildings, & mobile homes.

Cooling Equipment

Northeast Homes
CT, MA, ME, NH, NY, PA, & RI*



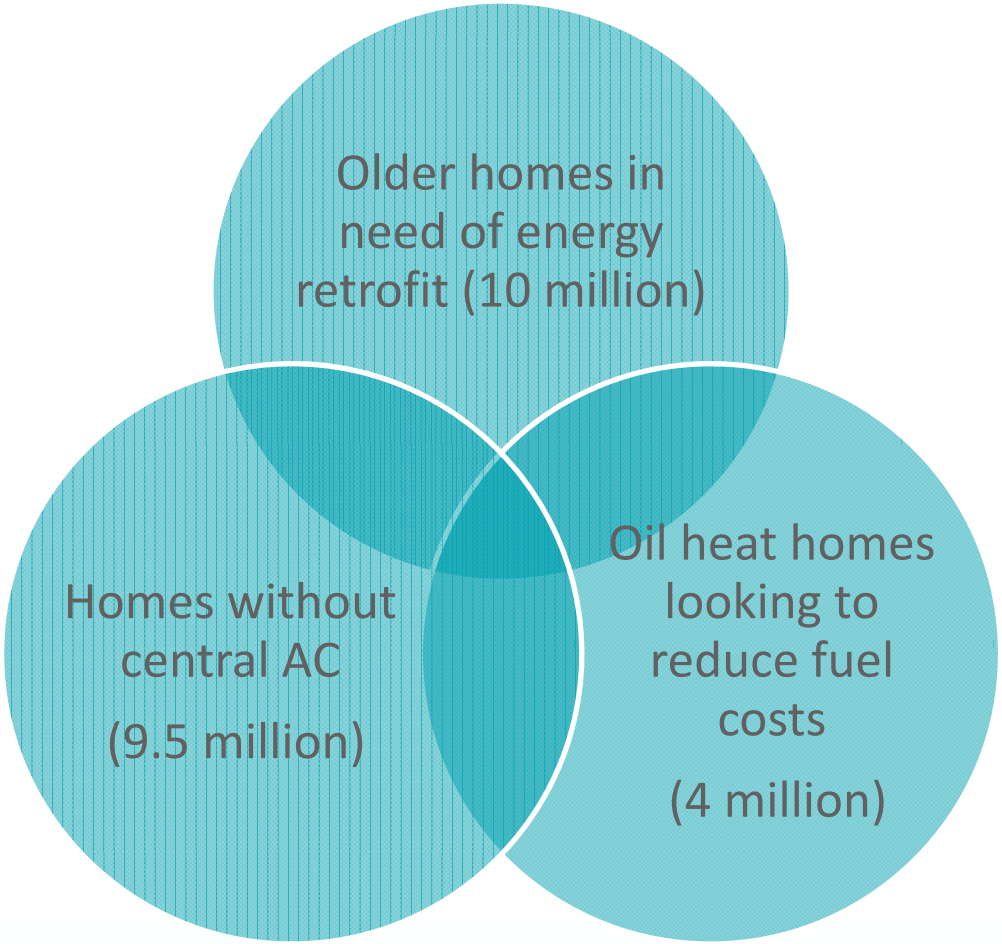
Middle Atlantic Homes
DC, DE, MD, WV, & NJ*



*2009 EIA RECS Data; Includes occupied single family attached & detached, apartment buildings, & mobile homes.

Market Candidates

Significant Opportunities in the Northeast



Much smaller market shares in the Mid-Atlantic

- Homes heated with oil (0.5 million)
- Homes without central AC (2 million)

