NYC Local Laws and Pathways to Municipal Electrification

Agenda

NYC DCAS
Citywide Administrative Services

- Intro to DCAS Energy Management (DEM)
- NYC GHG Emissions Goals and the Need for Building Electrification
- Local Laws Governing Municipal Capital Projects
- Drivers of Full HVAC Electrification in Municipal Capital Projects
- Drivers of Incremental Electrification in Smaller Municipal Projects
- Potential Market Opportunities
- DEM Is Hiring!

Our City's Ambitious Reduction Goals

Intensifying Our Commitments

- Frontload emissions reductions efforts
- Cap energy use intensity for large buildings
- Achieve 20% deeper cuts in City building's energy use by 2025
- Launch deep energy retrofits
- Procure 100% renewable electricity

What is the Department of Citywide Administrative Services?

DCAS serves as the back office for all New York City municipal agencies

- Support the City's Workforce Needs
- Manage the City's Portfolio of Facilities and Real Estate
- Procure Goods, Services, and Contracts for City Agencies
- Manage the City's Fleet
- Manage the City's Energy Use

NYC DCAS Citywide Administrative Services

Who is DCAS Energy Management?

SUPPLY

- Manage the City's $700 million Heat, Light, and Power budget
- Install clean energy projects
- Leading City towards long-term procurement of 100% renewable electricity

DEMAND

- Implement energy efficiency retrofit projects in City buildings
- Expanding O&M best practices across the City's portfolio
- Train City employees to change behaviors

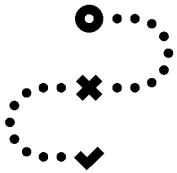
Our Energy Services for Agency Partners

Data Analytics

Project Funding

Staff & Training

Technical Expertise



Strategic Planning

Contract Resources

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A Diverse Portfolio of Municipal Buildings

4,600+ Buildings

Comfort stations	Campuses
200 sq. ft.	1M sq. ft.
Brand new	Historic

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A Diverse Portfolio of Municipal Buildings

4,600+ Buildings

Decarbonization Opportunities!

200 sq. ft. ↔ 1M sq. ft.

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Successes to date

Cut Total Emissions and Energy Use

- GHG emissions in City buildings down 26% since FY06

Flattened Utility Costs

- FY17 HLP Budget forecasted 3.4% below 5-year average, despite 29% growth in budget

Scaled Up Investments

- Completed $500 million of energy retrofits in 1,000+ City buildings since FY08

Clean Energy Development

- Increased solar generation on City buildings 10-fold since FY14

Agency Capacity

- 200% increase in agency energy professionals since FY09

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Local Laws Governing NYC Municipal Capital Projects

Local Laws Governing NYC Capital Projects

An incomplete list:

- LL86-2005 LEED Silver
- LL66-2014 80x50 GHG Target for Entire City
- LL06-2016 Geothermal Feasibility
- LL31-2016 Low Source EUI Targets
- LL32-2016 LEED Gold
- LL94 -2019 Solar or Green Roofs
- LL97-2019 40x25 and 50x30 GHG Targets for Government Ops

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Local Laws Governing NYC Capital Projects

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- LL86-2005 LEED Silver
- L119-2005 Environmentally preferable purchasing
- LL87-2009 Implement ECMs with payback ≤ 7 years
- LL107-2013 Minimum 5% biofuel
- LL66-2014 80x50 GHG Target for Entire City
- LL06-2016 Geothermal Feasibility
- LL24-2016 Solar PV feasibility & reporting
- LL31-2016 Low Source EUI Targets
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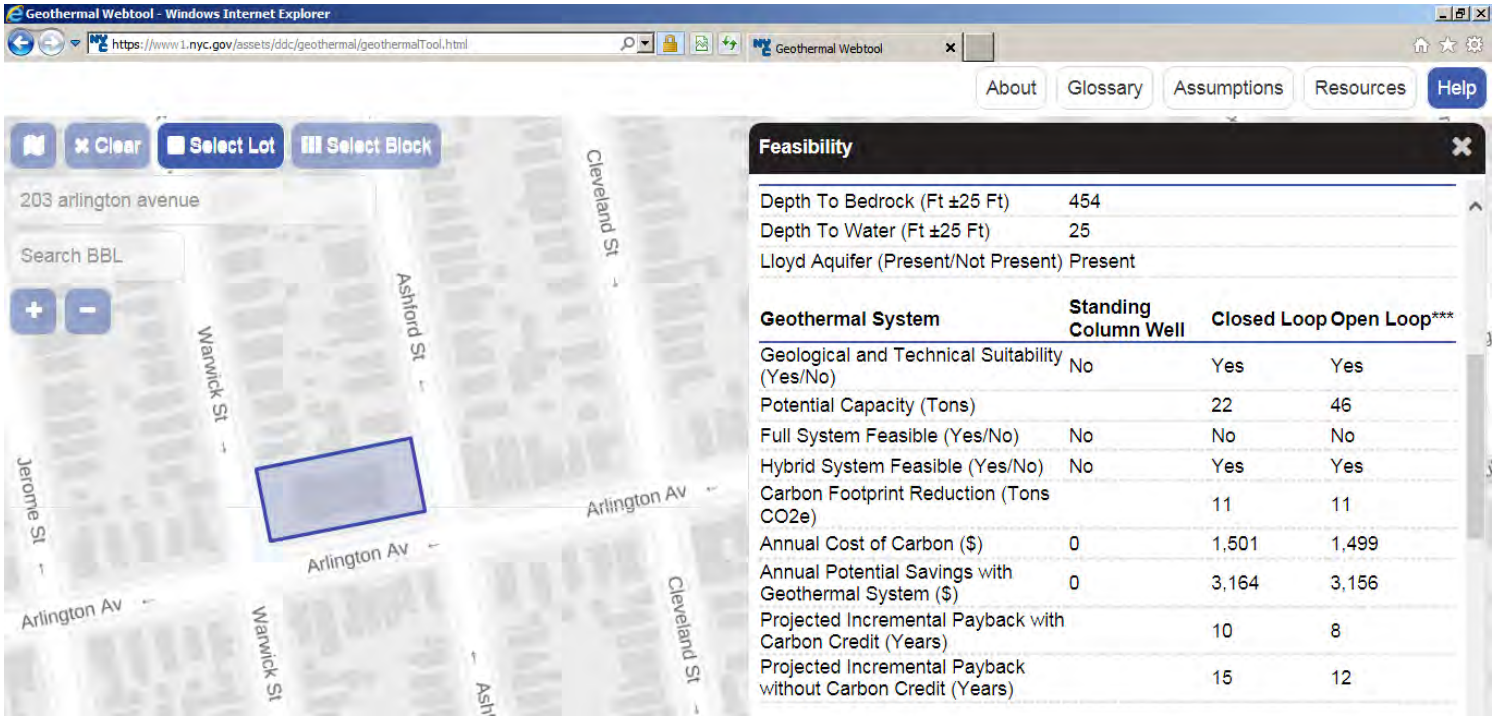
- LL24-2016 Solar PV Feasibility & Reporting
- LL31-2016 Low Source EUI Targets
- LL32-2016 LEED Gold
- LL45-2018 Real-time Energy Monitoring
- LL107-2018 100% Green Power by 2050
- LL94-2019 Solar or Green Roofs
- LL97-2019 40x25 and 50x30 GHG Targets for Government Ops
- LL147-2019 Modifies LL97

LL06 of 2016: GSHP feasibility

Requires feasibility study and, if lowest net present value, installation of ground-source (geothermal) heat pump systems for new or retrofit HVAC projects in NYC-owned buildings



Screenshot from DDC Geothermal Webtool

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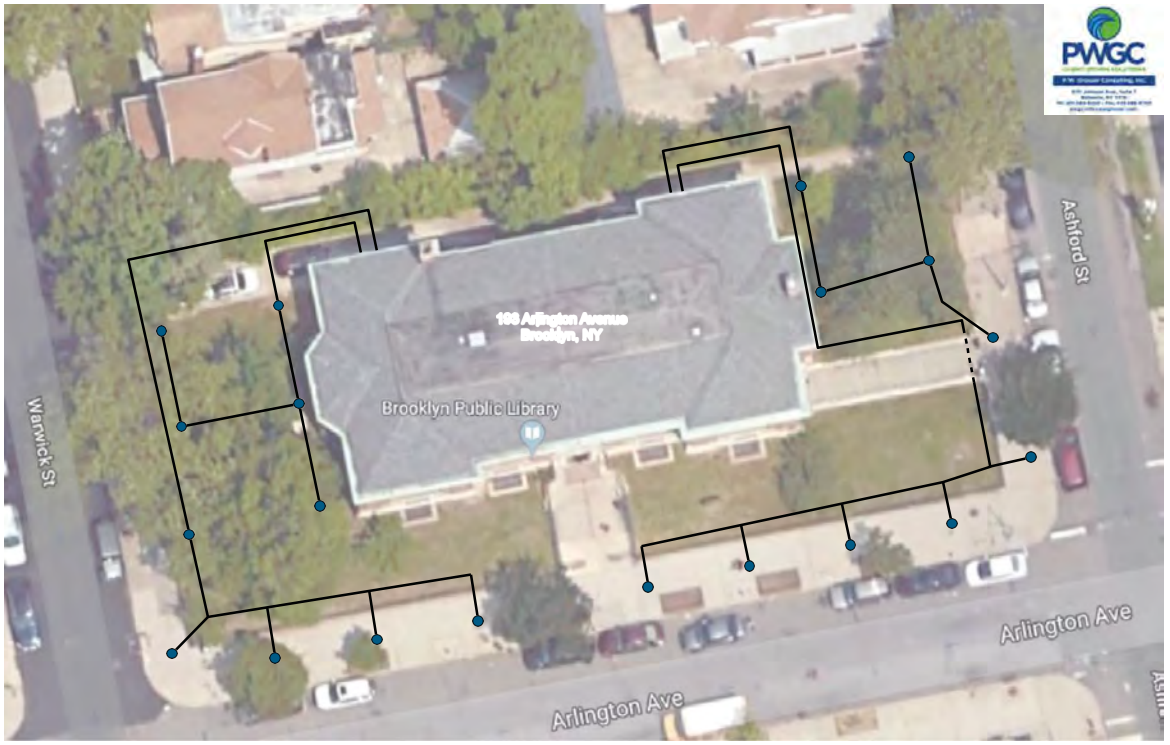
LL06 of 2016: GSHP Feasibility

