Northeast Chapter of Combined Heat and Power Alliance: Local Law 97

9/8/2023

Hospitals on the Front Lines of Climate Change

- Public Health Impact

- Operational Impacts
  - Increased frequency and severity of storms
    - NYC
      - Hurricane Sandy
      - Summer 2021 Flash Flooding

- Hospitals have made Commitments to Decarbonization
  - Nationally/Internationally
    - US Department of Energy: Better Buildings Challenge
    - Practice Greenhealth
    - Healthcare without Harm

  - NYC Mayors Carbon Challenge:
    - Launched in 2007
    - 30% emissions reduction by 2030

The New York Times

New York City faces the first 'flash flood emergency' in its history.

Record rainfall prompted the warning of "a severe threat to human life."

Better Buildings
U.S. DEPARTMENT OF ENERGY

Case Study:
Roof-Mounted Solar Array In Healthcare
BETTER BUILDINGS ALLIANCE

North Shore LIJ Benefits from Solar Array
In 2011, the North Shore-LIJ Healthcare System – Southside Hospital partnered with Senior Administration to evaluate the long term value of implementing renewable energy technologies that would result in clean energy resources, continuous energy cost savings and provide a safe environment to its patients and communities.

Project Keys to Success
North Shore-LIJ HS recognized that its Healthcare facilities consume large amounts of energy because of how they operate and the

Photo credit: NS-LIJ HS Southside Hospital

planNYC
NEW YORK CITY MAYOR'S CARBON CHALLENGE

Health Care Without Harm

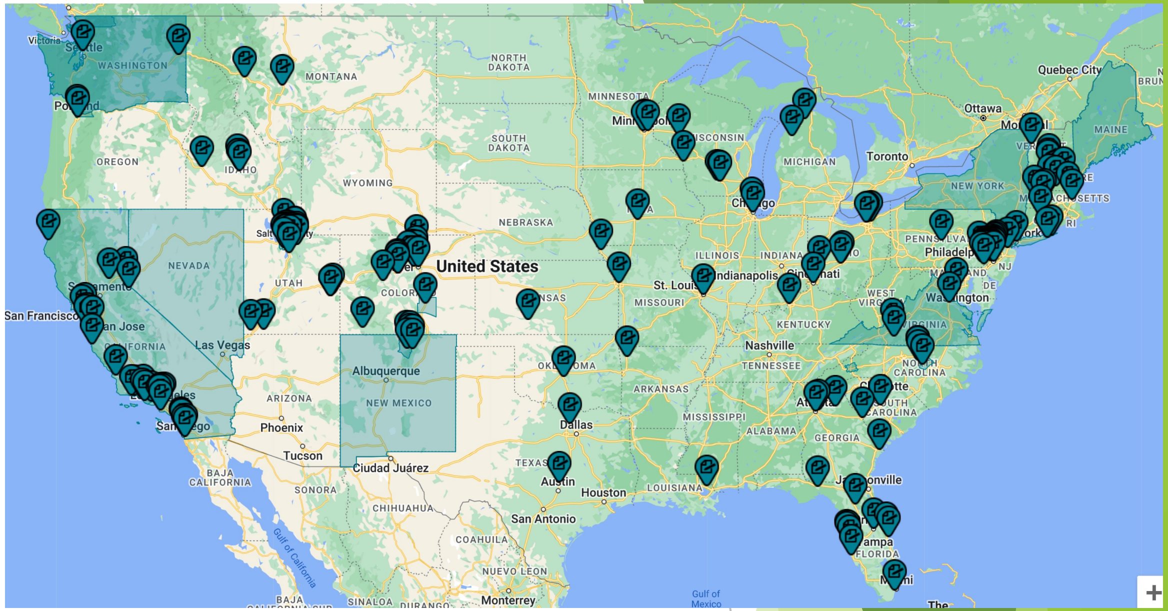
Leading the global movement for environmentally responsible health care

Welcome to Health Care Without Harm! Please join us as we work to transform the health sector worldwide, promoting environmental health and justice.

PRACTICE Greenhealth

Local, State and Federal De-Carbonization Evolving

- Voluntary commitments giving way to mandates
- According to Sierra Club 180+ Cities & Towns have made commitments to 100% Clean Energy
- 2019 New York City, Local Law 97 (LL97):
  - 80% reduction in building emissions by 2050 relative to 2005 baseline
  - Significant fines for non-compliance
- 2020 New York State, Climate Leadership and Community Protection Act (CLCPA)
  - 85% emissions reduction **across all sectors** by 2050 relative to 1990 baseline
- 2021 US Dep't of Health and Human Services creates Office of Climate Change and Health Equity (OCCHE)
  - Seeks to reduce carbon emissions in health care sector
  - Seeking commitments of 50% emissions reduction by 2030



Sierra Club map of Communities which have a commitment in place

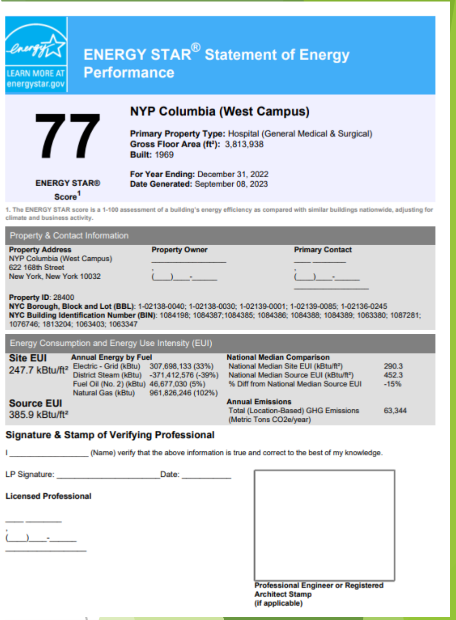
Will Biden leverage Medicare to tackle climate change?

By Ariel Wittenberg | 12/08/2020 01:32 PM EST

To solve the problem, Salas and her colleagues suggested that Medicare establish a "green loan" fund to help rural systems. Alternatively, the Centers for Medicare and Medicaid Services — which already requires hospitals to prepare for natural disasters — could also incentivize hospital decarbonization efforts by tying reimbursements to reducing carbon footprints.

Origins of LL97: Local Law 84 Benchmarking

- Local Law 97 sets limits on the emissions of each building based on building type and size
- Local Law 84 Required Buildings >25,000 Sqft to complete benchmarking annually via Energy Star Portfolio Manager
  - Benchmarking:
    - Building type
    - Building size
    - Input monthly energy consumption (and exports) from all sources
    - Key building characteristics:
      - Number of staffed bed
      - Number of MRIs
      - Workers on Main Shift
      - Etc.
  - Generates an EUI and a runs inputs through a model which generates a score 1-100



ENERGY STAR® Statement of Energy Performance

LEARN MORE AT energystar.gov

77

ENERGY STAR® Score[1]

NYP Columbia (West Campus)

Primary Property Type: Hospital (General Medical & Surgical)
Gross Floor Area (ft²): 3,813,938
Built: 1969

For Year Ending: December 31, 2022
Date Generated: September 08, 2023

1. The ENERGY STAR score is a 1-100 assessment of a building's energy efficiency as compared with similar buildings nationwide, adjusting for climate and business activity.

