DENSITY BONUS AS INCENTIVE FOR HIGH PERFORMANCE CITIES

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image: Seattle Municipal Archives

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FORM FOLLOWS ECONOMICS.

FORM FOLLOWS ECONOMICS X ENVIRONMENTAL PERFORMANCE.

Prologue: What is the city of the future? Economics has driven the form of cities of the past centuries while proactive zoning and regulations have vastly improved the living conditions and the environmental impact of intense urbanism. As the world concentrates economically and culturally in urban settlement, the environmental performance of cities is an opportunity for innovation in the service of a liveable planet. In the best cases, the low carbon city of the future is also a vibrant, experimental, creative and influential place to work and live.

FORM FOLLOWS ECONOMICS X ENVIRONMENTAL PERFORMANCE.

PROJECT DESCRIPTION

March, 2014

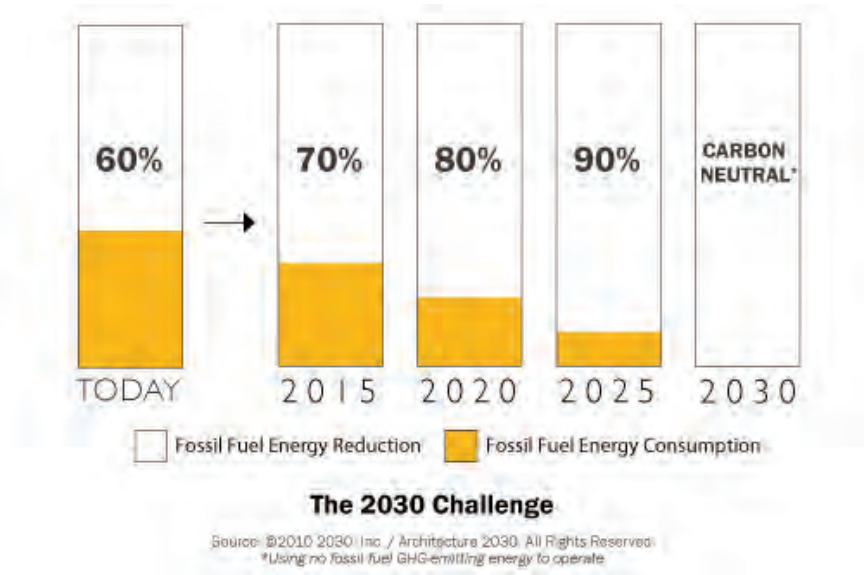
Earth's atmosphere reached a significant threshold of **400 ppm atmospheric carbon** last year, swiftly moving upward, away from the historically more environmentally stable 350 ppm that many scientists believe is sustainable. Perkins+Will is working to address these issues nationally as a participant in the AIA 2030 Commitment and, locally here in Seattle, as member of the Seattle 2030 District, following on architect Edward Mazria's 2030 Challenge initiative, to dramatically reduce carbon emissions from buildings.

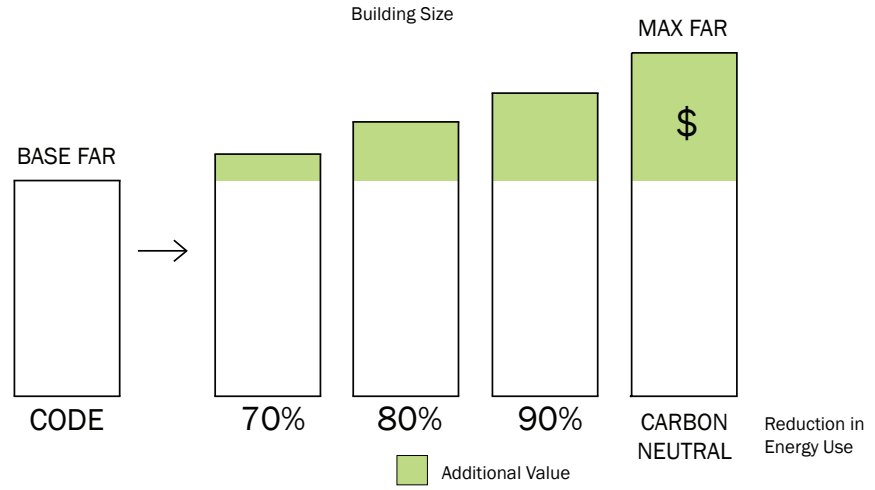
The city of Seattle is uniquely poised as an **environmental leader** with a robust and innovative economy, talented and motivated design and engineering companies and a benign, temperate climate. To date, the Seattle 2030 District has made progress in emissions reduction with existing buildings (2030 Challenge for Planning), but new construction is rarely meeting the 2030 Challenge targets, instead simply following the legal minimum of Washington State Energy Code performance.

This project studies incentives for 2030 Challenge energy performance based on the existing City of Seattle Density Bonus Program. If carbon emission reduction is, as it appears, a public benefit, this program is perfectly suited to incentivize a **new generation of leading edge, high performance buildings** in a schedule progressing to a rigorous threshold of carbon neutral buildings by 2030. From a public benefit point of view, this program, if approved by the City Council and tuned in a way that makes it financially successful, can produce a higher density of the best energy performing buildings in the country.

DENSITY BONUS AS INCENTIVE FOR HIGH PERFORMANCE CITIES

Q: How can the City promote leading-edge energy efficiency and share the risk with owners and tenants in new modes of designing, operating, and inhabiting buildings?





Density Bonus for Energy Performance

In May, 2011, the city of Seattle released a final report analyzing a pathway to a carbon neutral Seattle, describing the urgency of climate change response and the role of cities as leaders in addressing the issue. The report described an approach of **"silver buckshot over silver bullet"**, "aggressively implementing a suite of ambitious strategies in the transportation, built environment, energy supply and waste sectors out to the year 2050" (ref. 9 p.11). To achieve these goals, the responsibility, risk and reward can be shared by the city, potentially with county and state partners, incentivizing experimentation in development by leveling the financial playing field for next-generation energy performance. If successful, the results become influential case studies for further development, fostering a design, engineering and construction feedback culture of innovation.

ENERGY USE INTENSITY

	2012 energy code	70%	80%	90%	carbon neutral
OFFICE Regional average is 96.8 EUI (kbtu/sf/yr) City average is 92 EUI	40 B occupancy office = 59% reduction from average	30 15% premium cost	20 (Bullitt Center) 20% premium cost	10 25% premium cost	0 30% premium cost
RESIDENTIAL (Multifamily, 5 or more units) Regional average is 50 EUI (kbtu/sf/yr)	35 R-2 occupancy multifamily = 30% reduction from average	15 (Passive House) 15% premium cost	10 20% premium cost	5 25% premium cost	0 30% premium cost

Metrics Comparison for Your Design and/or Target

Metric	Property Estimate at Design	Design Target*	Median Property*
ENERGY STAR score (1-100)	Not Available	99	50
Source EUI (kBtu/ft²)	Not Available	73.1	243.6
Site EUI (kBtu/ft²)	Not Available	29.0	96.8
Source Energy Use (kBtu)	Not Available	26,940,211.2	89,800,704.0
Site Energy Use (kBtu)	Not Available	10,705,305.6	35,684,352.0
Energy Cost ($)	Not Available	199,458.28	664,860.93
Total GHG Emissions (MtCO2e)	0.0	991.9	3,306.2

* To perform calculations for your design target, we use the fuel mix that you've entered for your design energy estimates. If you have not entered estimated design energy, we'll use the average for your state. To perform calculations for the national median, we will assume the fuel mix and operational details of your property measurement in use, if available. Otherwise, we will use your design estimates.

