Agenda

• 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

CITYWIDE 80X50

GOVERNMENT OPERATIONS 50X30
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
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
A Diverse Portfolio of Municipal Buildings

4,600+ Buildings

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

DCAS
A Diverse Portfolio of Municipal Buildings

4,600+ Buildings

Decarbonization Opportunities!
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
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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- L119-2005  Environmentally preferable purchasing
- LL87-2009  Implement ECMs with payback ≤ 7 years
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- 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

<table>
<thead>
<tr>
<th>Feasibility</th>
<th>Standing Column Well</th>
<th>Closed Loop Open Loop***</th>
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</thead>
<tbody>
<tr>
<td>Geothermal System</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Geological and Technical Suitability (Yes/No)</td>
<td>No</td>
<td>Yes</td>
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<tr>
<td>Potential Capacity (Tons)</td>
<td>22</td>
<td>46</td>
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<tr>
<td>Full System Feasible (Yes/No)</td>
<td>No</td>
<td>No</td>
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<tr>
<td>Hybrid System Feasible (Yes/No)</td>
<td>No</td>
<td>Yes</td>
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<tr>
<td>Carbon Footprint Reduction (Tons CO2e)</td>
<td>11</td>
<td>11</td>
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<tr>
<td>Annual Cost of Carbon ($)</td>
<td>0</td>
<td>1,501, 1,499</td>
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<tr>
<td>Annual Potential Savings with Geothermal System ($)</td>
<td>0</td>
<td>3,164, 3,156</td>
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<td>Projected incremental Payback with Carbon Credit (Years)</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>Projected incremental Payback without Carbon Credit (Years)</td>
<td>15</td>
<td>12</td>
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</table>

Screenshot from DDC Geothermal Webtool
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.

<table>
<thead>
<tr>
<th>Social Cost of Carbon ($ / MTCO2e)</th>
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<tbody>
<tr>
<td>2017</td>
<td>$128</td>
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<tr>
<td>2018</td>
<td>$132</td>
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<tr>
<td>2019</td>
<td>$136</td>
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<tr>
<td>2020</td>
<td>$140</td>
</tr>
<tr>
<td>2021</td>
<td>$142</td>
</tr>
<tr>
<td>2022+</td>
<td>TBD</td>
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</table>
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

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

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

LEED v4 Energy & Atmosphere Credits
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

<table>
<thead>
<tr>
<th>Case Studies</th>
<th>LL84 Target</th>
<th>ASHRAE Target</th>
<th>2030 Target</th>
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</thead>
<tbody>
<tr>
<td>Westchester Square Library</td>
<td>103.2</td>
<td>60.2</td>
<td>38.0 (new)</td>
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<tr>
<td>Libraries</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Woodstock Library</td>
<td>46.1</td>
<td>46.1</td>
<td>42.0 (exg)</td>
</tr>
<tr>
<td>Libraries</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bergen Building</td>
<td>91.5</td>
<td>37.6</td>
<td>42.0 (exg)</td>
</tr>
<tr>
<td>Offices</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glenmore Building</td>
<td>38.7</td>
<td>38.7</td>
<td>42.0 (exg)</td>
</tr>
<tr>
<td>Glenmore Building</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spring Street Garage</td>
<td>111.4</td>
<td>45.8</td>
<td>38.0 (new)</td>
</tr>
<tr>
<td>Repair Garages</td>
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<td></td>
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<tr>
<td>Queens 7 Garage</td>
<td>49.3</td>
<td>42.0 (exg)</td>
<td></td>
</tr>
</tbody>
</table>
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
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)
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
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.

29% emission reductions achieved between FY06 and FY17.

- Buildings
- Streetlights and Traffic Signals
- Water Supply
- Fugitive and Process Emissions
- Transportation
- Wastewater Treatment
- Solid Waste Facilities


Emissions in MT

- 40x25
- 50x30
- 80x50
Will it drive electrification?

Eventually.

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

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
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
Case Study 1: Heating Concerns

NYPL Westchester Square Branch Library

Enabling Conditions: Backup Heating
Case Study 1: Heating Concerns

NYPL Westchester Square Branch Library

Enabling Conditions: Backup Heating + Envelope Upgrade

Upgraded Envelope Performance
Case Study 2: Heating Concerns

BPL Arlington Branch Library

Electrification: 100% Air-Source VRF for Heating/Cooling (proposed)
Case Study 2: Heating Concerns

BPL Arlington Branch Library

Enabling Conditions: Landmark

East Branch Library c. 1914

Conceptual HVAC Bulkhead at Former Skylight
Case Study 2: Heating Concerns

BPL Arlington Branch Library

Enabling Conditions: Landmark + Space Constraints
Case Study 2: Heating Concerns

BPL Arlington Branch Library

Enabling Conditions: Landmark + Space Constraints + Envelope Upgrade
Case Study 2: Heating Concerns

BPL Arlington Branch Library

Enabling Conditions: Landmark + Space Constraints + Envelope Upgrade

Built-In Bookshelves Preclude Wall Insulation
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
Case Study 3: Geothermal Feasibility

Staten Island Museum at Snug Harbor Cultural Center

Enabling Conditions: Landmark Exterior
Case Study 3: Geothermal Feasibility

Staten Island Museum at Snug Harbor Cultural Center

Enabling Conditions: Landmark Exterior + Landscape

Geothermal Field Installation

Post Installation
Case Study 4: Geothermal Feasibility

Weeksville Heritage Center

Electrification: Ground Source Heat Pump System for Heating/Cooling
Case Study 4: Geothermal Feasibility

Weeksville Heritage Center

Enabling Conditions: Historical Landscape

Remnant of Hunterfly Road

Site Hydrology Concept
Case Study 4: Geothermal Feasibility

Weeksville Heritage Center

Enabling Conditions: Historical Landscape + Incentives Eligibility
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
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
Case Study 5: Resiliency Concerns

Case Study: NYPD Bomb Squad Facility

Enabling Conditions: No Gas Infrastructure

NYPD Tactical Campus, Rodman’s Neck
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.
Case Study 6: Resiliency Concerns

DOHMH East Harlem Health Center

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

Proposed Lobby Renovation
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
Case Study 6: Resiliency Concerns

DOHMH East Harlem Health Center

Enabling Conditions: All-Electric Teaching Kitchen + Emergency Power

Smoothie Bike and Charging Station
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
Case Study 7: Refrigerant Management

DCAS Staten Island Campus

Electrification: 100% Water-Source VRF for Heating/Cooling (proposed)
Case Study 7: Refrigerant Management

DCAS Staten Island Campus
Enabling Conditions: Landmark

Judicial Center
1961

Supreme Courthouse
1913-1919

Borough Hall
1904-1906
**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
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
Potential Market Opportunities
New Technology Demonstrations + IDEA

- Building Controls
- Energy Storage
- HVAC Optimization
- Renewable Energy
Facilities and Technologies

30

50

50

DCAS
Innovation across the City

Challenge to the Market

Nascent Technology

RFI to Manufacturers

IDEA Program
Innovation across the City

Challenge to the Market

Nascent Technology

RFI to Manufacturers

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RFI to Manufacturers

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THANK YOU

IS HIRING!

DCAS

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