CNCA

CARBON NEUTRAL CITIES ALLIANCE

Performance Standards for Existing Buildings

Project Summary

March 2020

Project Overview

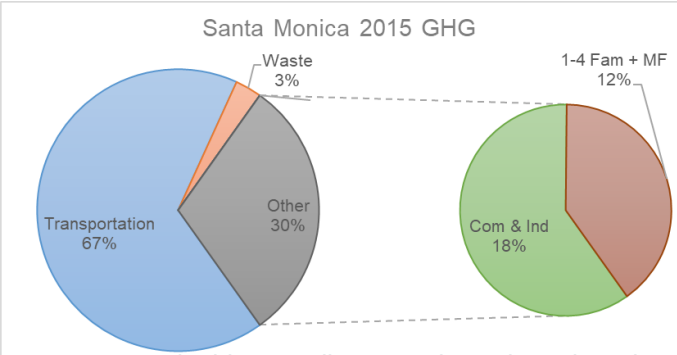
Goal 1: Develop Appropriate Performance Metrics

- **Task 1:** Compile relevant data sources and create analysis methodology
- **Task 2:** Develop energy use, fuel splits and carbon intensities, by building type and/or space use, necessary to meet building sector GHG reduction goals by 2050, for each of the four cities
- **Task 3:** Evaluate types of performance metrics that are enforceable and meaningful to building owners: Energy Star Score? Site Energy? GHG? Normalized?
  - Develop metrics for each building sector – common typologies such as office and multifamily – reflective of the characteristics and performance potential of those types
  - Weigh technical difficulty and cost of performance levels to create an appropriate goal that moves the industry in the right direction

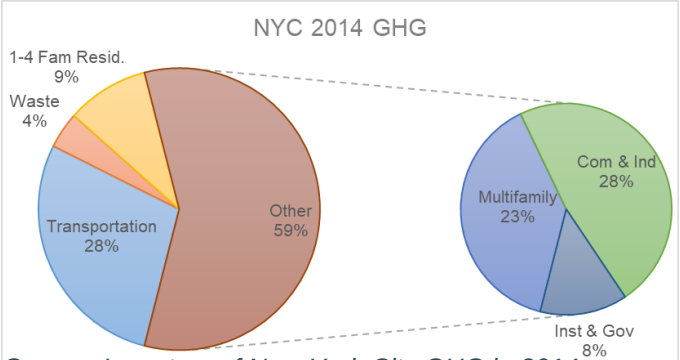
Goal 2: Simplify the required inputs and outputs so other cities can use results to develop performance standards for their building stock

- **Tasks 4 & 5:** Target Development Tool for Nationwide City Use - Any city that can compile the input information could then adapt the tool to apply to their targets

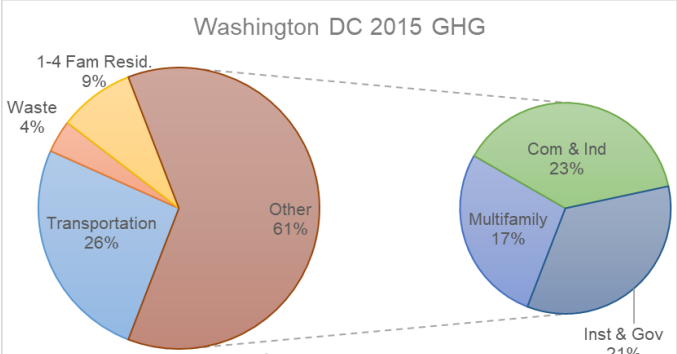
Project Overview



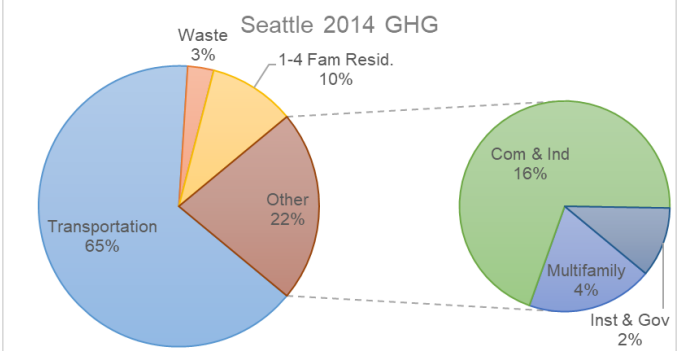
Source: Sustainable SM Climate Action Adaptation Plan



Source: Inventory of New York City GHG in 2014



Source: Clean Energy DC



Source: Seattle 2016 GHG Inventory

Two basic changes are required of buildings to reach long-term citywide climate action goals:

1. All buildings achieve a high level of energy efficiency, minimizing the required input energy to meet necessary end use energy demands
2. The source of input energy needs to emit as little greenhouse gas (GHG) as possible, which means a clean electric grid and eliminating as much on-site combustion as possible.

This analysis attempts to assess all building energy use in the participant cities in the context of these requirements.