Property & Contact Information

Property Address	Property Owner	Primary Contact
NYP Columbia (West Campus) 622 168th Street New York, New York 10032	______________ , (___)___-_____	___ _______ , (___)___-_____ ______________

Property ID: 28400
NYC Borough, Block and Lot (BBL): 1-02138-0040; 1-02138-0030; 1-02139-0001; 1-02139-0085; 1-02136-0245
NYC Building Identification Number (BIN): 1084198; 1084387;1084385; 1084386; 1084388; 1084389; 1063380; 1087281; 1076746; 1813204; 1063403; 1063347

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
247.7 kBtu/ft²

Annual Energy by Fuel

Electric - Grid (kBtu)	307,698,133 (33%)
District Steam (kBtu)	-371,412,576 (-39%)
Fuel Oil (No. 2) (kBtu)	46,677,030 (5%)
Natural Gas (kBtu)	961,826,246 (102%)

Source EUI
385.9 kBtu/ft²

National Median Comparison

National Median Site EUI (kBtu/ft²)	290.3
National Median Source EUI (kBtu/ft²)	452.3
% Diff from National Median Source EUI	-15%

Annual Emissions

Total (Location-Based) GHG Emissions (Metric Tons CO2e/year)	63,344

Signature & Stamp of Verifying Professional

I ______________ (Name) verify that the above information is true and correct to the best of my knowledge.

LP Signature: __________________Date: _________

Licensed Professional

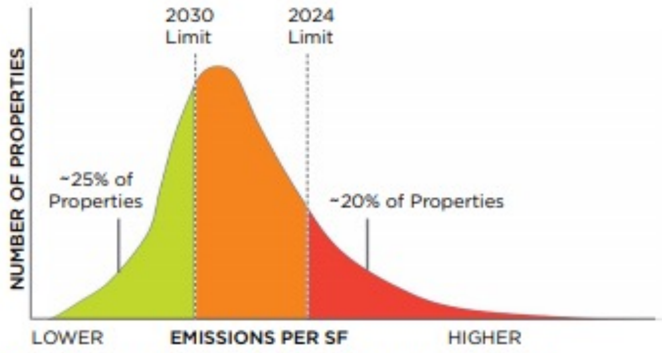
___ _______
,
(___)___-_____
____

Professional Engineer or Registered Architect Stamp (if applicable)

Origins of LL97: Local Law 84

- Local Law 97 Limit development
  - Used 2018 Local Law 84 Data
  - Divided roughly ~30k buildings into building types:
    - Hospitals;
    - Multi-Family;
    - Commercial Office;
    - Grocery Store;
    - Etc.
  - Apply emissions factors for electricity, gas and other fuels
    - Electric kWh X 0.000288962 tCO2e/kWh
    - Natural Gas kBTU X 0.00005311 tCO2e/kBTU
    - #2 Oil kBTU X 0.00007421 tCO2e/kBTU
    - ConEd District Steam kBTU X 0.00004493 tCO2e/kBTU

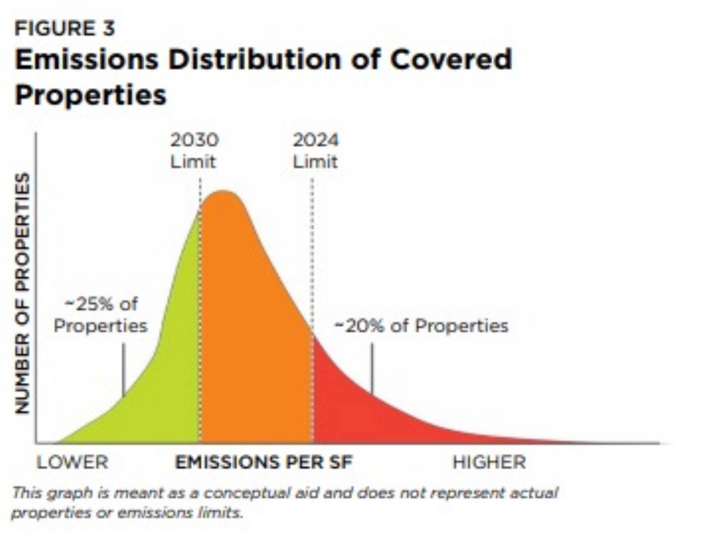
FIGURE 3
Emissions Distribution of Covered Properties



This graph is meant as a conceptual aid and does not represent actual properties or emissions limits.

Origins of LL97: Local Law 84

- Local Law 97 Limit development
  - Plot each buildings emissions (TonCO2e/sqft.) on a bell curve
    - 2024 limit set at 80th percentile for each building type
      - Hospitals: 0.02381 Tons of CO2 allowed per square foot
    - 2030 limit set at the 25th percentile
      - Hospitals: 0.01193 Ton of CO2 allowed per square foot
  - Limits decrease every 5 years thereafter (roughly halved)
  - Emissions in excess of limit fined at $268/ton



- NYC DOB Rules issued in Fall 2022
  - Went from 10 building types to 60 building types
  - Limits for many building types changed
  - 2030-2035 limit for Hospitals reduced from 0.01193 TCO2/sqft to 0.007335204 TCO2/Sqft
    - 38.5% reduction in the Hospitals allowable emissions limit in 2030
    - Carbon Coefficient for electric halved
      - 0.000288962 tCO2e/kWh to 0.000145 TCO2e/kWh

Local Law 97: Fine Calculations

-2024 to 2030 Example

-300k Sqft Hospital
-9.7 Million kWh
-500k Therms
-500 Gallon #2 Oil

6. For spaces classified as occupancy groups B civic administrative facility for emergency response services, B non-production laboratory, Group B ambulatory health care facility, H, I-2 and I-3: multiply the building emissions intensity limit of 0.02381 tCO_2e/sf by the corresponding gross floor area (sf);

Utility	Coefficient	Unit	Normalized (TonCO2/kBTU)
Electric	0.000288962	tCO2/kWh	0.000985938
Gas	0.00005311	tCO2/kBTU	0.000053110
Fuel Oil (#2)	0.00007421	tCO2/kBTU	0.000074210
District Steam	0.00004493	tCO2/kBTU	0.000044930

-Carbon Cap:

300,000 Square Feet X .02381 tCO2/Sqft. = 7,143 tons of CO2 allowed

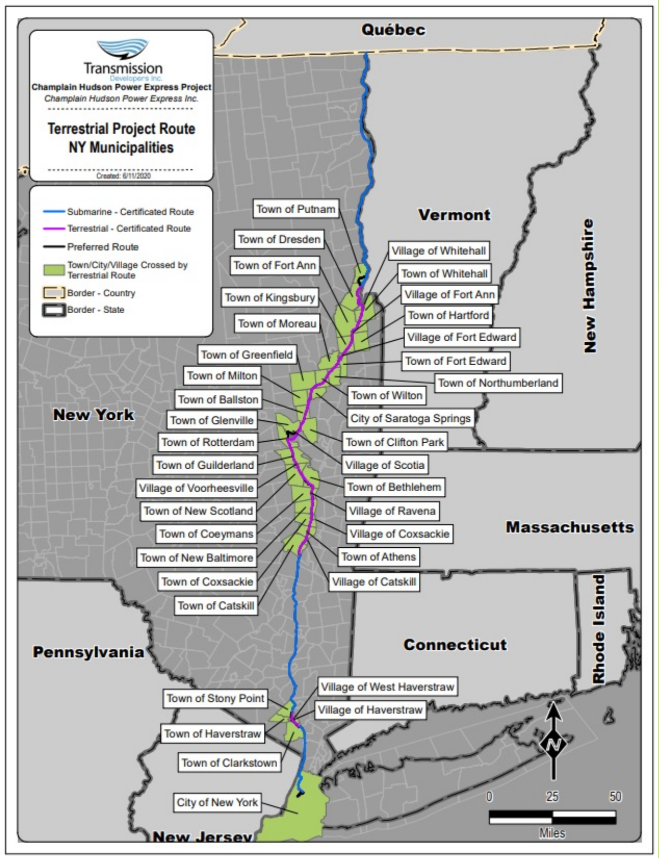
Carbon Emissions:

Multiply consumption of each fuel by coefficient;