From EPA Target Finder

ZONING

Zone	Construction Type	Base / Max FAR*	Height Limit	Podium	Tower	Tower Floor Plate Max.	View Corridor Setbacks	Notes
DOC1	Commercial	Base 6 **Max 20**	Office: Unlimited	65 - 85 feet, but 65 is good assumption for residential; commercial might do 2-5 stories depending on format	Complex.Tower size is departable through design review; basic standards are 145 max length (parallel to avenues) x 100 max width; 80 foot tour seperation if on same block.	Commercial: None If exceeding base, Maximum avg. floor plate 13,800; maximum any single story 16,500	Upper level setbacks on several east/west running streets of 20-40 feet required starting at heights 25 - 60' above sidewalk	Tower size is departable, massing tends to be driven by max FAR and desired floor plate. 5th / Madison (3014759) good recent permitted example. 36 story office tower with ~21,000 gsf floor plates.
	Residential	None (exempt)	Residential: Base 450 **Max Unlimited**					
DOC2	Commercial	Base 5 **Max 14**	Office: 500	65 - 85 feet, but 65 is good assumption for residential; commercial might do 2-5 stories depending on format	Complex.Tower size is departable through design review; basic standards are 145 max length (parallel to avenues) x 100 max width; 80 foot tour seperation if on same block.	Commercial: None If exceeding base, Maximum avg. floor plate 12,700; maximum any single story 16,500	Upper level setbacks on several east/west running streets of 20-40 feet required starting at heights 25 - 60' above sidewalk	Because tower size is departable, massing tends to be driven by max FAR and desired floor plate.
	Residential	None (exempt)	Residential: Base 300 **Max 500**					
DMC 340/290-400	Commercial	Base 5 **Max 10**	340	65 - 85 feet, but 65 is good assumption for residential; commercial might do 2-5 stories depending on format	Complex.Tower size is departable through design review; basic standards are 145 max length (parallel to avenues) x 100 max width; 80 foot tour seperation if on same block.	Commercial: None Residential (above 160') Maximum avg. floor plate 10,700; maximum any single story 11,500	Upper level setbacks on several east/west running streets of 20-40 feet required starting at heights 25 - 60' above sidewalk	Tower size is departable, massing tends to be driven by max FAR and desired floor plate. VIA 6 good recent example: two res towers with 10,400 sf each over 6 story base.
	Residential	None (exempt)	Base 290 **Max 400**					

Notes:
1. It would make sense for any prototype to maximize allowed development capacity (FAR for commercial, height for residential) as this is consistent with what most incentive zoning projects are doing

credit: Brennon Staley

The city has determined that the **Density Bonus Program** is only applicable to buildings **85' and taller**. This study has chosen, in consultation with DPD, 3 typical downtown zones to provide a range of theoretical development financial metrics.

1 - DOC1
2 - DOC2
3 - DMC 340/290-400

Seattle Downtown Zoning Complexity

Zone	Site Dims (ft)	Site Area (sf)	FAR (gsf)	Net ASF (85% efficiency)	Height Limit (ft)	Podium (20% open space)	Tower (gsf)	Floors 20,000 sf plates 13' fl/fl comm 10' fl/fl res	Total Area (gsf)	Const. Cost $180/sf office $180/sf residential (EUI)	Premium for 2030 Performance % Reduction (C|R) 70% 2015 29 | 15	 80% 2020 20 | 10	 90% 2025 10 | 5	 100% 2030 0 | 0	Lease Rate (*4) $/asf/yr 100% rented	Lease Rate (*4) $/asf/yr 95% rented 5% vacancy
DOC1 U/450/U (Urban Visions Site) Office	240x256	61,440	Base FAR 6=368,640 Max FAR 20=1,228,800 Delta: 860,160	313,344 1,044,480 731,136	Office: Unlimited	65'x206'x180'(.8) 4 stories = 118,656 gsf	249,984 1,110,144	4+13=17 4+56=60	368,640 1,228,800	$62,668,800 $208,896,000 $146,227,200	15%	20%	25%	30%	$9,400,320 $31,334,400 $21,934,080	$8,930,304 $29,767,680 $20,837,376
(77 Story Residential Tower) reference project Residential			None (exempt)	763,858 UNL	Residential: Base 450 Max Unlimited	65'x206'x180'(.8) 4 stories = 118,656 gsf	780,000 UNL	4+38=42 4+UNL	878,656 UNL	$158,158,080 UNL	15%	20%	25%	30%	$27,498,888	$26,123,944
DOC2 (*3) (Greyhound Parking Lot) Office	360x256	92,160	Base FAR 5=460,800 Max FAR 14=1,290,240 Delta: 829,440	391,680 1,096,704 705,024	Office: 500	65'x360'x256'(.8) 4 stories = 294,912 gsf	165,888 995,328	4+10=14 4+37=40	460,800 1,290,240	$82,944,000 $232,243,200 $149,299,200	15%	20%	25%	30%	$11,750,400	$11,162,880
DOC2 test (*3) Generic Downtown Site Office	240x256	61,440	Base FAR 5=307,200 Max FAR 14=860,160 Delta: 552,960	261,120 731,136 470,016	Office: 500	65'x206'x180'(.8) 4 stories = 118,656 gsf	188,544 741,504	4+8=12 4+36=40	307,200 860,160	$52,222,000 $147,227,200 $88,903,200	15%	20%	25%	30%	$7,833,600 $21,934,080 $14,100,480	$7,441,920 $20,837,376 $13,395,456
  Residential			None (exempt)	491,858 831,858	Residential: Base 300 Max 500	65'x206'x180'(.8) 4 stories = 118,656 gsf	460,000 860,000	4+23=27 4+43=47	578,656 978,656	$104,158,080 $176,158,080	15%	20%	25%	30%	$17,706,888 $29,946,888	$16,821,544 $28,449,544
DMC 340/290-400 (Public Safety Block) Office	240x256	61,440	Base FAR 5=307,200 Max FAR 10=614,400 Delta: 307,200	261,120 522,240 261,120	Office: 340	65'x206'x180'(.8) 4 stories = 118,656 gsf	188,544 495,744	4+10=14 4+25=29	307,200 614,400	$55,296,000 $110,592,000 $47,001,600	15%	20%	25%	30%	$7,833,600 $15,667,200 $7,833,600	$7,441,920 $14,883,840 $7,441,920
  Residential			None (exempt)	474,858 661,858	Residential: Base 290 Max 400	65'x206'x180'(.8) 4 stories = 148,320 gsf	440,000 660,000	4+22=26 4+33=37	558,656 778,656	$100,558,080 $140,158,080	15%	20%	25%	30%	$17,094,874 $23,826,874	$16,240,130 $22,635,530

*Assumptions:
1. parking is assumed below grade and not factored into these calculations.
2. for DOC2, this study tests the actual site dims and another 'artificial' site the same size as the other two zones for comparison.
3. initial studies use a range of 20,000-30,000 sf floor plates which could be (for future study) a parametric variable of developer leasability rate versus form-driven environmental performance.
4. current estimated lease rates $36/sf/yr residential, $30/sf/yr commercial, these have not been adjusted for escalation through 2030.