Project Team

Core Cities

City officials directly involved throughout the project and specific analysis for their building stock

Seattle	**Sandra Mallory**
Washington, D.C.	**Katie Bergfeld**
New York City	**Lia Cairone**
Santa Monica	**Drew Johnstone**

Observer Cities/Counties

City officials offering input for data sources and analysis methods

Berkeley, CA	Minneapolis, MN
Boulder, CO	Portland, OR
Cambridge, MA	Toronto, Canada
Ft. Collins, CO	Yokohama, Japan
Melbourne, Australia	*Montgomery County, MD*

Consultant Team

Technical and policy analysts responsible for methodology and generation of tool and report

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Advisory Group

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David Cohan, IMT

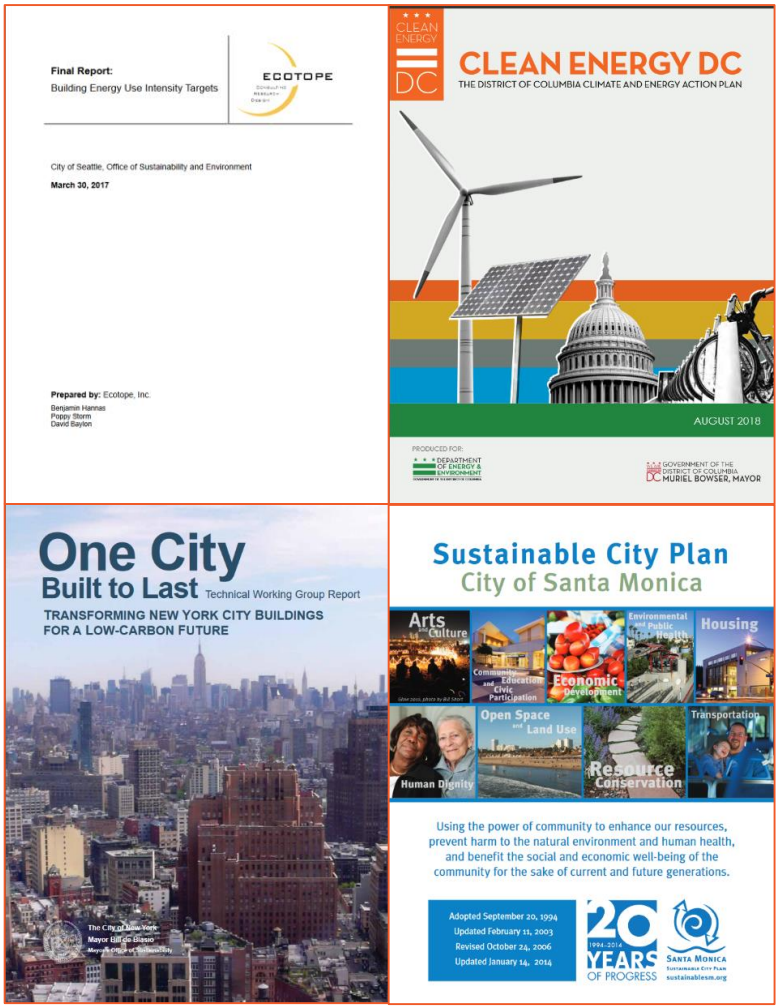
Methodology

Scope

- Analysis focuses on building types other than 1-4 family residential
- Each city has different levels of building information – benchmarking, tax data, national survey, utility assessments, etc.; these should be leveraged as inputs
- The analysis process needs to be applicable to cities with different starting points – not just those with benchmarking, or end use analysis
- Building stock and energy use trend analysis yields important similarities and differences between cities such as comparing similar buildings in different cities

Final Methodology

1. Establish building typologies that can be common across cities
2. Develop end use breakdown for building typologies
3. Analyze similarities & differences in building stock across core cities using existing benchmarking and national survey data
4. Determine energy efficiency and electrification potential of different end uses and apply to typologies



Establishing Building Typologies

Major typologies have analysis that draws on previous work defining performance potential by end use.

Major Typologies - assign based on type, age, and size

- MF-Tall-New
- MF-Tall-Old
- MF-Short
- Hotel-Dorm-Lodging
- Office

Other types do not have a basis of analysis with unified modeling studies.

All Others – CBECS Principal Building Activity

- Education
- Food sales
- Food service
- Health care Inpatient
- Health care Outpatient
- Mercantile Retail (other than mall)
- Mercantile Enclosed and strip malls
- Public assembly
- Public order and safety
- Religious worship
- Service
- Warehouse and storage
- Other
- Vacant

Performance target analysis methods - percentage of city floor area falling under each method

Note: Smaller residential 1-4 family homes are shown for context and are not included in this study

Analysis Method	Multifamily, Hotel, and Office	All Others	1-4 Family (outside study scope)
Percent of City Floor Area in Core Cities (estimate from tax data for each city)	35% Seattle 54% DC 54% NYC 43% Santa Monica	17% Seattle 15% DC 21% NYC 18% Santa Monica	47% Seattle 30% DC 26% NYC 39% Santa Monica

