

Clean Energy Action Plan

Scott Smith, Program Manager | Clean Heating and Cooling

October 2019

Clean Energy Action Plan

NYSERDA and Con Edison are working together to bring solutions to businesses and residents affected by the natural gas moratorium.





- Lower energy costs for consumers
- Promote economic development in Westchester County
- Deliver additional resources for new construction projects, energy efficiency awareness, and community support

The \$250 million investment is estimated to reduce energy consumption equivalent to the amount of gas needed to heat more than 90,000 homes.

Clean Energy Action Plan

NYSERDA enhanced incentives for existing programs and created and funded new programs.

New Construction: \$28 million in incentives and services are available to new customers, including low- to moderate-income residential developments and waitlisted natural gas customers, to access alternative heating and cooling systems and energy efficiency services.

Energy Efficiency: \$25 million in investments to implement energy efficiency measures for existing customers to reduce overall peak demand constraints.

Additional Incentives: NYSERDA has increased incentives for residential and commercial customers to install clean heating and cooling systems in the moratorium areas.



Community Outreach: A consumer awareness campaign will help communities, businesses, and individuals access the available programs and incentives to help them heat their homes with clean resources and reduce energy waste.

NYPA is providing additional financing services for its customers in Westchester.

Clean Heating & Cooling Solutions For Property Developers

Provide cleaner, more efficient, and comfortable spaces for building occupants. Save on project costs with incentives.

Clean heating and cooling solutions including geothermal or ground source heat pumps, air source heat pumps, and variable refrigerant flow systems are all-electric alternatives to natural gas, oil, and propane systems.

Benefits

- Reduce construction and other capital costs
- Reduce maintenance costs
- Save space in buildings

- Improve occupant comfort
- Improve indoor air quality
- Pursue green building certifications

Heat Pumps

Ground Source Heat Pumps







IN THE SUMMERTIME

The earth is cooler than your commercial building, so excess heat from the building is transferred to the ground. Cooler water returns from the ground through the pipe system to cool your building.



UNDERGROUND PIPE SYSTEM

Ground Source Heat Pumps

Commercial and Multifamily Buildings

- **Increased incentives** by 25% equating to \$1,500/ton in natural gas constrained areas. Customers can receive up to \$5 million per project.
- **Coming Soon Free Screening** tool and report to assess the potential electrification of buildings 25,000 square feet and larger in natural gas constrained areas.

Residential Homes

- **Increased incentives** by 25% equating to \$1,875/ton in natural gas constrained areas. An average single family home will receive approximately between \$7,500 \$9,375 of financial assistance.
- Loan options (including on-bill financing) are available to help residents finance energy efficiency and renewable energy improvements. Additionally, lower interest rates are offered to low income New Yorkers and those who cannot qualify for traditional financing.



Air Source Heat Pumps

Heat and cool by transferring the air between the inside and outside while creating a more comfortable indoor environment.





Air Source Heat Pumps

Commercial

• **Coming Soon - Free Screening** tool and report to assess the potential electrification of buildings 25,000 square feet and larger in natural gas constrained areas.

Multifamily Buildings and Residential Homes

- A new incentive of \$1,000/thermal ton for whole-house air source heat pumps is available Statewide. An average single family home will receive approximately \$3,000-\$4,000 in financial assistance.
- Provide **assistance** for control packages and dual fuel thermostats to ensure efficient operation during the heating season.

Residential loan options (including on-bill financing) are available to help homeowners finance energy efficiency and renewable energy improvements. Additionally, lower interest rates are offered to low income New Yorkers and those who cannot qualify for traditional financing.

Community Support

Sustainable Westchester Clean Heating & Cooling Campaign

NYSERDA has increased its support and scope of **HeatSmart Westchester**—a community-level initiative designed to facilitate adoption of fossil-free heating and cooling solutions, such as ground source and air source heat pumps, as well as high-efficiency building envelope measures.



2019 Multifamily Summit



October 21 – 23, 2019 | DoubleTree Hotel | Tarrytown, NY

Stay on the cutting edge – join industry experts to learn about the latest energy programs, technologies, and incentives available for multifamily buildings.

Solutions for Buildings in Gas Constrained Areas Session: October 23 | 1:30 – 2:30 p.m.



New Construction

MED.

Commercial New Construction

Support for Net Zero Energy, Deep Energy Savings Projects, and/or Smart Buildings

Net Zero Energy

Projects where the energy generated annually by renewable on-site or distributed generation resources matches the building energy consumption.

Deep Energy Savings

Projects where the predicted energy savings exceed the designated baseline by at least 25%. For all-electric projects, the predicted energy savings must exceed the designated baseline by at least 20%.

Smart Buildings

Projects that interconnect HVAC, lighting, plug loads, fire & life safety, security & access, people movement, analytics & management and smart metering to transform efficiency, comfort and safety for people and assets.

Technical Support (Energy Modeling, Analysis and Reporting, Integrated Project Delivery, and/or Advanced Controls Commissioning)

• NYSERDA will pay 100% of the technical consultant's costs up to a maximum \$200,000 per project. Includes assessment of electrification options.

