Heat Pumps: Not Pipelines

September 21, 2019

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AGREE New York

Alliance for a Green Economy

Aztech Geothermal, LLC

- Locally Owned & Operated
- 450+ Geothermal Customers
- Design by Engineers & Geologists
- Offer ***Best Available*** Technology
- Air & Water Based Solutions
- Experienced Field Technicians
- Consult on Large Projects

Energy Star HOME PERFORMANCE WITH ENERGY STAR

Building Performance Institute Inc. SM BPI GoldStar CONTRACTOR

Goldman Sachs 10,000 small businesses ALUMNI

Aztech GEOTHERMAL

WaterFurnace

NY-GEO

Capital Region Builders & Remodelers Association CRBRA

CERTIFIED GREEN PROFESSIONAL™

IGSHPA Accredited Installer

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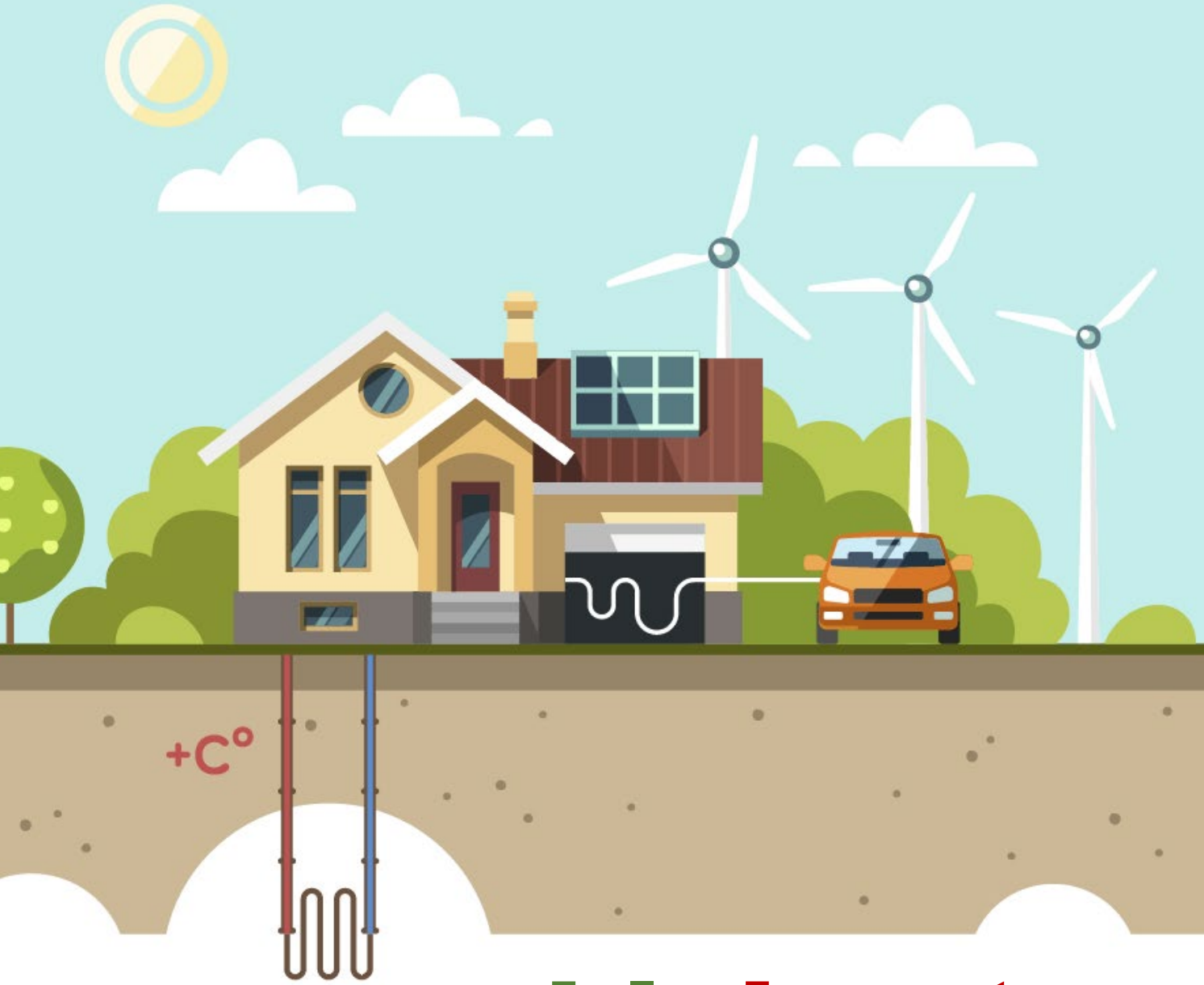


We work together to:

reduce fossil fuels used for heating and cooling;

educate people about heat pumps;

accelerate heat pump adoption;

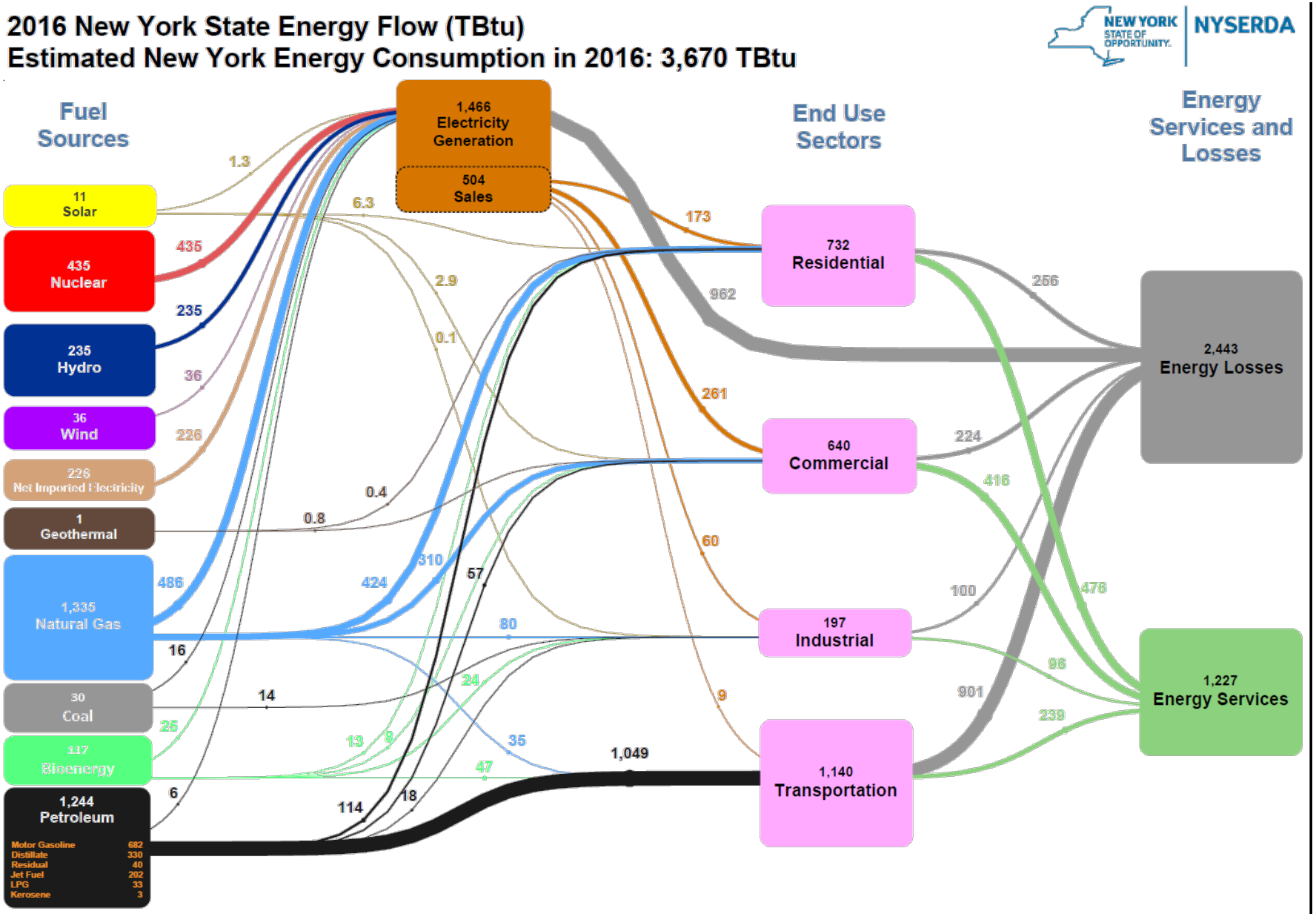
advocate for policies that will enable all New Yorkers to afford to make the switch!

renewableheatnow.org

We can't solve problems by using the same kind of thinking we used when we created them.

