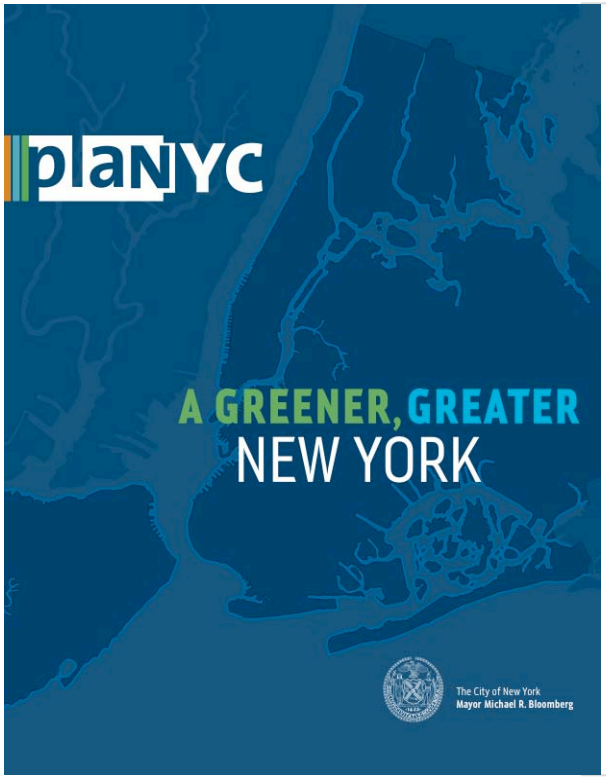
Thermal Energy in NYC
Implications and Opportunities

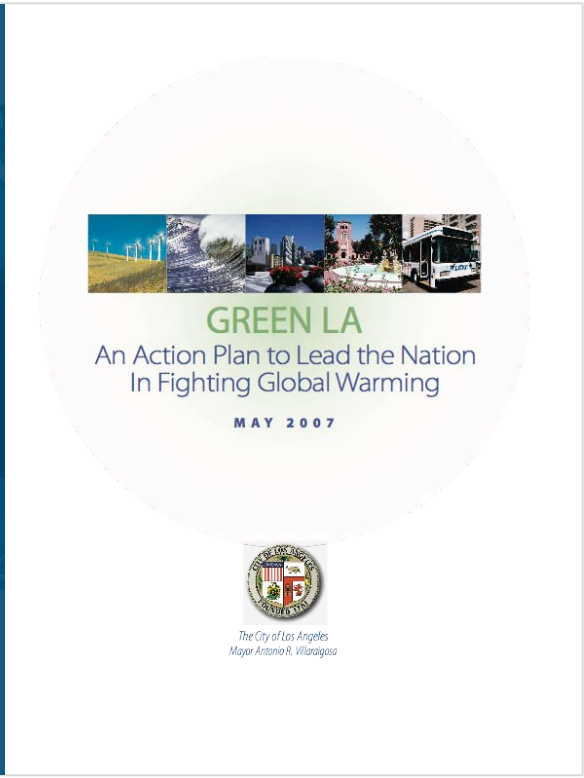
Bianca Howard

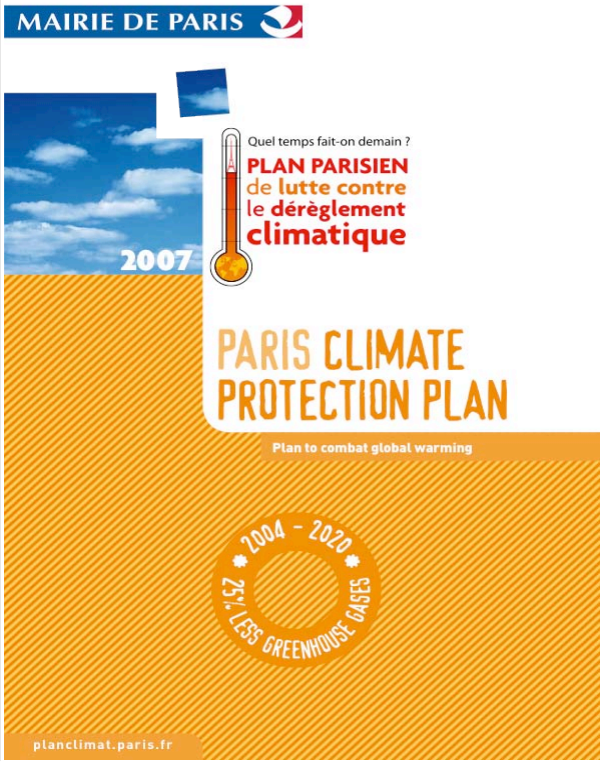
Ph.D. Candidate – Mechanical Engineering

Columbia University

What are we trying to achieve?