Requires feasibility study and, if lowest net present value, installation of ground-source (geothermal) heat pump systems for new or retrofit HVAC projects in NYC-owned buildings

Social Cost of Carbon ($ / MTCO2e)	
2017	$128
2018	$132
2019	$136
2020	$140
2021	$142
2022+	TBD



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LL06 of 2016: GSHP Feasibility

Requires feasibility study and, if lowest net present value, installation of ground-source (geothermal) heat pump systems for new or retrofit HVAC projects in NYC-owned buildings

Will it drive electrification?

Not likely.

- Capital cost still high (drilling)
- SCC too low

BPL Arlington Library Schematic Design Estimate	Split System	Split w/ VRF Heat Recovery	GSHP
Capital Cost	$1,190,000	$1,309,000	$1,915,900
Annual O&M Cost	$3,000	$4,000	$2,500
First Year Energy Cost	$29,000	$27,000	$19,000
Social Cost of Carbon			-$820
Net Present Value	$1,942,000	$2,091,800	$2,377,000

20-year study period. Energy cost inflation rate 3%. O&M inflation rate 6%. Discount rate 6%.

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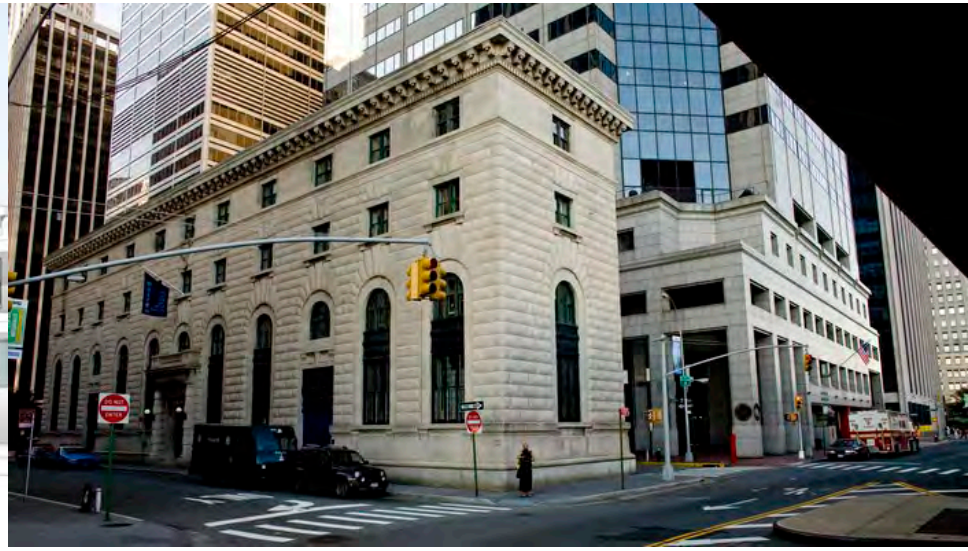
LL32 of 2016: LEED v4 Gold

Requires NYC-funded new construction and substantial construction to achieve LEED version 4 Gold certification, plus 20-30% energy cost reduction relative to NYS ECCC (ASHRAE 90.1-2013) baseline

NYC Parks Shirley A. Chisholm Community Center
1100 Architects



NYPD Operations Facility at 100 Old Slip
(former Police Museum)

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LL32 of 2016: LEED v4 Gold

Requires NYC-funded new construction and substantial construction to achieve LEED version 4 Gold certification, plus 20-30% energy cost reduction relative to NYS ECCC (ASHRAE 90.1-2013) baseline

Will it drive electrification?

Not likely.

- LEED and LL32 measure energy cost savings, not energy or GHG savings

ENERGY & ATMOSPHERE		
Prereq	Fundamental commissioning and verification	REQUIRED
Prereq	Minimum energy performance	REQUIRED
Prereq	Building-level energy metering	REQUIRED
Prereq	Fundamental refrigerant management	REQUIRED
Credit	Enhanced commissioning	6
Credit	Optimize energy performance	18
Credit	Advanced energy metering	1
Credit	Demand response	2
Credit	Renewable energy production	3
Credit	Enhanced refrigerant management	1
Credit	Green power and carbon offsets	2

LEED v4 Energy & Atmosphere Credits

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LL31 of 2016: Low Source EUI

Requires NYC-funded and -owned new construction and substantial reconstruction to be designed to have a low source EUI target:

- 50% lower than current median EUI for typology, per LL84, or
- 50% lower than ASHRAE 90.1-2013 baseline building, or
- 32/42 (new/existing) kBtu/sf/yr - only target after 1/1/2030

Case Studies	LL84 Target	ASHRAE Target	2030 Target
Westchester Square Library	103.2 Libraries	60.2	38.0 (new)
Woodstock Library		46.1	42.0 (exg)
Bergen Building	91.5 Offices	37.6	42.0 (exg)
Glenmore Building		38.7	42.0 (exg)
Spring Street Garage	111.4 Repair Garages	45.8	38.0 (new)
Queens 7 Garage		49.3	42.0 (exg)

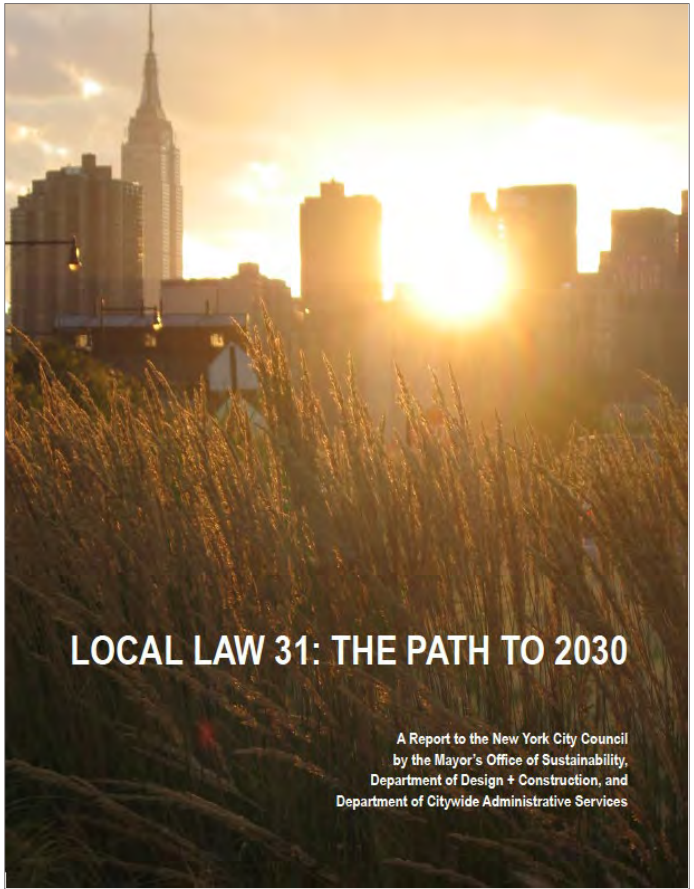
LL31 of 2016: Low Source EUI

Requires NYC-funded and -owned new construction and substantial reconstruction to be designed to have a low source EUI target (50% LL84 median, 50% ASHRAE baseline, or 38/42 kBtu/sf/yr)

Will it drive electrification?

Maybe.

- Source EUI targets can favor gas (source:site ratio of 1.05) over electricity (ratio of 2.80)
- Will shift with greener grid



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LL92/94 of 2019: Solar or Green Roofs

Requires new roofs on NYC-owned buildings to be covered by:

- Solar PV (if more than 4kW can be accommodated) or
- Green roof systems (if slope is less than or equal to 2:12)

NYC Parks 5-Boro Admin Building

Queens Public Library Kew Gardens Hills Branch

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LL92/94 of 2019: Solar or Green Roofs

Requires new roofs on NYC-owned buildings to be covered by:

- Solar PV (if more than 4kW can be accommodated) or
- Green roof systems (if slope is less than or equal to 2:12)

Will it drive electrification?