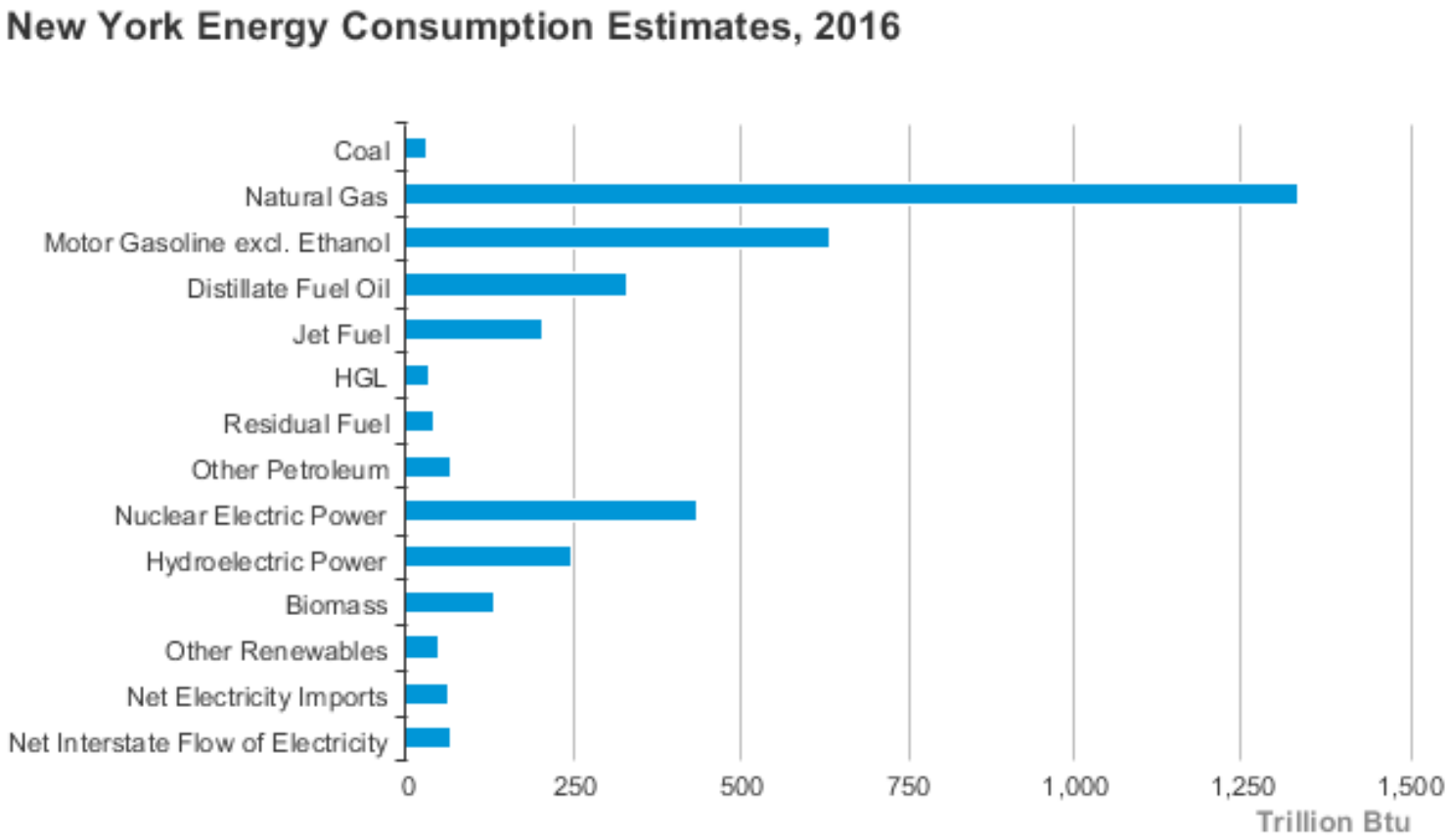
-Albert Einstein

What do we use energy for?



Source: NYSERDA, Patterns and Trends New York State Energy Profiles: 2002-2016 published January 2019. Motor gasoline includes ethanol which is not included in Total Petroleum so sums may differ from the total. Electricity Sales (504 TBtu) are a part of the total Electricity Generation sector (1,466 TBtu). Bioenergy includes ethanol (47 TBtu), wood (38 TBtu), landfill gas (6 TBtu), and waste (26 TBtu). Geothermal energy in this case represents ground source heat pumps. Electricity losses are calculated as the difference between energy input for electricity generation and energy from retail electricity sales. Energy losses for the end-use sectors are based on the following estimated end-use efficiency factors from the Lawrence Livermore National Laboratory, 65% for the residential sector, 65% for the commercial sector, 49% for the industrial sector, and 21% for the transportation sector. Totals may not equal the sum of components due to rounding.

NY Energy Consumption - all sources



Source: Energy Information Administration, State Energy Data System

How much does all this energy cost us?

$50 billion per year

Per person per year: $2,524

Hidden Costs

- Extreme weather, made worse by climate change, along with the health impacts of burning fossil fuels, has cost the U.S. economy at least $240 billion a year over the past ten years. (2017, National Geographic)