Electric Resistance Candidates

Northeast

Mid Atlantic

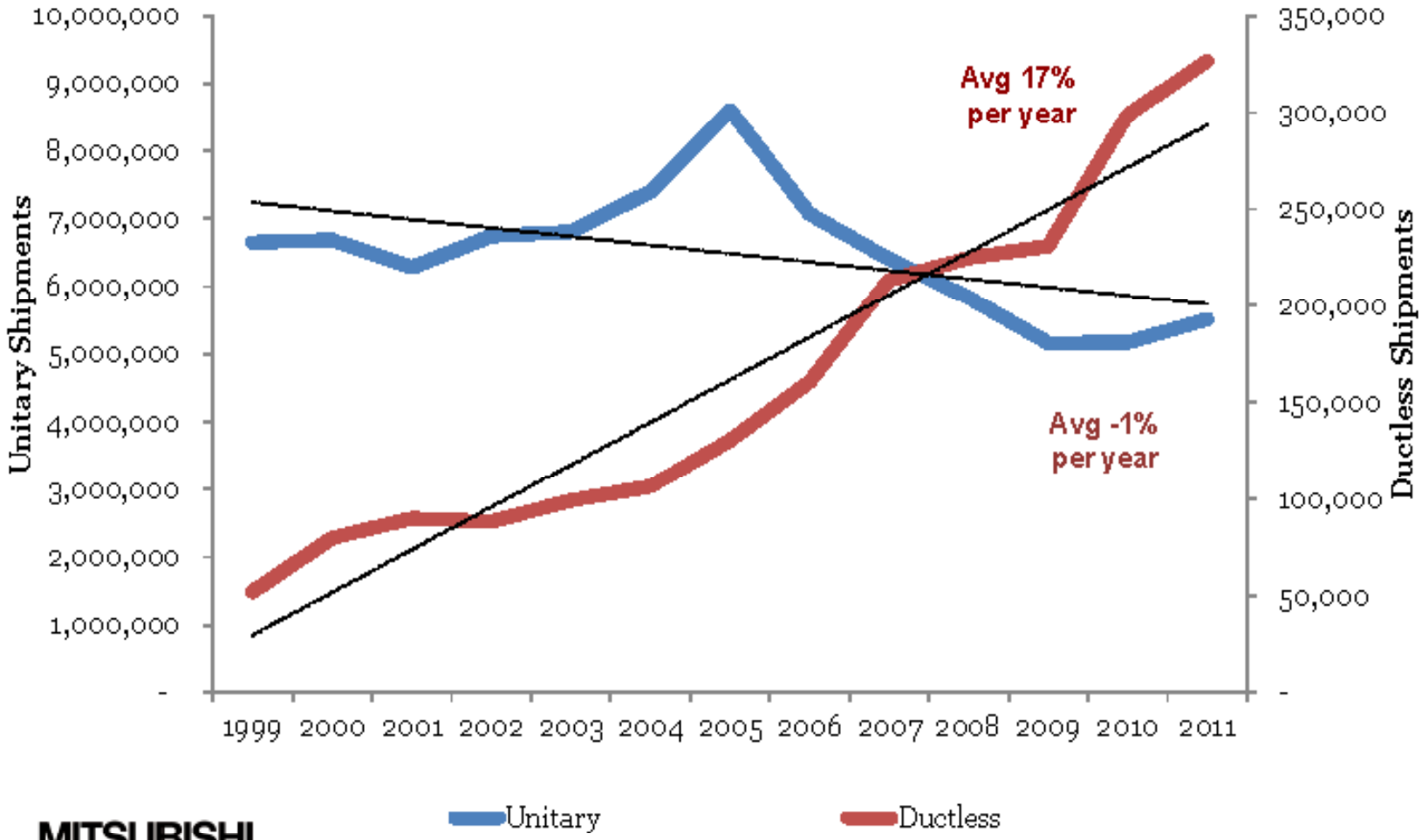
Current Installation Scenarios

- New construction
  - Low load homes
    - Net zero all-electric homes integrated with PV
    - Townhomes to avoid gas infrastructure cost
  - Homes without natural gas availability

- Replacement- replacing an existing heating system (e.g. end of useful life)

- Displacement –adding a heat pump to a zone without removing existing heating system; addition of cooling may be the primary motivation

AC & HP data, Mitsubishi



MITSUBISHI ELECTRIC
COOLING & HEATING
Live Better

Source: AHRI

Installed Costs

- See paper for summaries of several studies
  - Single-port ductless heat pump: $3,500 - $4,000
  - Cost per ton: $2,500 - $3,000

- Price goes down with:
  - contractor experience
  - maturity of market
  - program volume

ASHPs in Cold Climates

- HSPF is not a good indicator
- Look for published performance data at cold conditions
- Efficiency Vermont program has specific cold-climate requirements.
- More work needed on this front…

MARKET BARRIERS

RECOMMENDED STRATEGIES

1. Develop more accurate tools to predict energy and cost savings associated with ASHP installations, through collection of real world performance data
2. Develop standardized Metrics for Cold Climate ASHP Performance
3. Increase Consumer Awareness and Education
4. Expand HVAC Contractor Awareness and Education
5. Improve Integration of ASHPs with Other Heating Systems
6. Provide ASHPs at Affordable Costs to Consumers
7. Characterize policy implications of large scale deployment of ASHPs

