BUILDINGENERGY NYC

New Heat Pump Technologies to the Rescue

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Northeast Sustainable Energy Association (NESEA)
September 24, 2020

OVERVIEW

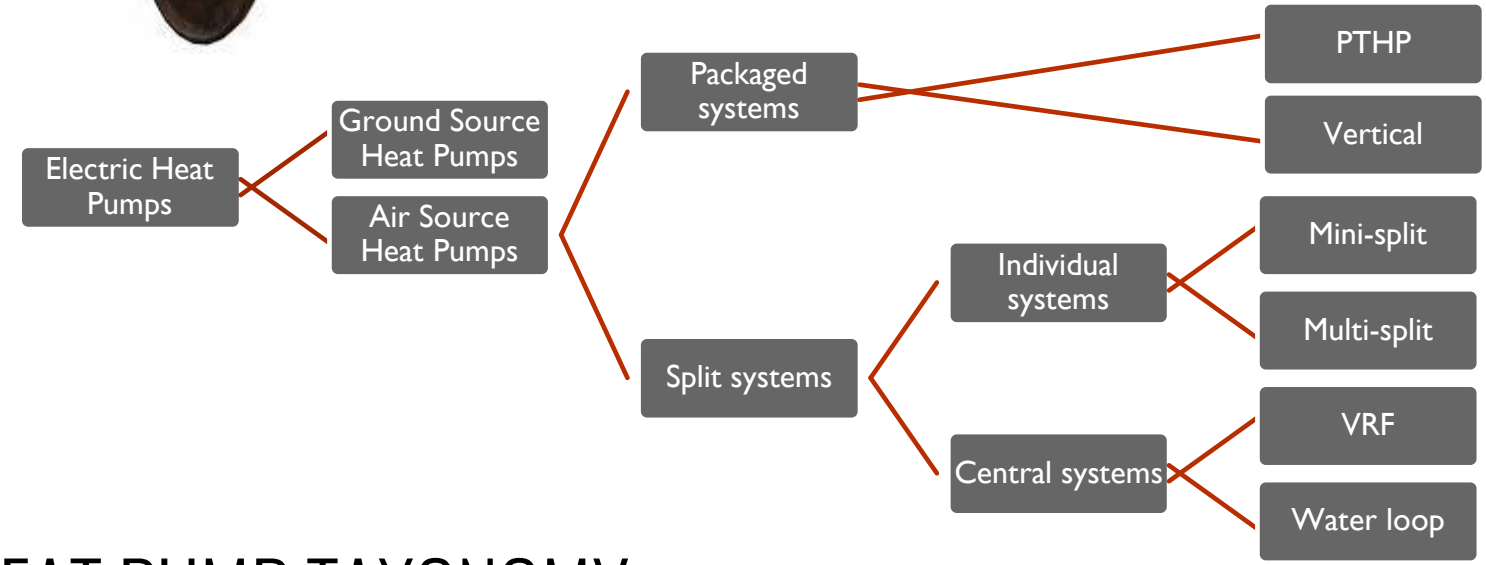
About heat pumps

Four new heat pump typologies

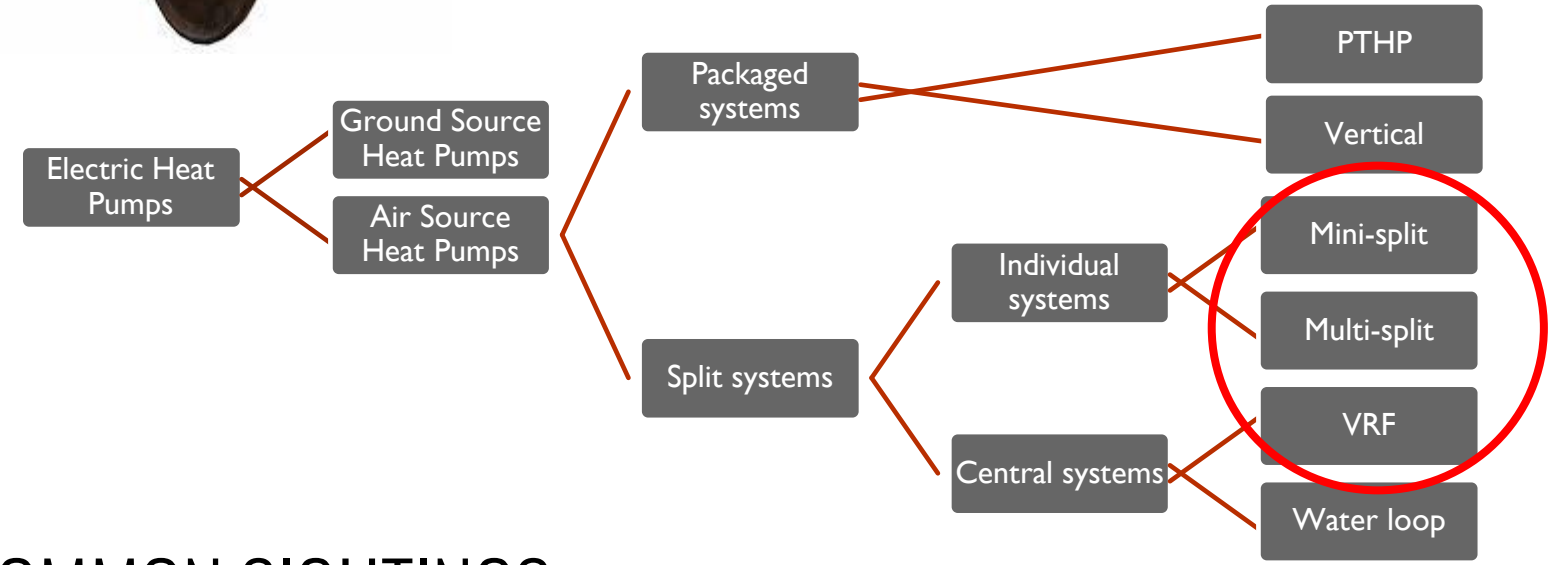
Discussion

Why heat pumps?

- Beneficial electrification
- Can meet full heating and cooling demand
- Efficient
- Reliable, comfortable, quiet, etc.
- Many suppliers and choices