Typology Baseline Using Benchmarking Data

Sum of floor area and median GHG Intensity per floor area

Floor Area and GHGI [CO2e/SF/yr]	Seattle		DC		NYC		Santa Monica*	
Building Type	Area	GHGI	Area	GHGI	Area	GHGI	Area	GHGI
MF-New-Tall (4+ stories, post 1979)								
MF-Old-Tall (4+ stories, pre 1980)								
MF-Short (1-3 stories, any age)								
Education								
Food Sales								
Food Service								
Health care Inpatient								
Health care Outpatient								
Lodging								
Mercantile Enclosed and strip malls								
Mercantile Retail (other than mall)								
Office								
Other								
Public Assembly								
Public order and safety								
Religious Worship								
Service								
Warehouse and storage								
City Total Floor Area [million SF]	**268**		**282**		**3,824**		**53**	

***uses LA County Parcel Assessor data in absence of benchmark data**

Defining Paths and Targets

Path

- Descriptions of the types of retrofits that would need to be completed in order to achieve a target.
- Technically appropriate paths are feasible to be implemented
- Paths are an assembly of retrofit technology packages to address all end uses (fossil fuel and electricity) responsible for GHG emissions

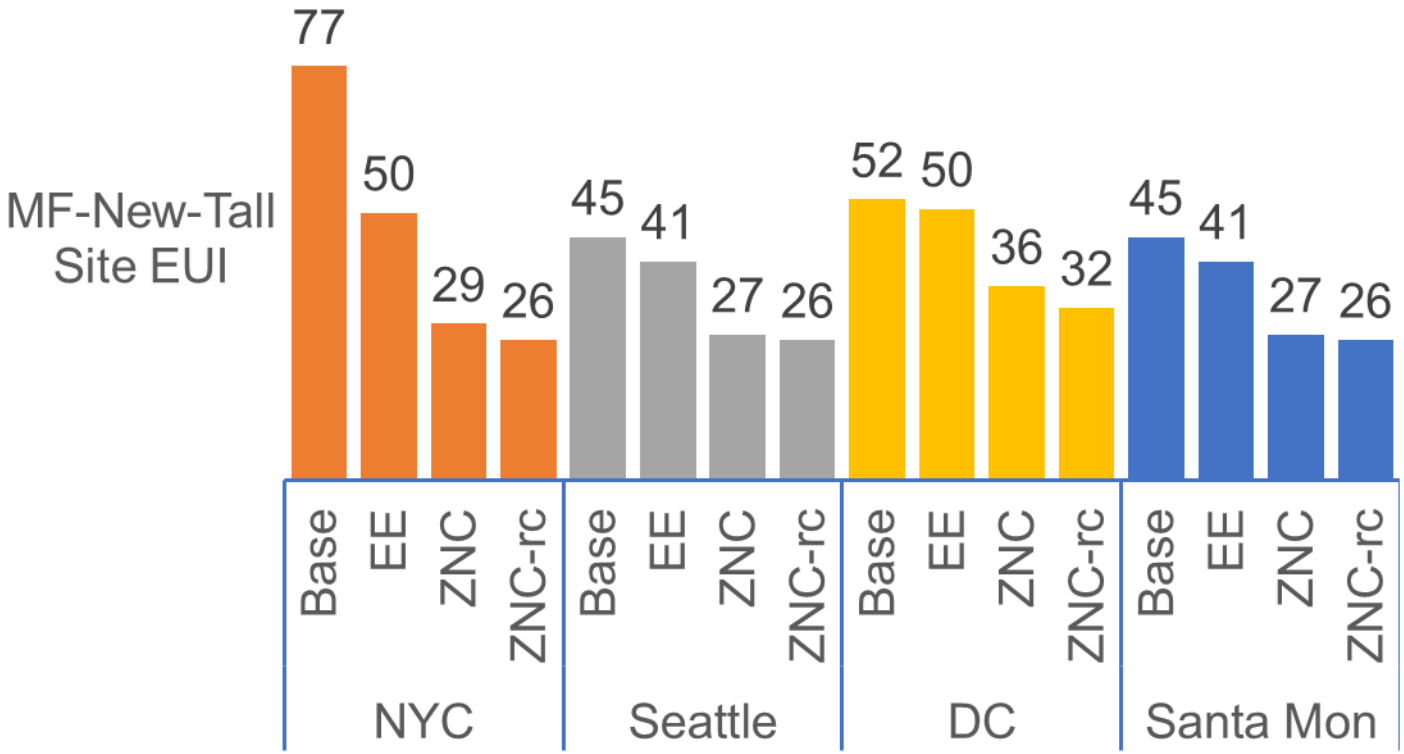
Target

- Overall building performance requirement that can be enforced
- Presented in site EUI, but policy can use a variety of metrics – GHGI, site EUI, ENERGY STAR
- Fair targets require significant efforts across typologies
- Every target needs a viable path that a building can follow to comply

The energy efficiency targets are approachable through the optimization of existing systems in the near term, while the more aggressive targets likely necessitate higher efficiency electrical equipment and the elimination of on-site combustion systems. Earlier electrification of building systems may be used to reach energy efficiency targets, but energy efficiency improvements alone will not get energy or emissions low enough to reach long-term **zero net carbon (ZNC) targets**.