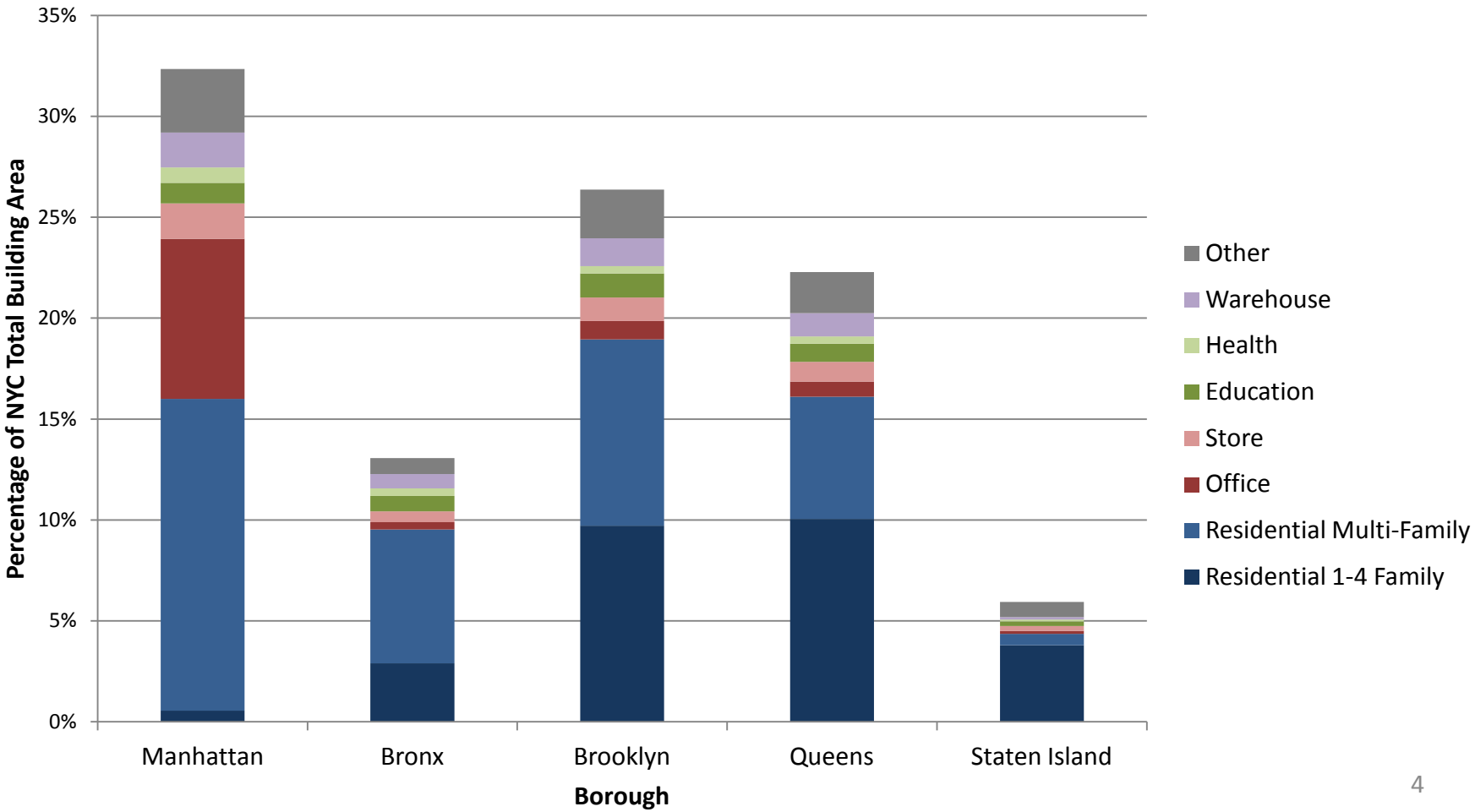




Estimation of New York City Building Energy Consumption

Building and Energy Data Sources

- Zip code level energy consumption
- Tax lot level building size and type



Estimation Method

Two Robust Multiple Linear Regressions

$$energy = \beta_1 x_1 + \beta_2 x_2 + \mathrm{K} + \beta_n x_n$$

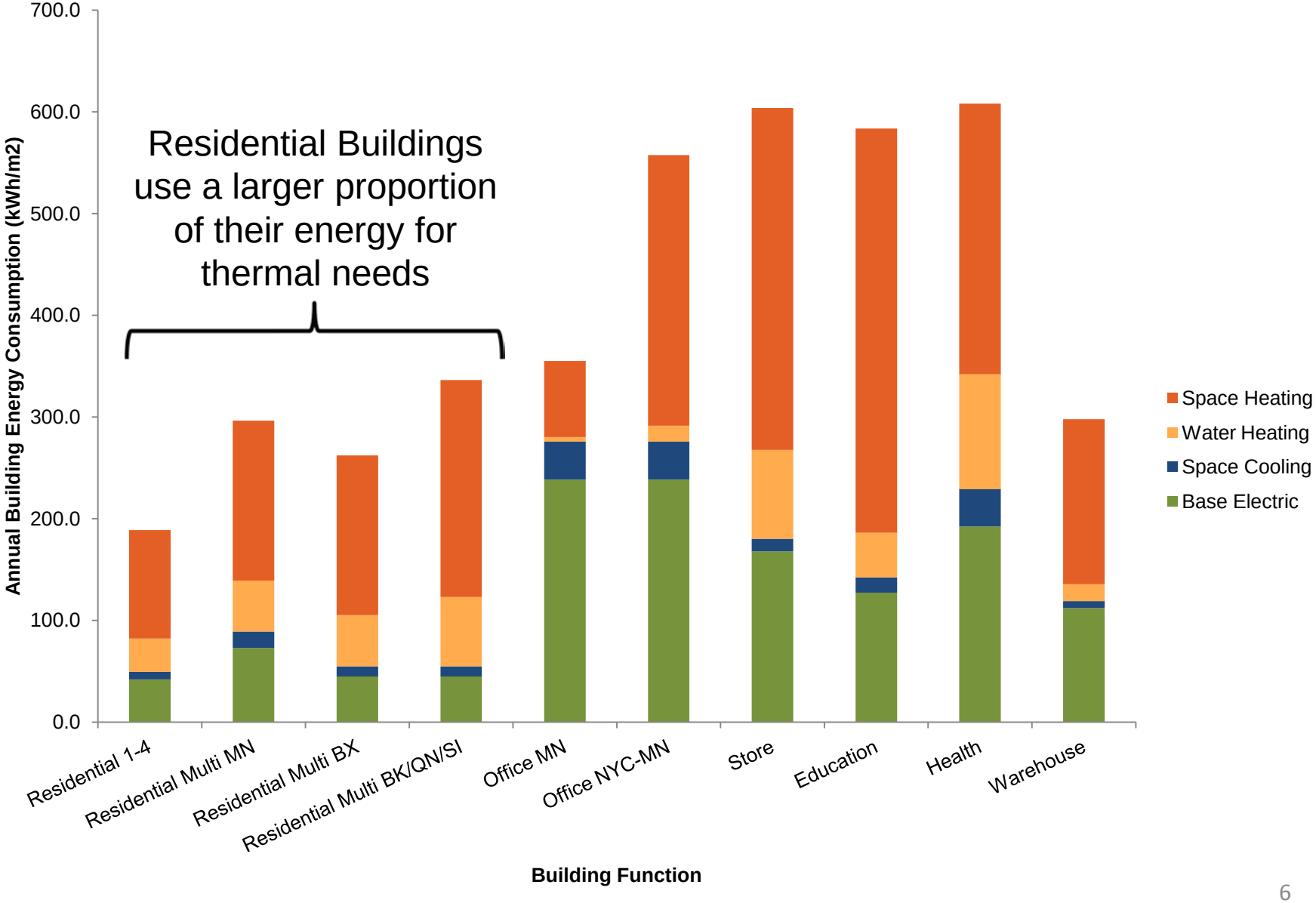
Electricity or Total Fuel

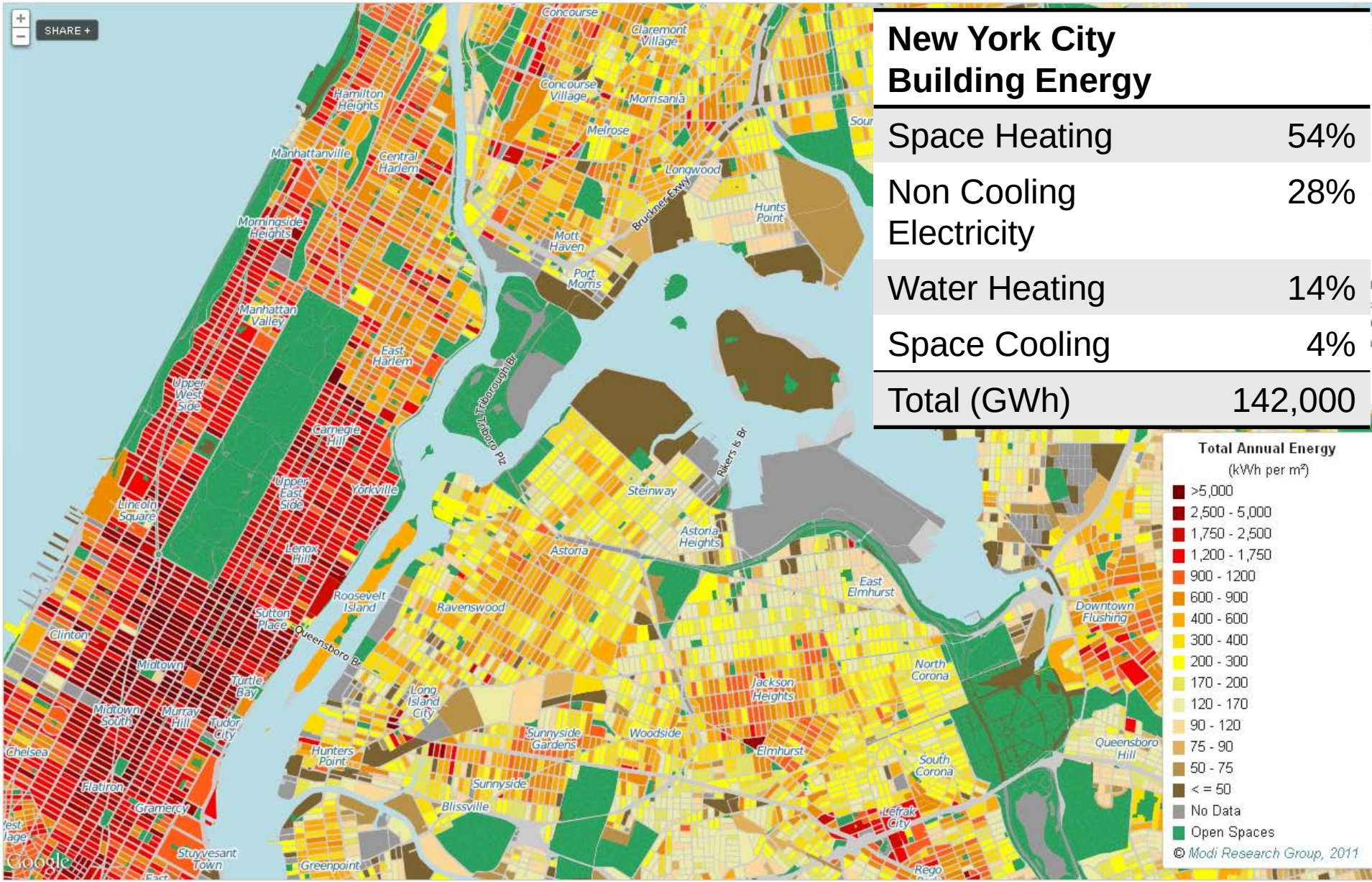
Estimated Energy per square foot of residential building area