Main Sources Of Greenhouse Gases in NYS

New York's goal is to reduce these emissions 80% by 2050

NEW YORK STATE OF OPPORTUNITY. Department of Environmental Conservation

TRANSPORTATION
34%

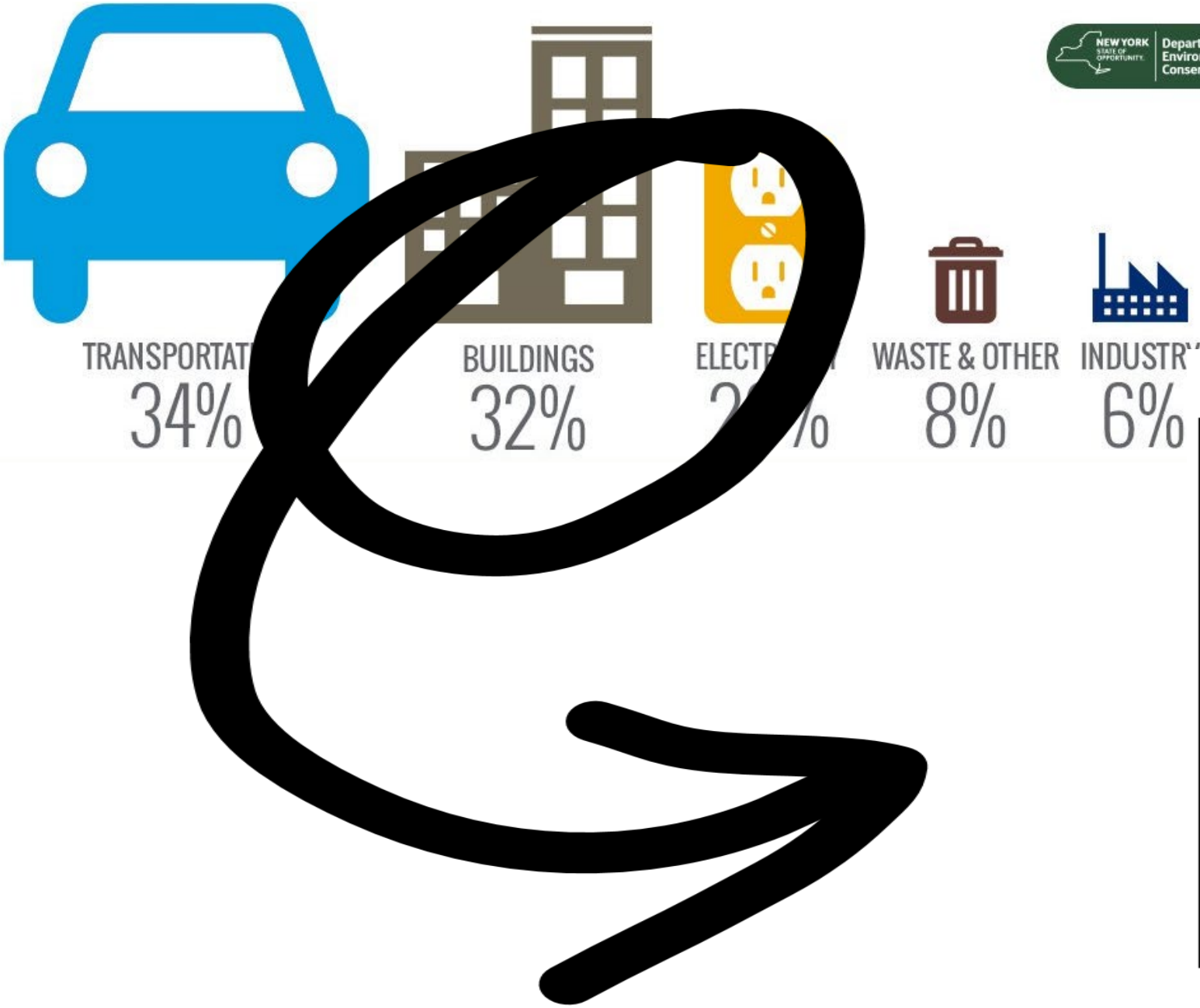
BUILDINGS
32%

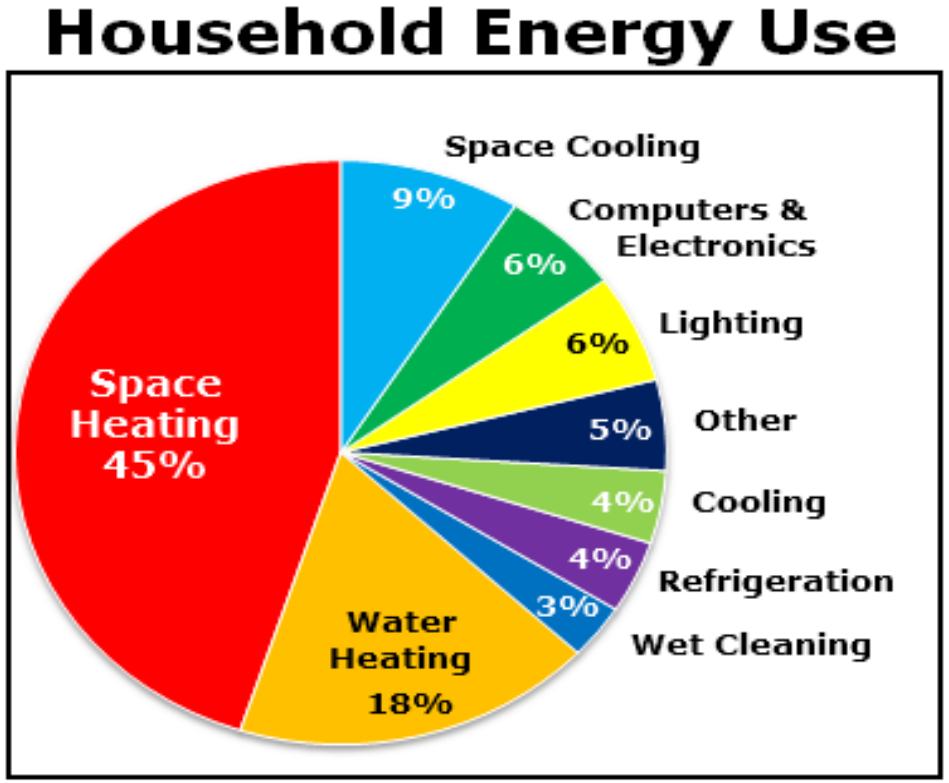
ELECTRICITY
20%

WASTE & OTHER
8%

INDUSTRY
6%

Heat Pumps: Not Pipelines





Source: US Dept. of Energy

Heat Pumps: Not Pipelines

2015 NYS Energy Plan: Goals by 2030

40% Reduction
in GHG emissions from 1990 levels

Reducing greenhouse gas (GHG) emissions from the energy sector—power generation, industry, buildings, and transportation—is critical to protecting the health and welfare of New Yorkers and reaching the longer term goal of decreasing total carbon emissions 80% by 2050.

50% Generation
of electricity must come from renewable energy sources

Renewable energy sources, including solar, wind, hydropower, and biomass, will play a vital role in reducing electricity price volatility and curbing carbon emissions.

23% Decrease
in energy consumption in buildings from 2012 levels

Energy efficiency results in lower energy bills and is the single most cost-effective tool in achieving energy objectives. 600 trillion British thermal units (TBtu) in energy efficiency gains equates to 23% reduction in energy consumption by buildings.

Heat Pumps Can Play a Big Role in These Areas

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70% ~~50%~~ 85%

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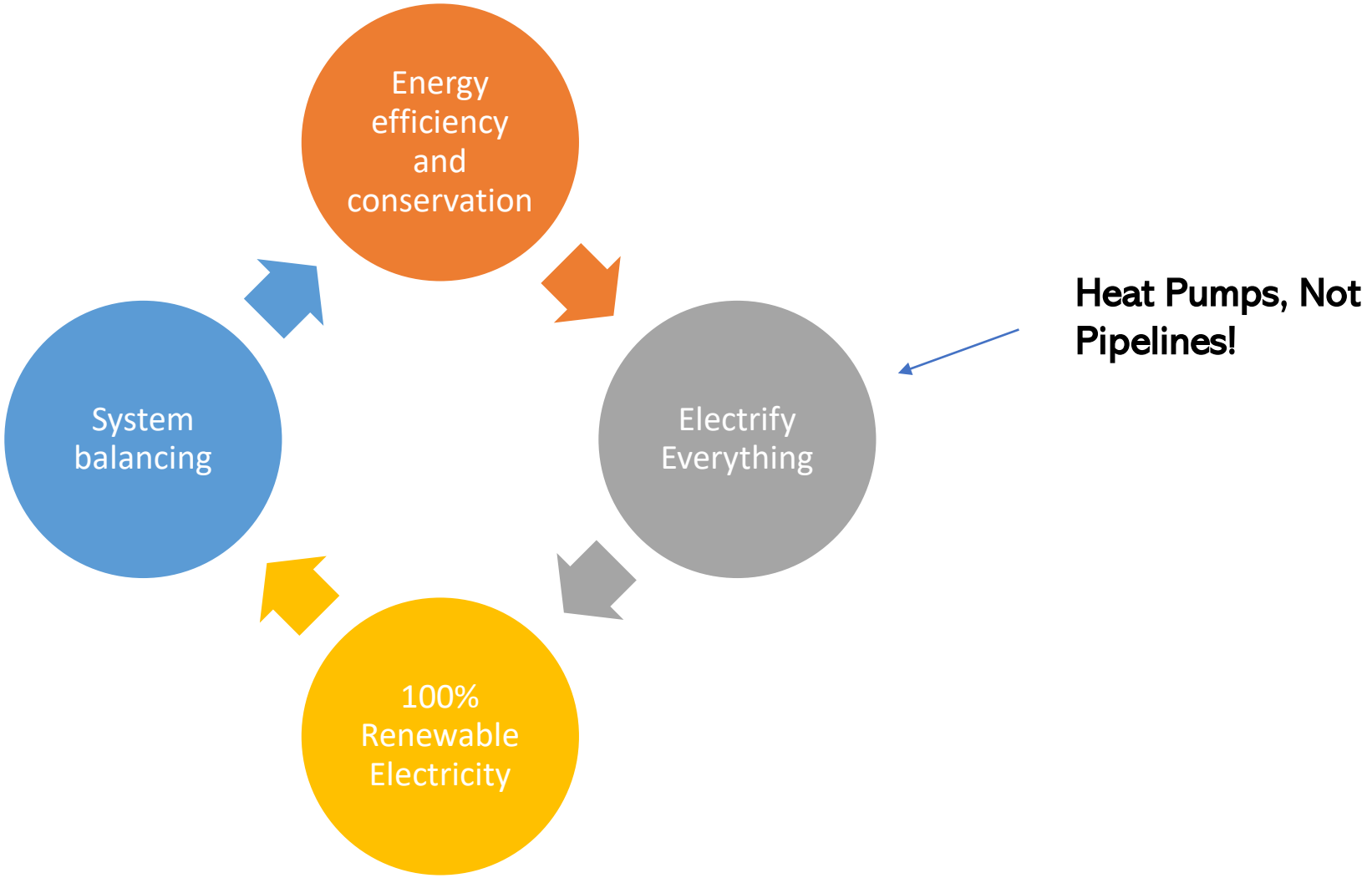
Heat Pumps Can Play a Big Role in These Areas

www.aztechgeo.com

How do we get there?