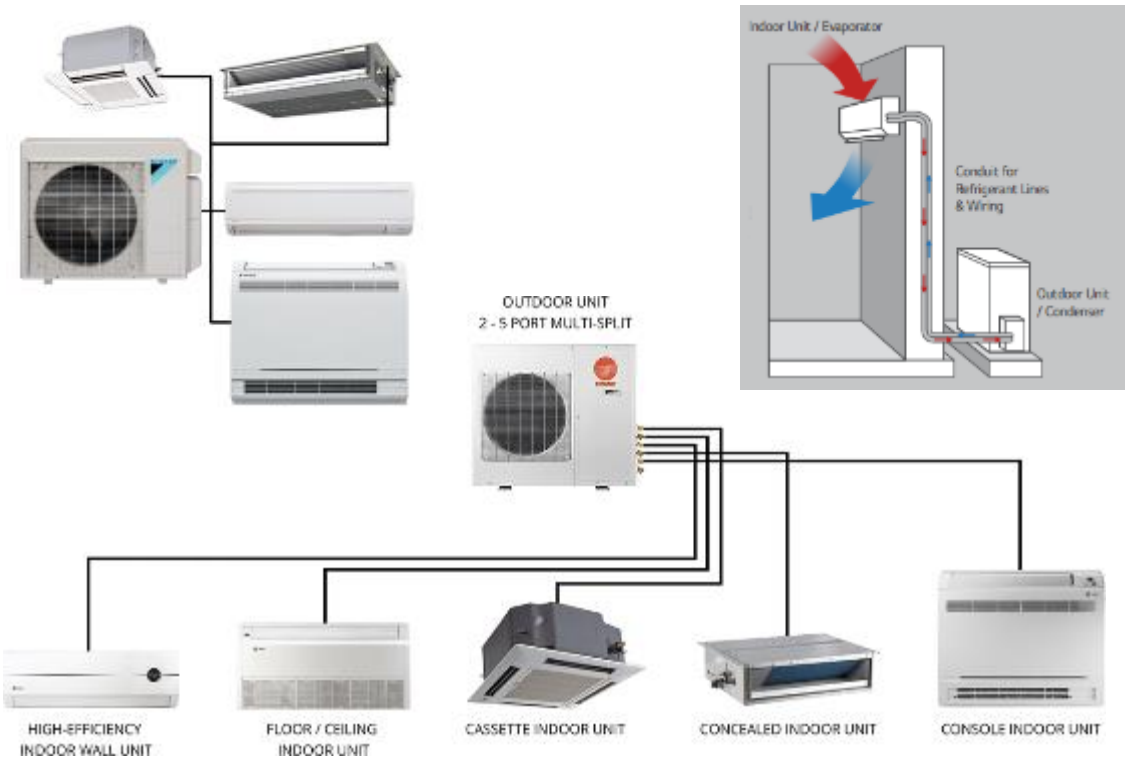


HEAT PUMP TAXONOMY

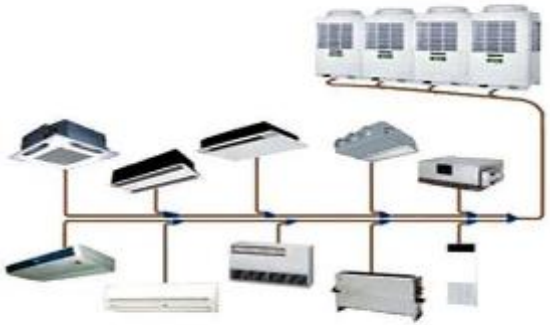


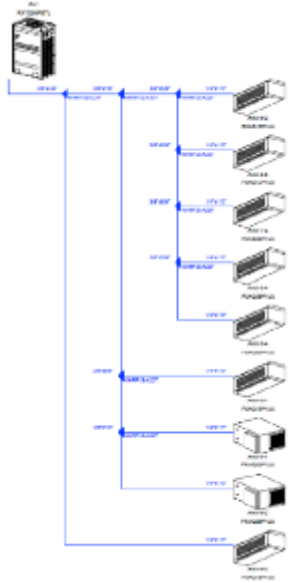
COMMON SIGHTINGS

MINI- and MULTI-SPLIT



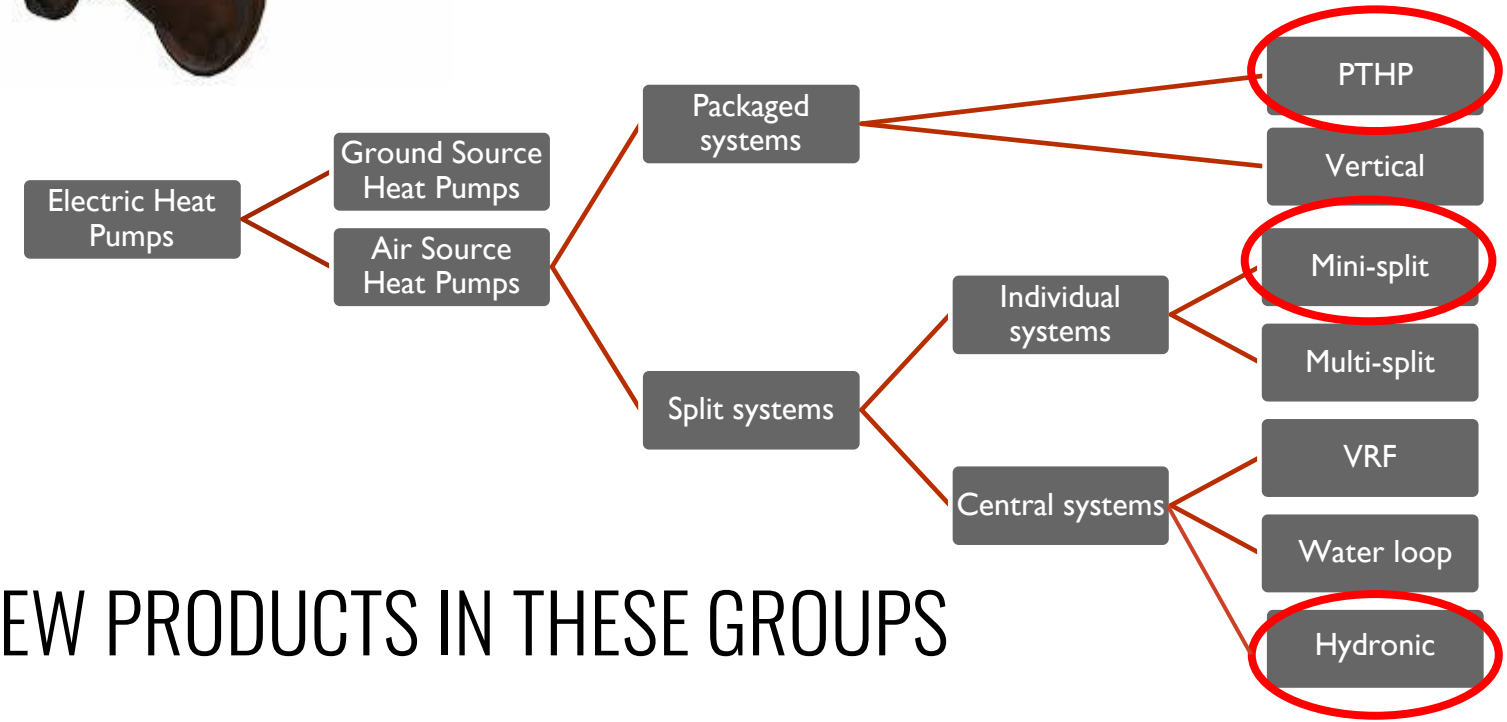
CENTRAL VRF





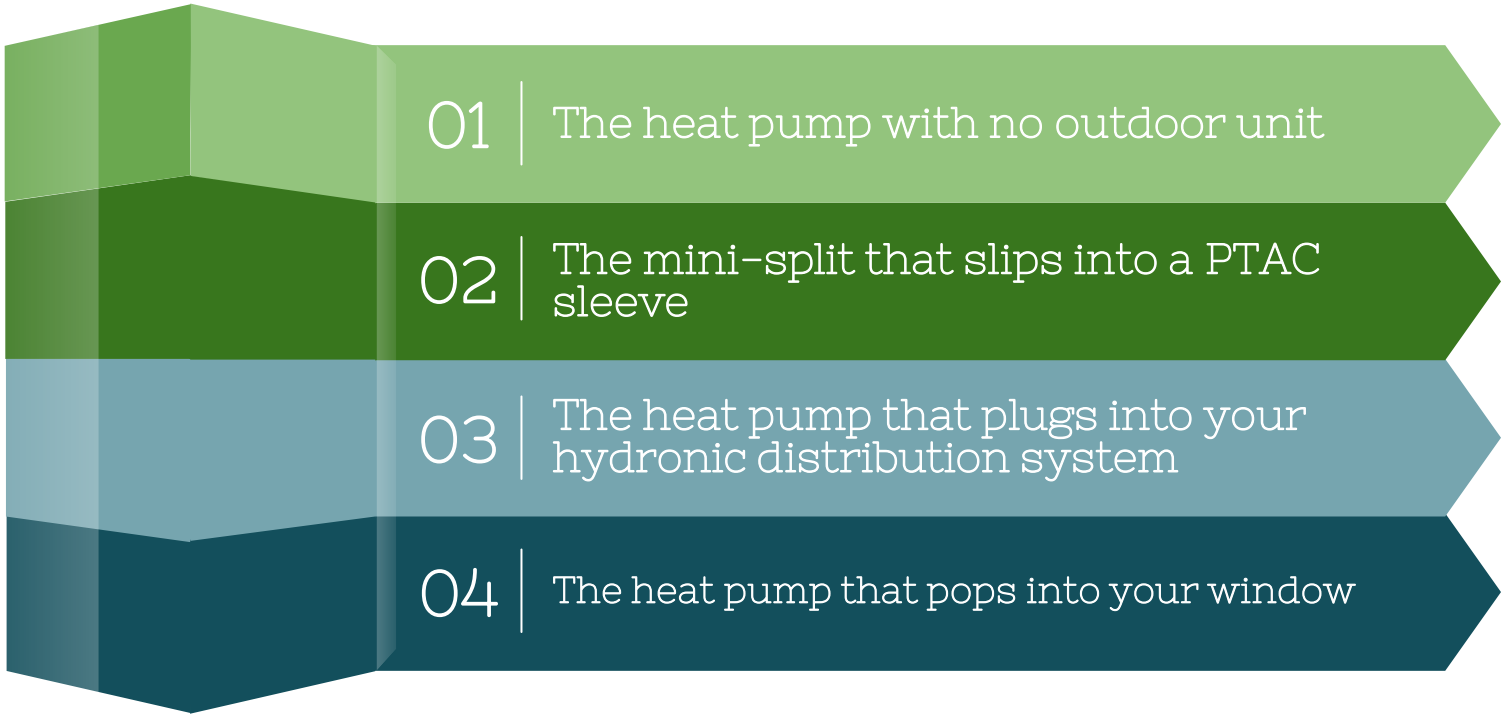
Why not heat pumps?

- Electrical service
- Labor costs
- Intrusive for existing residents
- Design and other soft costs
- Finish/aesthetics of refrigerant lines for retrofit
- Refrigerant leak potential
- Location of outdoor units
- Roof space for PV
- ASHRAE 15



NEW PRODUCTS IN THESE GROUPS

Technologies



The presenters have no financial interest in any of these products.

The heat pump with no outdoor unit