Residential building area

End use broken out using RECS and CBECS

Resulting Annual Energy Consumption Intensities





New York City Building Energy	
Space Heating	54%
Non Cooling Electricity	28%
Water Heating	14%
Space Cooling	4%
Total (GWh)	142,000

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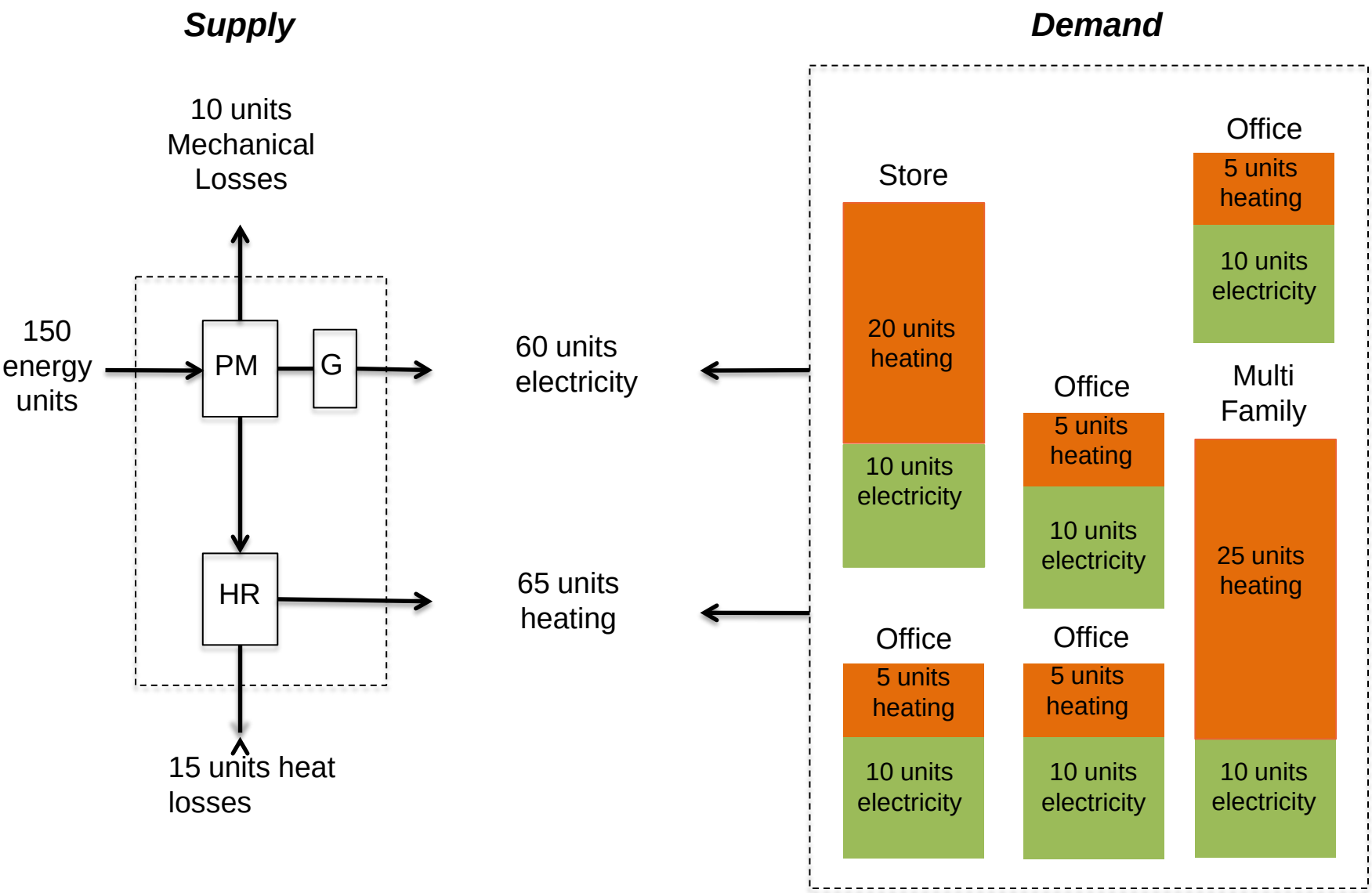
Potential for District CHP in NYC



CHP Sizing Methodologies

Electric Dispatch

- Peak Power
- 100% Utilization (Base Load)