Financial Support (in addition to the capital cost incentives for heat pumps)

Energy Performance Incentive:

• Up to a maximum of \$450,000 for all-electric projects or projects in gas constrained areas (traditional incentive is up to \$350,000 per project)

Design Incentive: (only for all-electric projects and projects in gas constrained areas)

• 5% of the energy performance incentive. The minimum design incentive is \$5,000 and the maximum is \$50,000.

Additional Smart Buildings Incentive:

• 50% of the increased costs of installing smart meters, equipment, and controls to achieve a fully integrated smart building, up to a maximum \$100,000 per project.

Multifamily New Construction

Technical and Financial Support to high-rise, multifamily residential builders and developers who construct to high energy-efficiency standards including net-zero energy buildings.

Increased incentive levels for projects in the gas constrained areas based on energy performance and the number of units. Higher levels of support will be allocated to buildings for low- to moderate-income residents.

Total Program Funds Available: \$26,850,000 Maximum Incentive per Building: \$500,000 for Market Rate buildings \$600,000 for LMI buildings



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Competitive Awards for New Construction

Statewide Comprehensive New Construction, Gut Rehabilitation, and Business Expansion Projects Including Gas Efficiency and Electrification

Commercial, Industrial, and Mixed Use Buildings

- **Re-launcing in 2020 Net Zero for Economic Development** (with extra points for gas reduction in constrained area):
 - \$15 million in funding available, awards of up to \$1 million with additional bonuses
 - One-stop program for Commercial, Industrial, and Mixed-Use Buildings to Achieve Net Zero Energy

Multifamily Buildings (with high efficiency and low/zero carbon emissions)



BUILDINGS OF EXCELLENCE COMPETITION

- \$30 million in funding available, awards of up to \$1 million
- Awards in addition to other funding
- Competition recognizes and rewards the design, construction, and operation of very low or zero carbon emitting multifamily buildings.

Coming Soon – Round 2

Existing Facilities

Existing Buildings: Commercial, Industrial, and Multifamily

Support is available to help existing Westchester natural gas customers: understand clean energy options, plan and design efficiency and electrification projects, and reduce their energy use.



FlexTech

Financial support for completing an energy study to identify and evaluate opportunities to reduce energy costs and incorporate clean energy into capital planning. The study can evaluate which building performance systems may be right for your business. (50% cost share)

Real Time Energy Management

Financial support for the hardware, software, and consulting services used to gain visibility into the operation of a building's energy systems. Data is gathered in real time for analysis that leads to improved building performance, increased occupant comfort, and greater energy efficiency. (30% cost share)

Coming Soon - Clean Heating and Cooling Screening for Large Buildings

Free Screening tool and report to assess the potential electrification of buildings 25,000 square feet and larger.

Existing Buildings: Commercial, Industrial, and Multifamily

Strategic Energy Management

Framework for aligning energy efficiency with business practices. Instead of managing energy saving projects one by one, SEM allows you to manage energy in a coordinated and strategic way across your organization—helping your business increase profitability, create a competitive advantage, and achieve greater resiliency.

On-site Energy Manager Program

A dedicated On-site Energy Manager (OsEM) can improve a company's profitability by delivering energy, process, and operational improvements. Companies can benefit from the successful energy and productivity projects that are driven by OsEMs. Projects may include operation and maintenance improvements, behavioral changes, energy efficiency upgrades, process improvements, throughput and scrap reduction improvements, cost management, and other improvements such as water savings.



Competitive Awards for Large Existing Buildings

Comprehensive Projects Including Gas Efficiency and Electrification

Statewide Efforts (with extra points for gas reduction in constrained area)

- Energy to Lead (Universities and Colleges): proposals are due February 20, 2020
 - \$5 million in funding available, awards of up to \$1.5 million
- Carbon Challenge: re-launching in 2020
 - \$15 million in funding available, awards of up to \$5 million



Specific Effort Only Available for Gas Constrained Areas

Westchester Carbon Challenge:

Launching in early 2020

• \$15 million in funding available, awards of up to \$5 million

Performance Based Incentives

Business Energy Pro – Pay for Performance Initiative in partnership with Con Edison to competitively select service providers that will offer comprehensive energy efficiency offerings to 63,000 small/medium businesses in Staten Island and Westchester County

Approximately \$10M available for selected service providers (Portfolio Managers)

- RFP issued in June 2019; Portfolio Managers will be active in the market January 2020
- Deliver measured energy efficiency outcomes to Con Edison; elevating energy efficiency as a utility resource to help meet system needs
- Service classes 2 and 9 with Con Edison electric service are eligible to join a portfolio. Will receive comprehensive efficiency solutions in the form of operations and maintenance, behavioral, lighting, heating, cooling and refrigeration with the potential to utilize innovative finance models
- Specific emphasis on measured gas reductions in Westchester that occur in peak periods through financial bonuses
- Portfolio Managers receive quarterly payments based on metered-energy savings at the portfolio level



Additional NYSERDA Programs

Energy Storage - Take advantage of technical assistance and expert one-on-one consulting for developers and contractors to help with project siting, sizing, and economics incentives and technical resources for installing energy storage for your business.