Ephoca – HPAC 2.0

The Heat Pump AC (HPAC) with no outdoor unit

Two 8” diameter penetrations

Ephoca – HPAC 2.0

- No outdoor unit
- Minimal distribution during installation
- No field refrigerant connections
- No ASHRAE 15 issues
- Possibilities for phased retrofit
- Reduced wall opening as compared to PTAC or AC Sleeve

Ephoca – HPAC 2.0 – Applications

Room-by-room

Retrofit

- PTAC/PTHP Sleeves
- Through Wall AC Sleeves
- New Penetrations

New Construction

a closer look...

Ephoca – HPAC 2.0

Ephoca – HPAC 2.0 – Performance

Manufacture reported performance with 8” ducts*

Heat Pump Heating

HSPF 10.3

Temp	COP	Capacity (Btu/hr)
47 F	3.58	7,520
17 F	1.86	4,930
5 F	1.41	4,133

BIN Analysis for Laguardia

Average Annual COP 2.86

Cooling

EER 11.1

Capacity 8,100 Btu/hr

Electric Resistance Heat Options

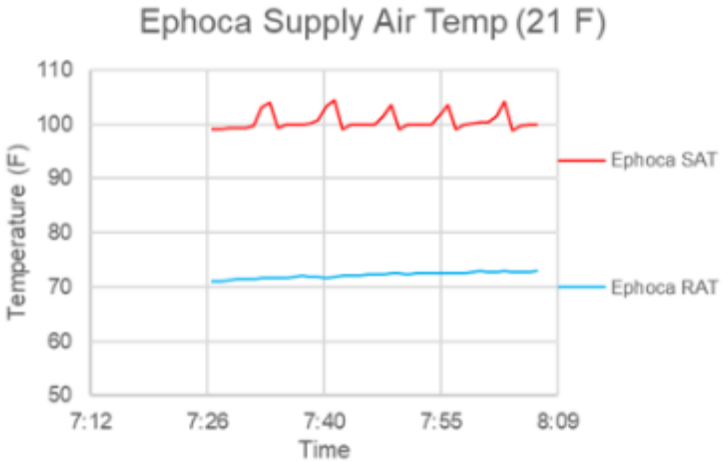
1 kW

2 kW

Ephoca – HPAC 2.0 – Heating Performance

Taitem's initial testing with 6" ducts*

Temp	COP	Capacity (Btu/hr)
47 F	2.5	5,920
21 F	1.7	4,720



Ephoca – HPAC 2.0 Electrical

Without Electric Resistance

15A/115V

With Electric Resistance

1 kW - 15A/208V

2 kW – 20A/208V

Ephoca – HPAC 2.0 Installed Cost

1 Bedroom Apartment – 650 ft^2

$1,000 demo

$6,000 equipment cost ($3,000 each)

$2,000 labor and misc. materials

$1,000 Design, Permit, Fees

$2,400 NYS Clean Heat Incentive (pending)

$7,600/apartment

~$11.70/SF

50% lower installed cost than VRF?

50%?