Thermal Dispatch

- Peak Thermal Load
- 50% Thermal Utilization

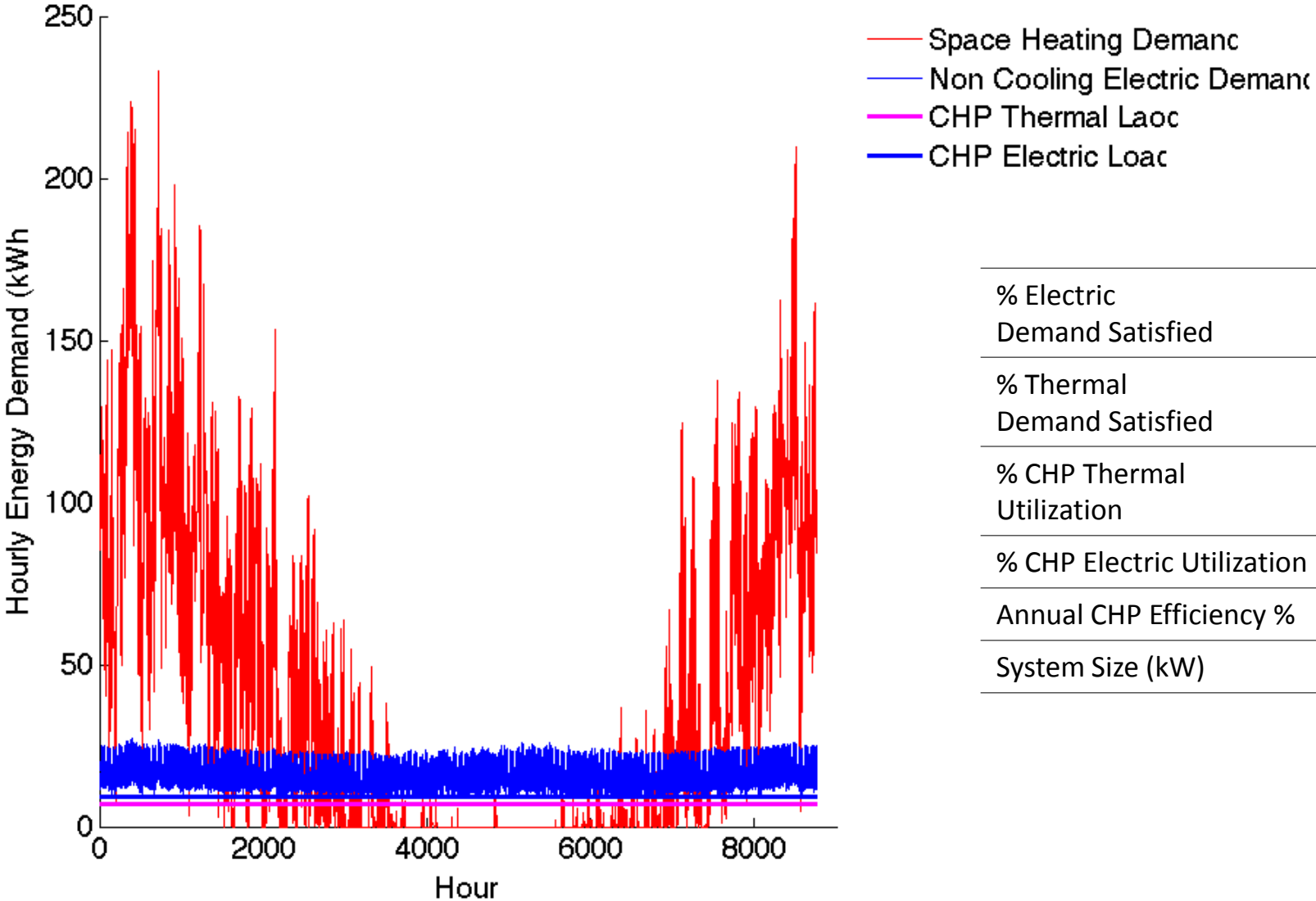
Maintain CHP Efficiency

- NYSERDA 60%

Economic Dispatch

- Run system to offset peak power
- May turn off the system (helps with annual efficiency as well)
- May not have high thermal utilization

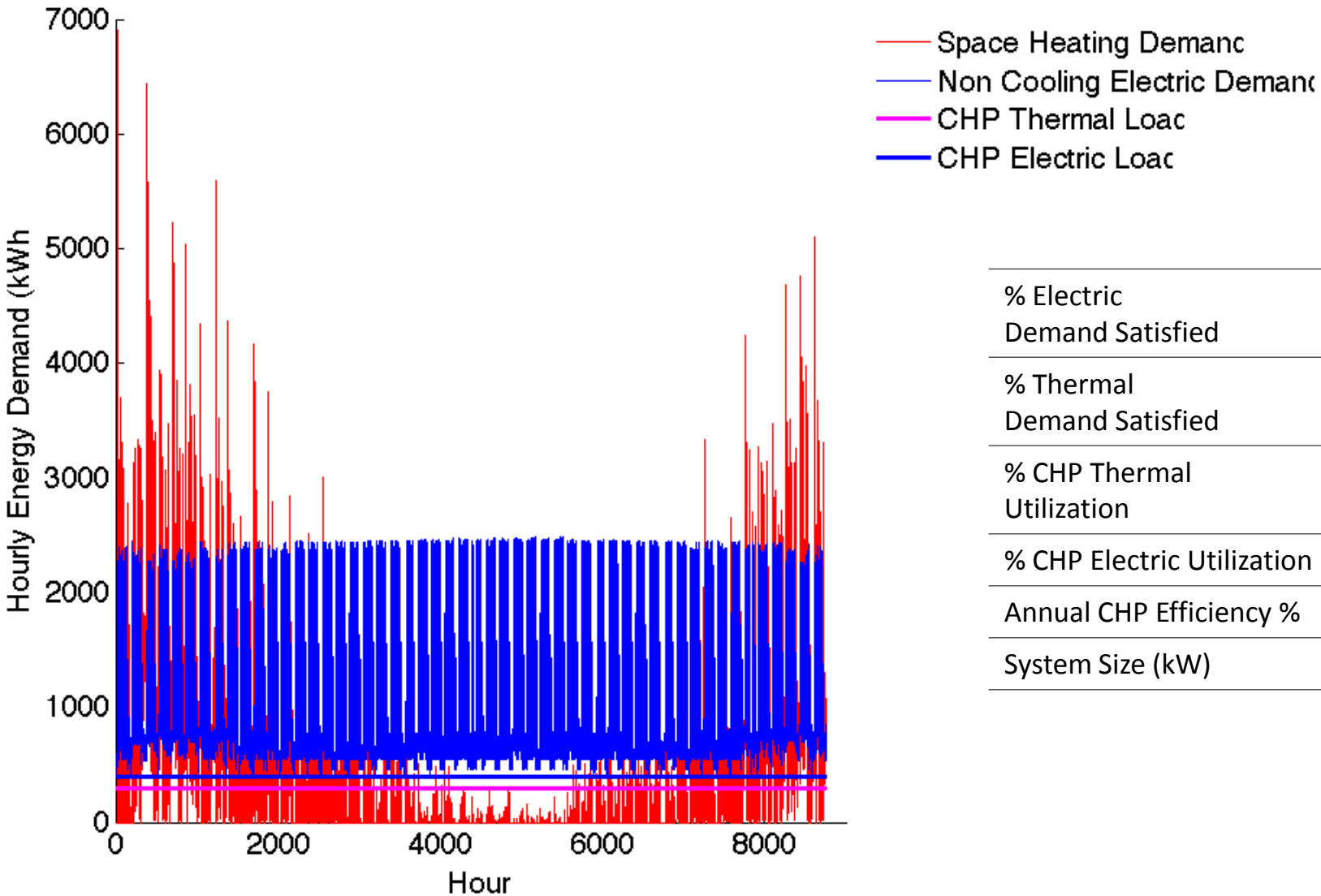
Multi Family Residential Building- **Electric Dispatch**



% Electric Demand Satisfied	62
% Thermal Demand Satisfied	12
% CHP Thermal Utilization	55
% CHP Electric Utilization	100
Annual CHP Efficiency %	60.6
System Size (kW)	16

Building Size: 33,640 sq.ft.