Large Scale Beneficial Electrification Required

Current Pace of System Conversions Must be Increased by 3-6 Times

40% GHG Emissions Reduction by 2030
Requires <u>Significant</u> Conversions / Additions:

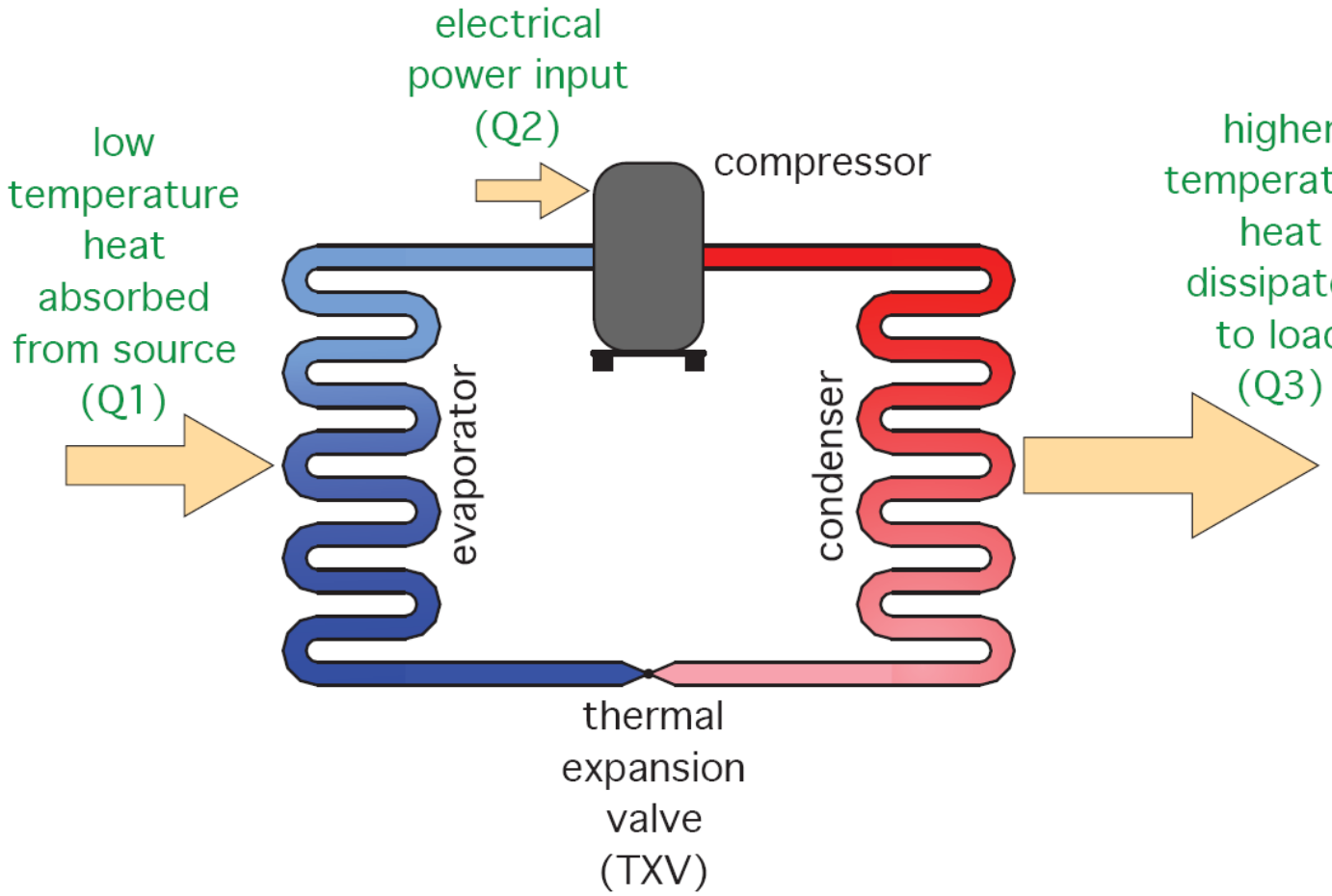
- **3.3 Million Battery Electric Vehicles** — **220,000 per Year**
- **3.5 Million Housing Unit Heat Pumps** — **233,000 per Year**
- **40% Commercial, Industrial Buildings with Heat Pumps** — **27,000 per Year**
- **82.1 Terra-Watt Hours of Carbon Free Electric Power** — **5.5 TWh per Year**

80% GHG Emissions Reduction by 2050
Requires <u>Additional</u> Conversions / Additions of:

- **5.2 Million Battery Electric Vehicles** — **260,000 per Year**
- **3 Million Housing Unit Heat Pumps** — **150,000 per Year**
- **80% Commercial, Industrial Buildings with Heat Pumps** — **20,250 per Year**
- **86.3 Terra-Watt Hours of Carbon Free Electric Power** — **4.3 TWh per Year**

Source: Jerry Acton - April 11, 2019

Heat Pump Basics

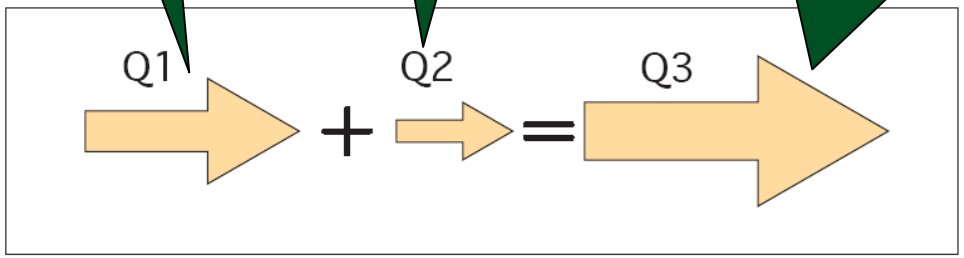


higher temperature heat dissipated to load (Q3)

3 Units of renewable thermal energy from the air, ground, lake or pond.

1 Unit of electricity we buy.

4 Units of thermal energy to the space - that's a COP = 4



Coefficient of Performance (COP)

$$COP = \frac{\text{power output}\ (Q3)}{\text{power input}\ (Q2)}$$

Source: idronics™ Journal by Caleffi Hydronic Solutions

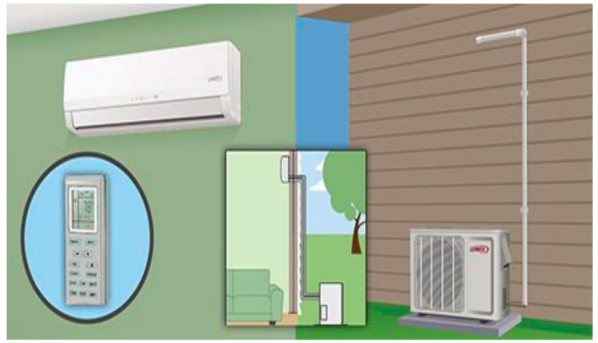
Heat Pumps: Not Pipelines

Heat Pump Types

Clean Heating & Cooling Technologies

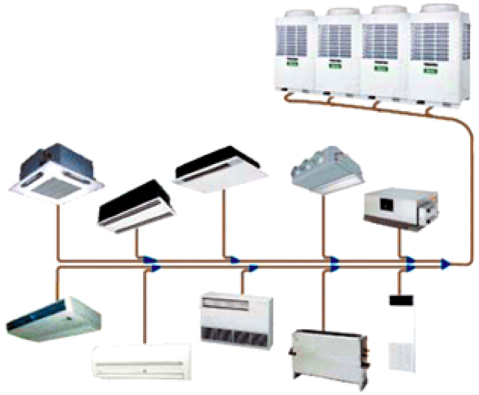
Air Source Heat Pumps

Central Ducted



Ductless Mini-Split

Heat Pump
Water Heater



Variable Refrigerant Flow (VRF)