Path / Package vs Target	Interim (EE) Target	ZNC Target	ZNC Target – reduced consumption
Energy Efficiency (EE) Path *Optimized systems – no fuel switching*	Target is achievable	Target not achievable	Target not achievable
EE + Electrification Path *Gas using systems are electrified*	Target is achievable	Target is achievable	Target not achievable
EE + Electrification + Envelope Path *Space conditioning load reduction*	Target is achievable	Target is achievable	Target is achievable

Defining Paths and Targets



ZNC-rc: = EnerPHit
A practical lower limit for space conditioning performance?

Path / Package vs Target	Interim (EE) Target	ZNC Target	ZNC Target – reduced consumption
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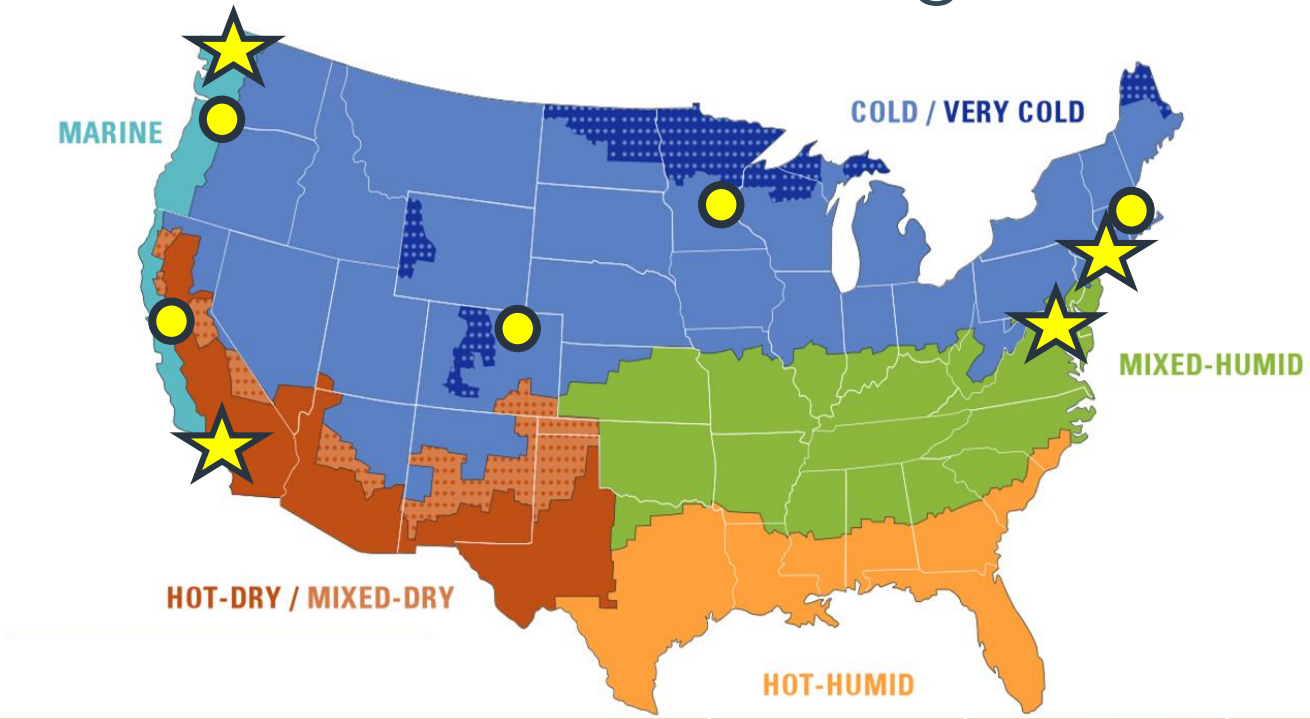
EE + Electrification + Envelope Path *Space conditioning load reduction*	Target is achievable	Target is achievable	Target is achievable

Regional Considerations – Heating and Cooling



Relative Space Conditioning Use Intensity Across Climates Zones (CZ) [CZ average EUI / national average EUI]	Space Heating Ratio	Space Cooling Ratio	Core Cities
Very cold/Cold	1.32	0.58	
Mixed-humid	0.84	1.05	DC, NYC
Mixed-dry/Hot-dry	0.52	0.88	Santa Monica
Hot-humid	0.54	2.20	
Marine	0.86	0.39	Seattle

Example Baseline with End Use Approximations
All units Site EUI [kBTU/SF]

Seattle	BM Count	Total Site – All Fuels	Total Site Electricity	Total Site Gas	Space Cooling Elec	Other Elec	Space Heating	Water Heating	Cooking	Other
MF-New-Tall	305	30	23	7	3	20	0	6	1	0
MF-Old-Tall	106	33	31	2	4	27	0	0	2	0
MF-Short	104	32	31	1	4	28	0	0	1	0
Education	157	44	22	22	2	20	14	4	1	3
Food Sales	27	217	130	87	2	128	43	5	38	0
Food Service	12	138	61	77	5	56	12	16	49	0
Health care Inpatient	5	201	81	120	8	73	55	29	14	21
Health care Outpatient	27	75	64	11	3	61	10	1	0	0
Lodging	108	68	34	35	2	32	9	20	0	5
Mercantile Enclosed / strip malls	11	64	41	23	2	39	8	6	6	3
Mercantile Retail (other than mall)	67	58	41	17	2	39	12	2	4	0
Office	324	52	49	3	3	46	0	1	0	2
Other	95	62	39	23	6	33	22	1	0	0
Public Assembly	46	85	39	45	4	36	32	2	7	5
Public order and safety	3	78	38	40	3	35	19	18	3	0
Religious Worship	51	38	12	26	1	11	20	0	5	0
Service	11	99	33	67	2	31	45	22	0	0
Warehouse and storage	236	31	20	11	1	19	6	1	0	3
Vacant		24	13	10	1	13	9	1	0	0