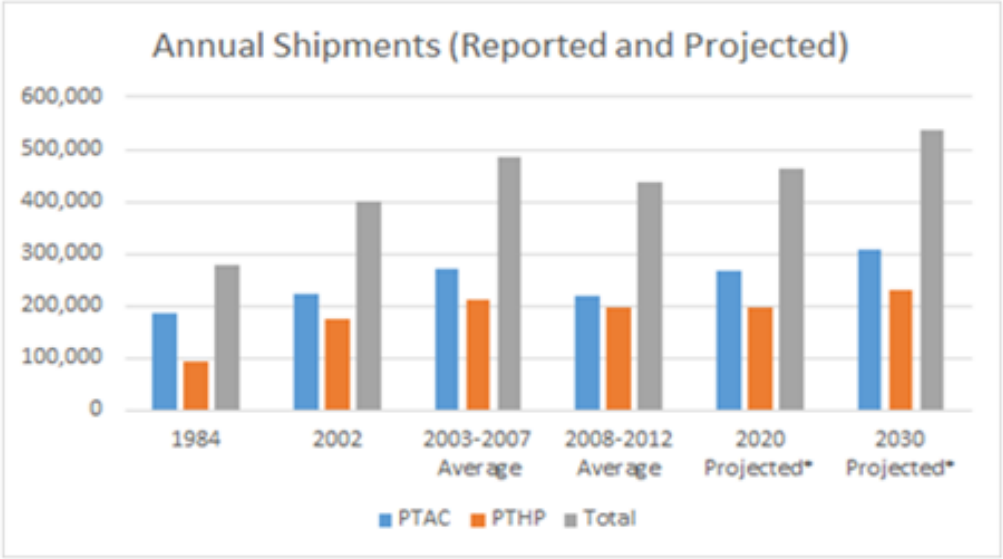
Installed Cost Reduction over VRF

The mini-split that slides into a PTAC Sleeve

VS.