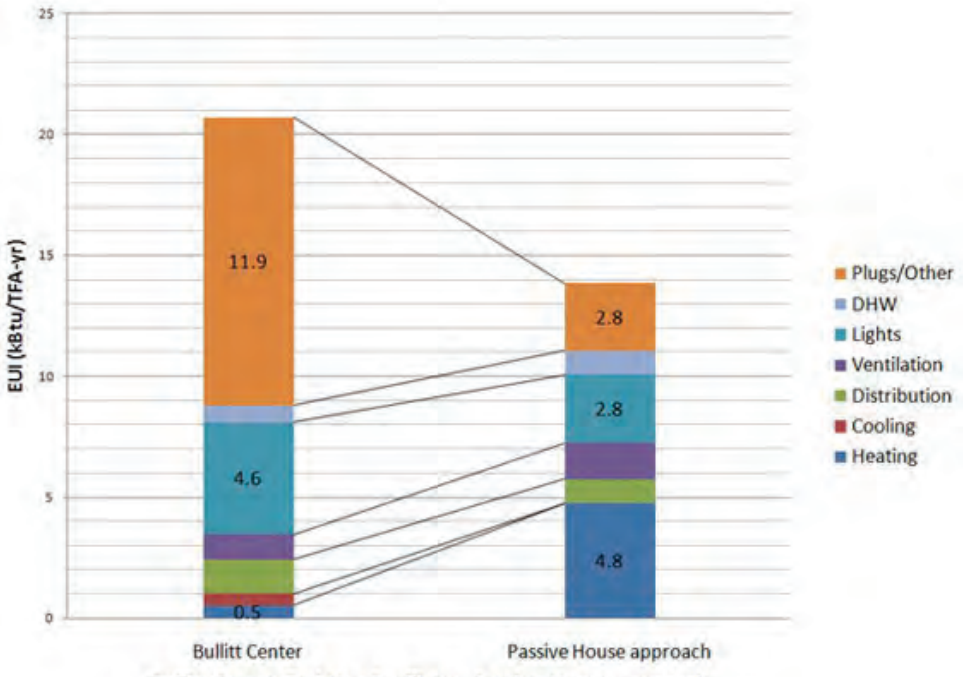
WHAT METRICS?

COMMERICIAL OFFICE: BULLITT CENTER

EUI 20 kbtu/sf/yr*

RESIDENTIAL: PASSIVE HOUSE

EUI 15 kbtu/sf/yr



Bullitt Center End Use Profile vs. Passive House approach

Jim Hanford, AIA, Miller Hull Blog, www.millerhhull.com/blog

Several pathways for analysis were considered and two comparative building systems were selected for this study, based on their high efficiency, availability of comparative data and general local familiarity. Although initially explored, this study has steered away from specific design solutions, relying instead on familar benchmarks for analysis.

Passive House provides a rigorous and well-tested performance system which may be particularly well suited for multi-family high rise. With party walls, economics of scale and limited operable fenestration, it's possible this approach can exceed the EUI 15 of referenced PH projects.

For commercial office buildings, the **Bullitt Center** is viewed as an exemplary project which can be replicated at scale in its level of energy conservation.

* achieved an EUI of under 10 in its first year of operation

OFFICE

BULLITT CENTER
EUI 20 kbtu/sf/yr
5-20% premium in cost
+

FUNDAMENTALS

52,00 sf office building.

14,300 sf PV array = 230,000 kwh

Ground source geothermal heat exchange with 26-400 foot wells.

Window system U-value 0.17, triple glazed, low-iron glazing for daylighting, 4'x10' units.

Lighting power density=0.4 w/sf, with dimmable ballasts, daylight sensors.

Green leases to incentivize conservation.

Laptops, single monitors and cloud-based computing to reduce plug loads.

Approx. 2% additional architectural and engineering fees.

Combined heating and cooling in radiant floors.

83% reduction in energy use

image: Cameron Hall

FUNDAMENTALS

Annual load not more than 15kWh/m2 (4.746 kbtu/ft2) in heating and 15kWh/m2 in cooling or peak load of 10W/m2.

Total annual primary source energy not more than 120kWh/m2.

No more air infiltration than 0.6 times the house volume per hour at 50 Pa (N/m2) by blower door test.

RESIDENTIAL

PASSIVE HOUSE
EUI 15 kbtu/sf/yr
10-15% premium in cost

BENCHMARKS

RUSSELL INVESTMENTS
EUI 28 (66% REDUCTION)

SUNSET ELECTRIC BLDG*
EUI 22 (65% REDUCTION)

TERRY / THOMAS BLDG
EUI 41 (58% REDUCTION)

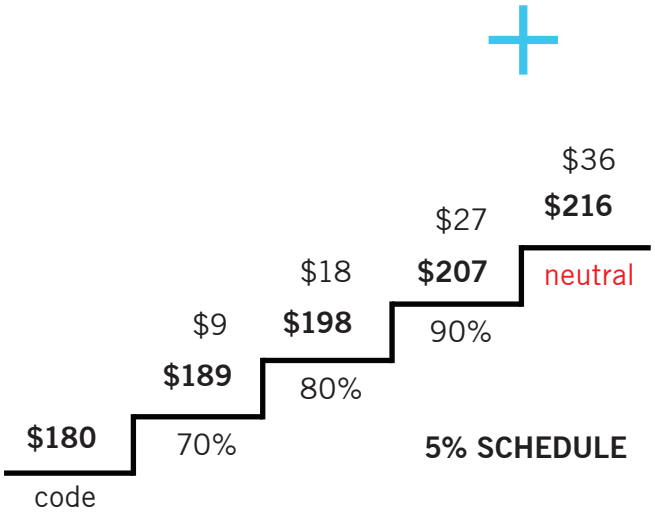
ALLEY 24
EUI 52 (50% REDUCTION)

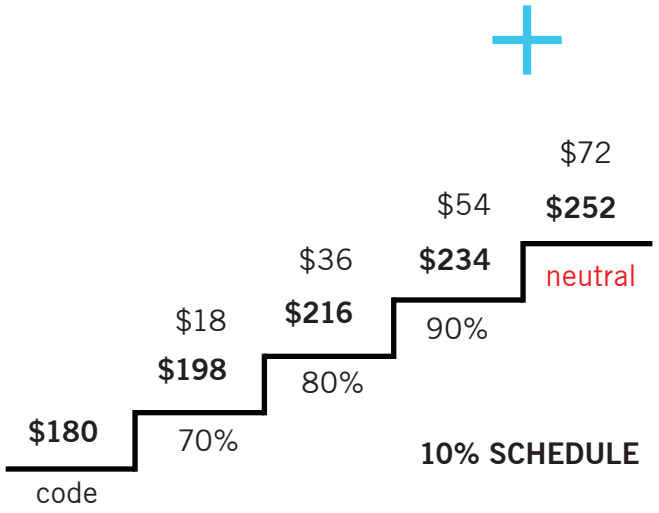
520 PIKE TOWER
EUI 44 (45% REDUCTION)