- 9,700,000 kWh * 0.000288962 tCO2/kWh = 2,802 Tons
- 500,000 therms * 100 kBTU/Therm * 0.00005311 tCO2/kBTU = 2,655 Tons
- 500 Gal Fuel Oil * 140 kBTU/Gal. * 0.00007421 tCO2/kBTU = 5 Tons
    - Total Emissions = 2,802 Tons + 2,655 Tons + 5 Tons = 5,463 Tons

2024 Fine: 5,463 Tons – 7,143 Ton Cap = Emissions are below cap, No fine assessed

Local Law 97: Fine Calculations



-2030 to 2034 Example

-Carbon Caps are reduced by 70% from 0.02381 to 0.007335204 tCO_2/sqft

-Emissions coefficients will be revisited as well (currently unknown)

Carbon Cap:

300,000 Square Feet X **.007335204 tCO_2/Sqft.** = **2,200 ton**

Carbon Emissions:

Multiply consumption of each fuel by coefficient;

- 9,700,000 kWh * 0.000145 tCO_2/kWh = 1,400 Tons
- 500,000 therms * 100 kBTU/Therm * 0.00005311 tCO_2/kBTU = 2,655 Tons
- 500 Gal Fuel Oil * 140 kBTU/Gal. * 0.00007421 tCO_2/kBTU = 5 Tons
- Total Emissions = 1,400 Tons + 2,655 Tons + 5 Tons = 4,060 Tons

2030 Fine: 4,060 Tons – 2,200 Ton Cap = **1,860 Tons over the limit**

1,860 Tons over the limit * $268/ton = $500,000 per year

Local Law 97: Carbon Coefficients- Renewables

- Most Hospitals will have no trouble hitting the 2024 goals;
- The 2030 EUI is ~155-160 kBTU/sqft which will be extremely difficult to hit for existing buildings;
    - The example Hospital requires a 42% reduction in EUI over the next 6 year
    - By 2050- Zero Emissions
  - How do we get there?

Pathway to De-Carbonization

- Energy Efficiency
  - Efficiency
  - Conservation

- Alternative fuel sources
  - Renewable Gas
  - Hydrogen

- On-site Generation

- Off-Site Generation
  - Carbon-free generation
  - Upgrades to Transmission and Distribution

- Electrification

AP Photo/Alan Welner

- Transitional Risk
  - Short Term, Policy Development- Medium Risk
  - Medium Term, Implementation- High Risk
  - Long Term, Steady State Operation- Low Risk

The grid is the largest, most complex machine man has ever built; the current grid evolved over 100 years; proposals are to totally redesign this system within two decades

De-Carbonization Challenges: Energy Efficiency

- Laws of Physics: Energy Efficiency (EE) alone cannot lead to full decarbonization-

- Energy efficiency initiatives have not translated broadly into macro-scale gains
  - Since 1975 formation of NYSERDA energy use has **Decreased** 2.7% in New York State
  - By sector, energy consumption has:
    - **Increased** 20.3% in the Commercial Sector
    - **Increased** 5.8% in the Residential Sector
    - **Increased** 21.6% in the Transportation Sector
    - **Decreased** 63.3% in the Industrial Sector

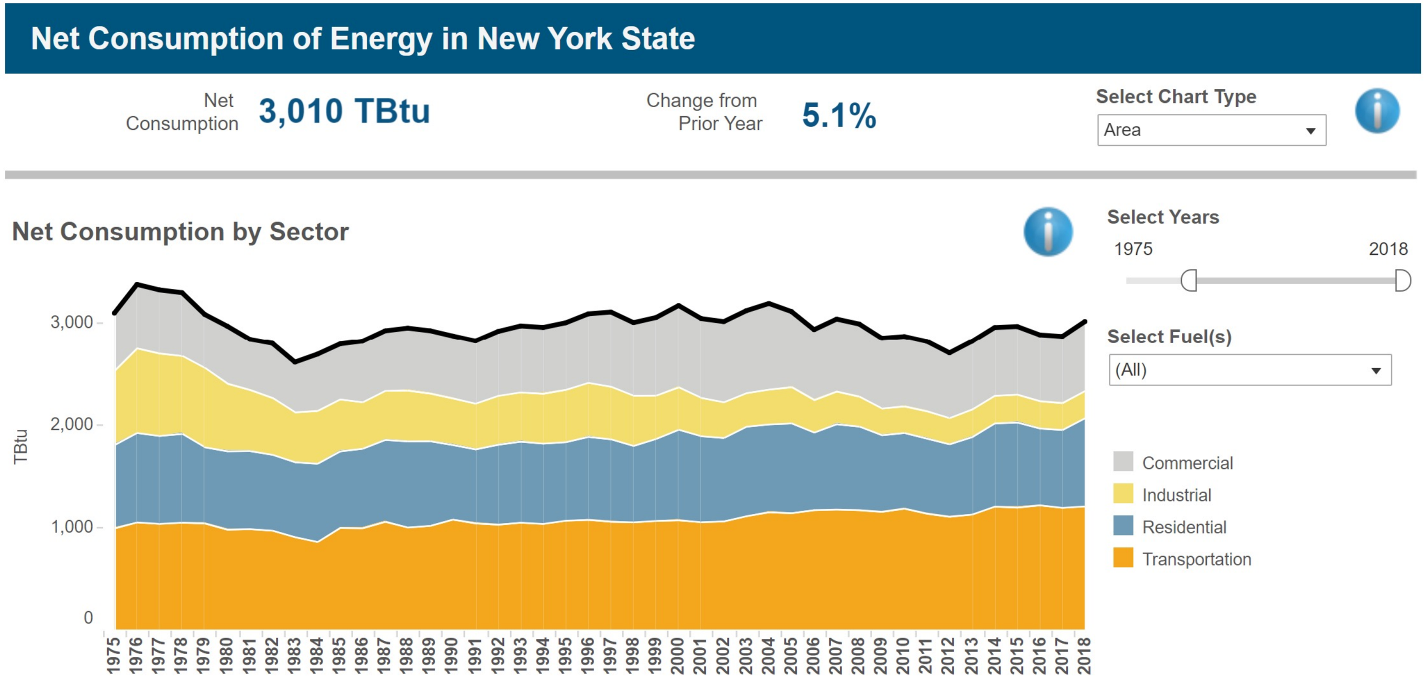
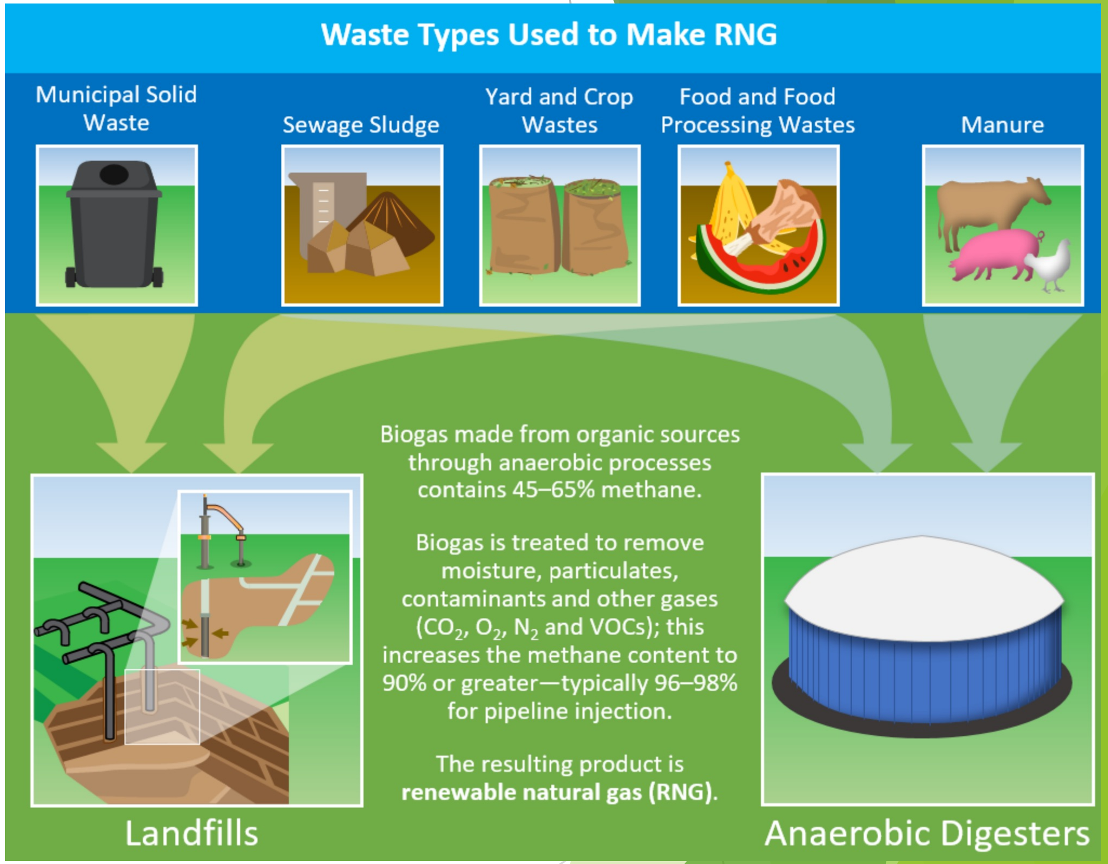