Office Building – **Electric Dispatch**



% Electric Demand Satisfied	31
% Thermal Demand Satisfied	32
% CHP Thermal Utilization	43
% CHP Electric Utilization	100
Annual CHP Efficiency %	57
System Size (kW)	395

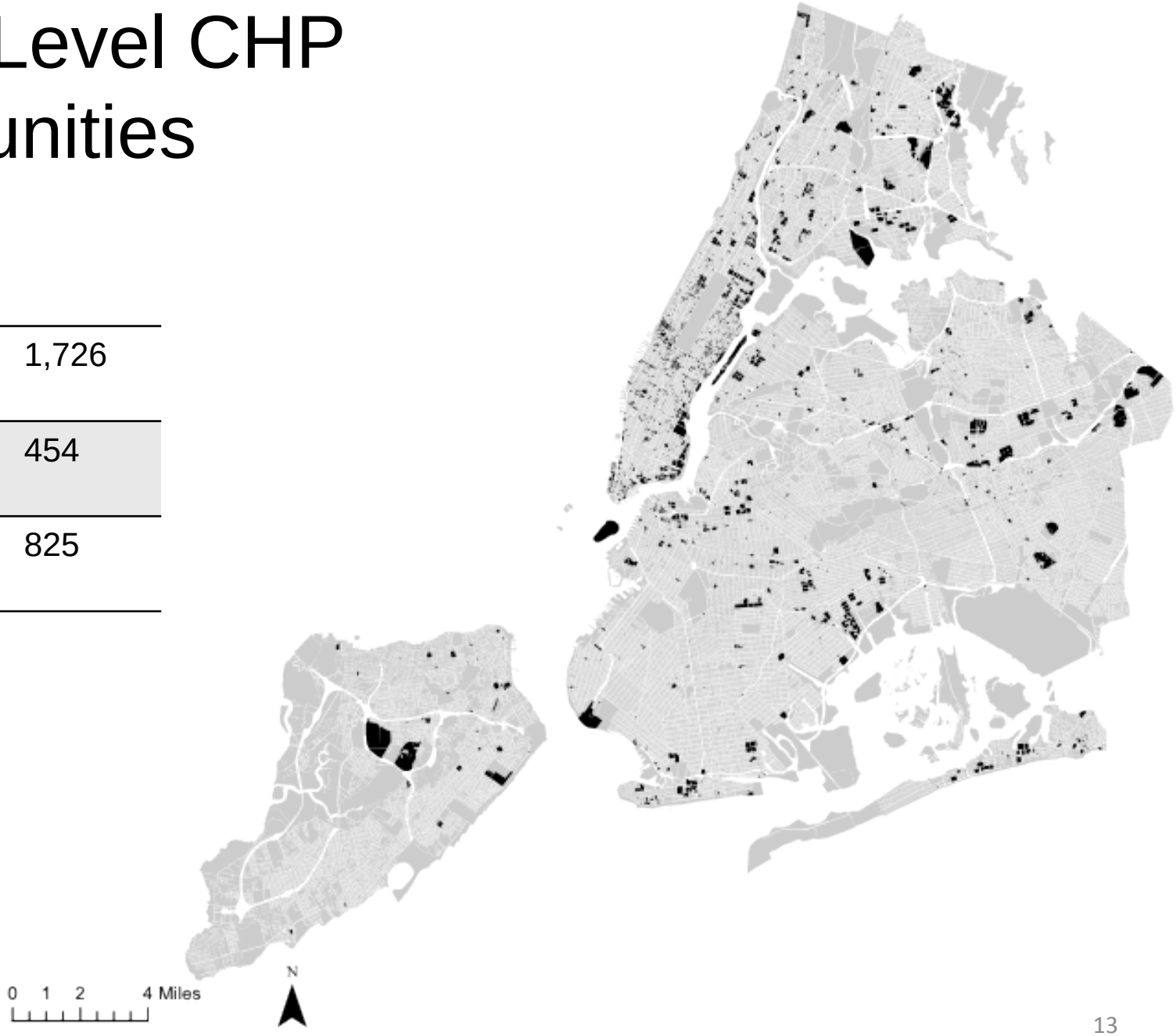
Building Size: 498,588 sq.ft.

Preliminary Analysis Assumptions

Loads considered:	Non-cooling electricity demand Space Heating demand
Sizing Method:	Minimum Electric Load
CHP Characteristics:	Heat to Electric Ratio = 1:2 CHP Efficiency = 72%-87% (Smaller systems have lower efficiencies and higher heat to electric ratios)
Viability:	CHP Electric Capacity > 30kW Annual CHP efficiency > 60%