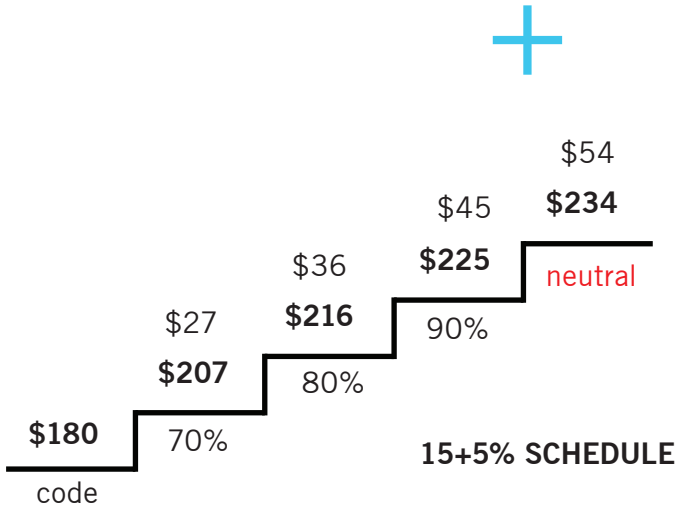
JOSEPH VANCE BUILDING
EUI 43 (63% REDUCTION)

At left are familiar projects built in Seattle over the past 10 years, to give a sense of **comparison in energy performance levels**.

* Multi-family housing







In this analysis, **a key idea is to incentivize 70, 80, 90 or 100% reductions**, not sometime in the future, but now. Seattle has the benefit of a carbon-neutral utility but is connected to the national energy grid and has the climatic, financial, and creative resources to lead nationally and internationally. Above are three possible schedules for which the Density Bonus Program could be tuned to credit developers for levels of energy efficiency. The schedule on the right, starting at a 15% premium for 70% reductions, with 5% additional premiums thereafter, loosely matches data on both Passive House and Bullitt Center and appears to be a starting point for discussion.

These schedules can also be differentiated by zone, as the pro forma calculations for each zone vary, based on development potential. Whatever final level of support is determined, these numbers could be translated into an FAR Density Bonus as a credit for superior environmental achievement.

GREEN LEASES

"The Bullitt Center lease incentivized conservation by refunding 100% of a tenant's submetered electricity bill as long as the tenant meets its agreed-on energy allowance"

-ULI article (ref. 1)

Tenant behavior becomes an important consideration in high performance architecture. Many building owners are cautious to put restrictions into building leases, seeing it as a competitive diadvantage in finding tenants. The language of the green lease of the Bullitt Center appears to have found an alternative by first **establishing a clear and objective performance level, then incentivizing conservation by refunding the tenants' submetered electric bill when performance targets are achieved**. This notion builds consciousness and leads to a participatory and proactive tenant culture.

CERTIFICATION AND PERFORMANCE BOND

In this process an early concern was voiced that neither the city nor the Seattle 2030 District are certification agencies to ensure performance. Fortunately, in the 2012 energy code, **the city has recently created a method for certification**. Based on a concept of "pledge and fine", the city first requires an accredited energy model proving the engineering and design standards, then prescribes a financial penalty for any under-performance, a portion of which an owner can recoup by taking remedial measures.

C402.1.5.2 Energy use targets. Buildings, including their initial tenant improvements, using the Target Performance Path shall be designed to use less energy than the weighted sum of the following energy use targets, as demonstrated by approved energy modeling. Energy use targets are expressed in terms of thousand BTU per square foot of conditioned floor area per year (kBTU/ft^2/yr).

1. B-occupancy office: 40 kBTU/ ft^2/yr
2. B-occupancy medical office: 50 kBTU/ ft^2/yr
3. R-2 occupancy multi-family: 35 kBTU/ ft^2/yr
4. S-1 & S-2 occupancy warehouse: 25 kBTU/ ft^2/yr
5. E-occupancy school: 45 kBTU/ ft^2/yr
6. M-occupancy retail: 60 kBTU/ ft^2/yr
7. I-2 occupancy hospital: 150 kBTU/ ft^2/yr
8. Parking garages, including unconditioned and conditioned spaces, within the above occupancies shall be calculated separately at: 10 kBTU/ ft^2/yr for enclosed garages and 6 kBTU/ ft^2/yr for open garages.

C402.1.5.11 Financial Security. The applicant shall provide a financial security to be used as a penalty for failing to achieve an operating energy use lower than the building's energy use target according to Section C402.1.5.6. The penalty shall be administered as provided in Section C110, except that the amount of the penalty shall be determined using Table C402.1.5.11 and not the amounts in Building Code Section C103. The financial security shall be submitted to and approved by the *code official* prior to issuance of the building's Certificate of Occupancy. The financial security requirement shall be fulfilled by one of the following methods:

1. An irrevocable letter of credit from a financial institution authorized to do business in Seattle, in an amount equal to $4.00 per square foot of gross floor area.
2. A bond secured by the applicant to ensure compliance with this section, in an amount equal to $4.00 per square foot of gross floor area.
3. A binding pledge that within 3 years of receipt of the Certificate of Occupancy, adjusted as allowed under Section C402.1.5, the applicant will comply with the requirements of this section.

A binding pledge pursuant to item 3 of this subsection shall be recorded as a covenant in the land records of King County between the applicant and the City of Seattle in a form that is satisfactory to the Seattle City Attorney. The covenant shall bind the applicant and any successors in title to pay any fines levied pursuant to this section. A lien will be placed on the property in cases of non-payment.

If the owner provides evidence that the building has operated at or below its target energy performance level as provided in Section C402.1.5.6, the financial security provided by the applicant shall be returned to the applicant, or the pledge and covenant shall be released, and the applicant will have no further obligations under this section.

(excerpted from 2012 Seattle Energy Code)

THE FUTURE

Last year was the celebration of the 50th anniversary of Seattle World's Fair.

We admire the civic energy of that era, when the construction of the space needle and many of the monuments and parks of the city defined an emerging and influential northwest modernism.

Other cities, New York, Melbourne, and Copenhagen, for example, have each, in their time, inspired with creativity, resourcefulness and persistence in changing the "rules of the game".

This city now hosts leaders in aerospace, technology, global health and service industries, and the hope of this study is that our built environment can be deeply integrated into the energies of the natural environment with the same degree of innovation and purpose as the residents and businesses they serve.

image: Seattle Municipal Archives

ACKNOWLEDGEMENTS AND REFERENCES

ACKNOWLEDGEMENTS

This study is the product of discussions with, and review and encouragement by many people in the Seattle Perkins+Will office, at the Seattle 2030 District, and the Seattle Department of Planning and Development.