Chart showing energy consumption by sector in NYS between 1975 through 2018; Source: New York State Energy Research and Development Authority (NYSERDA) (https://www.nyserda.ny.gov/about/publications/ea-reports-and-studies/patterns-and-trends)

Photo: US Cooler

De-Carbonization Challenges: Carbon-Free Fuels

- The challenges with energy efficiency will require renewable (zero-emissions) electric sources or the adoption of carbon-free fuels;
  - Carbon-free fuels
    - Renewable natural gas
      - Limited source potential
        - Fully mature market could support 4-7% of current gas market
        - Potential to increase with technology improvement
          - Ie: recovery from plankton/algae
    - Hydrogen fuel
- The time required to build out these industries to maturity does not align with some of the current regulations
- In the interim, Hospitals must remain tethered to existing, tried-and-true energy infrastructure, networks, fuels and supplies to ensure patient safety

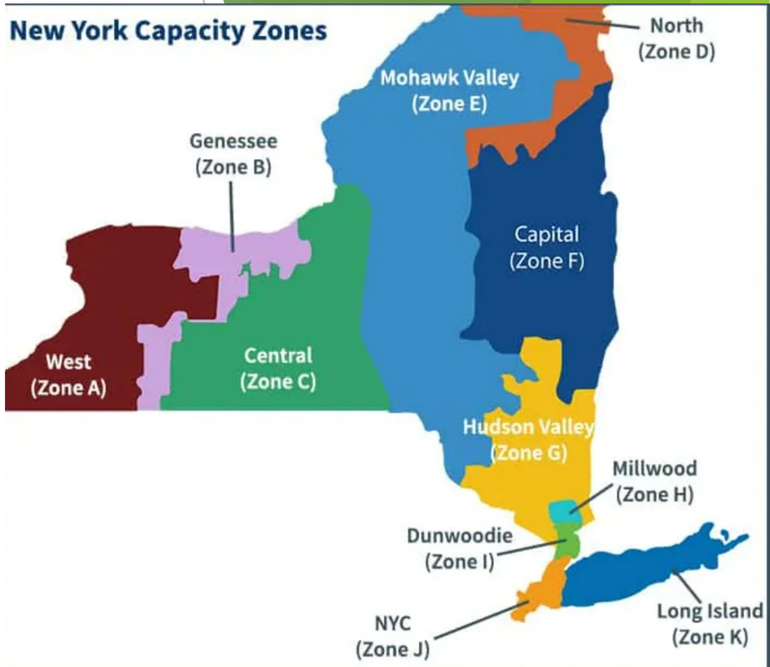


Source: EPA

De-Carbonization Challenges: Renewable Energy

- On-Site Renewable Generation is probably the preferable option for a Hospital;
  - Owning the system is a one-time purchase vs. purchasing RECs or carbon off-sets which need to be purchased annually;
  - Somewhat insulates the Hospital from energy cost volatility
  - Purchase of RECs or off-sets may be limited in quantity or geographically by regulation

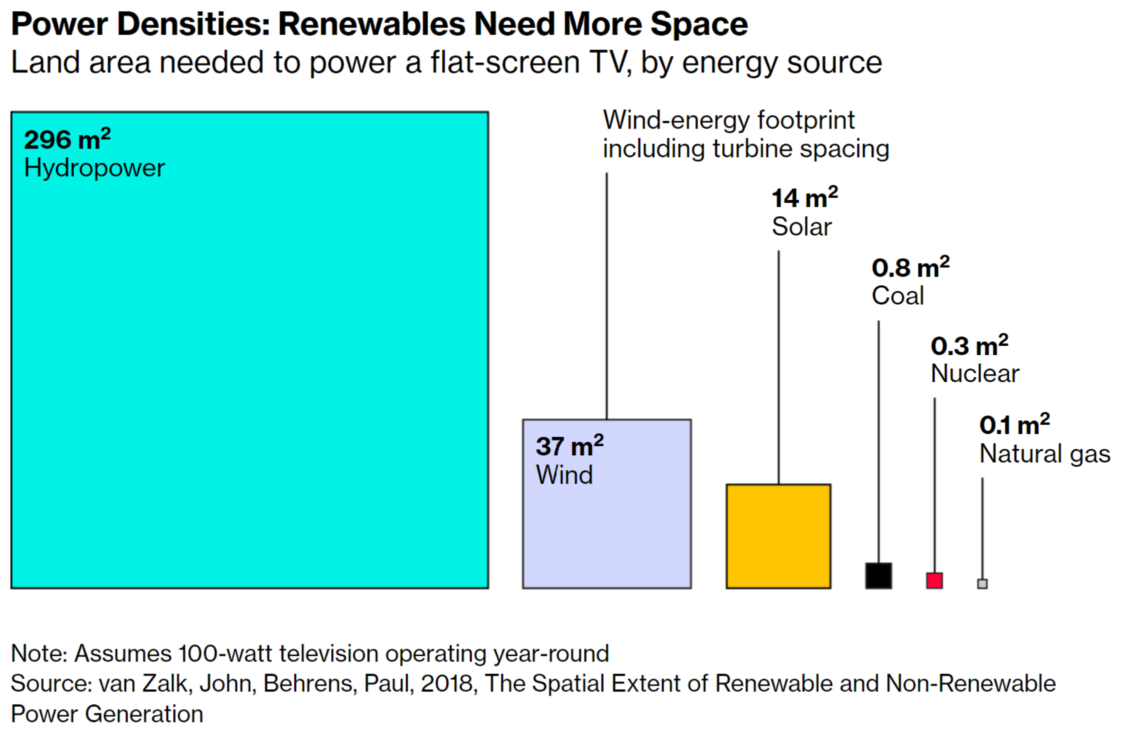
- On-Site Generation Options:
  - On-site wind opportunity is negligible; particularly in urban areas
  - Geothermal may be an option in select instances;
    - May be limited to meeting only part load in most cases due to large land area required
    - Challenging in dense urban areas
    - Still requires electricity to operate
    - Water sourced from river diversion is at best challenging (long-standing environmental restrictions; operational limitations)
    - NYC Geothermal Evaluation Tool: https://www1.nyc.gov/assets/ddc/geothermal/index.html