#1- Develop more accurate tools to predict expected savings

a) Implement large-scale utility bill analysis study
b) Conduct focused monitoring studies on inverter-driven ASHPs in different applications and across seasons.
c) Drive coordination and consistency on methods and protocols used in ASHP evaluations.
d) Improve energy modeling software

#2- Develop standardized metrics for ccASHP performance

a) Encourage AHRI to amend standardized test procedures for heat pumps in order to accurately measure:
   - Performance at colder outdoor conditions.
   - Part-load performance

#2- Develop standardized metrics for ccASHP performance

b) Examine alternative HSPF-type metrics which assumes a heat pump can provide more of a space's heating load at colder temperatures.
   - This could highlight the advantages of variable-speed heat pumps over conventional, single-speed heat pumps.

c) Voluntary programs (i.e. Energy Efficiency programs) should adopt and implement climate-appropriate performance requirements

d) Influence national groups (i.e. ENERGY STAR) to adopt similar requirements

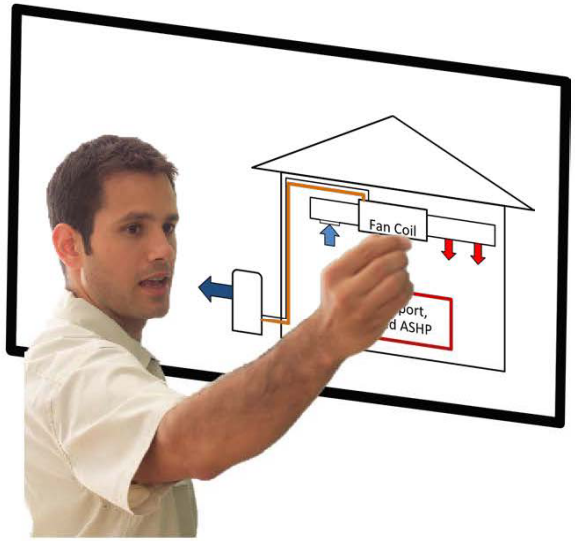
#3- Increase Consumer Awareness and Education

a) Develop consistent, consumer-oriented educational messages
   - Disseminate through utilities, manufacturers/retailers and installers through a variety of channels

b) As additional performance/survey data is collected, develop education and outreach materials (including case studies).

#4- Expand HVAC Contractor Awareness and Education

a) Develop contractor training materials to increase contractor understanding and confidence. Materials should highlight;
   - Profitability in cutting edge tech
   - Ease of installation
   - Controls
   - Snow considerations
   - Condensate lines
   - Air flow



#4- Expand HVAC Contractor Awareness and Education

b) Contractor trainings should deliver compelling messages that resonate with the target stakeholder groups.
   - Home performance contractors
   - Fossil-fuel heating system installers
   - Traditional HVAC contractors focused on air-conditioning installations

c) Develop consumer oriented educational material to be disseminated by contractors directly or via the internet.

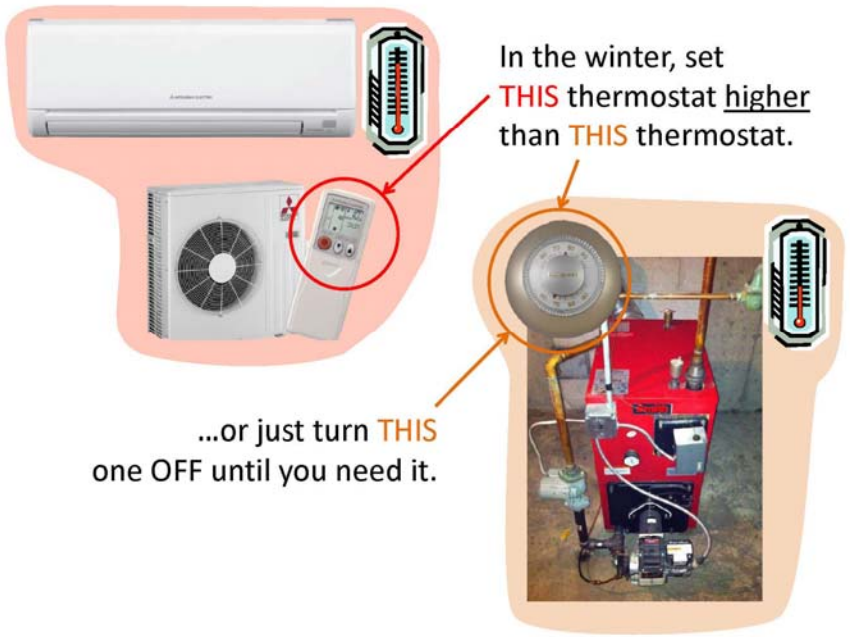
d) Support distributors/contractors who display inverter-driven ASHPs in their showrooms.