Maybe (indirectly).

- Solar can “offset” electricity use, but not enough to meet most buildings’ HVAC loads
- Also requires battery storage

100 MW on NYC Municipal Buildings by 2025

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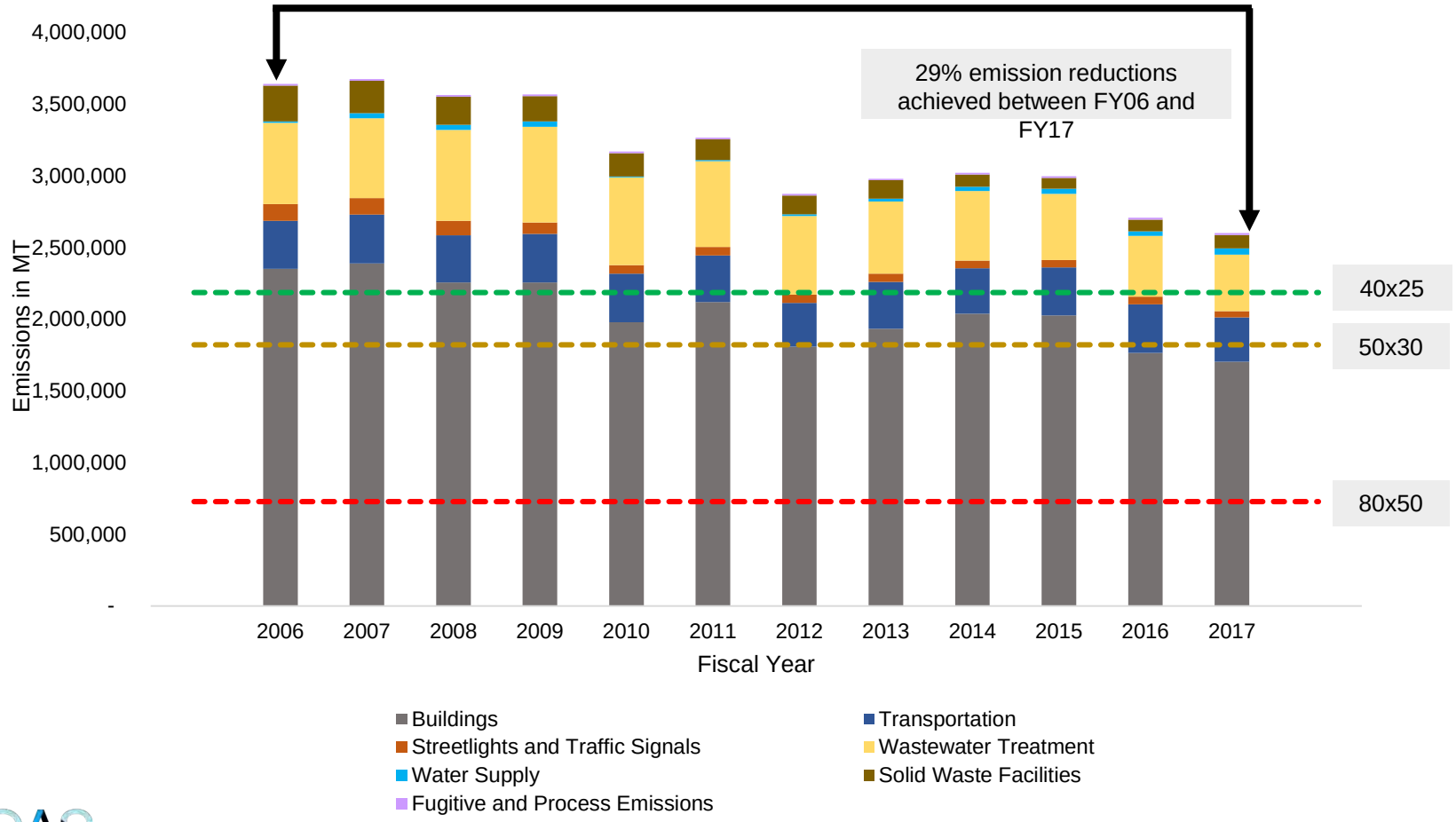
LL97 of 2019: 40x25 and 50x30

Requires NYC government operations to reduce GHG emissions 40% by 2025, and 50% by 2030, relative to FY2006 levels



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LL97 of 2019: 40x25 and 50x30

Requires NYC government operations to reduce GHG emissions 40% by 2025, and 50% by 2030, relative to FY2006 levels

Will it drive electrification?

Eventually.

- Depends on greener grid
- GHG conversion factors used for compliance of city-owned buildings will update annually

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Drivers of Full HVAC Electrification in NYC Municipal Capital Projects

Case Study 1: Heating Concerns

NYPL Westchester Square Branch Library

Electrification: Air-Source VRF for Supply Air Conditioning

Snohetta / Altieri Sebor Wieber Consulting Engineers / Atelier Ten

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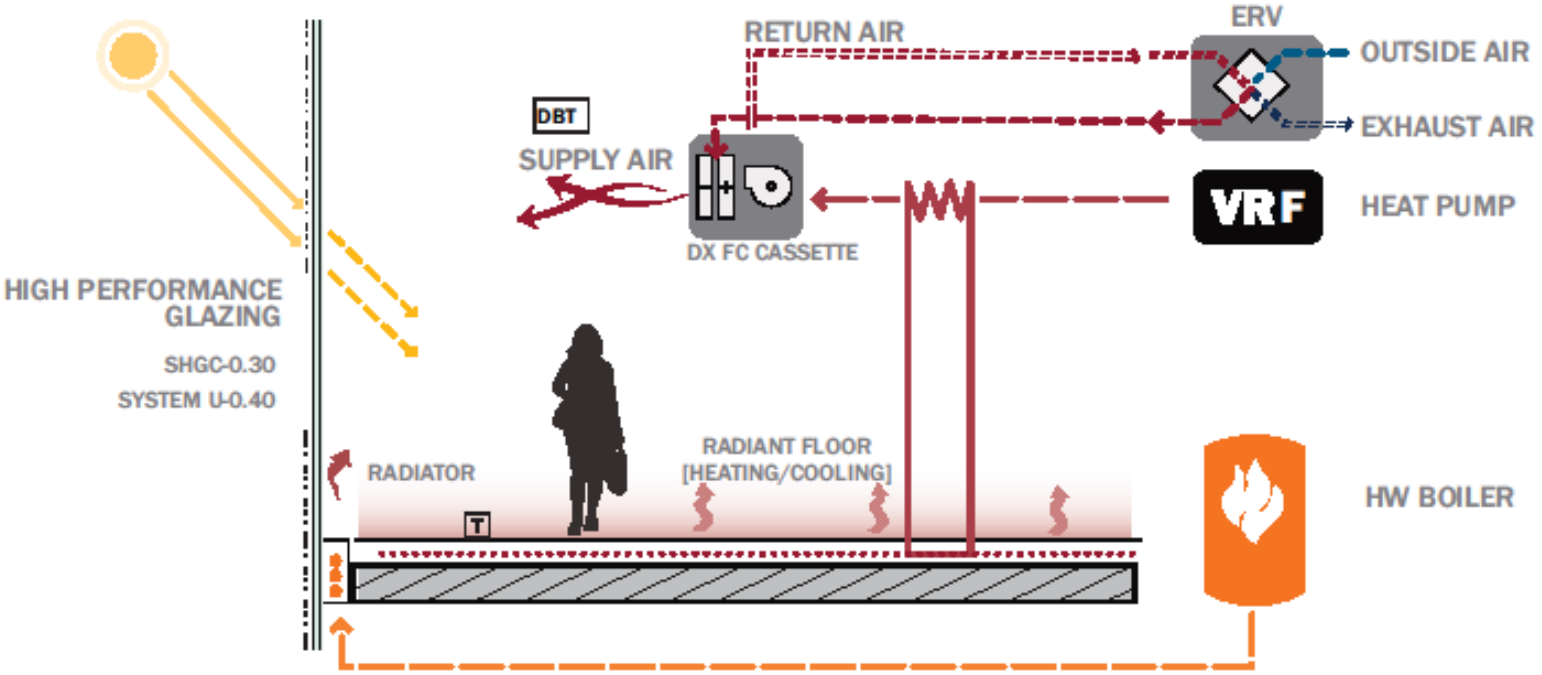
Case Study 1: Heating Concerns