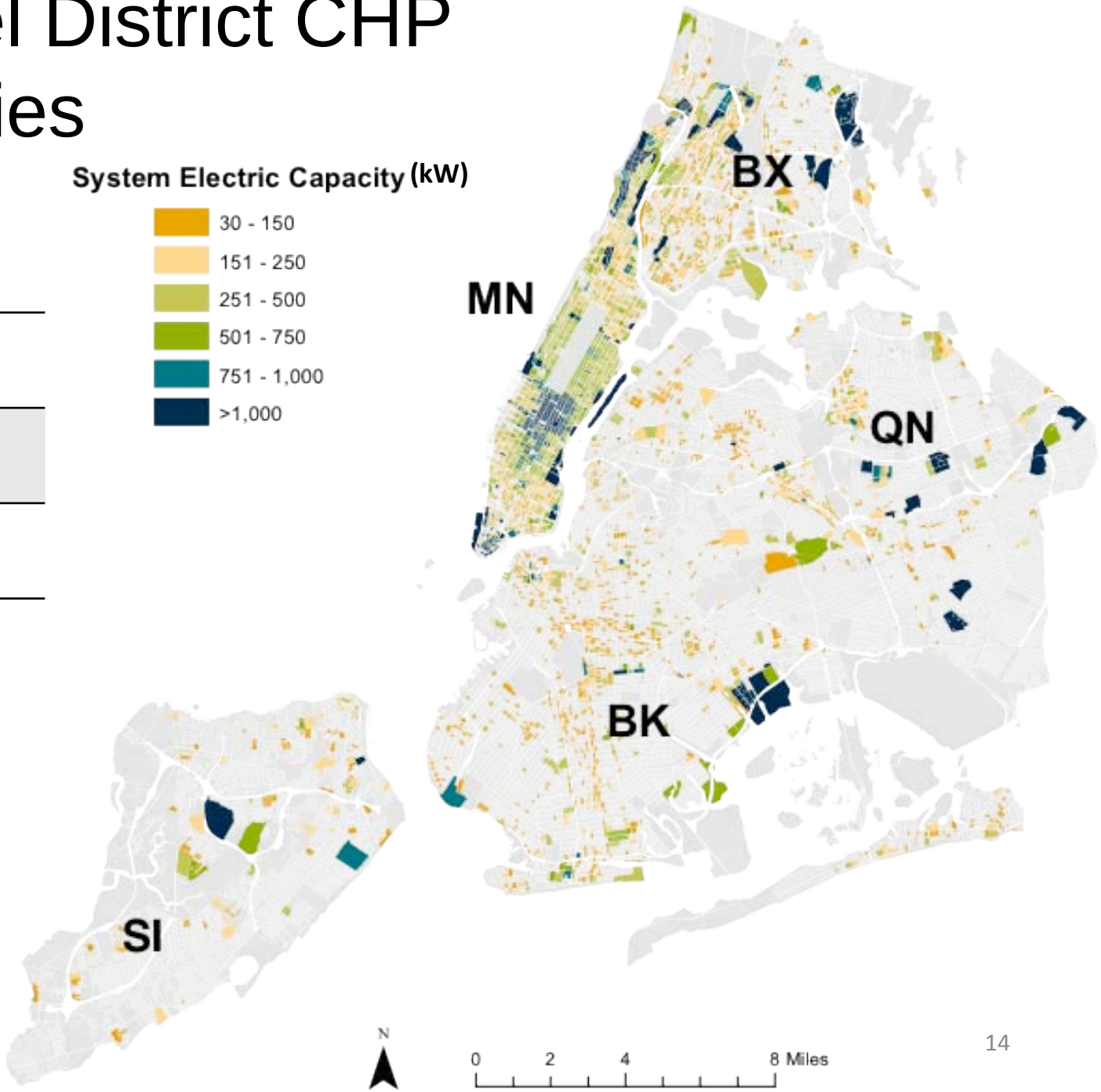
Tax lot Level CHP Opportunities

Number of Systems	1,726
Total Capacity (MW_e)	454
Built Area (M sq.ft)	825



Block Level District CHP Opportunities

Number of Systems	3,492
Total Capacity (MW_e)	1,262
Built Area (M sq.ft)	2,603

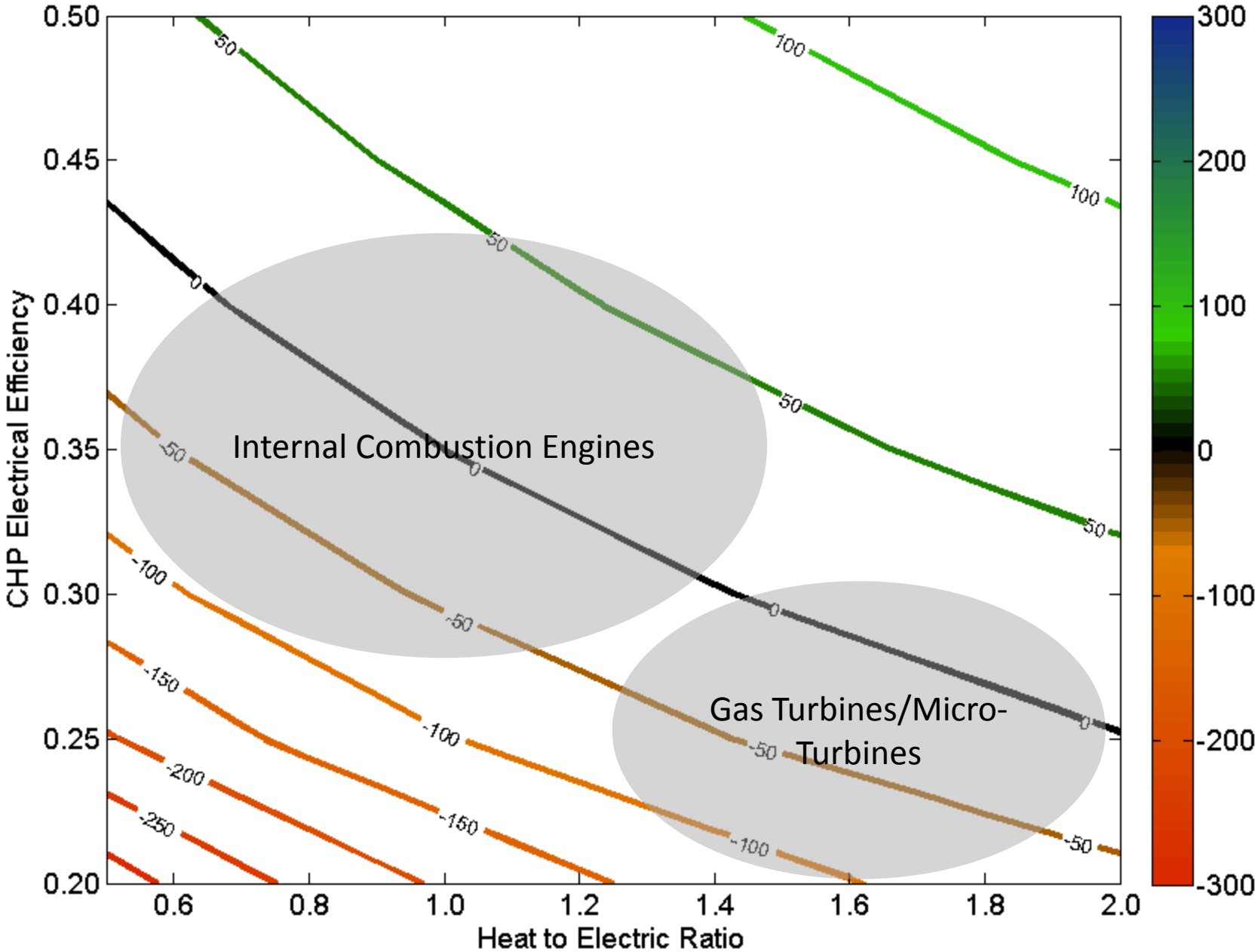


Tax lot and Block Comparison

	Taxlot	Block	Factor
Number of Systems	1,726	3,492	2.0
Total Capacity	454 MW_e	1,262 MW_e	2.8
Heat Used	3,000 GWh	7,400 GWh	2.5
Total M sq.ft	825	2,603	3.2
% City Heat Demand	4%	10%	
% City Elec Demand	10%	28%	
% City sq.ft	15.5%	49%	