How Targets are Calculated

All units **Site EUI** [kBTU/SF]

Electricity Use | "Gas" (Gas, Oil, District Steam) Use

Baseline assumes gas heating and gas hot water
Due to rounding, components may not add up to 100% of total

Baseline	BM Count	Total Site – All Fuels	Total Site Electricity	Total Site Gas	Space Cooling Elec	Other Elec	Space Heating	Water Heating	Cooking	Other
Food service	12	138	61	77	5	56	12	16	49	0
Health care Inpatient	5	201	81	120	8	73	55	29	14	21

Energy Efficiency **(EE) Target** EUI as a Percent of Baseline	70%	70%	100%

Zero Net Carbon **(ZNC) Target** EUI as a Percent of Baseline Converts gas EUI to electricity EUI	100%	Space heating	Water heating	Cooking	Other
		32%	**41%**	**61%**	**89%**

(sum of products)

	Baseline			**EE Target**			**ZNC Target**		
	Total Site Gas	Total Site Electricity	Total Site – All Fuels	Total Site Gas	Total Site Electricity	Total Site – All Fuels	Total Site Gas	Total Site Electricity	Total Site – All Fuels
Food service	77	61	**138**	74	49	**122**	0	88	**88**
Health care Inpatient	120	81	**201**	104	65	**169**	0	117	**117**

Targets for Seattle – All Typologies
All units Site EUI [kBTU/SF]

	Baseline			Interim - EE Standard Target			ZNC - Standard Target			ZNC Reduced Consumption Target		
	Gas EUI	Elec EUI	Site EUI	Gas EUI	Elec EUI	Site EUI	Gas EUI	Elec EUI	Site EUI	Gas EUI	Elec EUI	Site EUI
MF-New-Tall	7	23	**30**	7	19	**25**	0	21	**21**	0	21	**21**
MF-Old-Tall	2	31	**33**	2	25	**27**	0	26	**26**	0	26	**26**
MF-Short	1	31	**32**	1	25	**26**	0	25	**25**	0	25	**25**
Education	22	22	**44**	18	18	**36**	0	26	**26**	0	26	**26**
Food sales	87	130	**217**	74	104	**178**	0	139	**139**	0	132	**132**
Food service	77	61	**138**	74	49	**122**	0	88	**88**	0	88	**88**
Health care Inpatient	120	81	**201**	104	65	**169**	0	117	**117**	0	107	**107**
Health care Outpatient	11	64	**75**	8	51	**59**	0	54	**54**	0	54	**54**
Lodging	35	34	**68**	32	27	**59**	0	42	**42**	0	42	**42**
Mercantile Enclosed and strip malls	23	41	**64**	21	33	**54**	0	43	**43**	0	43	**43**
Mercantile Retail (other than mall)	17	41	**58**	14	33	**47**	0	38	**38**	0	38	**38**
Office	3	49	**52**	3	39	**42**	0	41	**41**	0	41	**41**
Other	23	39	**62**	17	31	**48**	0	37	**37**	0	35	**35**
Public assembly	45	39	**85**	36	32	**67**	0	48	**48**	0	44	**44**
Public order and safety	40	38	**78**	35	30	**65**	0	44	**44**	0	42	**42**
Religious worship	26	12	**38**	20	10	**29**	0	17	**17**	0	16	**16**
Service	67	33	**99**	53	26	**79**	0	45	**45**	0	38	**38**
Warehouse and storage	11	20	**31**	9	16	**25**	0	21	**21**	0	20	**20**
Vacant	10	13	**24**	8	11	**18**	0	13	**13**	0	13	**13**

Example

Example of a retail store in Seattle being subject to Energy Efficiency and ZNC targets.

Retail store, **Seattle 23,067 SF Baseline Usage (2017 Consumption)**			Seattle EE Target Mercantile Retail (other than mall)			Seattle ZNC – Compatible Target Mercantile Retail (other than mall)		
Non-Elec EUI	Elec EUI	Site EUI	Non-Elec EUI	Elec EUI	Site EUI	Non-Elec EUI	Elec EUI	Site EUI
26	40	**66**	14	33	**47**	0	38	**38**

29% reduction from baseline

42% reduction from baseline

Objectives of Performance Metrics

1. **Greenhouse Gas Emissions:** Enable reductions to meet city climate goals
2. **Consumption:** Overall energy consumption should be reduced in a way that moves building stock towards citywide GHG emissions goals
3. **Demand:** Energy demands should be conducive to grid and renewables integration, minimizing peak demands and adding demand flexibility
4. **Administration/Enforceability:** Does not place an undue administrative burden and is acceptable to building owners and city administrators alike, which means considering many of the following factors (in no particular order):
    - ***Fair and transparent*** *to energy users across major use types*
    - ***Easy to understand*** *for building owners so they know what to do*
    - ***Reproducible*** *by different parties, using objective parameters*
    - ***Repeatable*** *over time (annually, every five years, etc.) and across locations*
5. **Encourages GHG emissions reductions** both today and for the foreseeable future that will accommodate changing infrastructure, integration of renewables, and new technologies
6. **Create/ensure carbon neutral buildings:** long term goal