NYPL Westchester Square Branch Library

Enabling Conditions: Backup Heating



Conceptual Diagram of HVAC System

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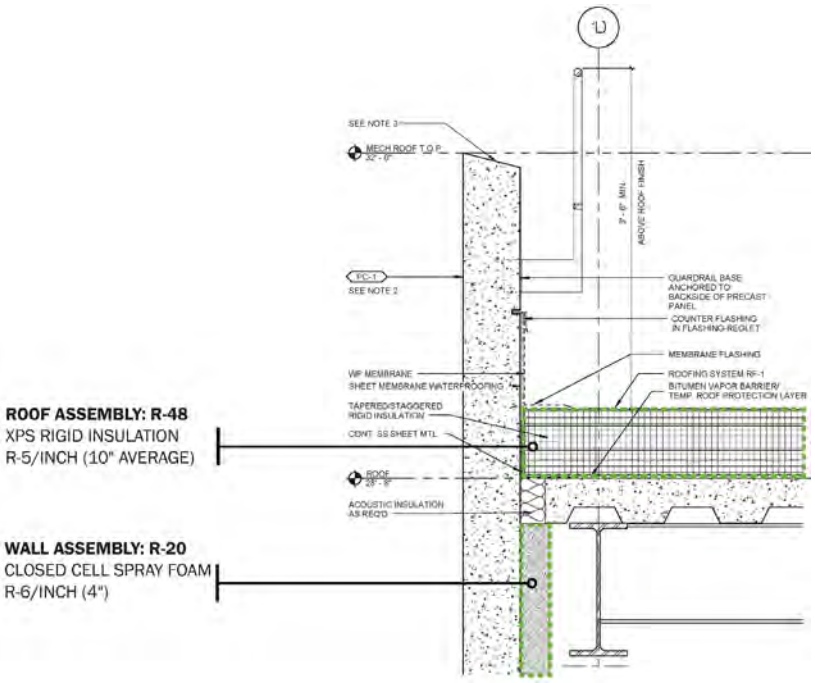
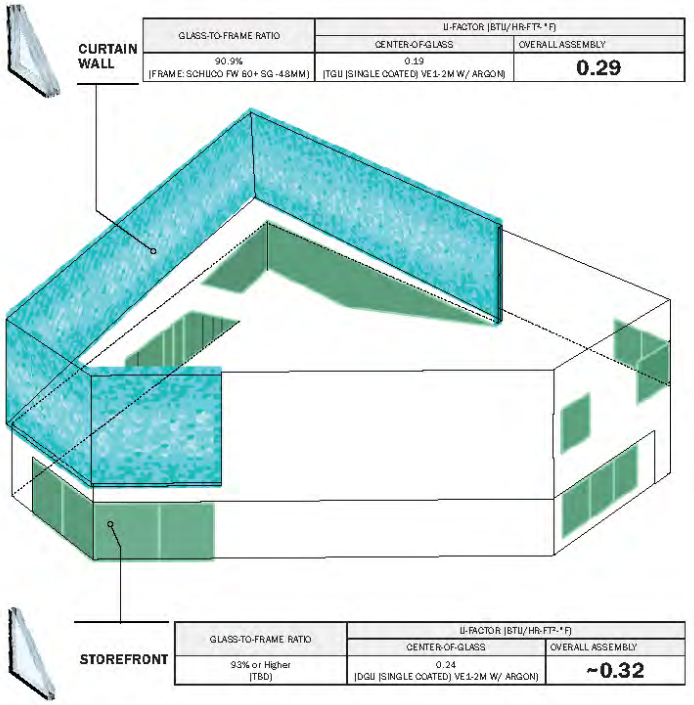
Case Study 1: Heating Concerns

NYPL Westchester Square Branch Library

Enabling Conditions: Backup Heating + Envelope Upgrade





Upgraded Envelope Performance

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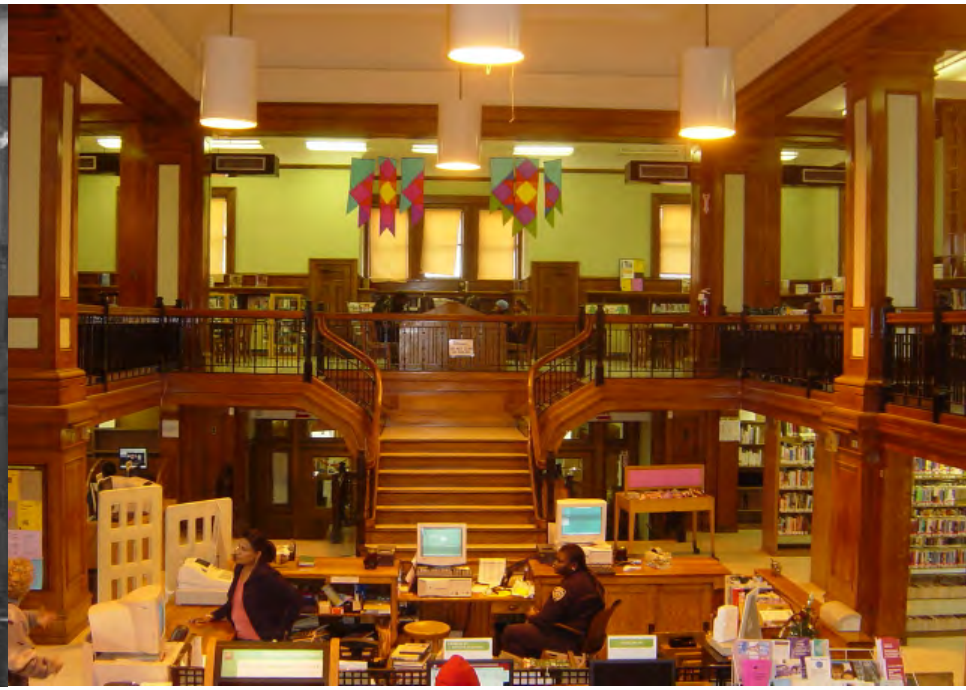
Case Study 2: Heating Concerns

BPL Arlington Branch Library

Electrification: 100% Air-Source VRF for Heating/Cooling (proposed)

East Branch Library c. 1914



Arlington Library c. 2009

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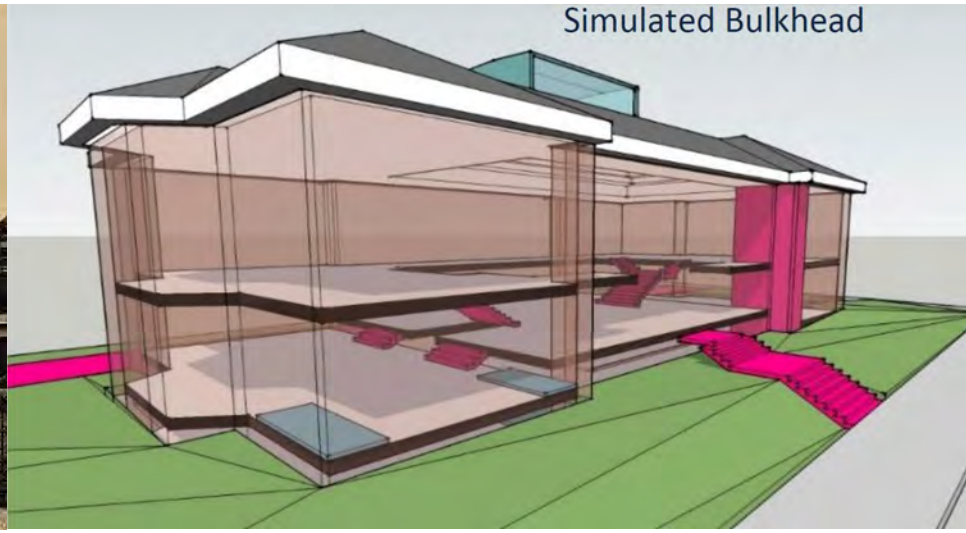
Case Study 2: Heating Concerns

BPL Arlington Branch Library

Enabling Conditions: Landmark

East Branch Library c. 1914



Conceptual HVAC Bulkhead at Former Skylight

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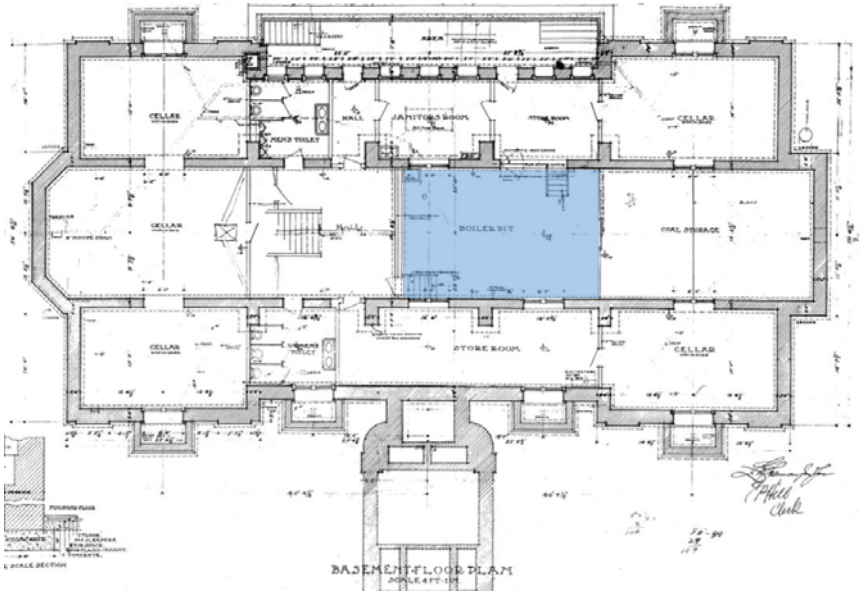
Case Study 2: Heating Concerns