Ground/Water Source Heat Pump Systems

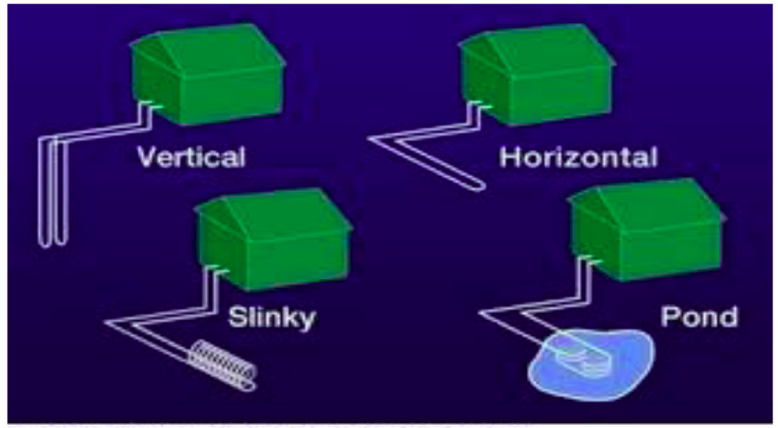
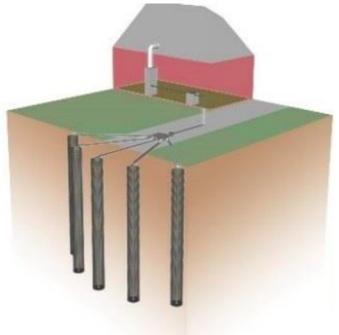
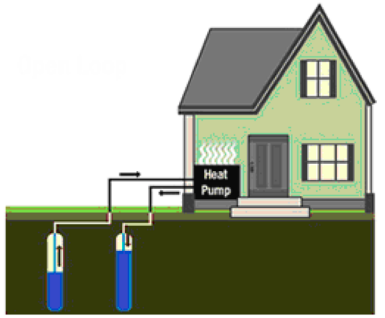


Figure 1 - Types of Closed-Loop Geothermal Systems



Direct Exchange



Open Loop
System

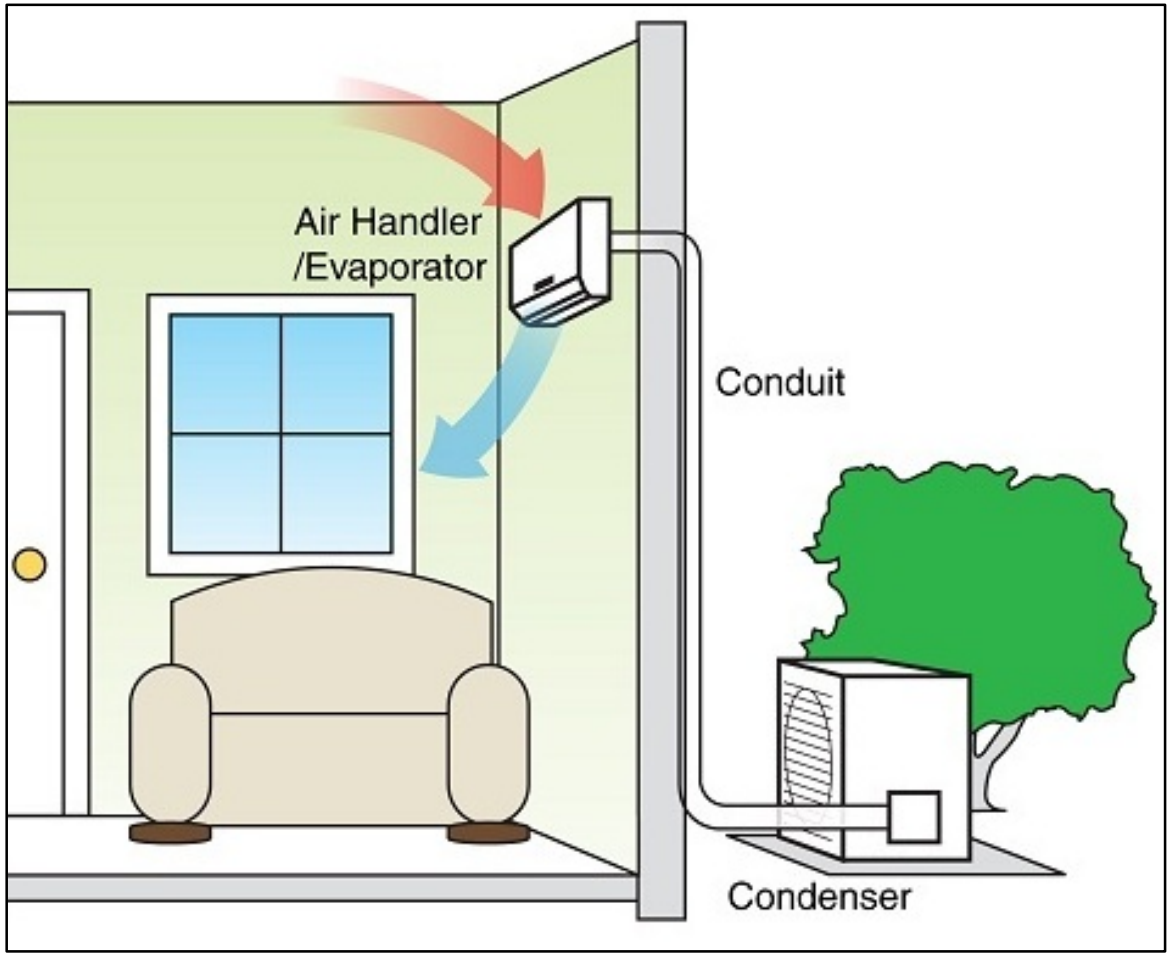
Source: NEW YORK STATE OF OPPORTUNITY. NYSERDA

Aztech GEOTHERMAL

www.aztechgeo.com

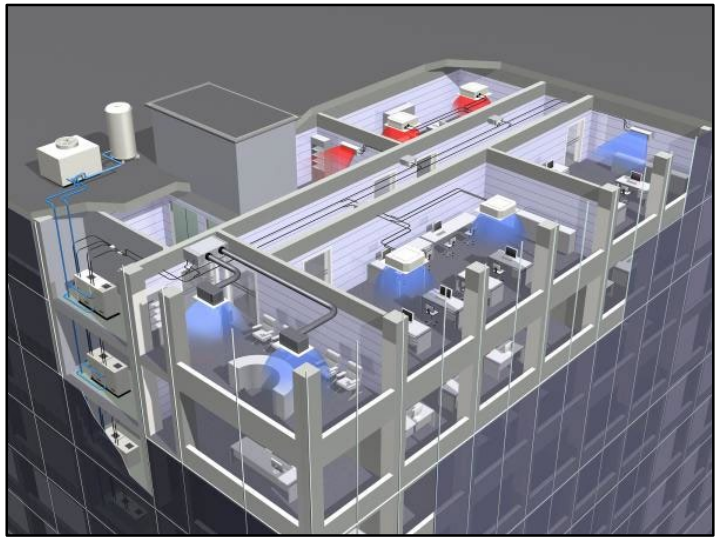
ASHP - Ductless Mini-Splits

- Heating & AC
- Ductless with conditioned air delivered directly
- Inverter / variable speed compressors increase part-load efficiency
- Current technology maintains operation to -13 F