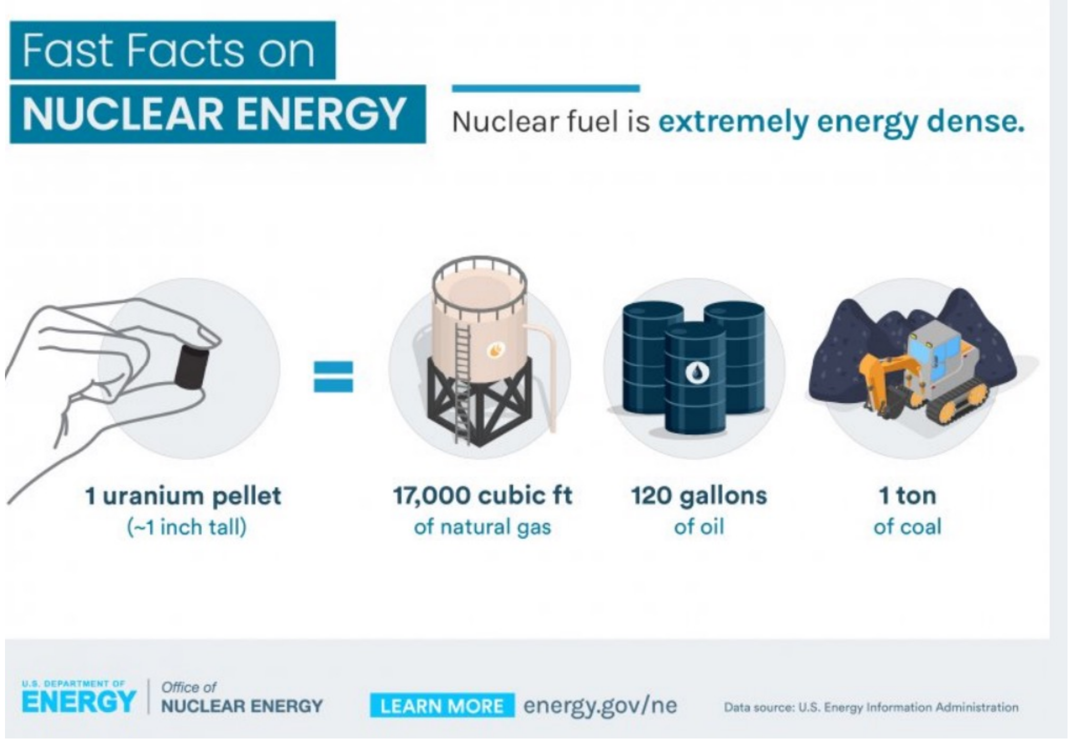


December 2019 Bronx wind-turbine (Photo: Peter Gerber)

De-Carbonization Challenges: Renewable Energy (On-Site)

- Renewables require significant land
  - Micro-Reactors as a potential solution?
    - Can be installed in 30 days, refueling every 8 years
    - Lots of experience with tech; Subs; Aircraft Carriers
      - Hospitals in particular employ many with system familiarity
    - Combined heat and power
    - As small as 5 MW



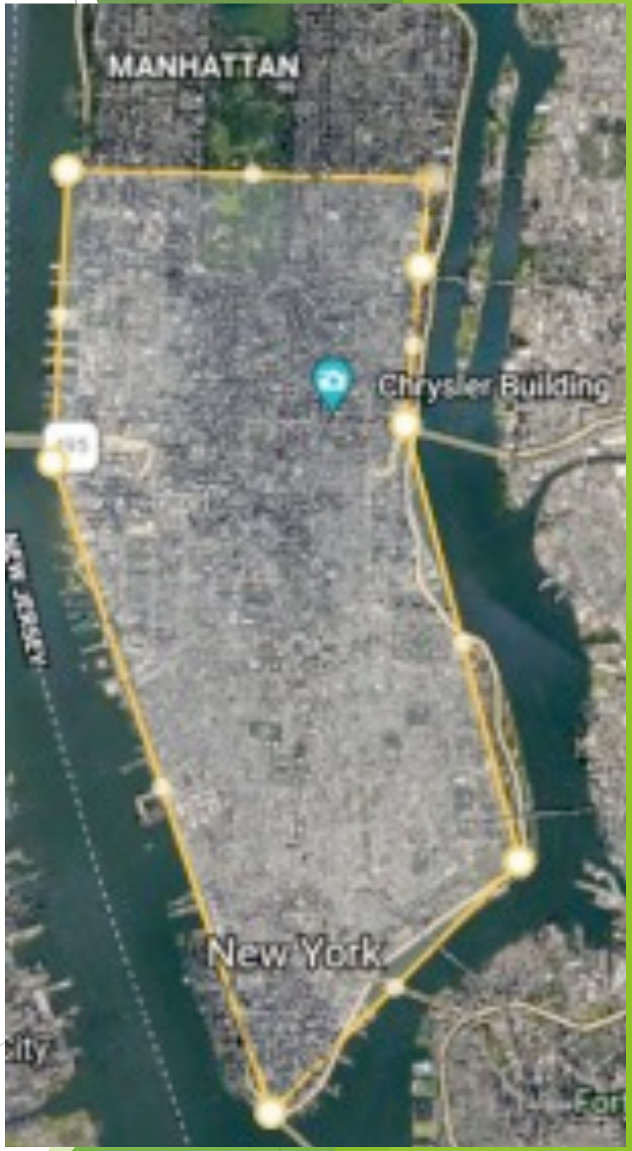


De-Carbonization Challenges: Renewable Energy (On-Site)

- On-Site Solar:
  - Requires significant open space to fully meet a Hospitals power needs
    - Using NYC LL84 data, the energy requirements of (82) Hospitals was summed:

Hospital Electric Consumption (kWh)	1,499,347,009
Hospital Heating Fuel Consumed On-Site (kBTU)	9,108,674,137
Hospital District Steam Consumption (kBTU)	709,719,470

- On-Site Solar:
    - An on-site PV System capable of meeting the electric power requirements would need to be **2,873 MW in size to power the Hospitals, using electric resistance boilers**
    - If using heat pumps the required system would be **1,997 MW in size**
  - According to PV Watts, a 1 MW DC PV system located in the New York City region would generate 1,337 MWh of electricity annually
  - **System would require between 14 square miles (36 sq.km.) (heat pump) and 20 sq.mi. (52 sq.km.) (electric resistance heat) of land**
- **For Urban Hospitals, not nearly enough space for meaningful on-site renewables**
- **The area overlain on the inset depicts the footprint of the solar array required (2/3+ of the land area of Manhattan Island), <u>solely to serve the load of the 82 hospitals</u>**