Types of Performance Metrics - Numerator

The numerator of a metric defines what type of energy/carbon/etc will be measured

Numerator	Strengths	Weaknesses
Site Energy	Number measured on site or directly from utility bill Reflects what owners can control and are responsible for	Not directly a GHG measurement Allows owners to forget about energy production methods outside their buildings Strong signal for efficient electrification, since heat pumps and electric systems tend to have higher equipment efficiency than gas systems
Source Energy	Some consideration of transmission and distribution losses impacting energy input	Can only be used for national summaries of measured energy if using ESPM Does not represent GHG emissions Not directly related to policy goals: weak signal for electrification; strong signal for increasing natural gas infrastructure with on-site cogeneration of electricity and heat.
CO2e Emissions	In line with policy goals of GHG reduction if appropriate forecasting of carbon coefficient is used	Dependency on factors outside the building that owners have no control over Variability due to fuel mix of electricity production and potential for revisions to gas GHG coefficients over time Typically scope 1 for fuels, scope 2 for electricity, which neglects fugitive emissions and waste in transit
Coincident Demand at System Peak	Demand on infrastructure is important if the grid and/or distribution network is constrained	Sensitive to building location within the city for distribution constraints, making metrics calculation difficult Requires utilities to map out constraints and system peaks for all buildings and provide times of limitation so buildings can take action

Types of Performance Metrics - Denominator

Similarly, the denominator is most regularly floor area, but others might be considered.

Denominator / Normalizing Variable	Strengths	Weaknesses
Floor Area	Physical characteristic of building; verified once unless significant change to floor area Consistent over time Simplicity	Process and appliance loads may not scale this way if highly dependent on equipment type
Occupant Density	Aligns with major driver of GHG emissions for some end uses	No accurate method to measure/validate over time
Person-hour (occupants *hrs occupied)	Aligns with two major drivers of GHG emissions	Even harder to measure and validate Complicated to legislate
Business output (customers, sales, etc.)	Most relevant for building types where activity doesn't scale with area or occupants	Extremely difficult to measure and validate Could change dramatically year over year
Absolute (Total energy or carbon; no denominator)	Straight-forward for individual buildings	Penalizes large buildings More complex calculation for initial limit/allocation
Residential Apartments	Proxy for people occupying a building	Not all end uses scale this way – space conditioning more proportional to floor area Occupants and apt count are not necessarily linked
Residential Bedrooms	More representative of occupancy	Actual occupancy and bedroom count are not necessarily linked

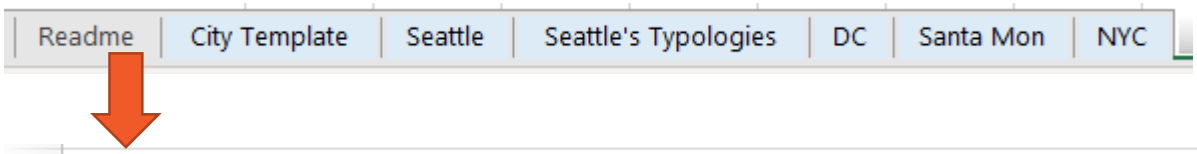
Performance Metrics Worthy of Close Evaluation

Metric	Strengths	Weaknesses
Site EUI kBTU/SF	Easiest way to measure energy use directly from energy bills Floor area is fixed once verified Applies to every space use type	Does not account for occupancy Overall consumption and GHG emissions are not necessarily correlated, and may further diverge in the future Needs weather-normalization for YoY changes
GHG Intensity kgCO2e/SF (annual)	Comparable measure of annual GHG emissions quantified for each building	Annual carbon emissions do not factor in time of use fuel mix for electricity Individual building performance is more difficult to compare year on year if the coefficients change, unless it is artificially fixed for segments of time.
Energy Star Score (1-100)	Familiarity in the industry Included in most benchmarking and disclosure policies Use of building adjustment factors	Some inputs are difficult to verify, opening the possibility of falsified data One national comparison for scoring curve – not city specific Source energy does not represent carbon emissions or site energy efficiency, and the factors are only on the national scale, neglecting local energy generation specifics Source EUI does not provide appropriate signal – to promote electrification technology necessary to realize carbon neutrality
Demand Intensity at System Peak + on-site combustion limits Max kW + Gas EUI	Encourages load flexibility to be grid-optimal, a requirement for renewables-based electricity grids Can support demand response and peak shifting with feedback from electricity suppliers	Needs to be combined with a fossil fuel usage requirement Relies on interval meters and utility cooperation/coordination Potentially requires multiple utility cooperation to enforce both electricity and gas limitations separately and accurately.