Variable Refrigerant Flow (VRF) Systems

- Centrally located compressors
- Multiple indoor distribution units from single compressor unit.
- Simultaneous heating & cooling
- Small diameter refrigerant distribution in building
- Available in ASHP, WSHP or used as GSHP

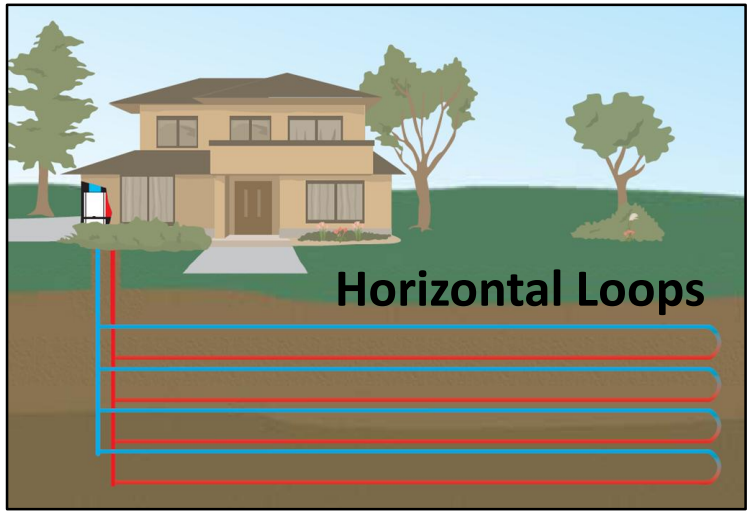


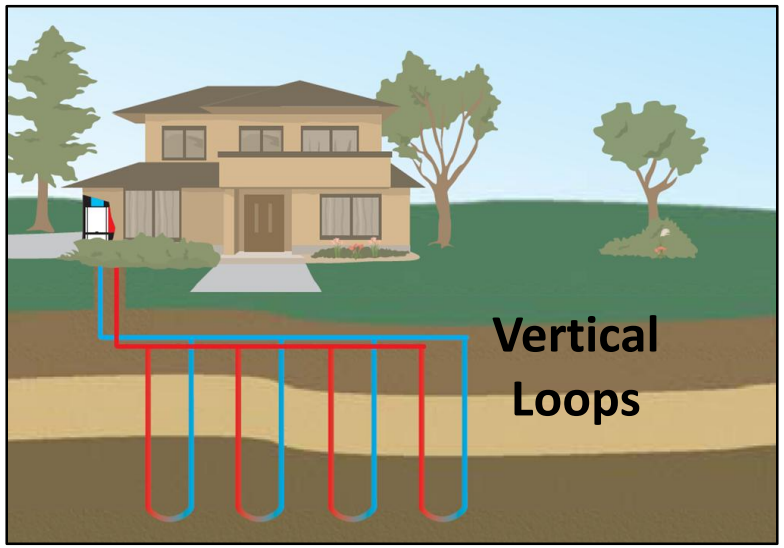
Source: Mitsubishi Electric

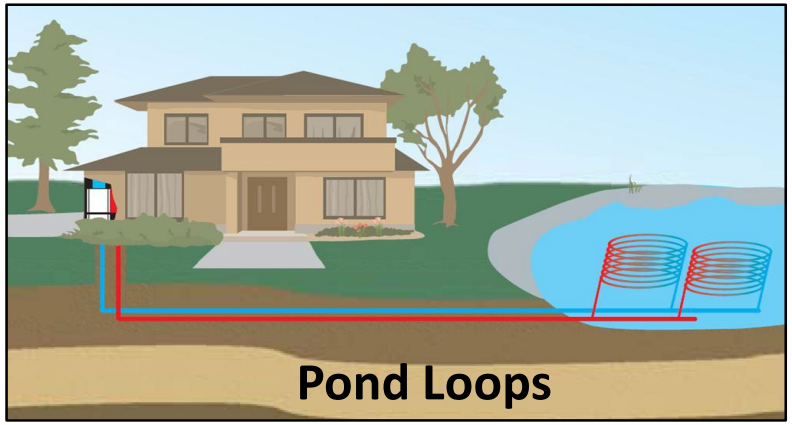
Outdoor - Air Source Unit

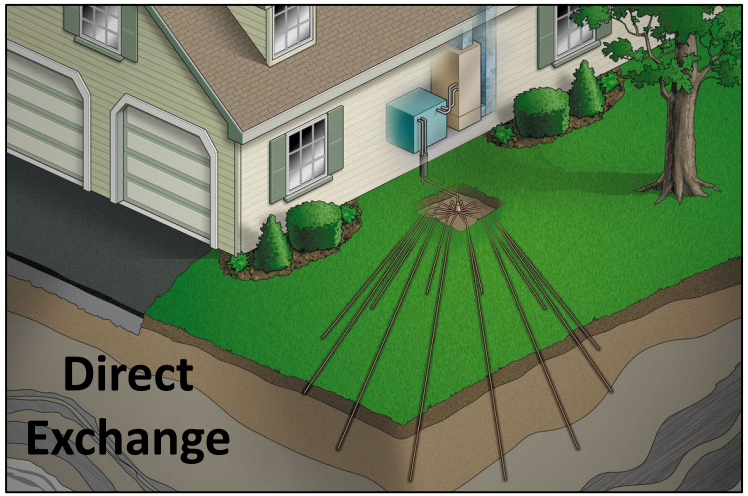
Indoor Water Source or Ground Source Compressor Unit