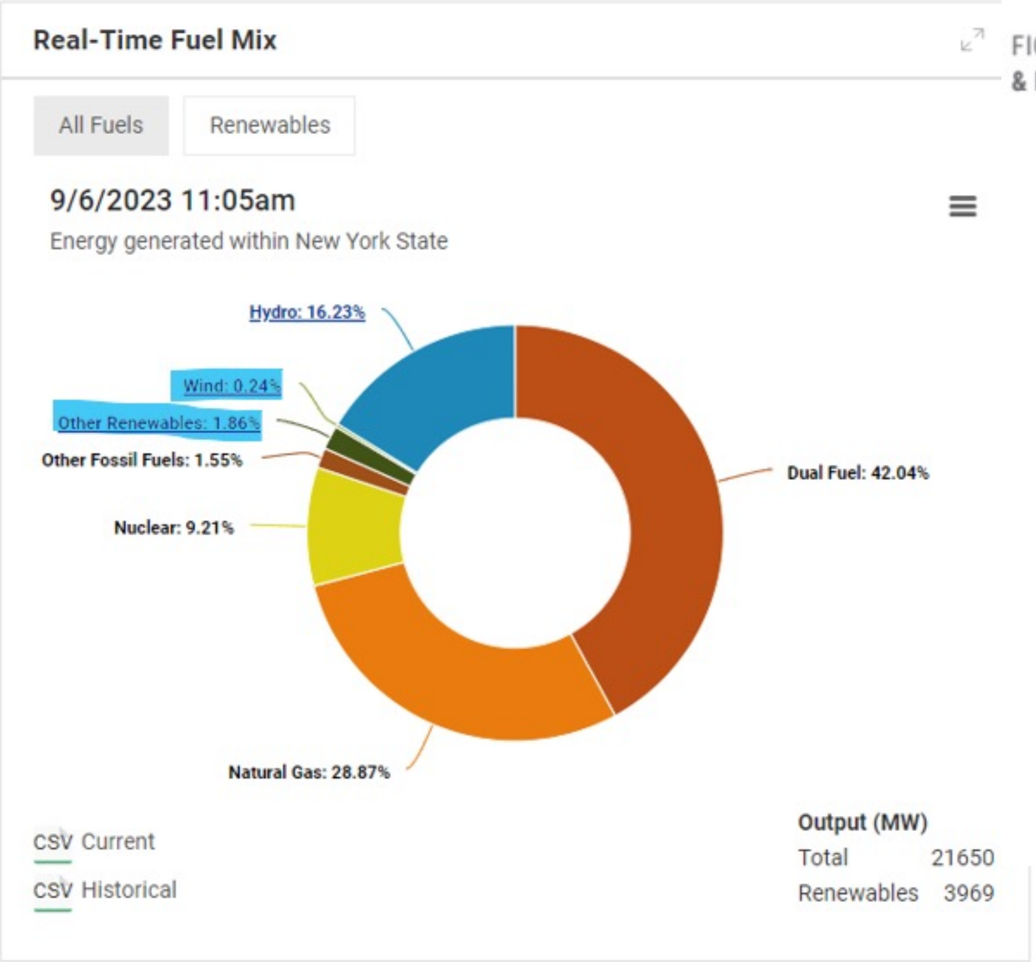
De-Carbonization Challenges: Back-Up Power

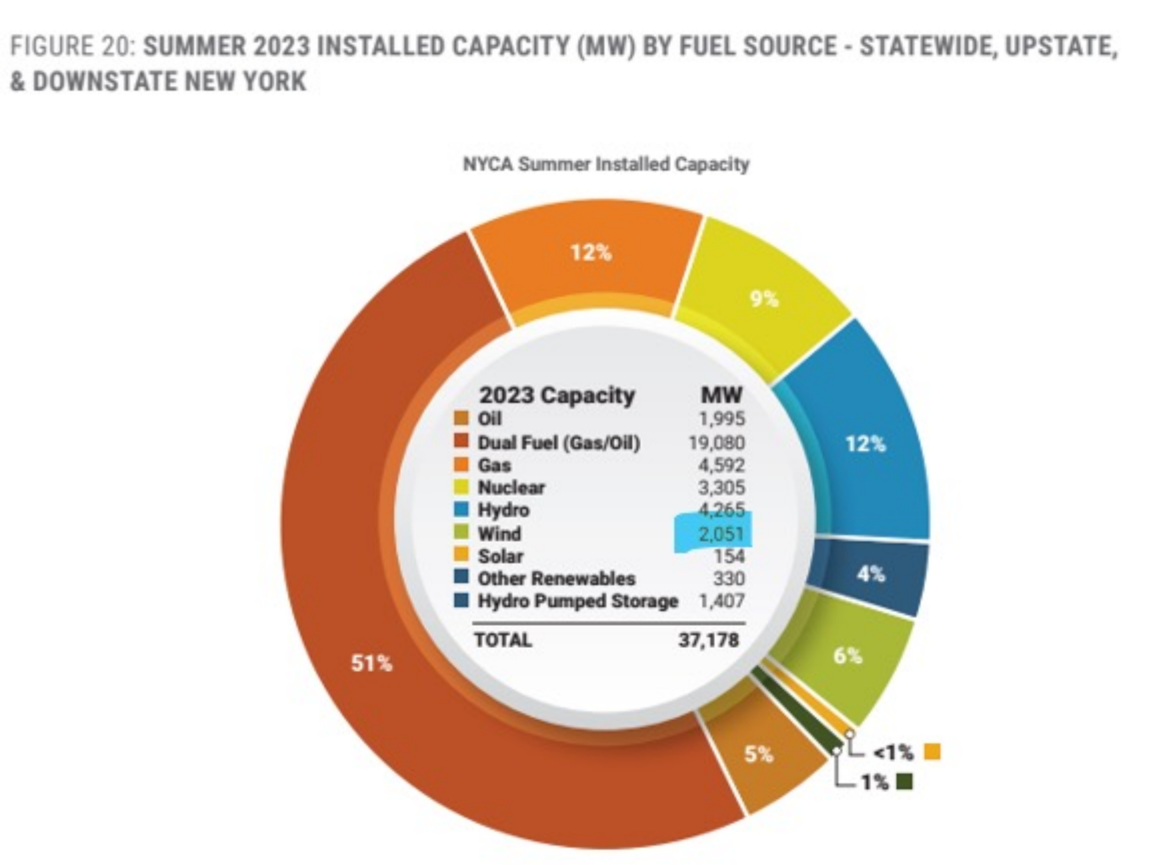
- Battery Storage:
  - NFPA 110 Requires that Hospitals maintain 96 hours of backup power;
  - The authors analyzed a full load of electric load profile on one Hospital campus
    - **During the peak 96 hour period the Hospital consumed 1,257 MWH of electricity**
    - **A battery system of this size would require approximately 800,000 Square foot of space**
    - **A 20% to 30% increase in the size of the Hospitals**

  - Other battery back-up limitations:
    - Batteries would need to remain topped off for potential use in an emergency; precluding use for demand response
    - For emergency situations exceeding 96 hours, how would the battery be refueled? During Hurricane Sandy outages lasted over 300 hours
    - Competition for finite source minerals for battery components by other sectors (e.g. transportation) is already intense---and demand is in its infancy

  - During emergency situations the Public becomes more reliant on Hospitals
    - **No currently available system to reliably replace emergency generators**
    - **Natural Gas-fired equipment can be a literal life saver in emergency situations**

De-Carbonization Challenges: Grid Integrated Renewables





<u>**9/6/2023 Peak Day; 52 MW of Wind output from 2 GW of installed capacity**</u>

De-Carbonization Challenges: Grid Integrated Renewables

- A wholesale re-imagining of the NYS electric grid
- Current Generation Resource Inventory Versus Y2040 Projected Capacity
  - From NYISO:

- Demand Response
  - Current NYS Demand Response resources 1,195 MW
  - Will require ~5X increase in DR resources

- Storage
  - 1,186 MW capacity deployed as of 2020
  - Will require ~15X increase in deployed storage

- Wind
  - 1,818 MW existing capacity
  - Will require ~30X increase in wind

- Solar
  - 2,840 MW existing capacity Q1 2021
  - Will require ~17X increase in solar

- **Dispatchable Emission Free Resources (DEFRS)** **"The Intermittency Problem"**
  - 26,459MW Existing Fossil capacity
  - ~1.2X increase above existing fossil capacity
  - Essentially identical to Fossil fueled plants in all characteristics, except it doesn't use fossil fuels

- At the same time the grid generation is transitioning, loads and load shapes are changing with the adoption of EV's and electrification of heating fuels
- DEFRs present a major hurdle, they are the "Unicorn"