Performance Metrics for New Buildings

Metric	Strengths	Weaknesses
Thermal Energy Demand Intensity (TEDI) [kWh/m^2/yr] or [kBTU/SF/yr]	Focus on HVAC energy use efficiency, allowing flexibility for different space use types	Requires energy model, not calibrated to actual building energy use Neglects non-HVAC loads Can't be tracked annually
Total System Performance Ratio (TSPR) [kBTU/lbCO2e]	Sets relative whole system efficiency for HVAC systems, instead of just individual components Ratio of predicted heating, cooling & ventilation load to carbon emissions	Requires energy model, not calibrated to actual building energy use Neglects non-HVAC loads The model doesn't change year to year unless equipment changes. Not available for all building types

Target Development Tool



18	**Instructions**
19	Enter Building Population and Available Energy Data
20	Starting Points:
21	1) Property tax – level data. Count and floor area by space use type, but no energy data.
22	2) Benchmarking-level data. Whole building energy data by energy type (gas + electricity) by space use type, but not end-use specific information.
23	3) End-use – level data. Energy type data specific to each end use from audit or survey data.
24	Descriptions of building types are on the table on this Readme tab.
25	Starting Point 1: enter count and floor area by space use type into the respective columns. Select Building America Climate Zone and make any edits to the heating and electricity EUI savings estimates, if desired, or leave defaults. Targets are developed based on estimated end use proportions and energy type totals from CBECS information and climate adjustments.
26	Starting Point 2: enter count, floor area, and energy use medians for gas and electricity EUIs. Select Building America Climate Zone and make any edits to the heating and electricity EUI savings estimates, if desired, or leave defaults. Targets are developed based on estimated end use proportions mapped to energy type totals.
27	Starting Point 3: enter count, floor area, and energy use medians for gas and electricity EUIs. Select Building America Climate Zone and make any edits to the heating and electricity EUI savings estimates, if desired, or leave defaults. In the section below, replace default end use estimates with actual end use EUIs per end use. note that typology names can also be changed in the "Baseline" section of the sheet if the end use default estimates are not needed.
28	Energy-specific GHG intensity coefficients: The GHG coefficient for natural gas is a fixed number as it does not change depending on location or type of use (assuming it is all burned in some way). The GHG coefficient for electricity is looked up from the table on this Readme tab.

Target Development Tool

Readme | City Template | Seattle | Seattle's Typologies | DC | Santa Mon | NYC

Blue cells are input cells						
Enter City Name	Seattle					
Building America Climate Zone	**Marine**	**Starting Point 1**			Electricity	30%
Climate Approximated Core City Overwrite for specific Core City Used for major typology targets	*Seattle*				Space Heating	30%
					Water Heating	0%
					Cooking	0%
Heat/Cool Load % Above EnerPHit (ZNC-comp red. Cons. Only	0%				Other	0%

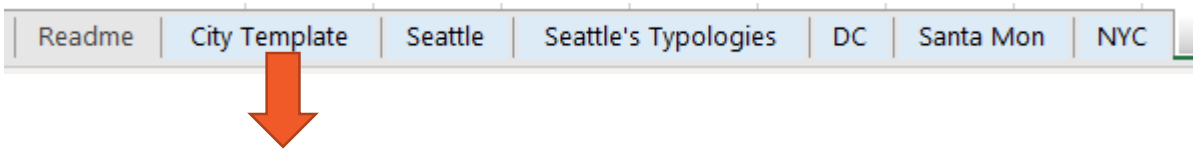
Energy efficiency gains across all typologi

Input Site EUI Data - Starting Point 2	kBTU/SF	kBTU/SF	Buildings	SF		
Paste in median gas and electricity site EUI per building type						
Primary Building Activity ***Default is CBECS types + Multifamily***	**Baseline Gas EUI**	**Baseline Elec EUI**	**Building Count**	**Covered Floor Area**	**Gas Heating?**	**Gas DHW?**
MF-New-Tall	12	21	185	25,788,474	TRUE	TRUE
MF-Old-Tall	17	20	142	13,179,312	TRUE	TRUE
MF-Short	21	17	148	10,261,521	TRUE	TRUE
Education	25	21	157	24,003,916	TRUE	TRUE
Food Sales	85	127	27	1,907,475	TRUE	TRUE
Food Service	89	80	12	410,849	TRUE	TRUE
Health care Inpatient	106	107	5	1,337,399	TRUE	TRUE
Health care Outpatient	15	57	27	4,176,747	TRUE	TRUE
Lodging	31	32	108	14,454,731	TRUE	TRUE
Mercantile Enclosed and strip malls	35	52	11	1,839,008	TRUE	TRUE
Mercantile Retail (other than mall)	21	41	67	6,165,819	TRUE	TRUE
Office	9	39	324	54,225,910	TRUE	TRUE
Other	23	39	95	12,323,030	TRUE	TRUE
Public Assembly	49	37	46	5,078,316	TRUE	TRUE
Public order and safety	43	50	3	639,680	TRUE	TRUE
Religious Worship	27	11	51	1,714,520	TRUE	TRUE
Service	66	31	11	405,042	TRUE	TRUE
Warehouse and storage	14	16	236	13,724,146	TRUE	TRUE
Vacant					TRUE	TRUE

Interim EE target savings across all different gas end uses

Option to select whether heating and/or DHW is a gas end use or not.