e) Develop case studies for contractors to highlight the potential operating cost and easy installation of efficient ASHPs.

#5- Improve integration with other heating systems

a) Educate consumers on how to operate their ASHP in conjunction with other heating system(s).
   - Programs
   - Manufacturers
   - Contractors

b) Encourage manufacture and installation of integrated control systems (for both heat pumps and displaced heating systems).



#5- Improve integration with other heating systems

c) Encourage manufacture and installation of more cost-effective heat pump systems that can integrate with conventional distribution systems (e.g. central duct systems, hydronic baseboard).

#6- Provide ASHPs at an affordable cost to consumers

a) Drive equipment and installation costs down through economies of scale.
   - Target low-rise multi-family buildings and townhomes (both new and existing).

b) Efficiency programs should continue to offer incentives for heat pumps
   - But require more rigorous performance qualifications (such as Efficiency Vermont's cold-climate criteria).

#6- Provide ASHPs at an affordable cost to consumers

c) Investigate implementing ASHP Lease programs

d) Investigate developing “Solarize”-like programs for ASHPs.

#7- Policy implications

a) Conduct further analysis to better describe regional impacts of broad ASHP deployment on;
   - Energy usage (across fuels)
   - Peak electricity impacts (summer/winter)
   - Costs to consumers and utilities
   - Associated emission impacts.

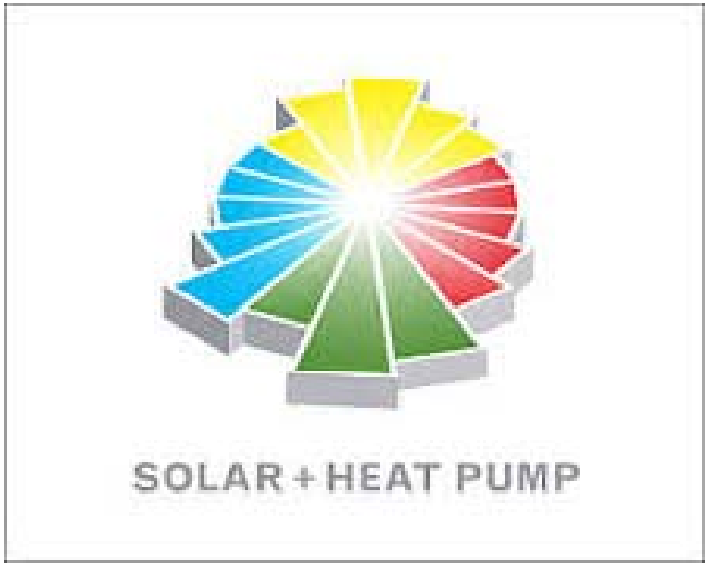
b) Fuel Switching- Begin/continue discussions at the state level to understand specific perspectives on fuel switching hurdles.
   - Commonalities across the state level discussions could then be used to initiate regional policy discussions.

#7- Policy implications

c) Outline a policy that links ASHPs to renewable energy generation and the associated positive climate impacts.

d) Leverage existing policy interests (i.e. expansion of solar PV, zero-net energy homes) to build support for ASHP deployment.

e) ASHPs as an alternative to gas infrastructure expansion



WHERE DO WE GO FROM HERE?

- Writing the report was the easy part, Implementing strategies effectively will be hard work
- NEEP to assemble Regional ASHP Working Group to work to implement strategies
  - Feel free to reach out to me directly if you would like to be invited
- Will continue to track and engage the many activities related to ASHPs in region

QUESTIONS / COMMENTS???

THANK YOU

FULL REPORT AVAILABLE ON NEEP's WEBSITE; WWW.NEEP.ORG

David Lis

djlis@neep.org

January 16, 2014

91 Hartwell Avenue Lexington, MA 02421

P: 781.860.9177

www.neep.org