NY-Sun - Capitalize on financial opportunities to install or participate in a solar project to reduce your electricity bills and contribute to a cleaner community.

New York Truck Voucher Incentive Program - Clean truck and bus technologies are more accessible than ever to fleets in New York State. These advanced vehicles are typically less expensive to operate and often far less noisy than diesel trucks or buses, and dramatically reduce or eliminate tailpipe pollution. Vouchers (or discounts) are available.



Additional NYSERDA Programs

Charge Ready NY - NYSERDA provides rebates of \$4,000 per charging port for Level 2 charging stations installed at public, workplace, and multi-unit dwelling parking lots.

Clean Energy Workforce Development - Workforce development and training are essential components to a bustling 21st century economy and a cleaner, healthier New York. But today's workforce is not yet set up to meet the requirements and achieve possibilities of the clean energy economy.

Funding is available under four different workforce development and training opportunities:

- Energy Efficiency and Clean Technology Training
- On-the-job Training
- Internships
- Building Operations & Maintenance
- Clean Energy Training Services



Learn more and sign up to receive program updates as more information becomes available.

NYSERDA.ny.gov/actionplan





Energy Efficiency Programs for Westchester County Customers

October 29, 2019









Energy Efficiency Programs:

- Residential 1-4 Family
 - Midstream HVAC (including ductless/mini-split HP and HPWH)
 - Geothermal Heating & Cooling
 - Home Weatherization & Financing
- Multifamily (5+ units)
 - Pipe Insulation, EMS, Boilers, Split HP, etc.
 - WC Low-Income Housing Authorities
- Small-to-Medium Business (<300 kW)
 - Split HP, PTHP, Smart Tstat, Kitchen Equipment, etc.
- Large Commercial & Industrial (>100 kW)
 - Extd.-Life Boilers, Steam Traps, Refrigeration, Pipe Insulation, PTHP, etc.
- Gas Demand Response
 - Smart Tstat (resi & small business customers)
 - Performance-Based (multifamily & large commercial customers)

ConEdison

Residential Geothermal Program:

- Heating up to 4.4 COP and 24.6 EER
- Eliminates exterior compressor noise and interior carbon monoxide
- <u>https://dandelionenergy.com/how-geothermal-works</u>
- Up to \$5,000 incentive with Dandelion Energy in addition to NYSERDA and Federal Investment Tax Credit
- Eligibility
 - Single family residential detached home
 - Con Edison electric customer





Residential Weatherization Program:

- Professional installation of air sealing, insulation and a smart thermostat
- Drafts, hot & cold spots and pests reduced
- Difference between previously wasted energy pays back the cost of the upgrades
- Eligibility
 - Single family residential detached home
 - Con Edison firm gas customer







Energize NY Open C-PACE Property Assessed Clean Energy Financing



Energy Improvement Corporation

- Not-for-profit, statewide Local Development Corporation
- Mission to operate a successful Commercial PACE program in NYS that increases clean energy adoption and reduces GHG emissions

□ Funded by NYSERDA and revenue from financings

Clean Energy Public Benefits PACE Property Assessed Clean Energy (PACE)



"Municipalities would fulfill an important public purpose by providing financing to property owners for the installation of renewable energy systems & energy efficiency measures."

- Article 5L of the NYS General Municipal Law





PACE is Nationwide





PACE Benefits

Property Assessed Clean Energy (PACE) = alternative, affordable financing

- PACE is not a bank loan
- Pays for up to 100% of the cost of renewable and energy efficiency projects
- Automatically transfers to new owner if the property is sold
- Flexible loan terms not to exceed the average useful life of the improvements, often 20-30 years
- Competitive interest rates

PACE and Economic Development



Lowers Cost of Funds

PACE has lower origination costs than mezzanine or equity capital

Less Need for Equity/Mezzanine Capital

PACE provides a long term, fixed rate payback period

Pass Through Expense

PACE is a municipal lien and may be passed through as an operating expense on net leases, similar to tax charges and utility expenses

Supports Deeper Efficiency in Gut Renovations

□ Facilitates deep energy efficiency retrofit choices and renewable energy projects that might not otherwise be prioritized



Eligible Building Types

Commercially-owned + Not for Profit buildings



- Multifamily
- Healthcare
- Retail

Office

- Hospitality
- Industrial
 - Warehouse
- Agricultural
- Institutional
- Private colleges

Ineligible Buildings Include

- > Public Sector Properties
- > 1-to-4 Family Homes



Eligible Improvements

Efficiency: HVAC Equipment, Chillers, Lighting Upgrades, Boiler Conversions, Furnace Upgrades, Insulation, Windows, Pumps, Smart Controls, Variable Frequency Drives, Combined Heat + Power

Existing Buildings Eligible

Renewables: Solar Photovoltaic (PV), Solar Thermal, Small Wind, Energy Storage, Fuel Cells, Ground Source Heat Pumps, Air Source Heat Pumps, Anaerobic Digester Gas, Wood Heating Systems