Target Development Tool



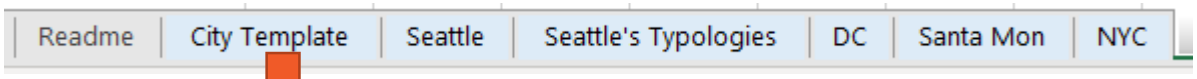
Baseline Site EUI	**Starting Point 3**		Baseline Estimate of Elec End Use Site EUI		Baseline Estimate of Gas End Use Site EUI			
Total Site	Total Elec	Total Gas	Elec Cool	Elec Other	Gas Heat	Gas WH	Gas Cook	Gas Other
33	21	12	3	18	4	7	1	0
37	20	17	2	17	7	9	1	0
38	17	21	2	15	8	12	2	0
46	21	25	2	19	15	5	1	4
211	127	85	2	125	42	5	37	0
169	80	89	6	74	14	18	57	0
201	81	120	8	73	55	29	14	21
72	57	15	2	55	14	2	0	0
63	32	31	2	30	8	18	0	4
87	52	35	3	49	12	9	10	4
61	41	21	2	39	14	2	5	0
48	39	9	2	36	6	1	0	2
62	39	23	6	33	22	1	0	0
86	37	49	4	33	34	2	7	5
78	38	40	3	35	19	18	3	0
38	11	27	1	11	21	0	5	0
97	31	66	2	29	44	22	0	0
30	16	14	1	15	8	2	0	0
24	13	10	1	13	9	1	0	0

Space Cooling Ratio Multiplier		Space Heating Ratio Multiplier	
0.39		0.86	Location Based Multiplier
		0.69	MF Space Heating Multplier

Depending on the selection of gas heat/DHW, the proportion of end uses will readjust accordingly, apportioning to the remaining end uses.
For example, if heating is entered as not gas, then the end uses of DHW, cooking, and other makeup 100% of the entered gas EUI for the typology.

Heating energy adjustments are made specifically for MF types to account for the different cities/climates, since the CBECS resource was not available and the RECS data does not align with Seattle and NYC audit/regional assessment findings

Target Development Tool



The selection of end use fuel type is used in the EE target, the ZNC target, and the ZNC reduced consumption target

Seattle: Targets Table

	Baseline			Interim - EE Standard Target			ZNC - Standard Target			ZNC Reduced Consumption Target			
	Gas EUI	Elec EUI	Site EUI	Gas EUI	Elec EUI	Site EUI	Gas EUI	Elec EUI	Site EUI	Gas EUI	Elec EUI	Site EUI	Site EUI Trend (Lowest point highlighted)
MF-New-Tall	12	21	**33**	11	15	**25**	0	19	**19**	0	19	**19**	
MF-Old-Tall	17	20	**37**	15	14	**29**	0	20	**20**	0	20	**20**	
MF-Short	21	17	**38**	19	12	**31**	0	20	**20**	0	20	**20**	
Education	25	21	**46**	20	15	**35**	0	24	**24**	0	24	**24**	
Food sales	85	127	**211**	72	89	**161**	0	123	**123**	0	116	**116**	
Food service	89	80	**169**	85	56	**141**	0	101	**101**	0	101	**101**	
Health care I	120	81	**201**	104	57	**161**	0	109	**109**	0	100	**100**	
Health care O	15	57	**72**	11	40	**51**	0	44	**44**	0	44	**44**	
Lodging	31	32	**63**	28	23	**51**	0	36	**36**	0	36	**36**	
Mercantile En	35	52	**87**	31	36	**67**	0	52	**52**	0	52	**52**	
Mercantile Re	21	41	**61**	16	28	**45**	0	35	**35**	0	35	**35**	
Office	9	39	**48**	7	27	**34**	0	31	**31**	0	31	**31**	
Other	23	39	**62**	16	27	**43**	0	32	**32**	0	31	**31**	
Public assem	49	37	**86**	39	26	**65**	0	44	**44**	0	39	**39**	
Public order a	40	38	**78**	35	27	**61**	0	40	**40**	0	39	**39**	
Religious wo	27	11	**38**	20	8	**28**	0	16	**16**	0	15	**15**	
Service	66	31	**97**	52	22	**74**	0	41	**41**	0	34	**34**	
Warehouse a	14	16	**30**	12	11	**23**	0	17	**17**	0	17	**17**	
Vacant	10	13	**24**	8	9	**17**	0	12	**12**	0	12	**12**	

Target Development Tool

Readme | City Template | Seattle | Seattle's Typologies | DC | Santa Mon | NYC

The resulting analysis can be modified for different scenarios by inputting different fuel splits for a given typology to approximate the wider population of the typology instead of just the median.

An example is shown here which shows that while the median office building has a baseline site EUI of 62 kBTU/SF, there are quite a few buildings that use a lot of gas that have higher baselines and thus may have a harder time getting to a typology-wide target. With energy efficiency alone, all buildings make some progress, but it is the gas based buildings that may need to electrify in order to hit even the interim target, since gas energy efficiency can only go so far