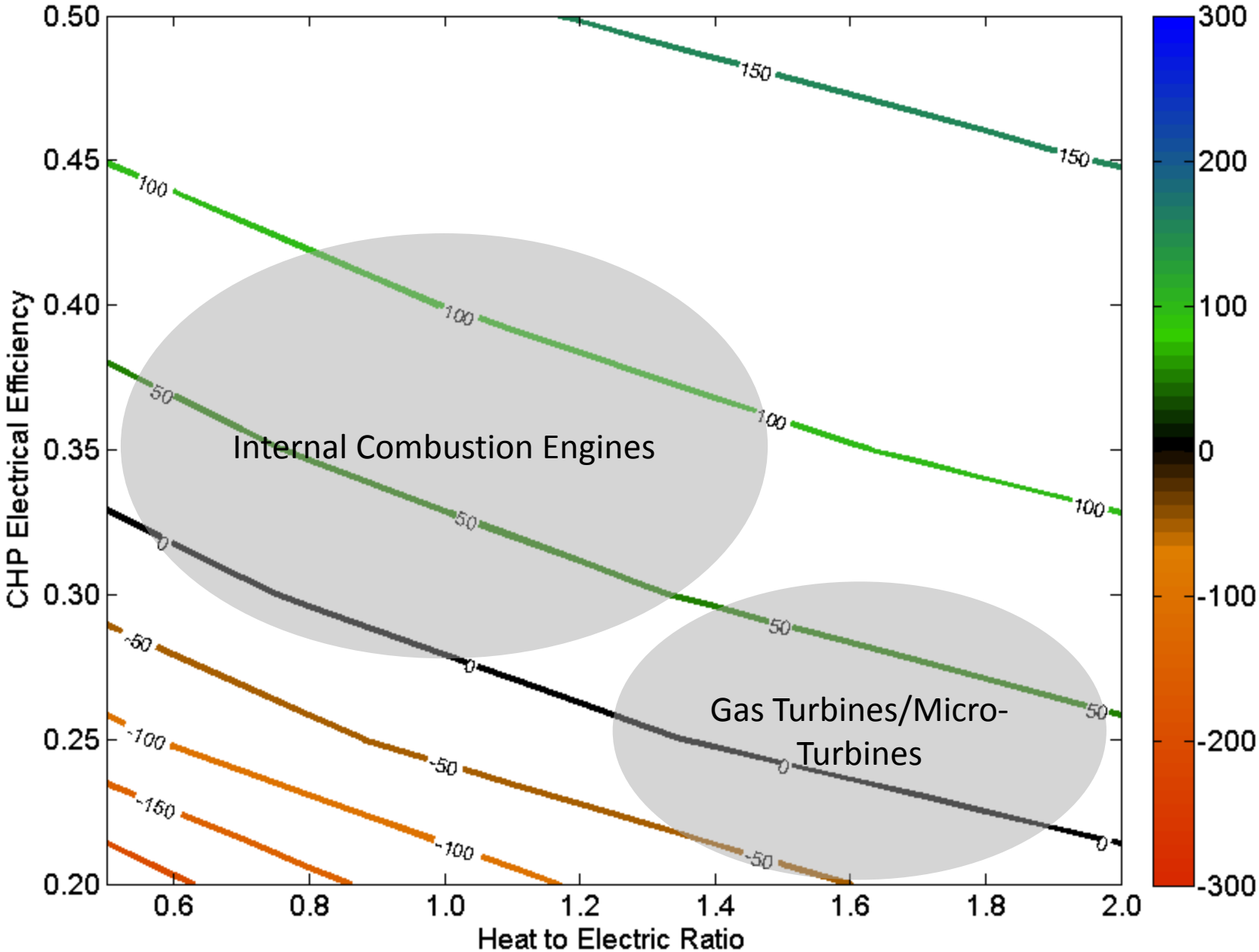
CO_2 Emissions Reductions from CHP

CO_2 Emissions Reductions (g/kWh total) – **NYC average grid emissions**



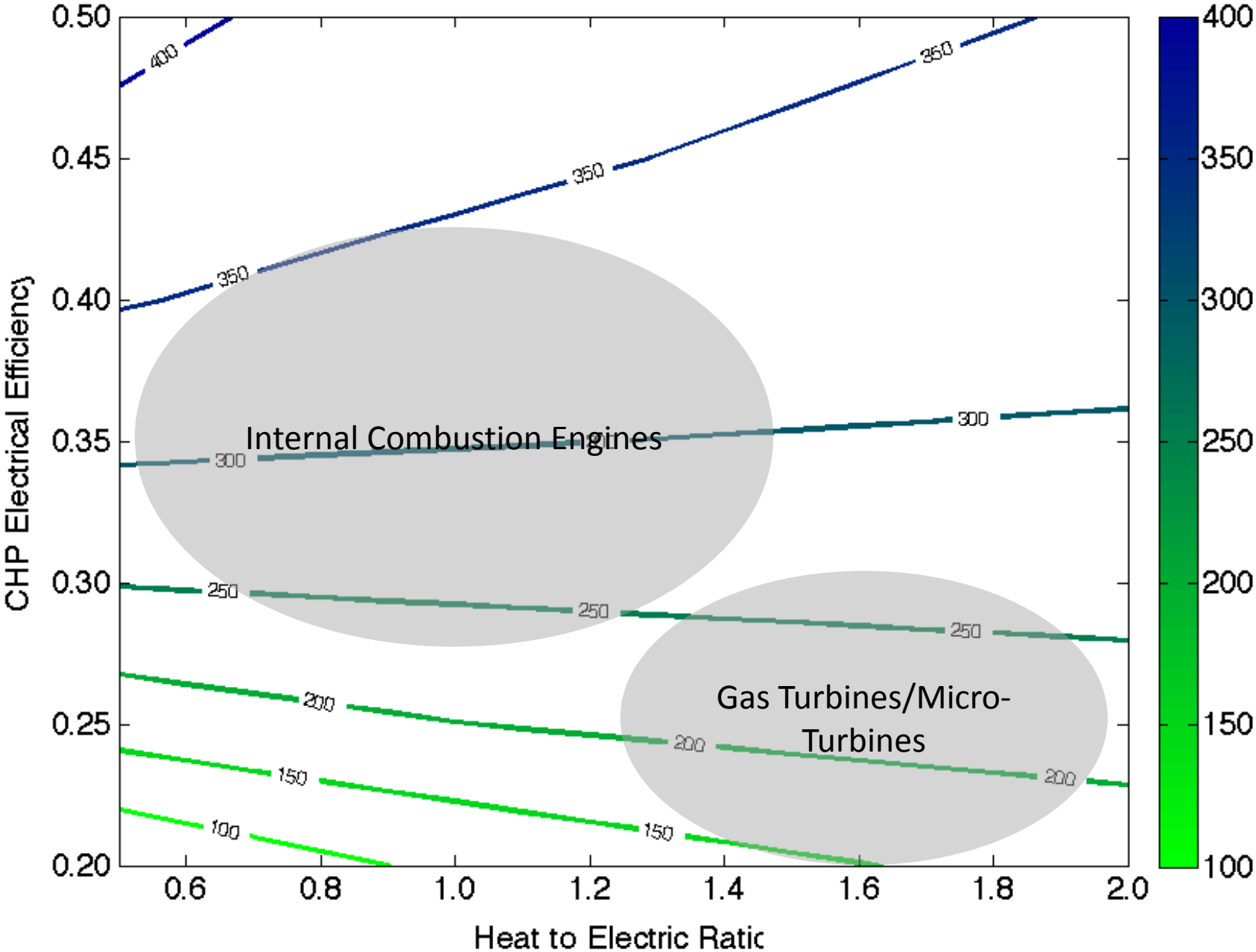
Natural Gas Boiler 90% - Natural Gas CHP

CO_2 Emissions Reductions (g/kWh total) – **40**% Efficient Grid Electricity Generation



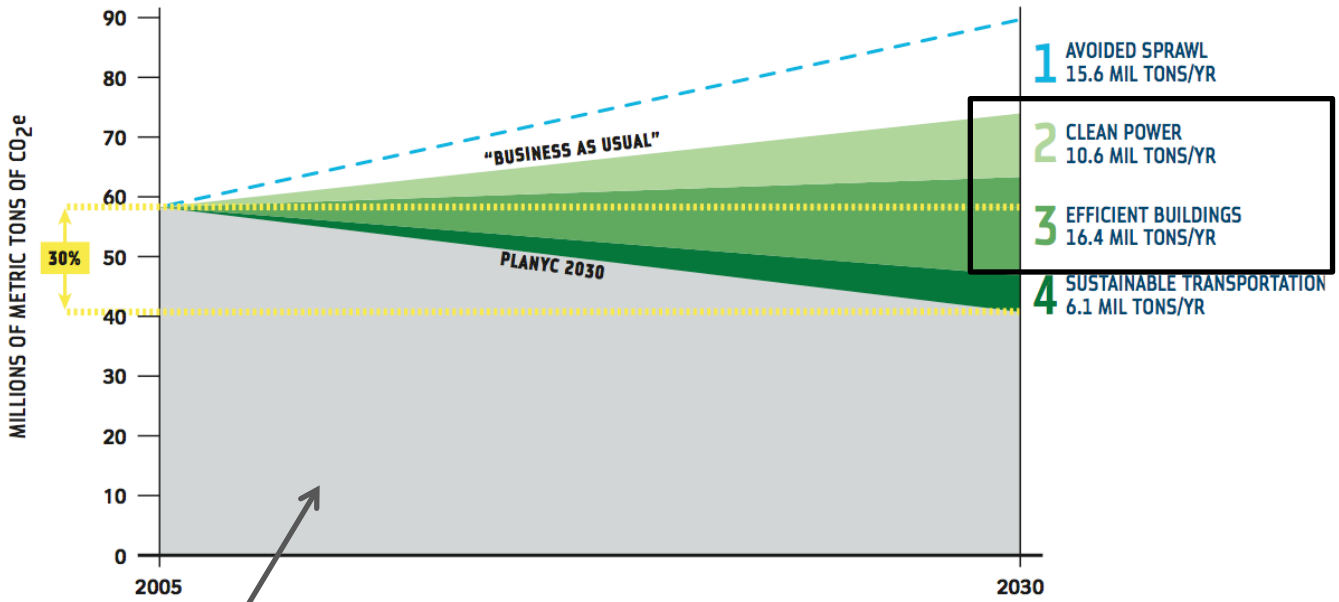
Natural Gas Boiler 90% - Natural Gas CHP - Natural Gas Grid Generation