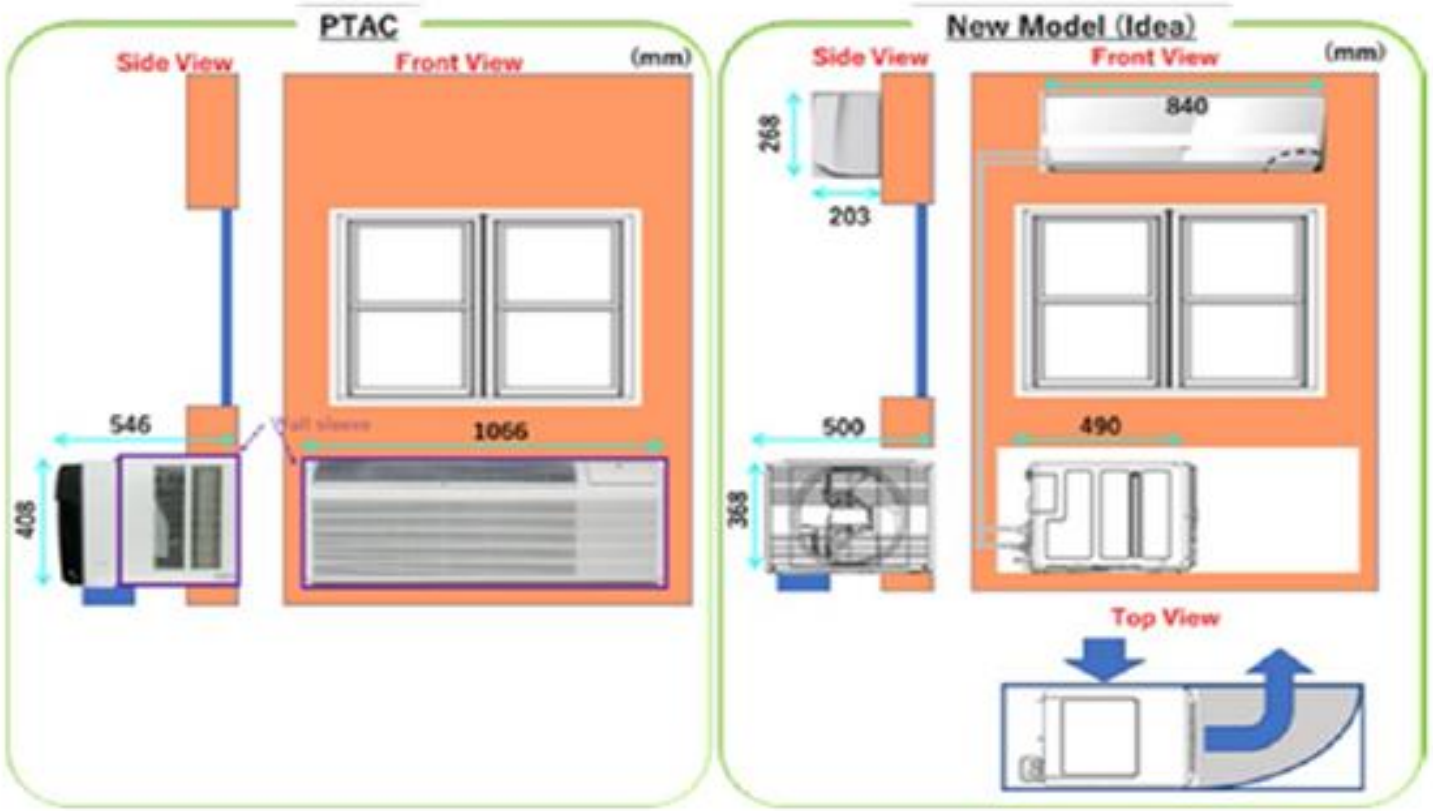
PTAC market

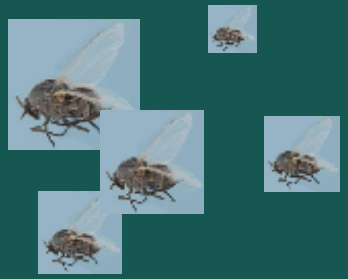
- 250k PTACs in NYC
- 100,000 all-electric PTACs in NYS
- 14% of Manhattan multifamily buildings are cooled with PTACs



US PTAC market; projections assume no disruptive technological change (NYSERDA 2018)

Fujitsu EZ Fit

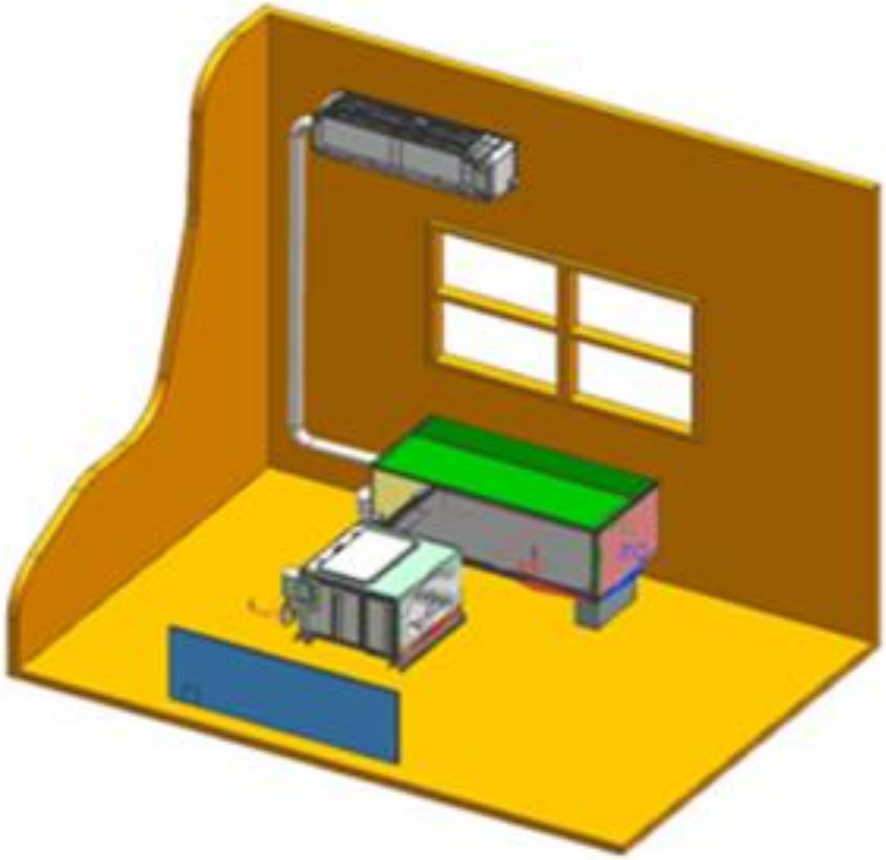




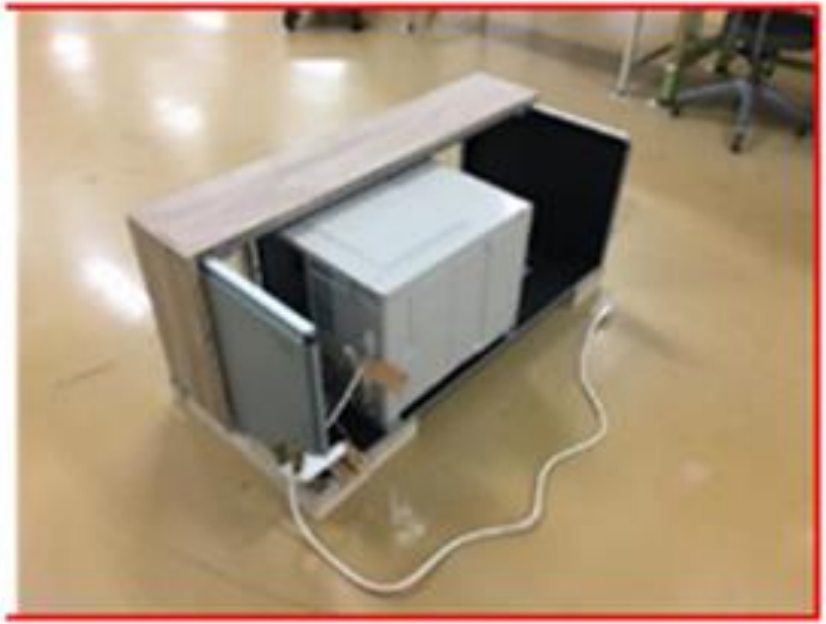
No-see-um outdoor units


FUJITSU

Fujitsu EZ Fit



Fujitsu EZ Fit



Fujitsu EZ Fit - tentative specs

Nominal cooling capacity	**9,000 Btu/hr**	**12,000 Btu/hr**
Min-Max cooling capacity	2,728 - 9,889 Btu/hr	3,069-12,276 Btu/hr
SEER	20	16
EER	12.5	8
Nominal heating capacity	10,900 Btu/hr	13,000 Btu/hr
Min-max heating capacity	2,728-12,968 Btu/hr	3,069-14,663 Btu/hr
Heating capacity at 5°F	9,050 Btu/hr	9,050 Btu/hr
HSPF	10	9
COP at 5°F	2.21	2.21