The project has benefited specifically from insight from **Brennon Staley, Dennis Meier, Sandra Mallory, Brian Geller, Peter Dobrovolny, Duane Jonlin, Matthew Combe, Brad Hinshaw, Erik Mott, Kay Kornovich, Tony Gianopolis, Devin Kleiner, A-P Hurd and Matt Anderson**. Thank-you all for the help.

REFERENCES

1. Berton, Brad, “An Environmental Model for the Next 250 Years: Seattle’s Bullitt Center”, Urban Land, ULI Blog, November 26, 2013.

2. Burdette, Rickey, The Endless City, Urban Age Project by the London School of Economics and Deutsche Bank’s Alfred Herrhausen Society, Phaidon Press, 2007.

3. Fuller, R. Buckminster, Critical Path, St. Martins Press, 1981.

4. Fuller, R. Buckminster, Operating Manual for Spaceship Earth, Jaime Snyder, Editor, Lars Mueller Publishers, 2013, originally published 1969.

5. Hurd, A-P and Hurd, Al, The Carbon Efficient City, University of Washington Press, 2012.

6. La Roche, Pablo, Carbon-Neutral Architectural Design, CRS Press, 2012.

7. Rogers, Richard, Cities for a Small Planet, Philip Gumuchdjian, editor, 1997.

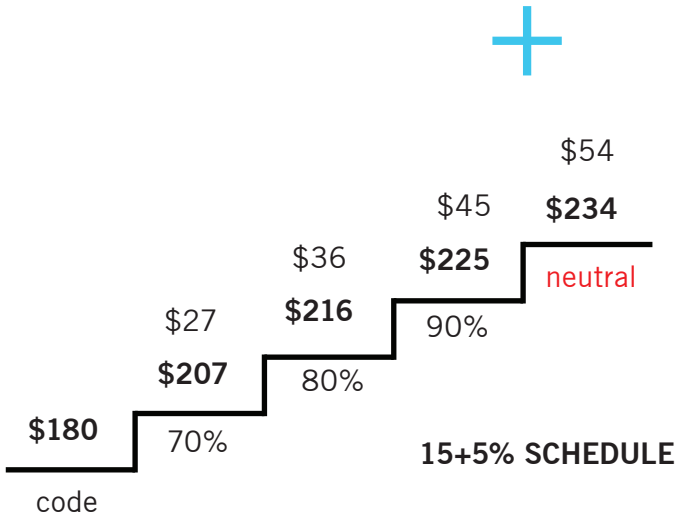
8. Seattle Planning Commission, “Incentive Zoning in Seattle: Enhancing Livability and Housing Affordabiity”, February, 2007.

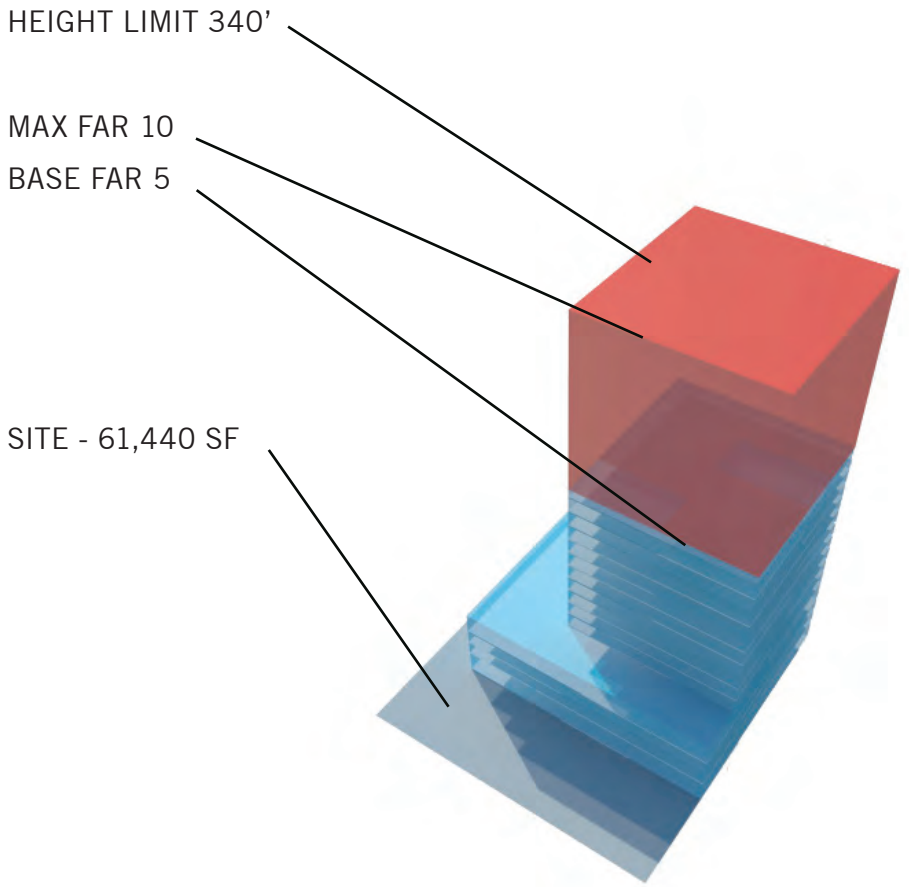
9. Stockholm Environmental Institute, Cascadia Consulting Group, IFC International, “Getting to Zero, A Pathway to a Carbon Neutral Seattle”, Prepared for City of Seattle Office of Sustainability and Environment, May, 2011.

CASE STUDY - DMC OFFICE

*** What is the value of additional FAR in the City of Seattle? According to Matt Anderson at Heartland LLC, $50 per square foot is a current working value.**