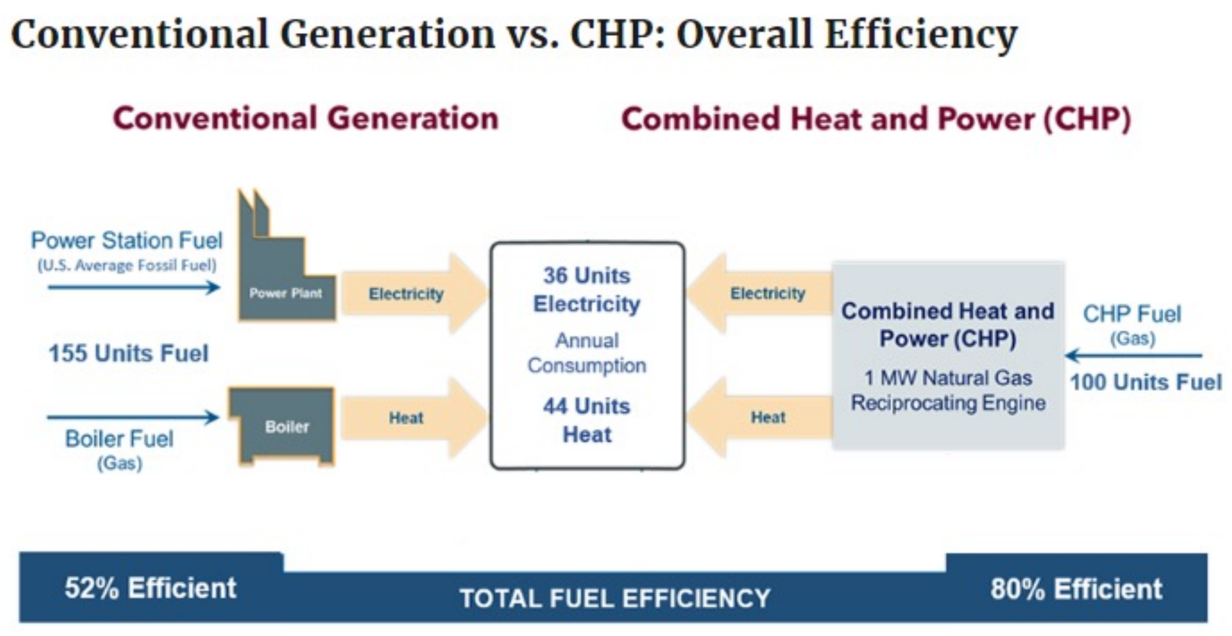
De-Carbonization Challenges: Distributed Generation

- "Upstreaming" Emissions:
  - Scope 1 decrease; Scope 2 increase;
  - Societal emissions increase overall;
- Local Law 97 uses average emissions
  - <68% efficiency CHP plants will be penalized
  - Likely still more efficient than the electric grid

- Emissions are "Upstreamed"

  - Leads to decrease in emissions at the local level increase in societal emissions

  - District thermal systems are being promoted
    - May lead to increased "up-streaming"
      - Example local utilities in NYC are exempt from LL97
        - District Steam
          - Combustion losses (~20%) are the utilities and LL97 exempt



Source US EPA

De-Carbonization Challenges: Distributed Generation

- Co-Gen/Fuel Cells
  - How are systems emissions measured?
    - Average (Total Output) or Mariginal (Non-Baseload)
    - EPA recommends Marginal; regulations may use Average
    - Using average may result in penalties
    - Average grid emissions for downstate NY are ~30% lower than marginal emission

1. Subregion Output Emission Rates (eGRID2020)

eGRID subregion acronym	eGRID subregion name	Total output emission rates lb/MWh							Non-baseload output emission rates lb/MWh							Grid Gross Loss (%)
		CO_2	CH_4	N_2O	CO_2e	Annual NO_X	Ozone Season NO_X	SO_2	CO_2	CH_4	N_2O	CO_2e	Annual NO_X	Ozone Season NO_X	SO_2	
AKGD	ASCC Alaska Grid	1,097.6	0.100	0.014	1,104.2	6.0	5.9	0.6	1,315.1	0.126	0.017	1,323.4	6.8	7.0	0.7	5.5%
AKMS	ASCC Miscellaneous	534.1	0.027	0.005	536.1	8.3	8.0	0.7	1,517.7	0.066	0.012	1,522.8	24.2	24.8	2.1	5.5%
AZNM	WECC Southwest	846.6	0.054	0.007	850.2	0.5	0.5	0.2	1,368.6	0.090	0.013	1,374.6	0.8	0.8	0.2	5.3%
CAMX	WECC California	513.5	0.032	0.004	515.5	0.5	0.5	0.0	1,006.5	0.053	0.007	1,009.9	0.9	0.9	0.1	5.3%
ERCT	ERCOT All	818.6	0.052	0.007	822.0	0.5	0.5	0.5	1,296.6	0.086	0.012	1,302.3	0.8	0.7	0.9	5.2%
FRCC	FRCC All	835.1	0.049	0.006	838.2	0.3	0.3	0.2	1,011.0	0.052	0.007	1,014.4	0.3	0.3	0.2	5.3%
HIMS	HICC Miscellaneous	1,143.2	0.110	0.017	1,151.1	7.5	7.3	3.9	1,542.1	0.134	0.022	1,551.8	11.4	11.4	5.0	5.6%
HIOA	HICC Oahu	1,653.0	0.178	0.027	1,665.5	3.8	3.8	6.8	1,753.5	0.175	0.027	1,766.0	4.5	4.5	7.9	5.6%
MROE	MRO East	1,526.4	0.139	0.020	1,535.8	1.0	1.0	0.4	1,628.9	0.143	0.021	1,638.5	1.1	1.1	0.4	5.3%
MROW	MRO West	979.5	0.104	0.015	986.6	0.7	0.8	0.9	1,810.0	0.185	0.027	1,822.5	1.3	1.3	1.6	5.3%
NEWE	NPCC New England	528.2	0.074	0.010	533.0	0.4	0.4	0.1	882.5	0.070	0.009	886.9	0.4	0.4	0.1	5.3%
NWPP	WECC Northwest	600.0	0.056	0.008	603.8	0.5	0.5	0.3	1,653.0	0.159	0.023	1,663.8	1.5	1.5	0.8	5.3%
NYCW	NPCC NYC/Westchester	634.6	0.022	0.003	636.0	0.2	0.2	0.0	970.2	0.021	0.002	971.4	0.4	0.4	0.0	5.3%

Local Law 97: Marginal Emissions Time of Use

(iii) Greenhouse gas coefficient for utility electricity based on time of use (TOU). Notwithstanding any other provision of this paragraph, an owner may elect to calculate emissions generated by utility electricity based on time of use (TOU) in accordance with this subparagraph (iii).

a. Such an owner shall submit to the Department documentation of hourly consumption of all utility electricity consumed on the premises of the covered building during the calendar year for which emissions are being reported. Utility records must be made available to the Department upon request.

b. A TOU coefficient may be utilized to calculate emissions generated by utility electricity where:

1. Hourly utility electricity consumption for the covered building is separately metered by the utility; or,
2. Hourly utility electricity consumption for the covered building is separately metered or sub-metered by the owner in a manner that produces data on such hourly consumption for the year being reported.

c. *Calculations.*

1. Until such time that hourly TOU electric emissions coefficients for New York City are published by a source approved by the Department, TOU coefficient values must be calculated for each hour of each day in the calendar year being reported, as follows:

$$TOUn = (HM_n - RAM_n) + g_{ue} \qquad \text{(Equation 103-14.2)}$$

Where:

TOU_n = the hourly time of use electricity coefficient in tCO_2e per kWh, for n, a given hour on a given day in the calendar year being reported.

HM_n = the hourly marginal emissions coefficient in tCO_2e per kWh (see Equation 103-14.3).

RAM_n = the hourly rolling average marginal emissions coefficient in tCO_2e per kWh (see Equation 103-14.6).

g_{ue} = the GHG coefficient for utility electricity for the calendar year being reported, in tCO_2e per kWh, as provided pursuant to Article 320 of Chapter 3 of Title 28 of the Administrative Code or this paragraph.

If $TOU_n < 0$, then $TOU_n = 0$.