BPL Arlington Branch Library

Enabling Conditions: Landmark + Space Constraints

Downsize Ductwork



Convert Boiler Pit to Community Room

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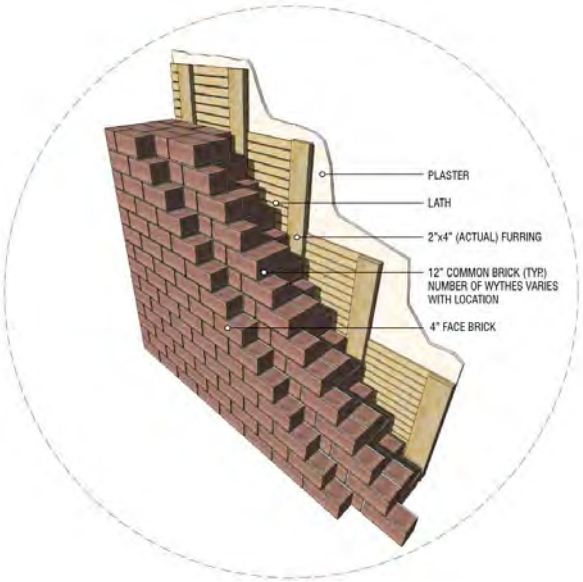
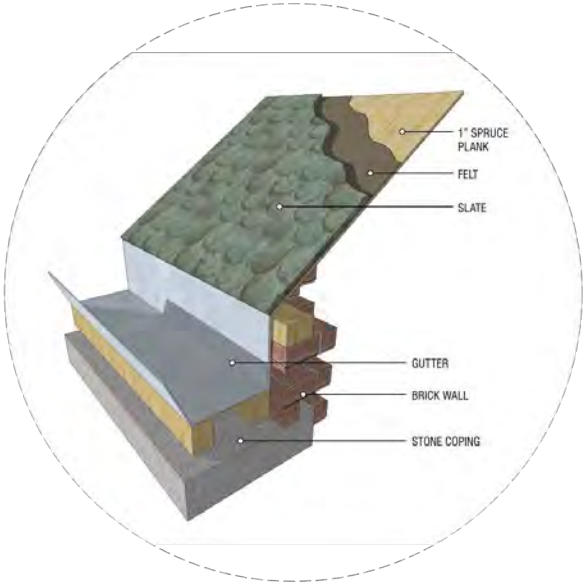
Case Study 2: Heating Concerns

BPL Arlington Branch Library

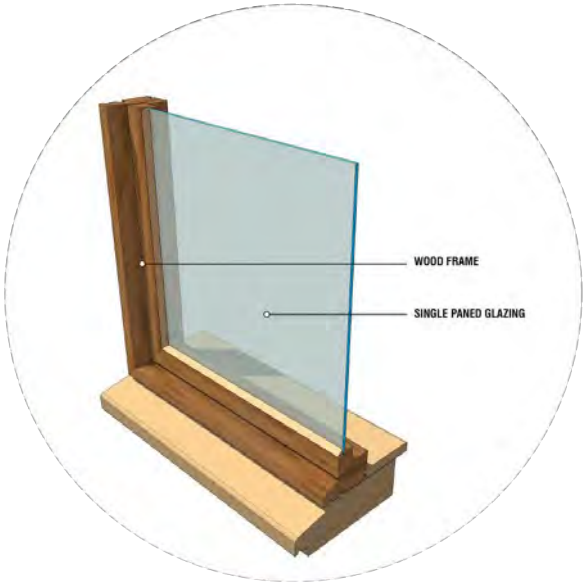
Enabling Conditions: Landmark + Space Constraints + Envelope Upgrade



Existing Wall



Existing Roof



Existing Window

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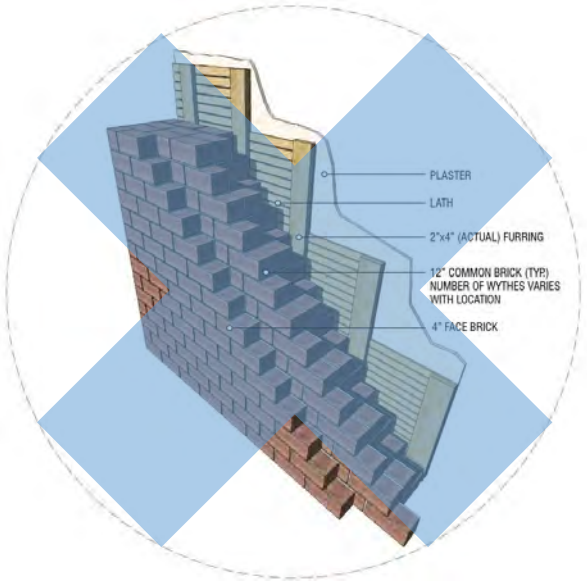
Case Study 2: Heating Concerns

BPL Arlington Branch Library

Enabling Conditions: Landmark + Space Constraints + Envelope Upgrade



Built-In Bookshelves Preclude Wall Insulation

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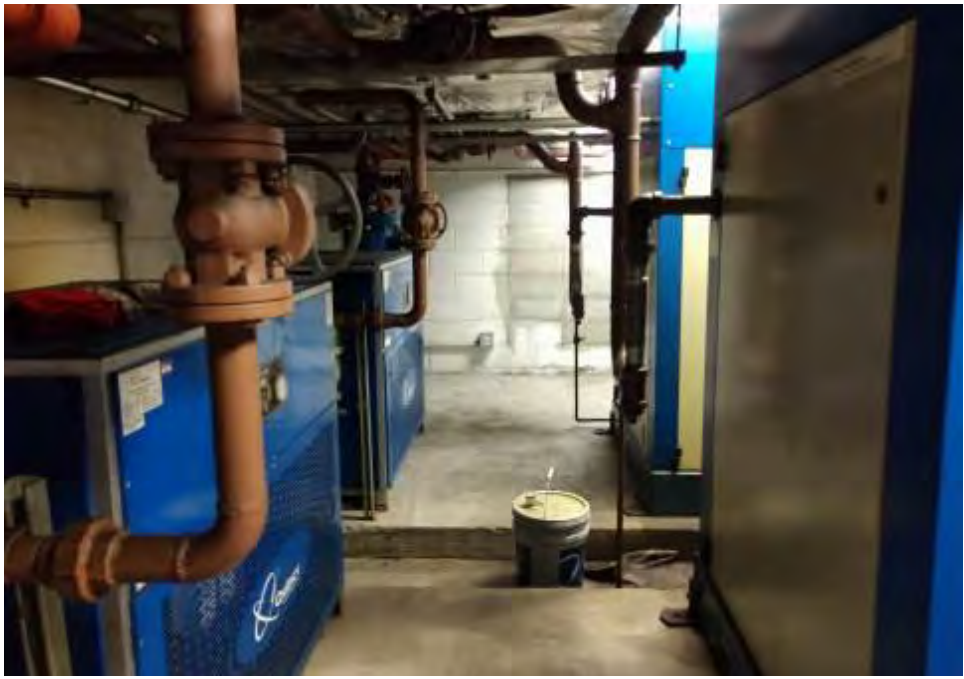
Case Studies: Heating Concerns

Other solutions to lingering concerns about meeting heating loads on design days:

- Envelope commissioning and airtightness testing
- Locate heat pumps in rooms with ambient waste heat
- Maximize ERV efficiency to preheat fresh air
- Add electric resistance coils to ducts (not preferred!)



Compressor Room at DSNY District 4/4A/7 Garage

Case Study 3: Geothermal Feasibility

Staten Island Museum at Snug Harbor Cultural Center

Electrification: Ground Source Heat Pump System for Heating/Cooling

Gluckman Tang Architects / Arup / P.W. Grosser Consulting

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Case Study 3: Geothermal Feasibility

Staten Island Museum at Snug Harbor Cultural Center

Enabling Conditions: Landmark Exterior

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Case Study 3: Geothermal Feasibility