DMC COMMERCIAL
EUI 20 kbtu/sf/yr
$207-234/sf



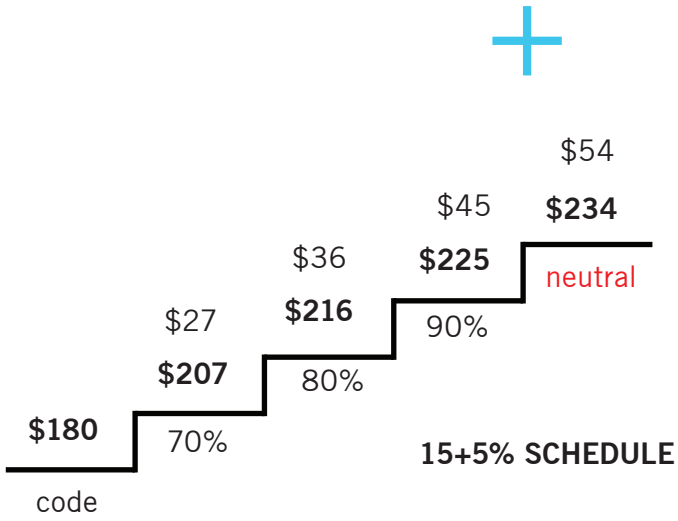


BASE AREA - 307,200 SF, MAX AREA - 614,400 SF, **DELTA - 307,200 SF**

*** 307,200 SF x $50 / SF = $15,360,000 VALUE**

CASE STUDY - DMC HOUSING

DMC RESIDENTIAL
EUI 15 kbtu/sf/yr
$207-234/sf

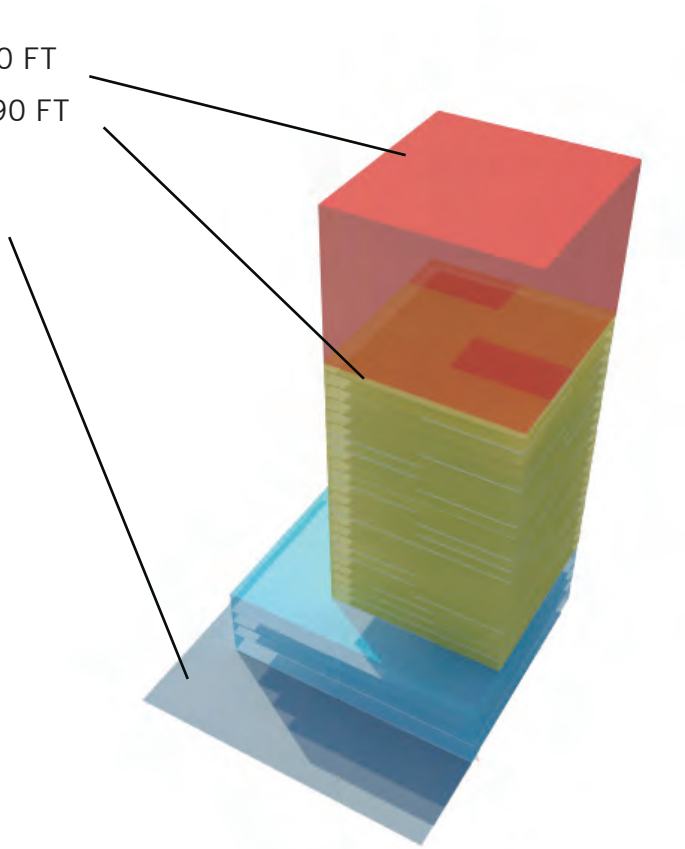


FAR - EXEMPT

MAX HEIGHT - 400 FT

BASE HEIGHT - 290 FT

SITE - 61,440 SF



BASE AREA - 558,656 SF, MAX AREA - 778,656 SF, **DELTA - 220,000 SF**

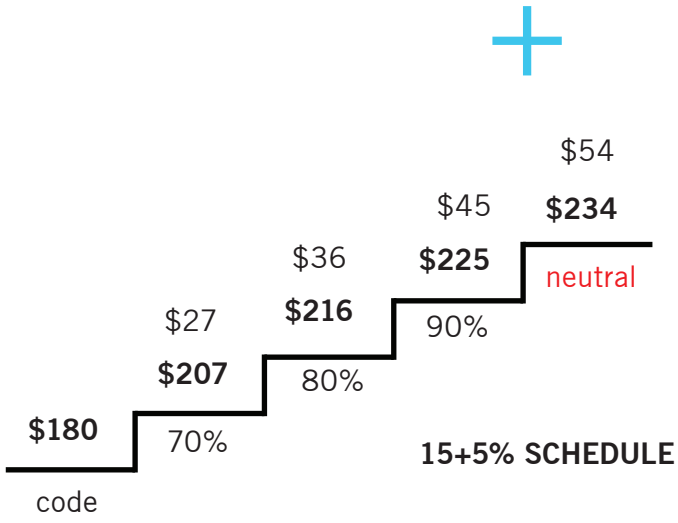
*** 220,000 SF X $50 / SF = $11,000,000 VALUE**

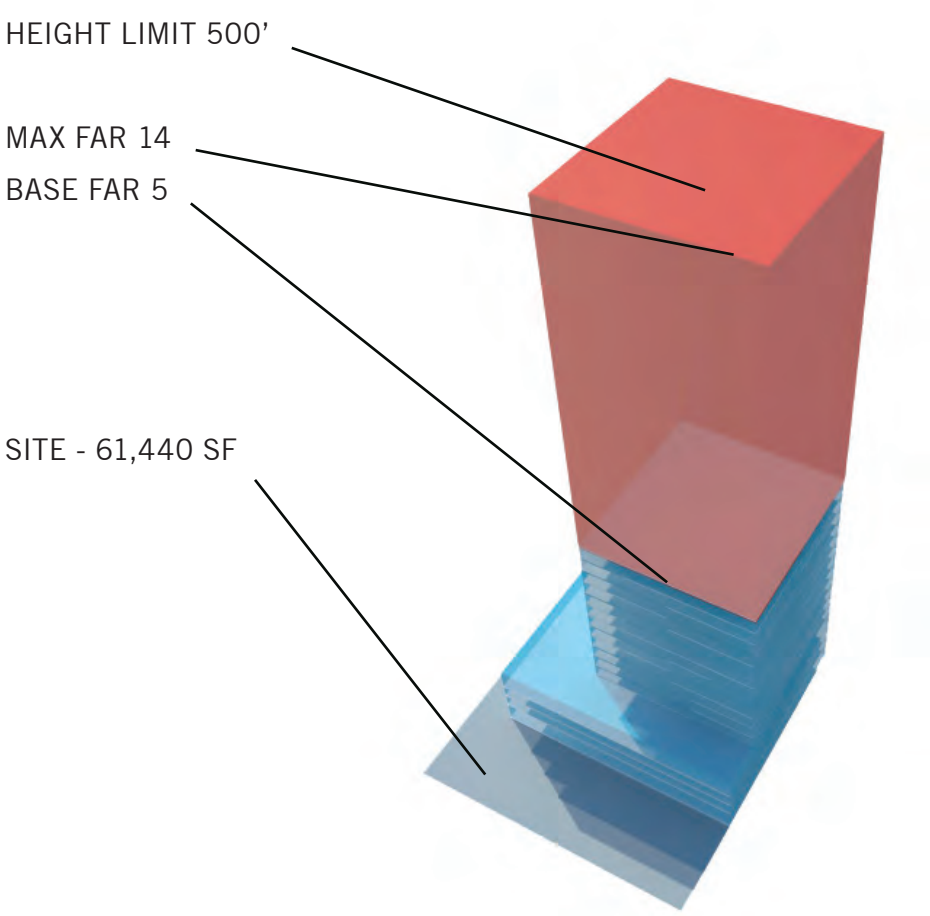
APPENDIX

CASE STUDY - DOC2 OFFICE

(Generic Downtown Site)