Sample apartment - technology comparison

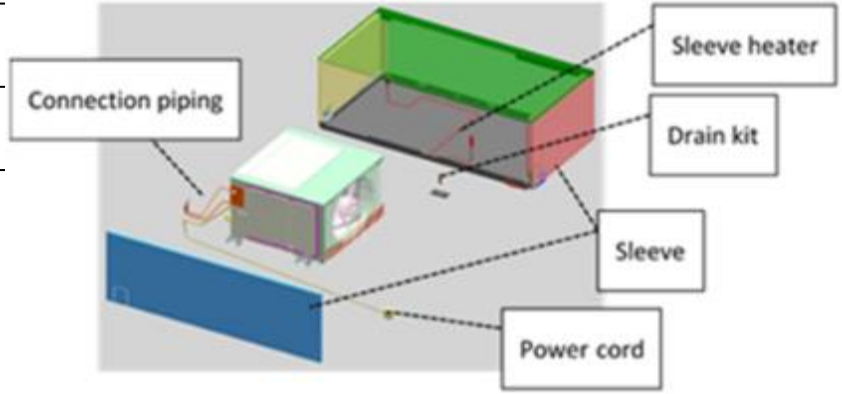
800 sf two-bedroom apartment modeled in eQuest

System	Htg efficiency	Cooling efficiency	Annual site energy (kbtu)	Annual emissions (kgC02e)	EZ Fit CO2 savings	Utility cost
EZ Fit	HSPF 10	SEER 20	11,464	971	n/a	$774
PTAC with resistance heat	COP 1	EER 8.9	32,892	2,786	65%	$2,217
PTHP	COP 2.7 (1 @ <40°F ambient)	EER 8.9	28,524	2,448	63%	$1,923
PTAC with gas heat	82% AFUE	EER 8.9	42,430	2,649	60%	$888

*Wall R value of 19, window U value of 0.67.

Sample apartment - 15 year PTAC cost comparison

	NPV	Installed cost	Year 1 energy cost
Fujitsu EZ-Fit	$15,457	$4,200	$773
PTAC	$33,286	$1,000	$2,217
PTHP	$29,105	$1,100	$1,923
High efficiency PHTP	$26,494	$1,300	$1,730
Gas PTAC	$13,932	$1,000	$888



3% discount rate; not factoring in potential LL97 penalties

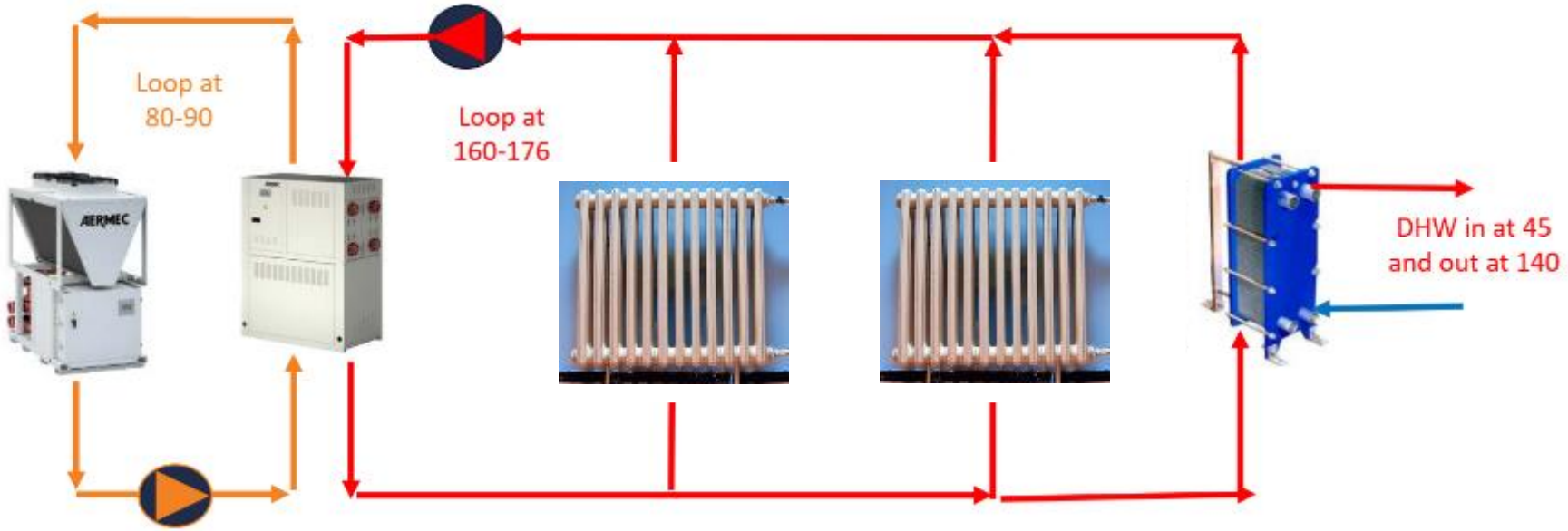
The heat pump that plugs into your hydronic distribution system