Staten Island Museum at Snug Harbor Cultural Center

Enabling Conditions: Landmark Exterior + Landscape

Geothermal Field Installation

Post Installation

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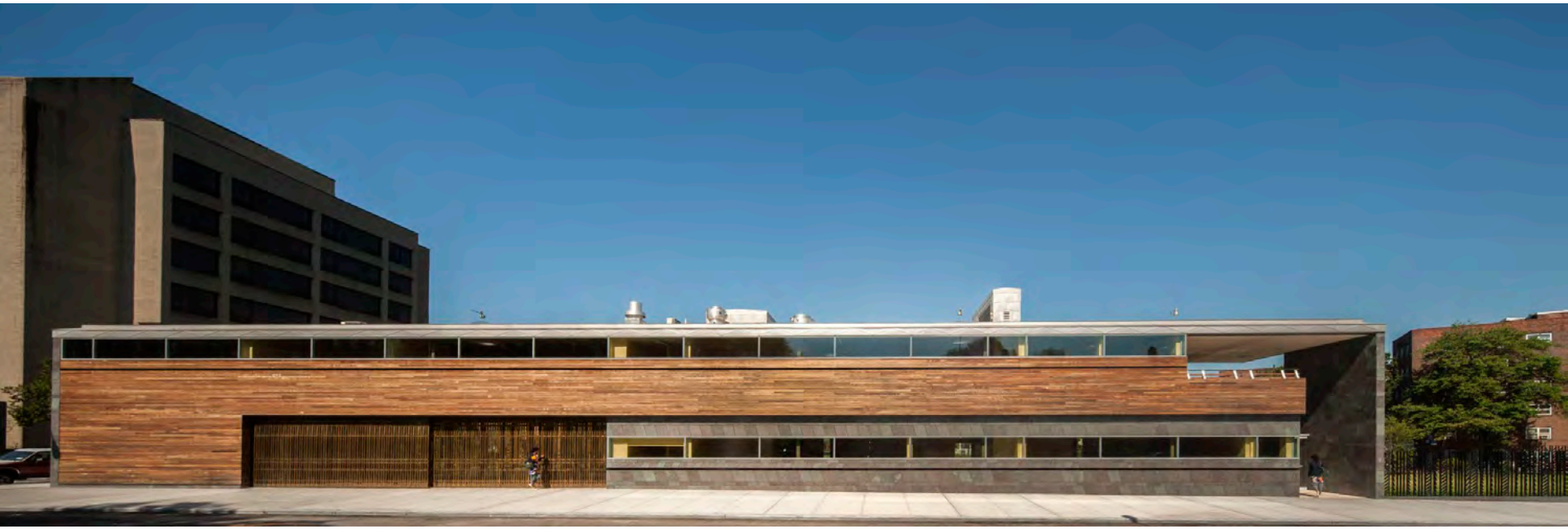
Case Study 4: Geothermal Feasibility

Weeksville Heritage Center

Electrification: Ground Source Heat Pump System for Heating/Cooling



Caples Jefferson Architects / Loring Consulting Engineers / P.W. Grosser Consulting

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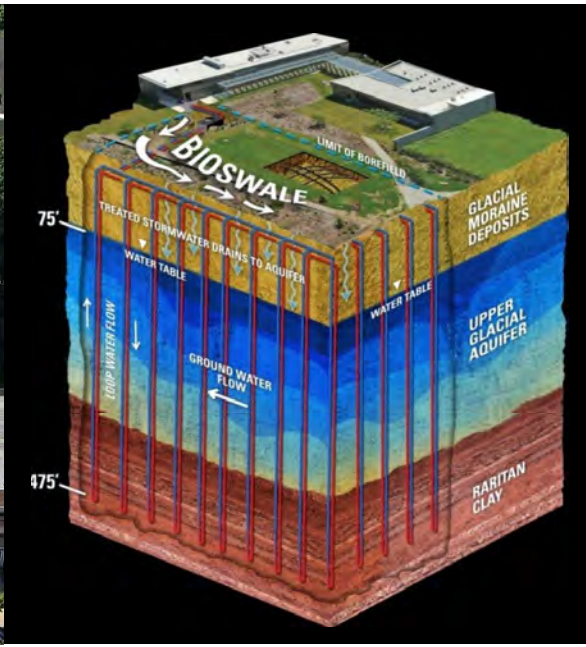
Case Study 4: Geothermal Feasibility

Weeksville Heritage Center

Enabling Conditions: Historical Landscape

Remnant of Hunterfly Road



Site Hydrology Concept

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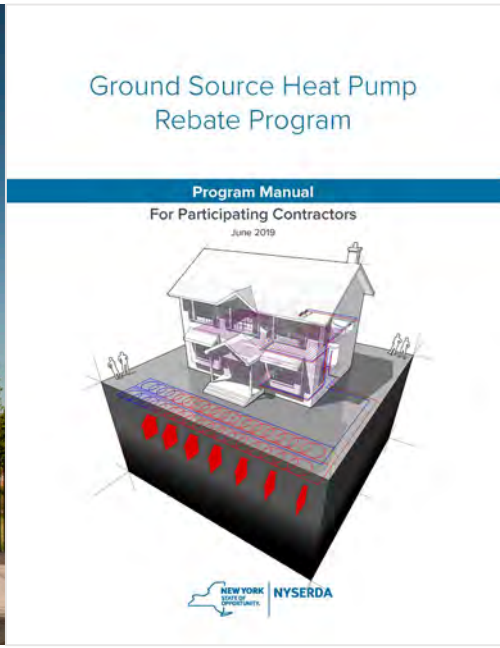
Case Study 4: Geothermal Feasibility

Weeksville Heritage Center

Enabling Conditions: Historical Landscape + Incentives Eligibility



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Case Studies: Geothermal Feasibility

Other conditions favoring geothermal in NYC municipal buildings (aside from hydrogeography):

- Limited access to gas infrastructure
- Similar-sized annual heating and cooling loads
- Sufficient site area accessible to drilling rig
- Pile foundations

Geothermal Pile Frame

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Case Study 5: Resiliency Concerns

Case Study: New NYPD Bomb Squad Facility

Electrification: 100% Air-Source VRF for Heating/Cooling

Rice + Lipka Architects / Plus Group Consulting Engineers

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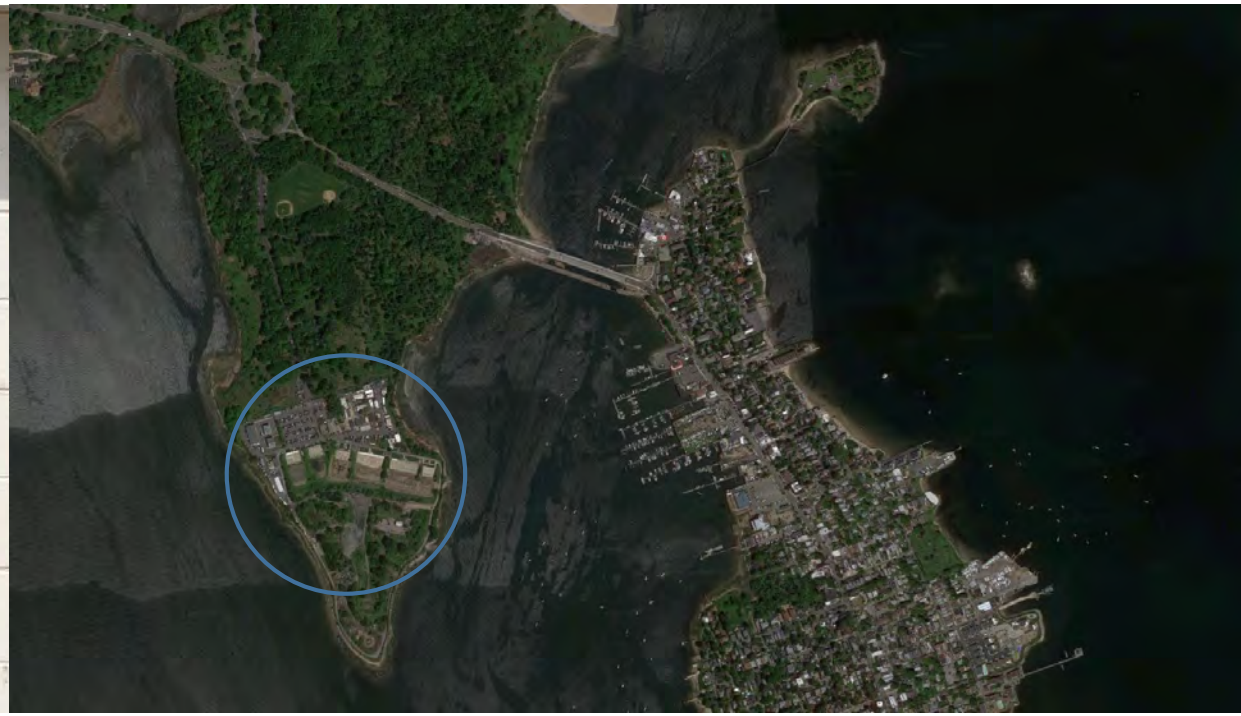
Case Study 5: Resiliency Concerns

Case Study: NYPD Bomb Squad Facility

Enabling Conditions: No Gas Infrastructure



NYPD Tactical Campus, Rodman's Neck

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Case Study 5: Resiliency Concerns

Case Study: NYPD Bomb Squad Facility

Enabling Conditions: No Gas Infrastructure + Space Constraints

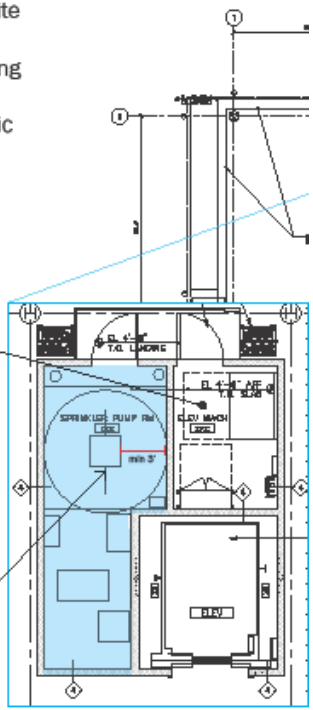
Option 1: VRF

Multiple hydrant flow tests at the site have revealed extremely low water pressure in the water main supplying the building, thus requiring the addition of a sprinkler and domestic water pump system to be added to the building.

1st Floor
Option with 80x50 ECMs

The 80x50 VRF system would replace the boiler system in the current design, allowing the elevator machine room to replace the oil tank room to accommodate the necessary size for the new sprinkler pump room without expanding the building core.