DOC2 COMMERCIAL
EUI 20 kbtu/sf/yr
$207-234/sf

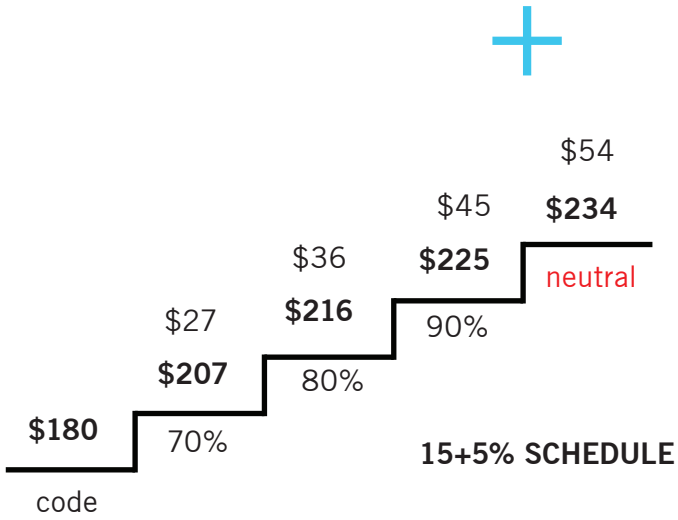


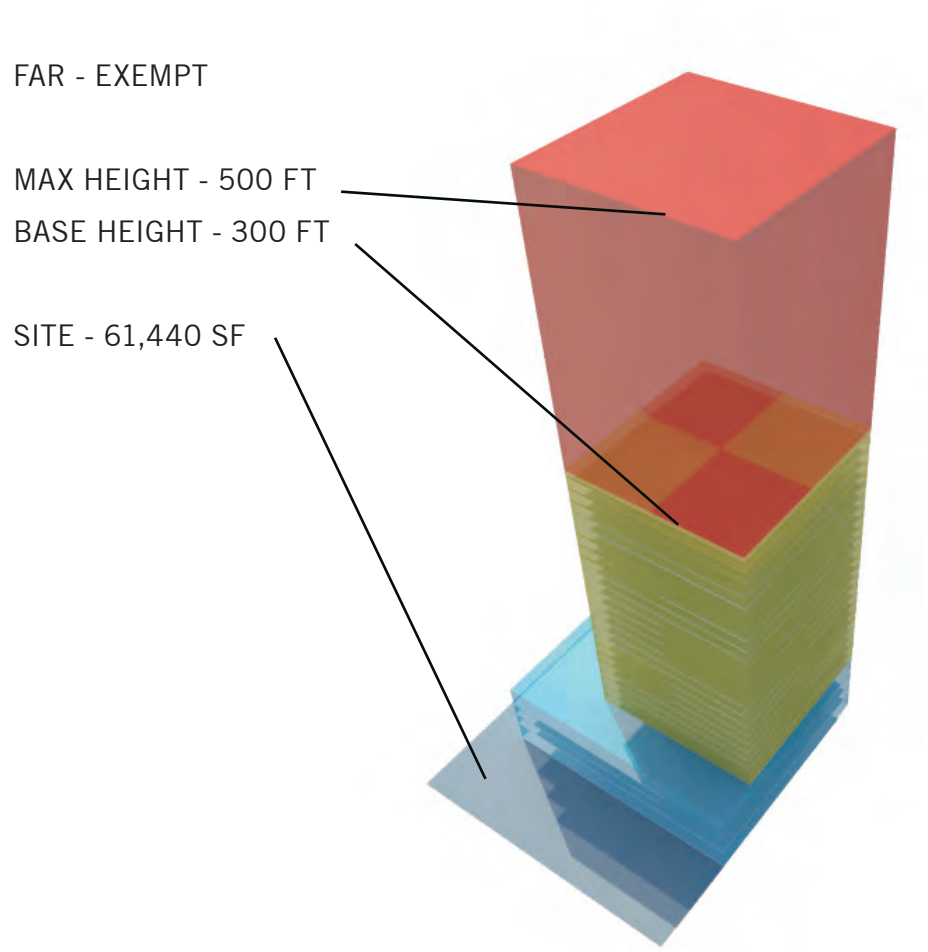


BASE AREA - 307,200 SF, MAX AREA - 860,160 SF, **DELTA - 552,960 SF**

*** 552,960 SF X $50 / SF = $27,648,000 VALUE**

DOC2 RESIDENTIAL
EUI 15 kbtu/sf/yr
$207-234/sf



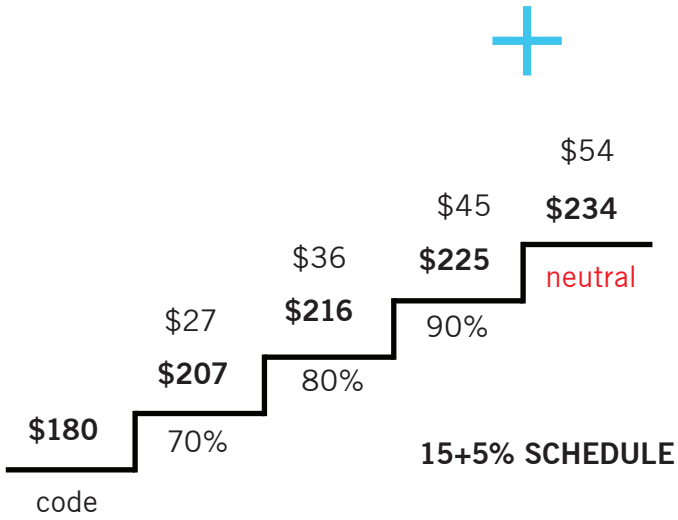


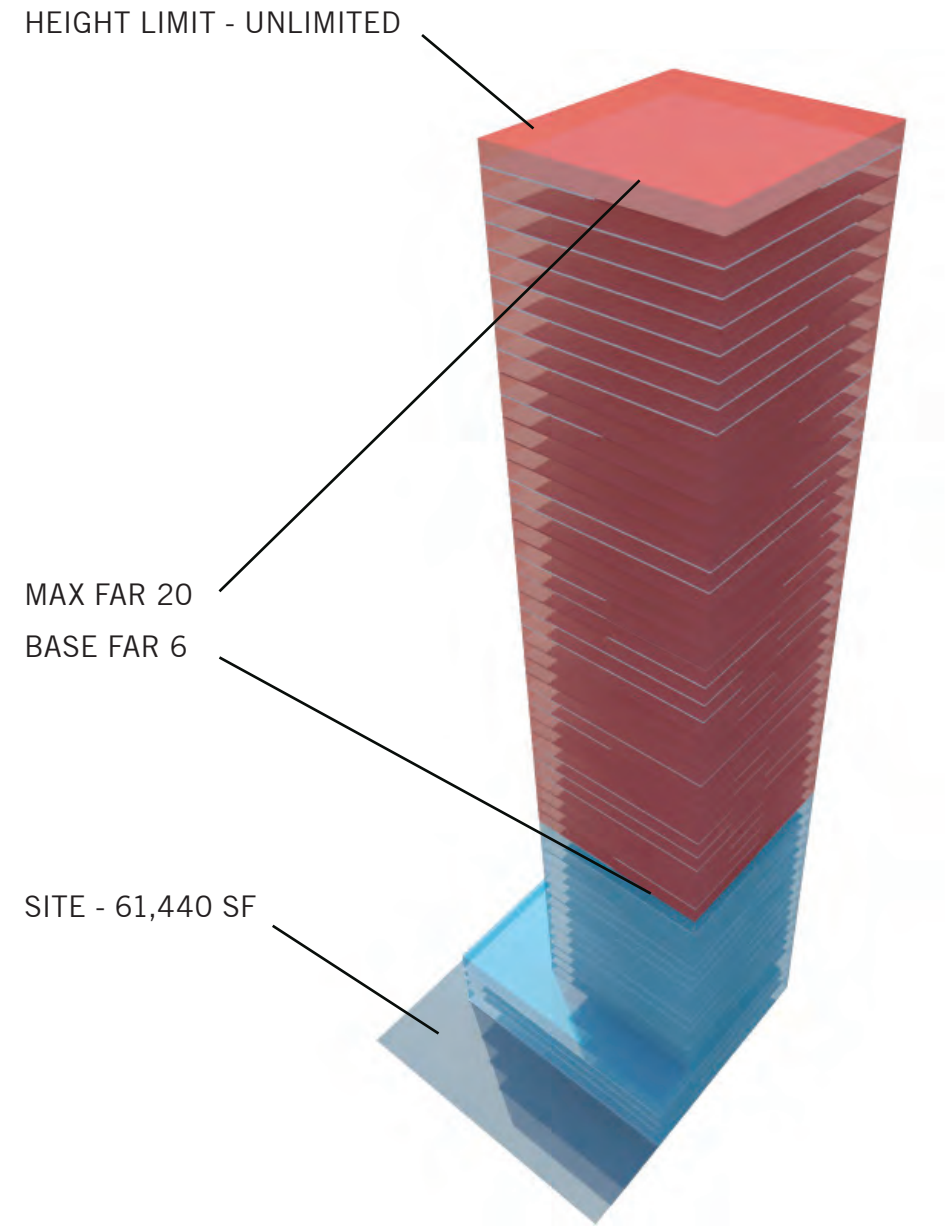
BASE AREA - 578,656 SF, MAX AREA - 978,656 SF, **DELTA - 400,000 SF**