CO_2 Emissions Reductions (g/kWh total) – **30**% Efficient Grid Electricity Generation



Fuel Oil Boiler 90% - Natural Gas CHP – Fuel Oil Grid Generation

Projected Impacts of Our Greenhouse Gas Reduction Strategies

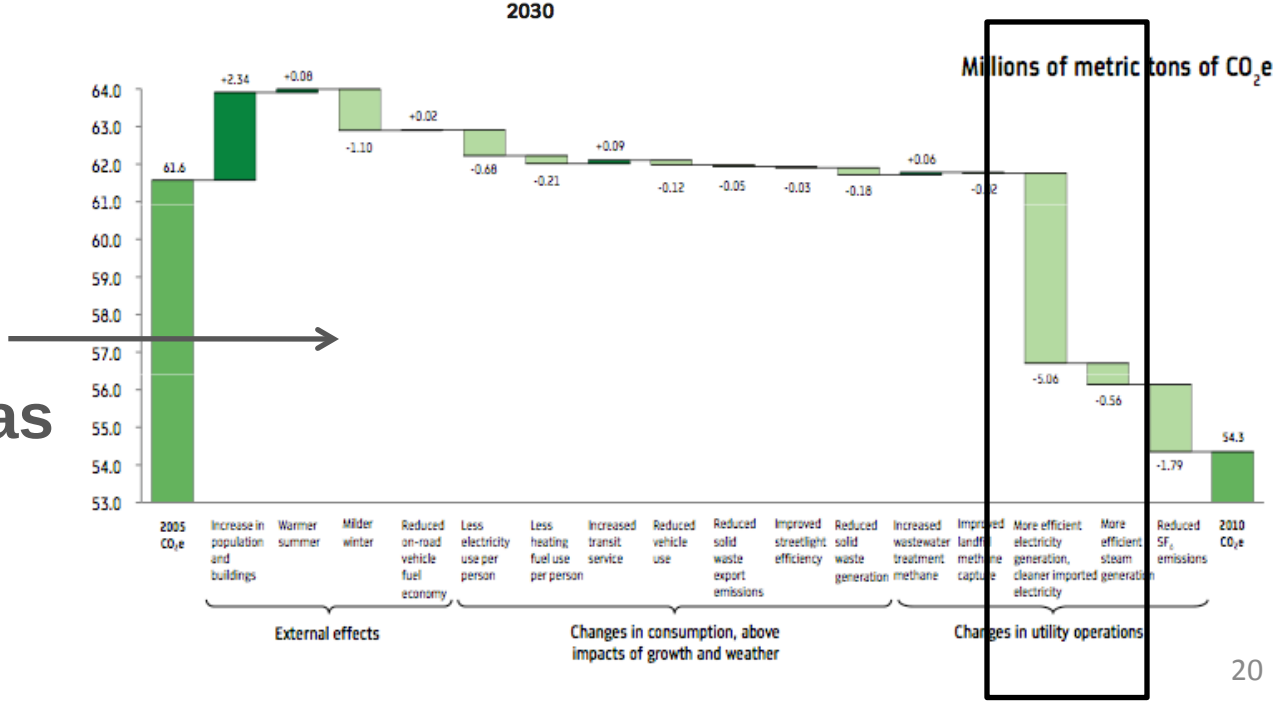


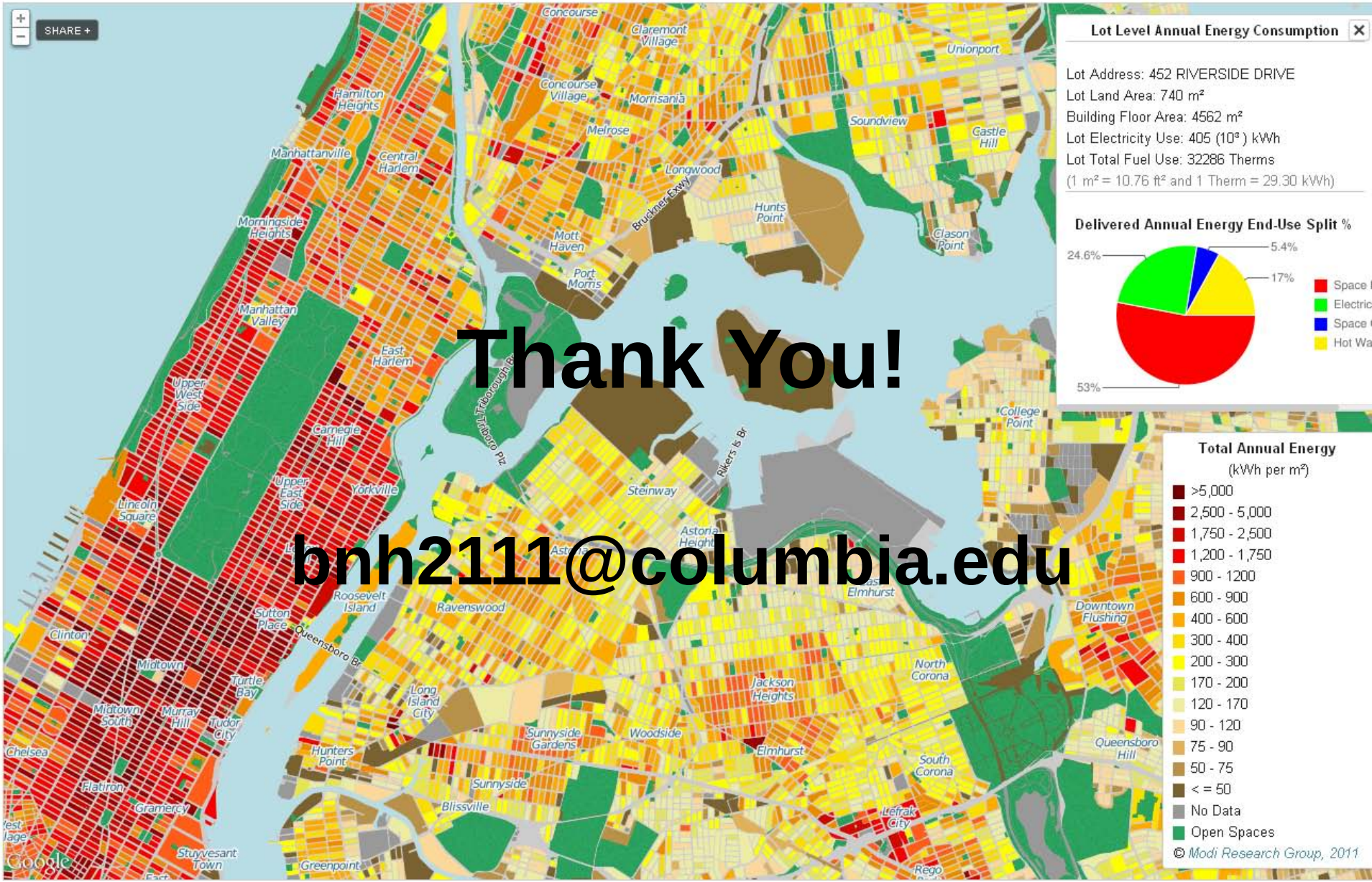
Clean Power and Efficient Buildings

More efficient electricity and steam generation

PlaNYC

2011 NYC Greenhouse Gas Inventory





Thank You!

bnh2111@columbia.edu