□ New Construction + Existing Buildings Eligible




Open C-PACE: Capital Providers

Competition and choice for property owners and developers = lower rates and longer terms

3rd Party Capital Providers

- CleanFund
- Counterpointe Energy
- Dividend Finance
- Greenworks Lending
- Lever Energy
- LordCap PACE

- NYCEEC
- PACE Equity
- PACE Loan Group
- Petros PACE Finance
- Twain Financial Partners
- White Oak



Starting a Transaction

- Apply directly to participating capital providers
- Property Underwriting
 - No bankruptcy
 - Current on property taxes & mortgages
 - Mortgage Lender Consent required
- NYSERDA CPACE Guidelines for technical qualifications
- □ If qualified for capital:
 - Finance Agreement between Capital Provider and Property Owner
 - Benefit Assessment Lien placed on improved property
 - > EIC bills and collects directly with property



Program Administration

EIC's Responsibilities:

- Review applications, energy audits, scopes of work
- Manage capital provider list
- □ Record the PACE lien on the property when financing is originated
- Bill property owner with instructions to repay the capital provider
- The bill is backed by a PACE lien that is subordinate to municipal taxes
 Deliver an Annual Report to Member with lists of improved properties and schedule of repayments

Member Municipality Advantages:

- □ No collection or enforcement responsibilities
- □ No obligation to backstop finance repayments
- □ No financial exposure for EIC and its member municipalities
- No fees to participate



Lien Enforcement

Financing is secured through a PACE Lien that is subordinate to municipal taxes, and senior to non-municipal liens.

If property owner does not pay the <u>Annual PACE Installment</u>:

□ The capital provider may redeem the property by **first** paying off any unpaid municipal liens, **then** enforcing the Annual PACE Installment Lien through to foreclosure.

If a benefitted property owner is delinquent on <u>municipal taxes</u>:

□ The municipality will provide, upon EIC's request, verification to EIC of such delinquencies.

> Capital provider may then pay off the delinquent taxes to avoid the municipality redeeming the property.



Enabling Open C-PACE

- 1. Municipality passes local law establishing program within municipal borders
- 2. Sign Municipal Agreement that codifies EIC responsibilities and program operations
- 3. Certify Local Law and Municipal Agreement are in effect
- 4. Provide letter for EIC to provide to County Clerk when filing the PACE lien

ENERGIZE NY Participating Cities & Towns (as of 10/28/19): Active programs and in-process (Westchester only)

- City of New Rochelle
- City of White Plains
- City of Yonkers
- City of Rye

- Town of Bedford
- Town of Lewisboro
- Town of Mount Kisco
- Town of North Salem
- Town of Ossining
- Town of Rye
- Town of Cortlandt
- Town of Greenburgh
- Town of Harrison
- Town of New Castle
- Town of Yorktown

Case study: Retlaw Renovation



Historic hotel renovation in Fond du Lac, WI

Capital Provider: PACE Equity

Built in 1924, the hotel fell on hard times and was acquired in 2015.

Total rehabilitation utilized historic tax credits, public financing, bank construction loan, and state grant. PACE filled the funding gap to see the project move forward.

\$2,400,000 PACE financing = approximately 11% of total financing. The building represents an investment of nearly \$21m to the area.

PACE Equity provided project governance, energy engineering, funding and an energy savings guarantee.

Case study: Cambridge Court



Energy conservation measures for affordable multifamily housing in Greenville, MI.

Capital Provider: Petros PACE Finance

Owner of multiple affordable multifamily properties faced prohibitive upfront costs to installing energy efficiency upgrades.

Used PACE to add 20kw solar installation, LED lighting, low-flow plumbing fixtures, and HVAC upgrades.

Combined \$117,580 PACE financing with USDA REAP grant.

Achieved 40% reduction in electricity and natural gas consumption, and 29% reduction in water use.



For More Information

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Geothermal Energy as a Replacement for Natural Gas in Westchester Developments

Venetia Lannon, Vice President Matrix New World Engineering



Engineering Progress

Presentation Outline

- Geothermal Energy vs. Natural Gas in Multifamily Buildings
- Cost Savings
- Success Stories: Examples from NYS and Beyond
- Our Team: Matrix New World and Buffalo Geothermal
- Appendix: GHG Comparison for Heating Buildings



Geothermal vs. Natural Gas



Geothermal vs. Natural Gas



Geothermal vs. Natural Gas



Cost Savings: NYS and Fed Incentives

NYSERDA's Ground Source Heat Pump Rebate Program

- Large systems in areas impacted by a gas moratorium
 \$1,500 per ton of cooling capacity up to \$5M per project
- Federal govt. energy tax credit provides 10% tax credit
 - All commercial geothermal system-related expenses, broadly defined (heat pumps, hot water plumbing, GC expenses, etc.)
- Federal govt. also offers 1-5 year accelerated depreciation
 - For all costs associated with geothermal installations provides tax savings of 25% (on corporate income) in the first year after construction is completed or it can be spread out over 5 years.