GSHP Closed Loop Options



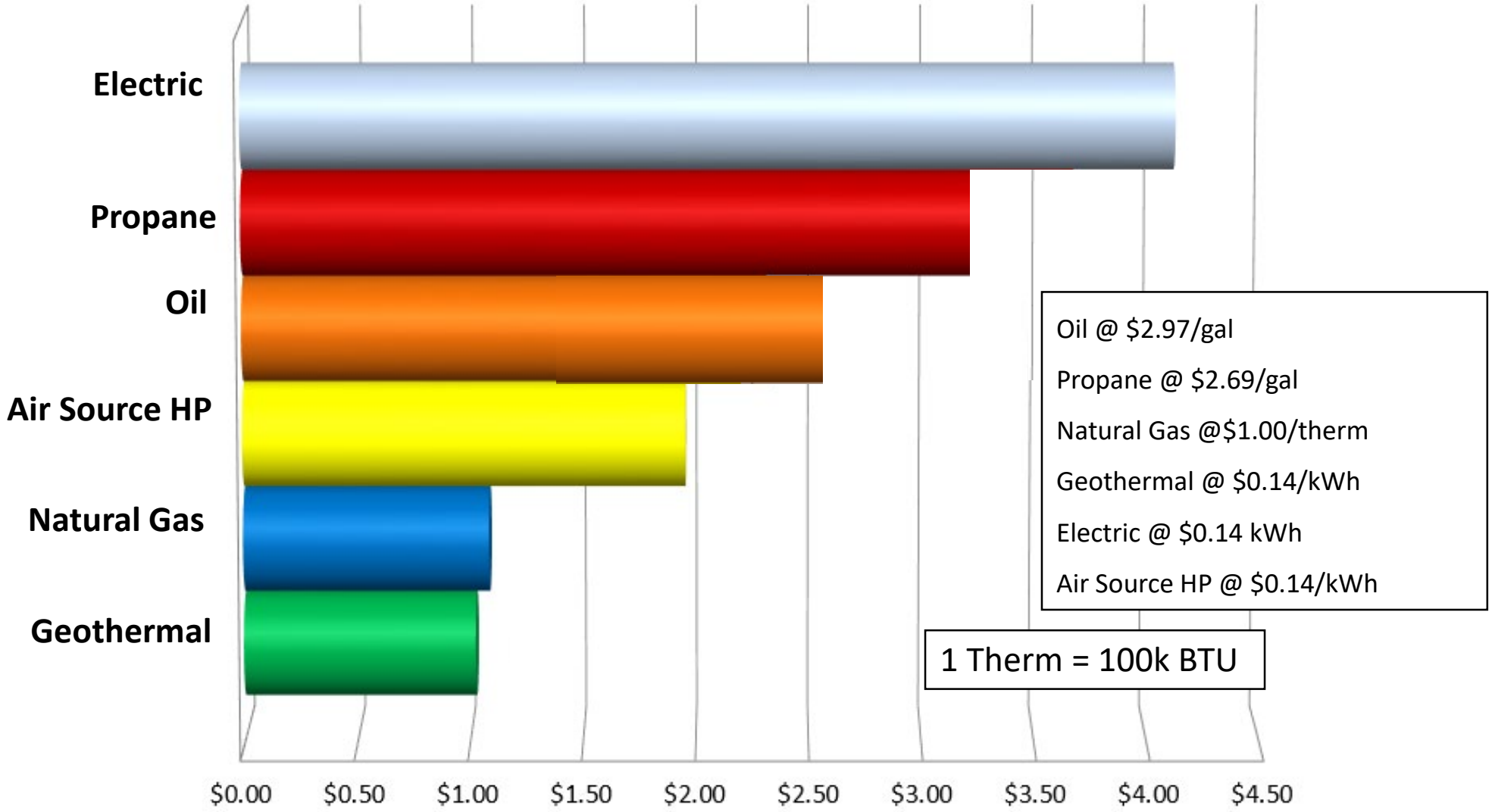






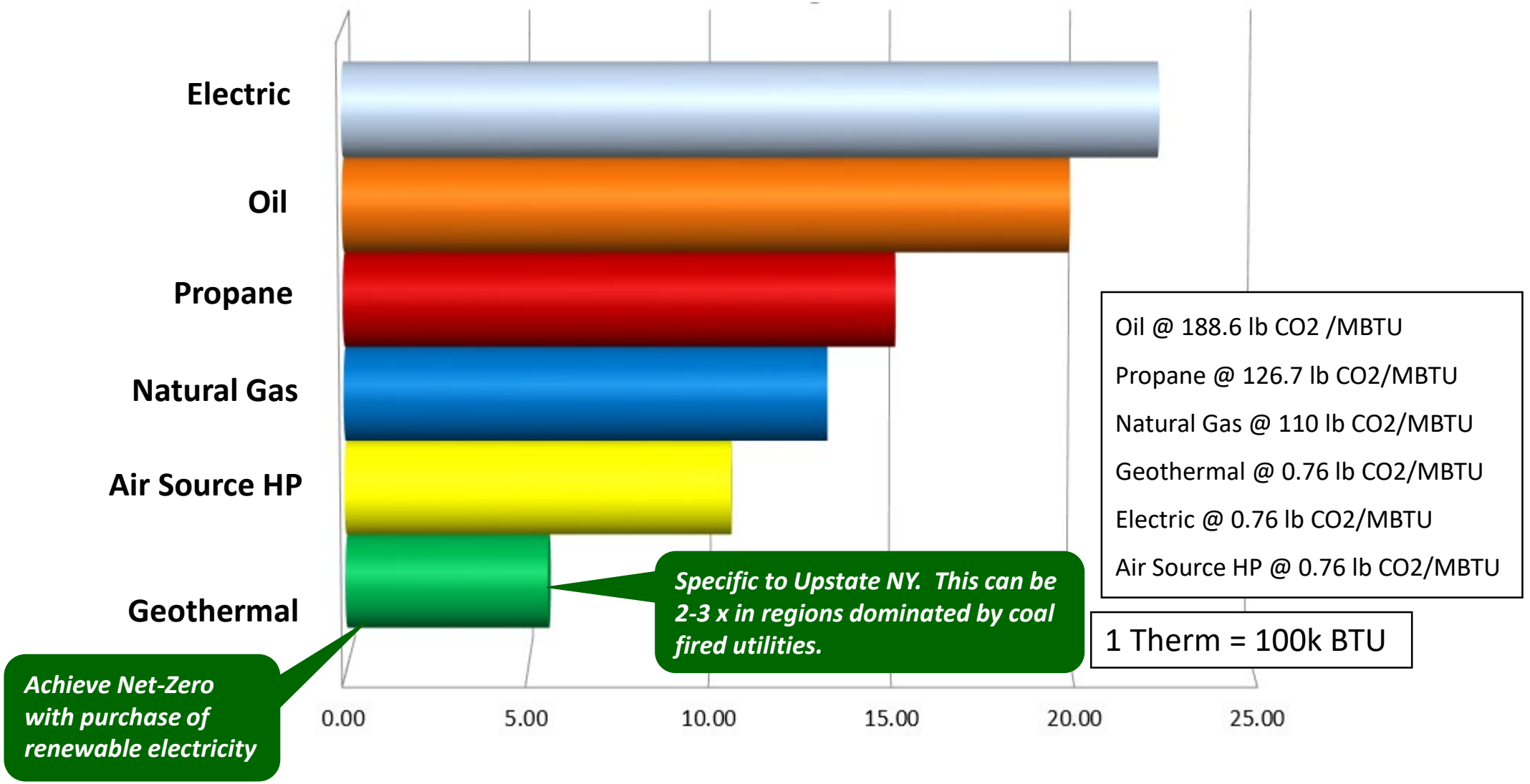
Heat Pumps: Not Pipelines

Cost of Heat per Therm NYS



Heat Pumps: Not Pipelines

Pounds of CO2 per Therm



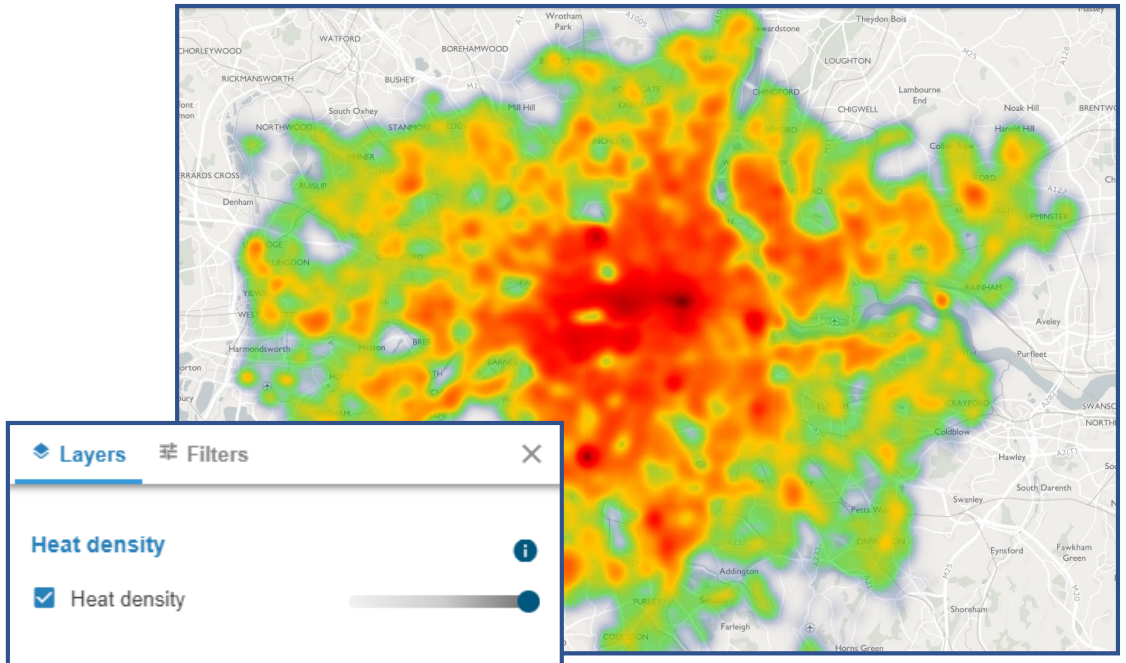
Heat Pumps: Not Pipelines

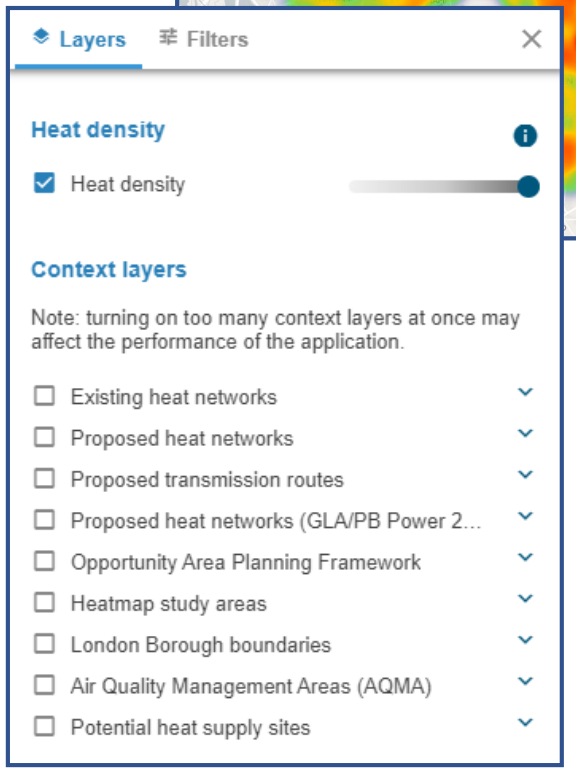
London Heat Map - 2009

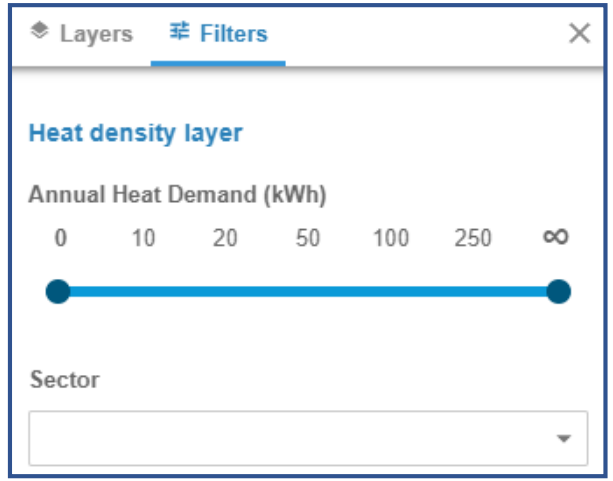
WHAT IS IT?

- A user-friendly, map-based, web application which provides a variety of heating data for the greater London area.
- The map's primary use is for identifying opportunities for decentralized energy projects in London.
- Provides energy and financial analysis for various combinations of buildings.

- Primarily focused on high temperature heating but it's moving in the right direction.







Heat Pumps: Not Pipelines

London Waste Heat Map - 2014

WHAT'S DIFFERENT?

- Also an interactive map-based, web application showing "waste heat" sources.
- The published study cites 11 sources of waste heat into 3 categories.

<u>Environmental Sources</u>
- Ground, Air, River

<u>Process Sources</u>
- Power Plants, Industrial, Commercial

<u>Infrastructure Sources</u>
- Sewer Heat, Substation Transformers, London Underground

FAST COMPANY

09.13.19 | WORLD CHANGING IDEAS

London is going to use heat from the Underground to help heat its homes

"I am convinced that with the increasing use of renewable power sources, ***large-scale heat pumps connected to district heating systems*** *will play a major role in the future heating of cities in the UK."*