*** 400,000 SF X $50 / SF = $20,000,000 VALUE**

CASE STUDY - DOC1 OFFICE

DOC1 COMMERCIAL
EUI 20 kbtu/sf/yr
$207-234/sf



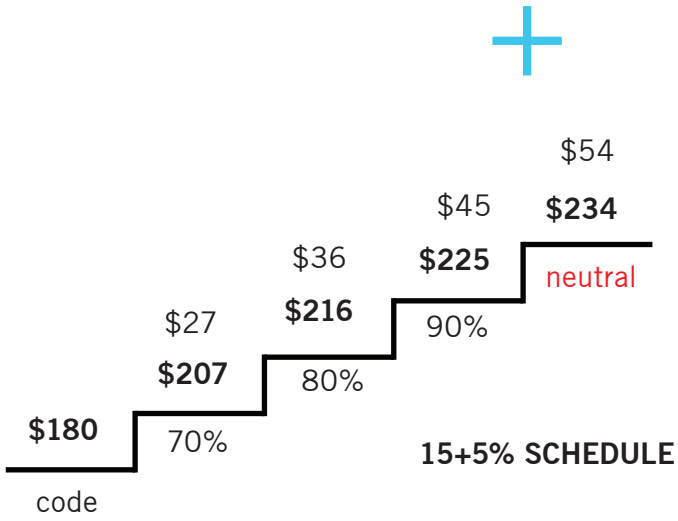


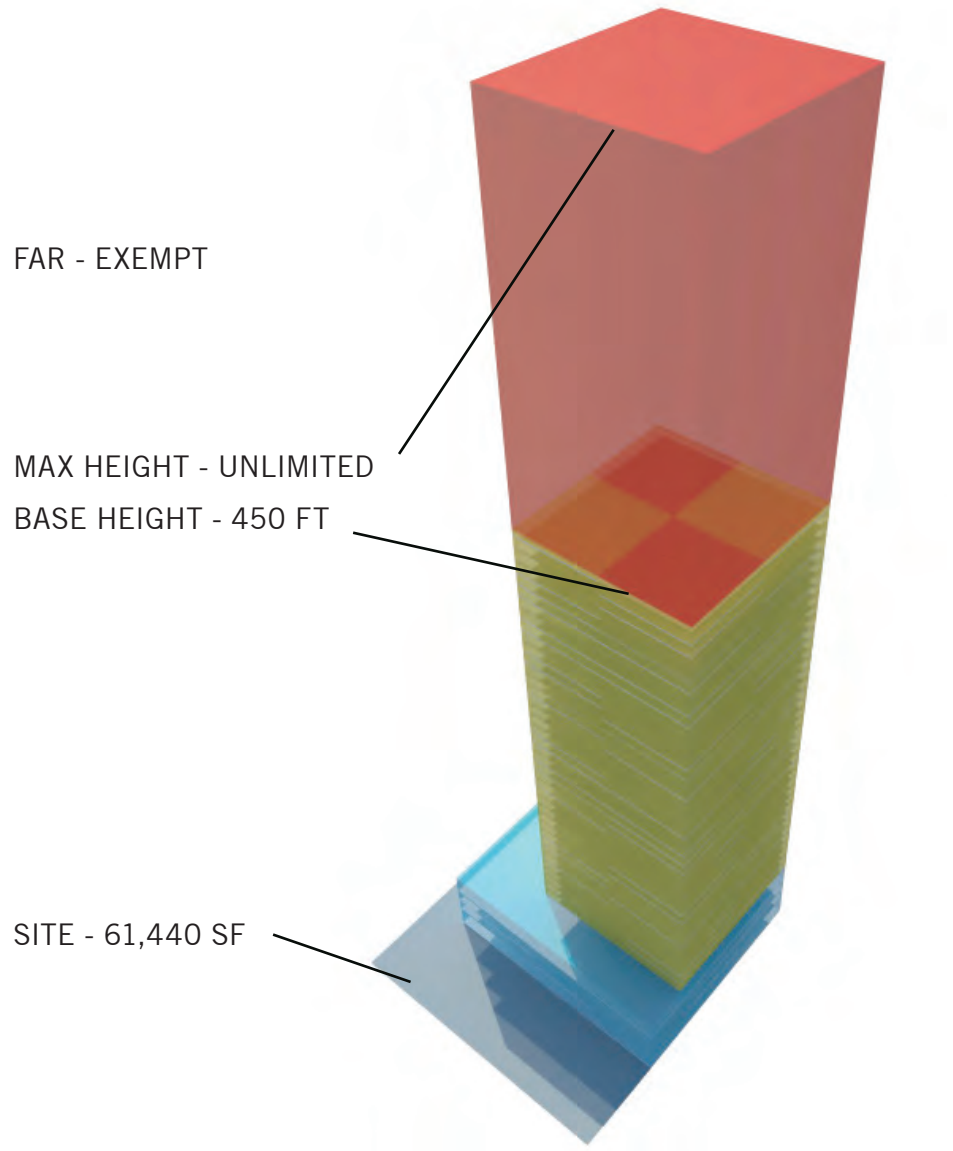
BASE AREA - 368,640 SF, MAX AREA - 1,228,800 SF, **DELTA - 860,160 SF**

*** 860,160 SF X $50 / SF = $43,008,000 VALUE**

CASE STUDY - DOC1 RESIDENTIAL

DOC1 RESIDENTIAL
EUI 15 kbtu/sf/yr
$207-234/sf





BASE AREA - 878,656 SF, MAX AREA - UNLIMITED, **DELTA - UNLIMITED SF**

*** UNLIMITED VALUE**