Cost Savings: Example 400-Unit Building

Capital Costs and Subsidies

	Natural Gas	Geothermal
Upfront System Equipment	\$13M	\$19M
Cost Avoidance	na	-\$2.5M
NYSERDA Rebate	na	-\$1.5M
10% Federal Tax Credit	na	-\$1.6M
2020 Tax Benefit	-\$0.4M	-\$3.8M
Total Cost	\$12.6M	\$9.6M

Cost Savings: Example 400-Unit Building

Annual Operating Costs

	Natural Gas	Geothermal
Power for boilers, domestic hot water, make-up air units	\$205K	\$30K
Water/power cooling tower	\$67K	na
Electricity for heat pumps	\$250K	\$250K
Maintenance	\$100K	\$50K
Total Cost	\$622K	\$330K

Zero Place, New Paltz



Type Lot Size/Wells Drilled Use Completion NYSERDA Rebate New Construction 15,000 sf; 15 wells < 20% of lot; 500' deep 42 apartments, 6 commercial spaces Fall 2019 \$109K MATRIXNEWORLD

Siano Building, Buffalo



Type Lot Size/Wells Drilled Use Completion NYSERDA Rebate New Construction 4,000 sf; 9 wells ~ 20% of lot; 230' deep 11 apartments, 3 commercial spaces 2017 \$38K MATRIXNEWORLD

Autumn Garden Complex, Lockport



Type Lot Size/Wells Drilled Use Completion NYSERDA Rebate New Construction 10 acres; 39 wells ~15% of lot; 225' deep 72 residential units in multiple buildings 2017 \$92K MATRIXNEWORLD

Pierce Arrow Building, Buffalo



Type Lot Size/Wells Drilled Use Completion NYSERDA Rebate Retrofit 40,000 sf; 50 wells 350' deep 127 apartments, 2 restaurants Winter 2019 \$398K MATRIXNEWORLD

Success Stories: Beyond NYS



Modello, Burnaby, British Columbia

уре	New Construction
leight	37 stories
Jse	163 residential units
	4-story commercial podium
	238 underground parking spaces
Completion	2017

Success Stories: Beyond NYS



Compass at Seylynn Village, North Vancouver BC

Гуре	New Construction
leight	28 stories
Jse	247 residential units
	pool and underground parking
Completion	2018
-	



Success Stories: Beyond NYS



The Exchange, Vancouver BC

Туре	New Construction/Restoration
Height	31 stories
Use	372K sq. ft new office tower
	202-room hotel in restored
	historic Old Stock Exchange
	building
Completion	2017



Our Team

- Matrix New World Engineering
 - Complete project management services from our Manhattan office
 - Wholly owned construction subsidiary Blue World experienced in site work and all aspects of construction management
 - Deep understanding of regulatory landscape
- Buffalo Geothermal
 - Designed and installed 600+ geothermal systems in NYS
 - Proven track record of obtaining NYSERDA rebates and fed incentives

GREENHOUSE GAS EMISSIONS FOR RESIDENTIAL HEATING OPTIONS

(GRAMS PER KILOWATT HOUR)1



the grey bar indicates additional emissions accounting for distribution loss and associated methane release for propane (0.2%) and natural gas $(2\%)^2$

- 'T. Bucholz et al. "Greenhouse Gas Emissions of Local Wood Pellet Heat From Northeastern US Forests." Energy vol. 141, December 15, 2017.
- ²R.A. Alvarez et al. "Assessment of Methane Emissions From the U.S. Oil and Gas Supply Chain." Science vol. 361, issue 6398, July 13, 2018, pp. 186-188.

³Indicates the greenhouse gas emissions from electricity used to power geothermal heat pumps; derived by the NY Geothermal Energy Association from New York State's energy grid emissions data. See https://www.eia.gov/electricity/state/newyork/



VRF Concept

Julian Mercado Business Development Manager, NYC

Agenda

Typical Air-conditioning Systems

VRF System

Indoor Unit Range

Outdoor Unit Features

Typical Air Conditioning Systems

Packaged Air Conditioner



- Commercial Applications
- Typically mounted on the roof
- Can provide Cooling or Heating
- Lower efficiency than other commercial systems
- Cheaper equipment cost
- Noisier, but noise can be treated
- Usually requires metal ducts to distribute air, grilles & diffusers
- Often requires balancing of supply air during commissioning
- Lacks ability to control differing area demands

Typical Air Conditioning Systems

Chiller System

- System capacities from 5 to 500 Ton
- Usually large commercial & industrial sites
- Chiller unit only a fraction of the cost of the entire system & running cost
- Historically the most common type of system used in larger commercial projects
- Have struggled to keep up with increasing system efficiency requirements demanded



Agenda

Typical Air-conditioning Systems

VRF System

Indoor Unit Range

Outdoor Unit Features

Daikin VRV Continuous Innovation



What is VRV?