-Lucy Padfield, Dir of District Heating, Ramboll

These Waste Heat Sources are in the temperature range of commercially available Heat Pumps.

Heat Pumps: Not Pipelines

Are the utilities on board with this?

HEAT PUMP INCENTIVES

OIL TO GAS CONVERSIONS

PIPELINE EXPANSIONS

ONGOING GAS INVESTMENT

MANUFACTURED MORATORIA

Natural Gas – forces changing the market

- NYS GHG Reduction goals indicate no fossil fuels after 2050
  - Pipeline extensions and repairs are being viewed from this perspective.
  - Presently 60 to 85 years are common depreciation schedules
  - Potential of “Stranded Assets” based on NYS policy direction
- 20 Year GWP methane goes from a 34 to 86 multiplier based on CO_2
- Leakage rates for natural gas will likely be set at 4% of delivered fuel
  - Will make buildings the #1 GHG emissions source in NYS – larger than transportation
- “100 Foot Rule” is being challenged by environmental groups
  - Presently utilities book these connections at $12K - $25K+ for single family homes

Utilities not permitted to rate-base ground loop assets

Heat Pumps: Not Pipelines

Who makes decisions over the utilities?

John B. Rhodes, Chair

Gregg C. Sayre

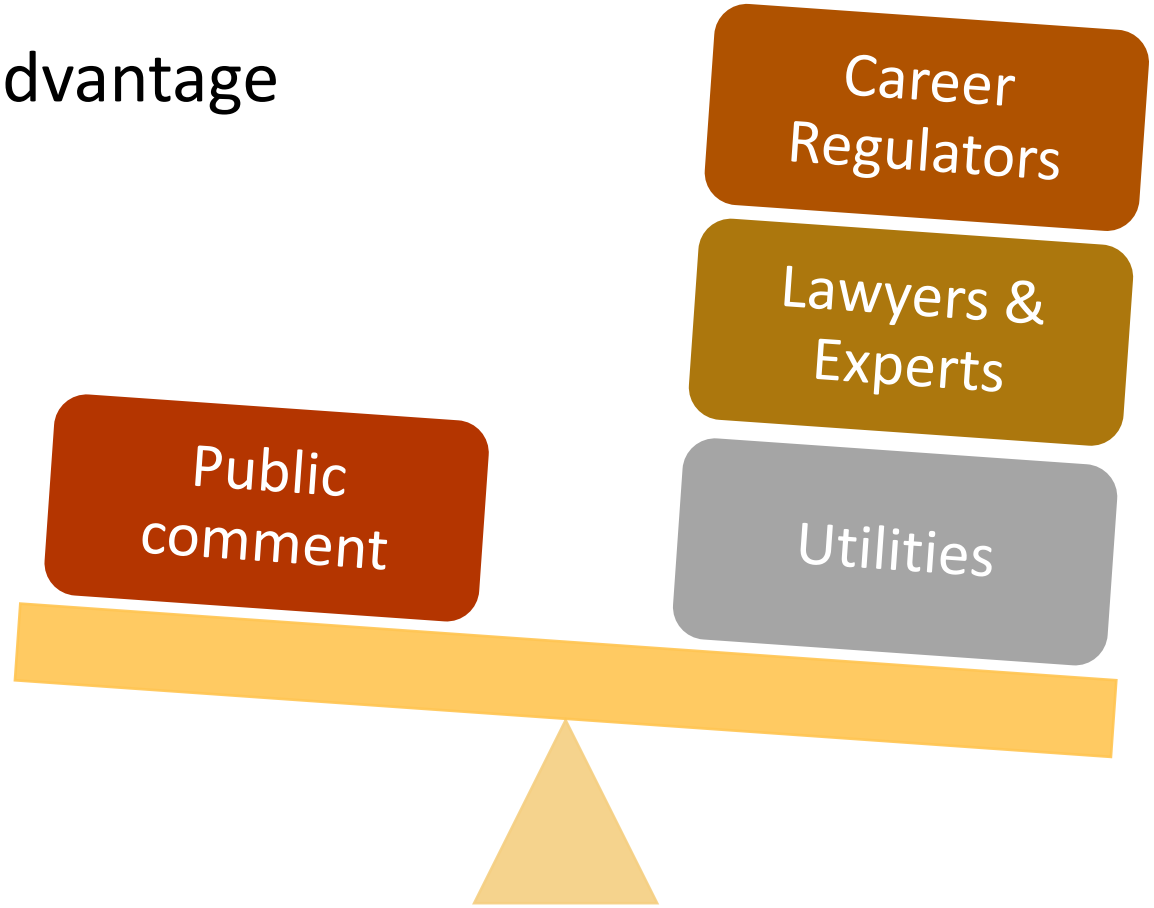
Diane X. Burman

James S. Alesi

Tracy Edwards

PSC Process

- Legalistic vs Democratic
- Utilities have an advantage



Join us on October 17 to hold the PSC accountable