2. The hourly marginal emissions coefficient must be calculated as follows:

$$HM_n = IHR_n \times \frac{1kBtu/kWh}{MMbtu/MWh} \times MF_n \qquad \text{(Equation 103-14.3)}$$

Where:

IHR_n = the implied heat rate in MMBtu per MWh, for *n* every hour of the calendar year, see Equation 103-14.4.

MF_n = the marginal fuel emissions coefficient, in tCO_2e per kBtu, for the fuel that is the marginal fuel for *n* during the calendar year being reported, provided pursuant to Article 320 of Chapter 3 of Title 28 of the Administrative Code or this paragraph.

3. The hourly implied heat rate must be calculated as follows:

$$IHR_n = \frac{LBMP_n - VOM}{RE_n + MSP_n} \qquad \text{(Equation 103-14.4)}$$

Where:

$LBMP_n$ = hourly location based marginal price, in dollars per MWh, as defined in subdivision (a) of this section.

VOM = \$3 per MWh (the variable operating and maintenance cost, as defined in subdivision (a) of this section.

RE_n = Regional greenhouse gas initiative (RGGI) emissions cost, in dollars per MMBtu (see Equation 103-14.5).

MSP_n = Hourly marginal fuel spot price, in dollars per MMBtu.

If $IHR_n < 5$ MMBtu/MWh for a given hour *n*, then $IHR_n = 0$ Btu per MWh for that hour *n*.

If $IHR_n > 17$ MMBtu/MWh for a given hour *n*, then $IHR_n = 17$ MMBtu per MWh for that hour *n*.

4. The RGGI emissions $cost_n$ must be calculated as follows:

$$RE_n = RA_n \times \frac{1.10231\ USton}{metric\ ton} \times g_n \times \frac{1000\ kBtu}{MMBtu} \qquad \text{(Equation 103-14.5)}$$

Where:

RA_n = RGGI allowance cost, in dollar per US ton, of CO_2e, as published by RGGI.

g_n = Greenhouse gas coefficient for the marginal fuel at a given hour, in tCO_2e per kBtu.

5. The hourly rolling average marginal emissions must be calculated as follows:

$$RAM_n = \frac{\sum_{i=n-8759}^{n}(HM_i \times HLF_i)}{\sum_{i=n-8759}^{n} HLF_i} \qquad \text{(Equation 103-14.6)}$$

Local Law 97: Marginal Emissions Time of Use

Where:

HM_i = hourly marginal emissions coefficient, in tCO_2e per kWh (see Equation 103-14.3).

HLF_i = the hourly load forecast, which is the day-ahead load projection, published by the New York State Independent System Operator (NYISO) as the day-ahead zonal forecast for New York City, in MW.

(iv) *Greenhouse gas coefficient for campus-style electric systems.* The greenhouse gas coefficient for electricity generated by a campus-style electric system, where electricity consumed by any covered building served by such system is generated in whole or in part on the premises of the campus, must be calculated in accordance with this subparagraph (iv).

a. The GHG coefficient for electricity generated by the campus-style electric system, must be calculated as follows:

$$g_{ce} = \frac{\Sigma_n(m_n \cdot g_n)}{m_{ce}} \quad \text{(Equation 103-14.7)}$$

Where:

g_{ce} = the on-site campus generated electricity GHG coefficient in tCO_2e per kWh.

m_n = the plant input energy for each energy source consumed, n, in kBtu.

g_n = the GHG coefficient for each plant input energy source, n, in tCO_2e per kBtu as provided pursuant to Article 320 of Chapter 3 of Title 28 of the Administrative Code or this paragraph.

m_{ce} = the total electricity consumed by buildings and other campus loads from the campus-style electric system, in kWh, during the year being reported, excluding any electricity delivered into the utility grid.

b. Where a covered building consumes electricity generated by the campus-style electric system and also consumes utility electricity, the combined GHG coefficient for campus electricity must be calculated as follows:

$$g_e = \frac{(m_{ue} \cdot g_{ue}) + (m_{ce} \cdot g_{ce})}{m_{ue} + m_{ce}} \quad \text{(Equation 103-14.8)}$$

Where:

g_e = the GHG coefficient for electricity generated by a campus-style electric system on-site, in tCO_2e per kWh.

m_{ue} = the total electricity consumed by buildings and other campus loads from the utility grid, in kWh.

g_{ue} = the GHG coefficient for utility electricity, in tCO_2e per kWh, provided pursuant to Article 320 of Chapter 3 of Title 28 of the Administrative Code or this paragraph.

m_{ce} = the electricity consumed by buildings and other campus loads from the campus-style electric system, in kWh, excluding any electricity delivered into the utility grid.

g_{ce} = the on-site campus generated electricity GHG coefficient in tCO2e per kWh (see Equation 103-14.7).

c. Where electricity consumed by any covered building on the campus is generated on the site of the campus, and the owner elects to calculate emissions from such electricity based on time of use (TOU), the GHG coefficient shall be calculated as follows:

$$g_e = \frac{(\Sigma_h(m_{ueh} \cdot g_{TOU})_h) + (m_{ce} \cdot g_{ce})}{m_{ue} + m_{ce}} \quad \text{(Equation 103-14.9)}$$

Where:

g_e = the GHG coefficient for electricity generated by a campus-style electric system on-site, in tCO_2e per kWh.

m_{ueh} = the hourly electricity consumed by buildings and other campus loads from the utility grid, in kWh.

g_{TOU} = the hourly TOU GHG coefficient, as calculated in accordance with subparagraph (iii) of this paragraph for the calendar year being reporting, in tCO_2e per kWh.

m_{ce} = the electricity consumed by buildings and other campus loads from the campus-style electric system, in kWh, excluding any electricity delivered into the utility grid, see Equation 103-14.7.

g_{ce} = the on-site campus generated electricity GHG coefficient in tCO_2e per kWh, see Equation 103-14.7.

m_{ue} = the total electricity consumed by buildings and other campus loads from the utility grid, in kWh, see Equation 103-14.8.

(v) *Greenhouse gas coefficients for certain campus-style energy systems.* Notwithstanding any other provision of this section, the GHG coefficient for energy generated by a campus-style energy system must be calculated in accordance with this subparagraph (v). Such energy may include district heating and cooling or other district energy.

a. The GHG coefficient for each type of campus energy resource that is generated by a system or equipment in a campus central plant and consumed by a covered building shall account for the plant input energy utilized by such plant to generate and deliver such campus energy resource. Such systems or equipment in a campus central plant may include, but need not be limited to, prime generators, such as boilers, chillers, and cooling towers; ancillary equipment, such as pumps and fans; and associated controls. Any energy generated by any such system or equipment that serves a single building shall not be included in the input energy for the campus-style energy system and shall be considered part of the energy use of the covered building it is serving. Any plant input energy recovered by the campus-style energy system from any other plant energy source on campus and included in the calculation of the emissions coefficient for such other central plant energy source may be assigned an emissions coefficient of zero for purposes of calculating the GHG coefficient for a campus energy resource generated by the campus-style energy system.

b. Calculations.

1. For each type of campus energy resource generated by the campus-style energy system, the GHG coefficient shall be calculated as follows:

Local Law 97: Future of the Distributed Energy Industry

- Development of Tools for Prospective and Existing CoGen owners:

  - Industry develop marginal emissions calculation methodology
  - Make calculations available to general public

- Education

  - Benefit of Cogen
    - Not all kWh generation from fossil has the same emissions
    - Marginal emissions
  - Resiliency/Reliability of Local Generation
    - Risks of the energy transition
    - Mission Critical facilities
  - What is a Microgrid?
  - Future of Cogen
    - Need for DEFRs
    - The role of clean fuels and adaptability of CoGen systems
  - Develop Case studies
    - Hurricane Sandy
    - California
    - Winter Storm Uri

Thank You!