VRV/VRF Concept

- Think of a VRV/VRF system as a heat pump chiller that circulates refrigerant to each zone instead of water
- A heat pump system is equivalent to a 2 pipe chiller
 - Smaller heat/cool changeover zones
- A heat recovery system is equivalent to a 4 pipe chiller system





Heat Pump Series

Whole system is in cooling OR heating mode

- Note: Units are not forced into heating or cooling
- If demand is not required a FCU will operate fan only

Heat Recovery Series

The system can cool AND heat simultaneously

 The system will ALSO provide a Heat Recovery Process



VRF Overview

Variable System capacity varies with load

Refrigerant R-410A Direct Expansion System

Flow Refrigerant flow regulated by EEVs and variable speed compressor

- Introduced in 1982 Worlds first VRF system
- Over 1 million installations worldwide
- Over 40,000 (500,000-Tons) systems in USA and Canada
- Commercial Market Share: US 10% EU 40%



VRF has three core features:

Modular Design / Easy to Install
Ultra High Energy Efficiencies Exceptional Comfort Control

VRF = Industry term
Why VRV?- Simple Modular Concept Product

Building Blocks

Chilled Water Loop

Chilled Water (C



Balancing

Etc.



Modular Design: Building Size

Building Size (Tons):	<50	<100	<250	<500	<1000	>1000
VRF	•	•	•	•	•	•
PTAC		•				
SPLIT SYSTEM		•				
CV RTU		•				
VAV ROOFTOP		•	•			
AIR COOLED CHILLER		•	•	•		
WATER COOLED CHILLER				•	•	•
CENTRAL AHU	•	•	•			
CUSTOM AHU				•	•	•
FAN COIL		•	•			
UNIT VENTILATOR	•	•	•			

A Key attribute of direct expansion systems is their Energy efficiency



Efficient Design

ENERGY EFFICIENCIES

Reduced Construction = Increased Space



Reduced mechanical chases



No mechanical rooms!

Indoor Unit Options



ASHRAE Standard 90.1

Current VRF systems in the US market tend to significantly exceed the minimum efficiency requirements set for electrically operated air to air VRF systems



Integrated Energy Efficiency Ratio

Comfort Control

On/Off versus Inverter & PID Control

On/Off Control

- On/Off control basically means all or nothing as far as the system output is concerned
- On/Off control is the crudest form of any control system. It is inadequate to respond to part load conditions and the temperature control would always include large deflections



Inverter & PID Control

- The combination of Inverter driven compressors and PID (Proportional Integral Derivative) control offer not only better efficiencies but a much greater degree of comfort control.
- Air-conditioning works most of it's operational life at part load conditions. VRF systems benefit from both a closer level of temperature control and a faster response time to deviations from set point.



VRF outdoor unit location examples

Floor-by-floor type

- Air-cooled outdoor units installed on each floor (typically on floor balconies).
- Air-cooled outdoor unit can be applied for high rise buildings by this method.
- Restriction may be put on to façade design because of large grills.



Example building (Office: Rooftop type)



Example building (Office: Rooftop type)

- Air-cooled outdoor units are installed on rooftop. (10-story, 12,039 m2 [129,587 sf])
- Indoor units are concealed in the plenum and ducted to mount only air outlets on the surface of ceiling.
- Outdoor air treatment units are also installed in the plenum.

Talo Architect

Tapani Talo

https://www.taloarchitect.com/

The MAIN OBJECTIVE TODAY = CLIENT'S comfort

10 DEG WEATHER

GOING BEYOND CODE

- 1. Makes us THINK and understand more
- 2. Code is the LOWEST Minimum, as Erika Krieger always points out.
- 3.Envelope well done eliminates equipment and ducts
- 4. You don't have to move to a HOTEL in a winter outage, however long

Trillion dollars a year wasted in US economy + equal amount of carbon blown to atmosphere

WHY – RESIDENTIAL FIRST COST - + ARCHITECTS' AND ENGINEERS' LIMITED ROLE - JUST TO MEET THE MIN CODE

- Only \$30 000 added to residential average 2500 sf house would save the nation and add RESPECT for <u>our</u> profession
- And each house family half a million in 30 years
- Equal to mortgage at 6% for \$250 000 dollars.

COMMERCIAL – FIRST COST ARCHITECTS' AND CONSULTANTS' LIMITED ROLE – MIN. CODE RULES

- 5 to 7% more per office building saves approx. ¹/₂ million per 1500 sf in 30 years – or
- The cost of the entire cost of the building
 - So 1 million sf office bldg could save roughly 150 to \$300 million +/- in 30 years..by being passive standard – not counting health issues for occupants – counted to be 100 times that in studies.

¹/₂ Million +/- savings In 30 years for an average 'old' 2500 sf house or 1500 sf of office space. Just with right insulation +glass+ ERV + good simpler heating and cooling

Tapani Talo, AIA Talo Architect, P.C.

BASELINE – OUTLINE -30x50 TWO STORY EXISTING RESIDENCE

Infrared - WHY current method of ATTIC AND BASEMENT really 'SUCKS' normally

ATTIC BATT INSULATION

Matt Schwoegle

BASEMENT conc. or cmu WALL R=1, freezing down to 4 feet below

700 dollars a year for heating with only one wood burning fireplace no AC

House market price \$550 000 +/-

Standard contractor siding, new windows cost \$70000, 10% utility savings. Architect added insulation cost \$10 000, 90% utility savings, \$173000 for owner in 20 years with \$60 a barrell oil

No boiler, only wood buring fireplace for the whole house. Annual heating cost \$250 dollars

Elmsford solar and geo house

Transformation

Your electricity charges

These charges are for the electricity you used (supply) and getting that electricity to you (delivery). Rates are based on a 30 day period. When your billing period is more or less than 30 days, we prorate your bill accordingly.