Pump requires room 3' clearance on all sides.

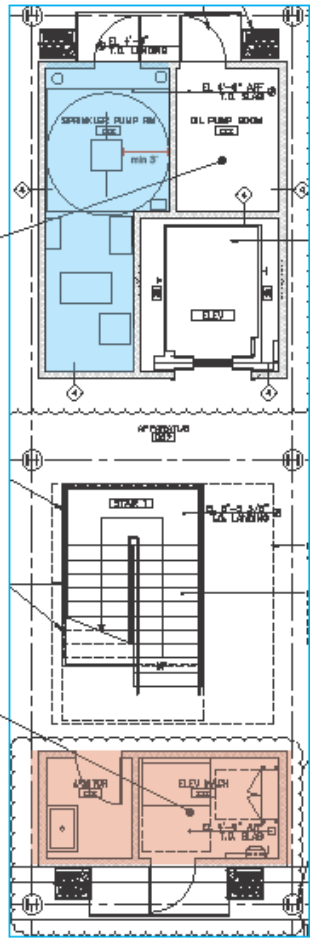


Option 2: Fuel Oil Boiler

1st Floor
Non 80x50 (Base Design) Option 2
EMR relocated to area south of stair

Without 80x50 the oil pump room needs to remain on the first floor mezzanine level. The ECM room must be relocated.

The elevator machine room could be located in the area south of the central stair (currently an open muster area.) Pipes would run overhead from this room to the hydraulic elevator.



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Case Study 6: Resiliency Concerns

DOHMH East Harlem Health Center

Electrification: 100% Air-Source VRF for Heating/Cooling (proposed)

Proposed Lobby Renovation

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Case Study 6: Resiliency Concerns

DOHMH East Harlem Health Center

Enabling Conditions: All-Electric Teaching Kitchen

Teaching Kitchen Concept

Neighborhood Health Action Center Cooking Class

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Case Study 6: Resiliency Concerns

DOHMH East Harlem Health Center

Enabling Conditions: All-Electric Teaching Kitchen + Emergency Power

Smoothie Bike and Charging Station

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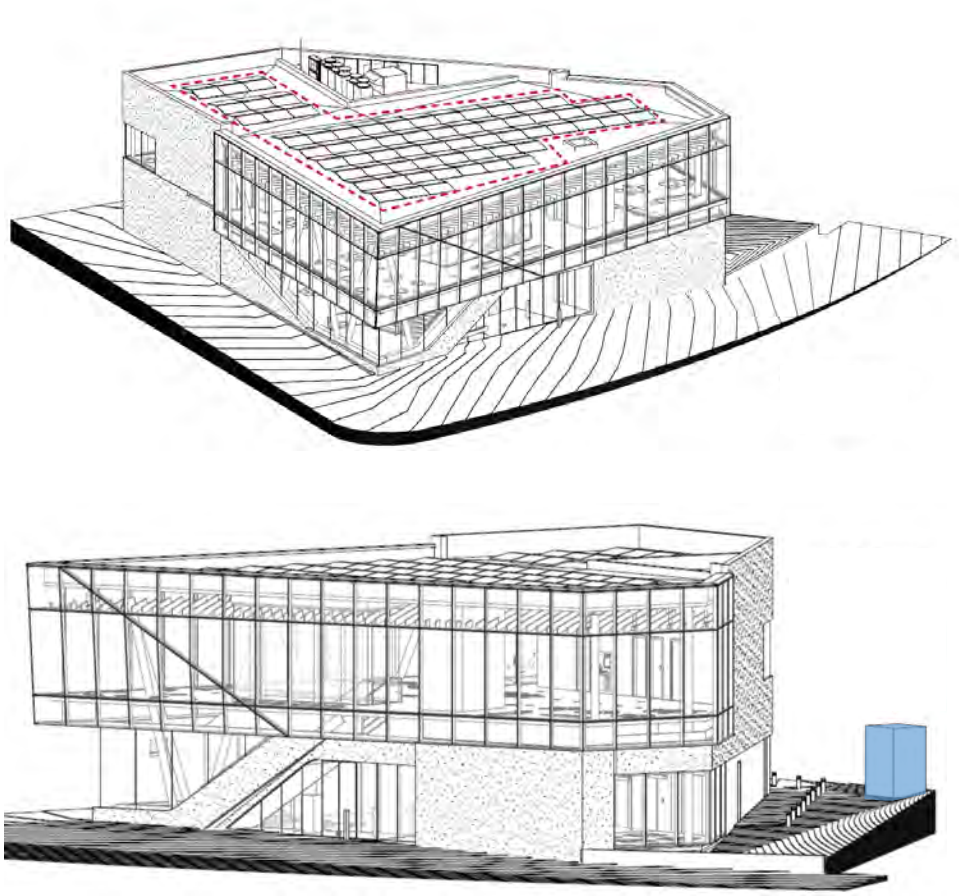
Case Study 6: Resiliency Concerns

Other solutions to concerns about maintaining heat during disruption in electrical service:

- Size emergency generators to power heat trace
- Size emergency generators to maintain minimal interior temperature (easy for geothermal)
- Battery or thermal storage



Proposed Li-ion Battery at Westchester Square Library

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Case Study 7: Refrigerant Management

DCAS Staten Island Campus

Electrification: 100% Water-Source VRF for Heating/Cooling (proposed)

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Case Study 7: Refrigerant Management

DCAS Staten Island Campus

Enabling Conditions: Landmark

Judicial Center
1961

Supreme Courthouse
1913-1919

Borough Hall
1904-1906

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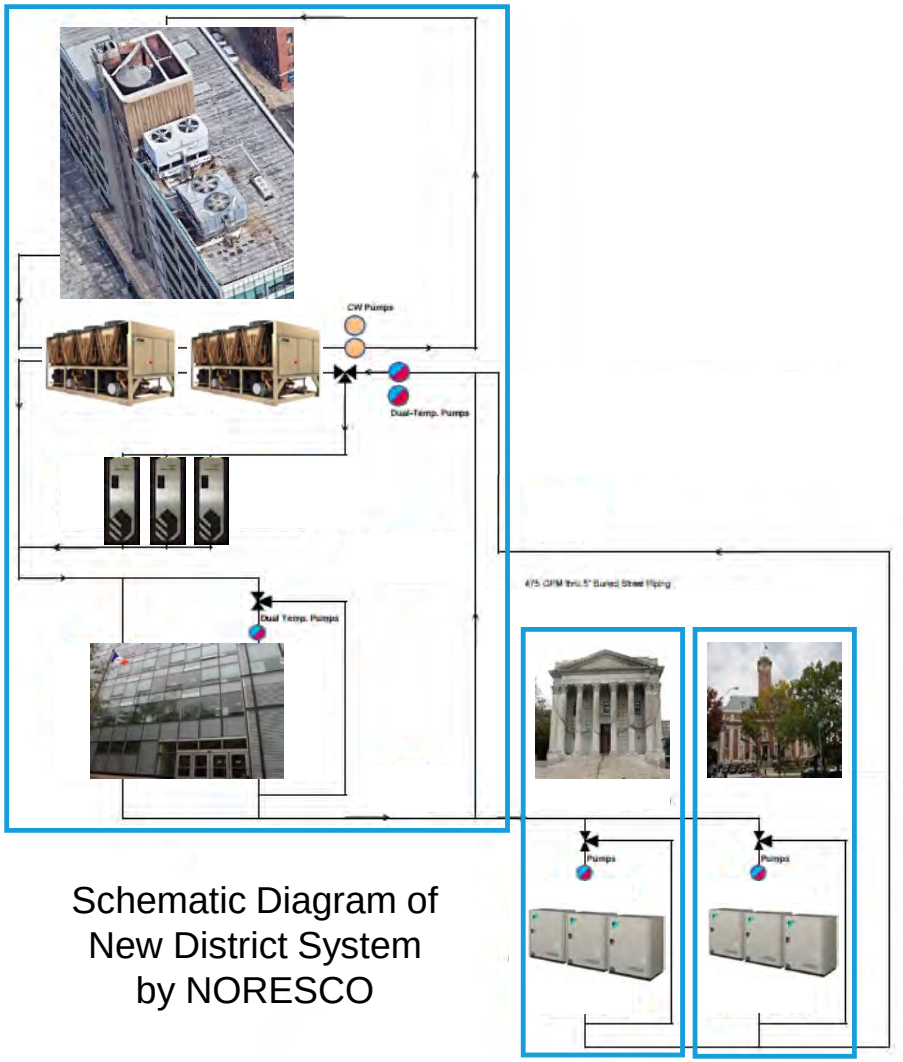
Case Study 7: Refrigerant Management

DCAS Staten Island Campus

Enabling Conditions: Landmark Served by New District System Housed in Modern Neighbor

- New cooling tower, chillers, condensing boilers located in Judicial Center
- HHW / CHW runs beneath street to water-source VRF units at Borough Hall and Supreme Courthouse