Aermec NRK/WWB

Air to Water Heat Pump with Water to Water Heat Pump Booster

A matched set of components to deliver high temp heating hot water

Aermec – NRK/WWB – Heating



Aermec – NRK/WWB – Cooling

Aermec – NRK/WWB - Applications

- Existing buildings with high temp hot water distribution
- Exsting hydronic fan coils
- Existing steam buildings converted to hot water
- Domestic hot water
- New construction

Electrify without ever entering an apartment?

Aermec – NRK/WWB – Heating Performance

BIN Analysis for NYC with Outdoor Reset Curve

Annual average heating COP of 2.52

Ambient T (F)	Supply Water T (F)	COP	Outdoor NRK Input kW	Indoor WWB Input kW	Energy Output kW
0	176	1.52	24.8	27.5	79.7
14	160	1.90	22.6	23.0	86.7
20	152	2.17	19.6	21.1	88.2
30	138	2.36	19.0	18.3	88.2
55	131	2.94	13.0	17.1	88.5

Aermec NRK/WWB Installed Cost

$15-$25/SF depending on a number of factors

NYS Clean Heat Incentives may be available

The heat pump that pops into your window

Treau

- **Over-the-window-sill heat pump**
- **User-installable**
- **Plugs into standard wall outlet like a window AC unit**
- **But does not block the window**

Treau

- **San Francisco start-up**
- **Availability projected 2021**
- **Field tests underway in California and New York**
- **Preliminary MSRP ranging from $500 to $2,000, depending on features and coming down over time**
- **Goal is a low-cost mass-market product**

TREAU

DIY Electrification?

Treau

- Inverter driven, variable speed compressor
- Target efficiencies (based on manufacturer simulations)
  - Heating: COP 2.62 @5°F max. cap., HSPF 13.2
  - Cooling: SEER 21.1, EER 14.8
- R290 in sealed outside section refrigerant cycle
- Water/glycol loop between inside and outside sections

Note: Target efficiencies are based on simulations and not a promise of final specs

TREAU

Ambient	Capacity	Power	COP
47°F	8,985 Btu/hr	584 W	4.51
17°F	6,679 Btu/hr	635 W	3.08

Note: Target efficiencies are based on simulations and not a promise of final specs

Example Building Analysis

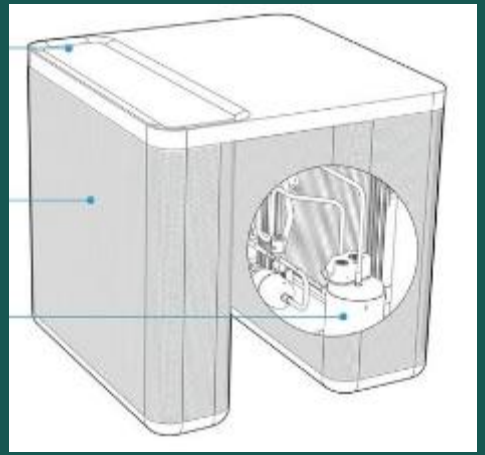
Example Building Analysis

	Space Heating	Space Cooling
Existing Annual Energy Usage	17,598 Therms/yr	32,482 kWh/yr
Existing Annual Emissions	102.8 tCO2e	
Electricity Rate	$0.21/kWh	
Gas rate	$1.08/therm	

	Ephoca HPAC 2.0	Fujitsu EZ Fit	Aermec NRK/WWB*	Treau
Assumed Efficiency	**2.86 COP/11.1 EER**	**3.51 COP/12.5 EER**	**2.52 COP**	**4.03 COP/14.8 EER**
Projected Annual Energy Usage	170,608 kWh/yr	140,941 kWh/yr	196,218 kWh/yr	122,139 kWh/yr
Projected Annual Emissions	49.3 tCO2e	40.7 tCO2e	47.3 tCO2e	35.3 tCO2e
Total Site EUI Savings	**32.6 kBtu/sf/yr**	**35.1 kBtu/sf/yr**	**30.4 kBtu/sf/yr**	**36.8 kBtu/sf/yr**
Total Annual Emission Savings	**53.5 tCO2e**	**62.1 tCO2e**	**46.1 tCO2e**	**67.6 tCO2e**
Annual LL97 Emissions Penalty Savings	$14,351/yr	$16,649/yr	$12,368/yr	$18,105/yr
Annual Energy Savings	**-$9,921/yr**	**-$3,831/yr**	**-$15,177/yr**	**$28/yr**
Total Savings	**$4,431**	**$12,817**	**-$2,809**	**$18,133**
Estimated Installed Cost per SF	$13.00/SF	$15.00/SF	$20.00/SF	$10.00/SF

*Heating savings only

Discussion



THANK YOU

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