Electricity you used during this 31 from Dec 30, 2008 to Jan 30, 2009 Rate: EL1 Residential or Religious	day billing period Meter# 7505647	
We measure your electricity by how many One kWh will light a 100 watt bulb for 10 h	kilowatt hours (kWh) you use. ours.	
Jan 30, 09 actual reading	4495	
Dec 30, 08 actual reading	-3294	
Your electricity use	1,201 kWh	

Your supply charges

Total supply charges	\$124.39
GRT & other tax surcharges Taxes on Con Edison gross receipts from sales of other tax surcharges.	\$1.24 Tutility services and
Merchant function charge Charge associated with procuring electricity, crea related activities and uncollectible accounts.	\$4.34 dit and collection
Supply 1,201 kWh @9.8926¢/kWh Charge for the electricity supplied to you by Cor	\$118.81 n Edison.

Your total electricity supply cost for this bill is 10.4¢ per kWh. You can compare this price with those offered by energy services companies (ESCOs). For a list of ESCOs, visit www.PowerYourWay.com or call 1-800-780-2884

Your delivery charges

		and the second second second
Sasic	Service	charge
Juoio	0011100	onargo

\$13.30 Charge for basic system infrastructure and customer-related services, including customer accounting, meter reading and meter

maintenance. A billing and payment processing charge of \$0.47, which may be avoided by switching to an energy services company (ESCO), is also included.

Delivery 1,201 kWh @7.9142c/kWh

\$95.05

Charge for maintaining the system through which Con Edison delivers electricity to you.

Ways to pay your Con Edison bill:

If you have a checking or savings account, the easiest way to pay your Con Edison bill is with the Direct Payment Plan (DPP). It's free, and there are no checks to write or stamps to buy. Once you set it up, it's automatic every month. Con Edison also offers Pay-by-Phone and Pay-by-Internet services. Call Payment Express at 1-888-925-5016 for DPP enrollment or to make a payment by phone, or go to www.conEd.com to make a payment. You can also pay your bill by mail in the enclosed envelope. The address to mail all payments is Con Edison, JAF Station, PO Box 1702, New Yest NY 10116 1702 Can Edinar has a natural of Authorized

Account number: 58-8920-0640-0000-2

Billing period ending: Jan 30, 2009

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\$7.20

\$247.34

SBC/RPS charges @0.28896/kWh The System Benefits Charge/Renewable Portt fund New York State renewable energy, envir related public policy programs.	\$3.4 folio Standard charges conmental and other
GRT & other tax surcharges See earlier definition.	\$3.9
Total delivery charges	\$115.7

Your sales tax

Sales tax @3.0000% \$7.20 Tax collected on behalf of New York State and/or your locality. Buying your energy from an energy services company (ESCO) will lower your sales tax.

Total sales tax

Total electricity charges

🖾 a year ago

SAVINGS

THE JANUARY **ELECTRICAL** FOR **EVERYTHING** WAS \$95 DOLLARS,

ANNUAL + \$ 250,-- +/-

Moving? Contact us to make sure you have service at your new address.

Changing your mailing address? Contact us to make sure your bills go to the right place.

For information about your account:

You can speak to someone in person about your Con Edison account at one of the following locations:

· Bronx Walk-in Center - 448 East Fordham Road

Greenwich, CT example, on the way becoming passive....

BEFORE

PROBLEM

- House 5000 sf living / 2000
 garage sf, built 1984 could
 not be heated beyond 58
 deg in the winter in 10 Deg
 weather??? (similar to
 older houses)
- Calculations pointed to over 600 000-btuh heat losses ++++ at zero deg day...

After renovation this house can be heated with one fireplace if needed – 45 000 btuh

EXPOSURE.....

HEATABLE WITH ONE FIREPLACE

GARAGE

\$14000 OIL CONSUMPTION \$1400

COOLING

3000

NEAR ZERO

FINAL 24000 - TO 30 000

Btuh +major

infiltration

70000

474000

28 TON

SURFACE TEMP OF ROOF, WALLS AND WINDOWS CRITICAL FOR COMFORT

> FINAL will be 45000 Btuh, One fireplace

The roof losses actually due to ducts have double impact

Finished – note snow stays uniformly

Dining room with new Windows

Near Passive 5000 sf in Greenburgh

Greenbugh 5000 sf, solar + geo, a year after completion the AC in the summer did was not needed once ...

Ok Green??