Schematic Diagram of New District System by NORESCO

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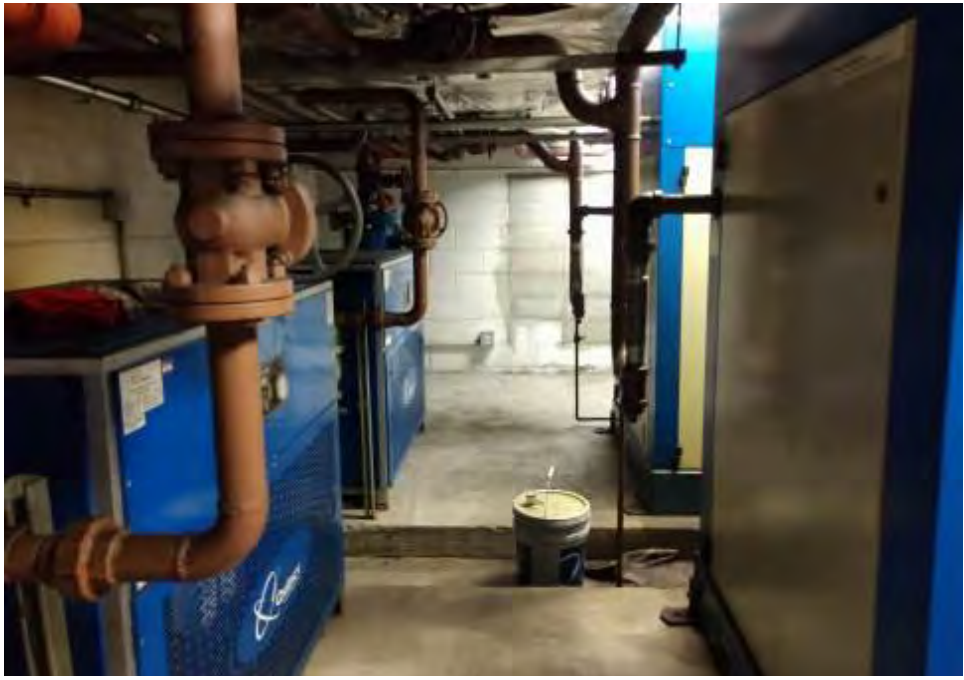
Case Studies: Refrigerant Management

Other solutions to lingering concerns about refrigerant leakage:

- Circulate HHW / CHW instead of refrigerant
- Zone refrigerant distribution to allow for targeted shutdown
- Better maintenance contracts
- Double-pipe (not preferred!)



Compressor Room at DSNY District 4/4A/7 Garage

Summary of Capital Scale Projects

- Currently, electrification of NYC municipal buildings is opportunistic
- Moving toward a more prescriptive approach for some typologies as we implement solutions to common concerns
- Ultimately, some typologies will be 100% electrified, while the majority of the portfolio will likely see partial electrification
- Much of the work will have to be incremental as buildings must remain in service
- Eager to demonstrate innovative solutions

Drivers of Incremental Electrification in Smaller Municipal Projects

Expense Projects and 1:1 Retrofits

- Capital isn’t all we do!
  - Expense funded retrofits are a large portion of our VRF portfolio
  - What is Expense vs. Capital?
- Case studies
  - Brooklyn Public Library
  - DCAS Facilities Management
- Focus on small scale building portfolios and equipment at end of life
- Installation with in-house teams
  - Train the trainer
  - Relationship with manufacturer
- Focus on partial building electrification allows us a later opportunity to downsize central systems with capital dollars

Expense Projects and 1:1 Retrofits

- Capital isn't all we do!
  - Expense funded retrofits are a large portion of our VRF portfolio
  - What is Expense vs. Capital?
- Case studies
  - Brooklyn Public Library
  - DCAS Facilities Management → ~250 tons in 25 buildings
- Focus on small scale building portfolios and equipment at end of life
- Installation with in-house teams
  - Train the trainer
  - Relationship with manufacturer
- Focus on partial building electrification allows us a later opportunity to downsize central systems with capital dollars

Expense Projects and 1:1 Retrofits

- Connections to the marketplace are difficult due to contracting, however, procurement is just the first hurdle…
  - Workforce Development → in-house and contractor availability
  - Long term maintenance questions + refrigerant uncertainty
  - Products aren't new, but change is slow
  - What do we have and where do we have it? Fully non-invasive retrofits aren't in the market as of yet

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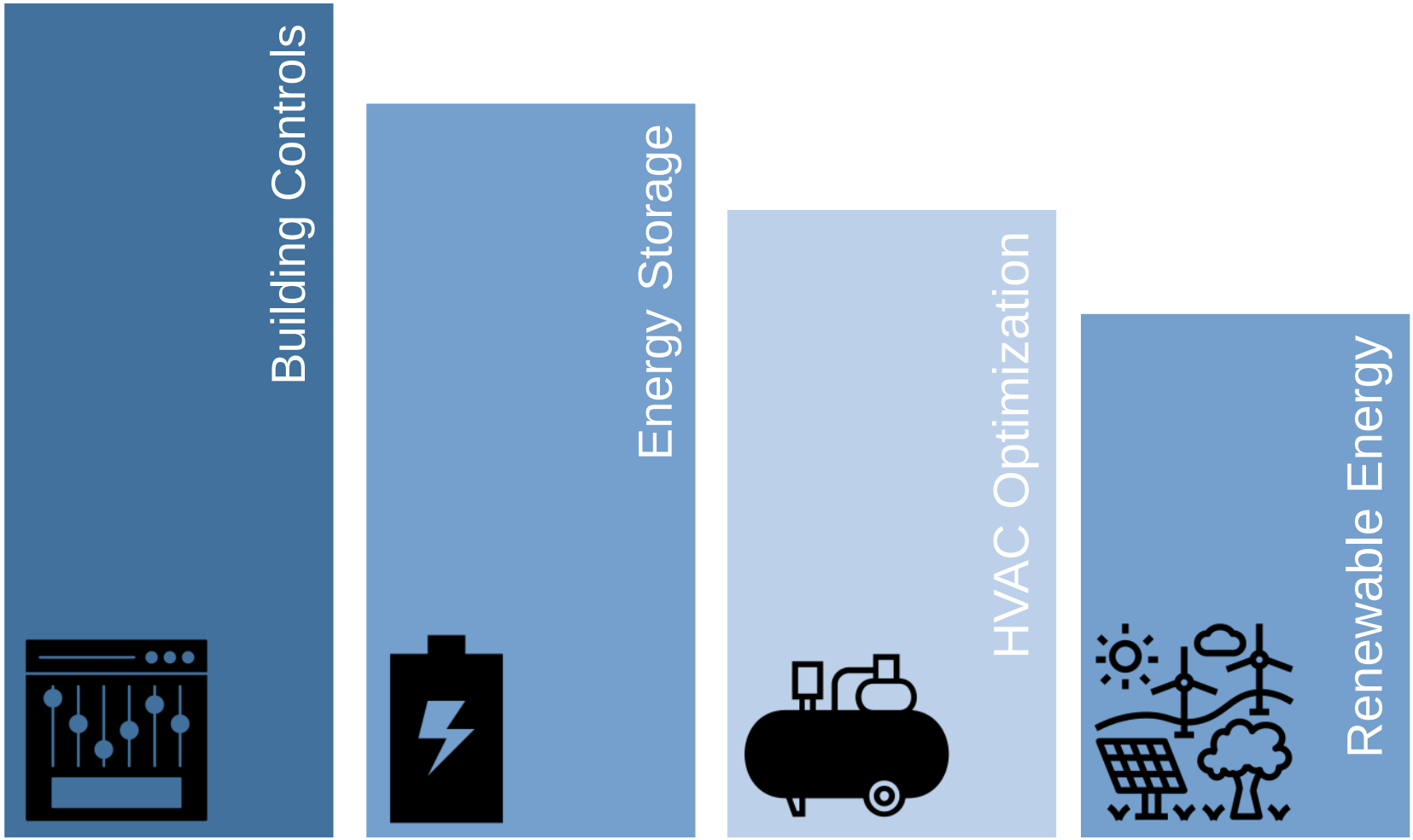
Potential Market Opportunities

New Technology Demonstrations + IDEA



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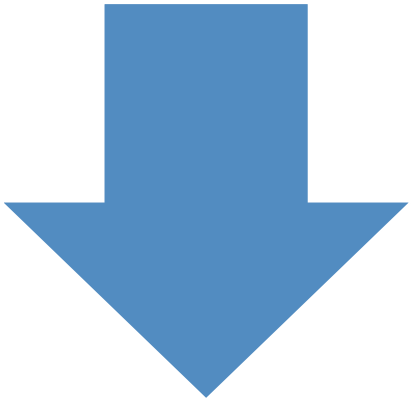
Facilities and Technologies



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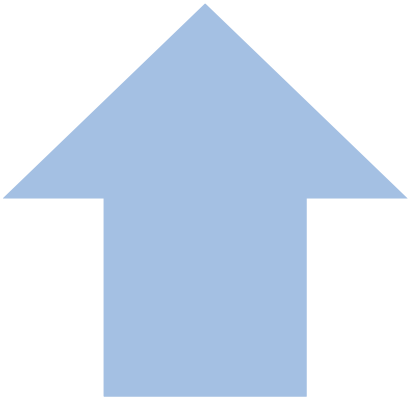

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