First two GEO wells out of four total

Summary of Residential – Green – savings with different wall, roof , window methods

- First typical older existing small 30 X 50 bldg 2 story – losses in red – if improved in green
- Walls R=3 around 3700 sf, roof R=5 2000 sf energy loss at zero deg = 115 000 Btuh /7000 Btuh
- Basement with 2' exposure above ground 22000 Btuh, + rest 54000 = 70 000+ Btuh/ 3500 Btuh
- 24 windows, 3'x4', 20 000 Btuh / 2000 to 4000 Btuh
- Garage doors and walls 70000 Btuh / 2500 Btuh
- TOTAL 280 000 Btuh not counting infiltration
- Improved product is thus 17000 to 20000 Btuh + ventilation heatable with one small fire place
- For Greenwich and Scarsdale 2x/3x the numbers

HOW? + avoid fire hazard and mold

90% IMPROVED ENERGY FOOT PRINT 500 000\$ +/- SAVINGS OVER 30 YEAR MORTGAGE, BASED ON USA AVERAGE CONSUMPTION

RESIDENTIAL : 2x/3x the code R values for

- I. Walls 3x
- 2. Roof 2X

decorations.

3. Basement 2x to 3x
 FOR WINDOWS 4x VALUE +
 Garage doors and walls 3x to 4x

 GEO, SOLAR, ERV'S or HRV'S are then effective rather than ADD MINIMUM OF (R = 18 TO 11!) WALLS , + 3" TO 5" FOAM, (R = 38 ???) ROOF, + 5" TO 8" – R=30 To R+ 50 FOAM, MIN + VENT SURFACE CAVITY

(Near) Passive - why don't we do it? – maybe as most of us never lived in one!!!!

- Professional game developers vs common sense, first cost governs.
- Architects + builders are mandated to think CODE only, not long term client interest. Passive is actually <u>cost neutral</u> due to less equipment and ventilation, fixed high efficiency windows.
- Clients told only one message instead of what they would save – which is <u>more than they will</u> <u>ever earn from investments or savings.</u>
- No realtor will ever deal with smart building.

Green Smart vs. NYSEDRA

NYSEDRA + 2015 CODE

- 15 to 20% improvement in renovations of older houses. New CODE R values are still 'lacking'
- The renovation of older proj. effort does not TRULY pay off, as professional and labor fees are high to do it right
- Cannot be used in power outages in severe winter for instance
- NO CHANGE IN COMFORT due to surface temps

GREEN & SMART & COMFORT

- 90% improvement + in renovations, 50% to 70% improvement in new construction
- We gain constant savings in fan usage, heating and cooling – \$¹/₂ million ave in 30 years
- Can be used in catastrophic power outages summer or winter at any temperature
- Professional effort pays off for architects and builders, and owners
- SUPREME COMFORT
WP house that used only fireplace to heat after insulation at any weather

Before, impossible to keep warm

After, 3 ½ chords of wood – 700 dollars



So In lieu of 'Net Zero' term

\$\$\$\$\$\$\$\$\$

- This lecture is simply
- Net CASH
 POSITIVE
 1⁄2 MILLION
- OVER 30 YEARS
- Architects and builders can do it and take pride doing it.
- Comfort/Performance

HOW, JUST ADD MIN OF R=21 TO R=50 + CODE all around

A MIN. 3.5" panel, OSB on one side only is \$3.61/sf. Priced out at 3" of urethane foam and the 1/2" OSB. 4" TO 5" PREF. AS MORE EFFECTIVE BY FAR

Green Smart vs. NYSEDRA

NYSEDRA + 2015 CODE

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- The renovation of older projects' effort does not TRULY pay off, as professional and labor fees are high to do it right
- Cannot be used in power outages in severe winter for instance
- NO CHANGE IN COMFORT due to inadequate radiant surface temps resulting in constant fan usage

GREEN & SMART & COMFORT

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Nysedra/Code vs. Real comfort + savings and security – how to operate and use house without power at zero deg when needed

NYSEDRA/CODE (IS MAKING US) FOCUS IS 10 TO 20% IMPROVEMENT THUS ENERGY COMPANY MARKET SHARE IS STILL CONSTANT FOR **THEM & RESIDENCE** COMFORT IS STILL PROVIDED BY LARGE MECHANICAL NEEDS

AIR SEALING YOUR HOME



1 Air Barrier and Thermai

- 4 Shaft for Piping or Ducts
- 5 Dropped Ceiling/Soffit
- 6 Staircase Framing at Exterior Wall
- 8 Flue or Chimney Shaft
- 13 Exterior Wall Penetrations
- 15 Garage/Living Space Walls
- 17 Rim Joists, Sill Plate, Foundation, Floor
 - ttached Dwelling Units

STATE OF THE ART HOUSE **DESIGNED TO BE USED** WITHOUT UTILITY POWER -PREFERABLE – CONTINUOUS **EXTERIOR INSULATION + BACK UP SOLAR PV AND HOT WATER**







It is a team effort

PRICING FIRST

- Without contractor(s) who is/are inclined to go Green near passive the project will be priced out
- UNNESSESARILY
- Reduce the number of operable windows as they are leaky and HUGE drain overall package
- ROOF, ROOF, ROOF

WITH RIGHT CONTRACTOR

- Knowing how to make airtight envelope initially seems as tedious task as taping and caulking is truly the game, but it is no different that applying the right nails and screws
- Geo and solar know your team