CHOOSING GREEN
deciding where to live in Manhattan
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There are a number of factors in choosing a place to live. One that is extremely important, but not typically emphasized in Manhattan, is energy efficiency.

Energy use is not a large component of housing cost in New York. Purchase prices are high and labor and real estate taxes are greater costs. Many do not pay close attention to electricity or gas bills. But considering energy use, among other factors, is something that can be of interest.

The City of New York is poised to help with this. In December 2017, the City Council passed Local Law 33. Beginning this year, 2020, owners of covered buildings are required to submit an energy efficiency score, annually, to the Department of Finance. This score is the 100-point Energy Star Rating developed by the United States Environmental Protection Agency using its benchmarking portfolio manager tool. Covered buildings (originally those with over 50,000 square feet, now 25,000) will then be issued a score-based grade (A, for 90 to 100, B for 50 to 89, C for 20 to 49, D for less than 20, F for non-compliance, N for exempted buildings). Once issued, these scores (and now also the Energy Star number) will have to be posted near each public entrance to each building.

In anticipation of the new regulation, we have reviewed some of the broader thinking on energy efficiency in buildings. We have also consulted some of the public data that has already been available under existing city regulations. And we considered an alternative approach.

Considerations
Analysts of energy consumption in buildings consider two major sources of *life cycle* energy use. The first is *embodied energy*, which is the energy used to build, maintain, and renovate structures. The second source is *operational energy,* that is the energy used to run buildings, including heating, lighting, air-conditioning, appliances and building equipment (such as elevators).

From the perspective of embodied energy, re-use of existing buildings is energy efficient. This would generally indicate that buying existing houses or older re-sale apartments as the greener choice.

Regarding operational energy, most of us see frequent references to the energy efficiency of new buildings (LEED certified, for example). However, preliminary research indicates that new and taller buildings do not necessarily operate more efficiently.

Green Manhattan
In his widely-read *New Yorker* article of October 18, 2004, *Green Manhattan: everywhere should be more like New York,* David Owen argued that Manhattan, despite its artificial, man-made environment and its remove from nature, is actually much more energy efficient than the suburbs or the country side.

This efficiency, as measured by energy use per inhabitant, is a function of its higher density: it benefits from the greater energy efficiency of apartment buildings (as compared to houses) and the availability of public transportation (rather than cars).

The inefficiency of high rises
It may seem counter-intuitive but at least some studies have concluded that high rise buildings are actually less energy efficient. As reported in a June 2017 article [1], researchers at University College London found that energy use per square meter increases with building height. Electricity use is nearly 2.5 times greater in high-rise office buildings, with 20-storys or more, than it is in low-rise buildings of 6 stories or less. Gas use increases with height by about 40%. "As a result, total carbon emissions in gas and electricity from high-rise buildings are twice as high as in low-rise." The research also analyzed residential buildings in 12 London boroughs and discovered that, while electricity use increased less sharply, gas use increased substantially with height. A professor involved explained that air temperature decreases and direct sunlight increases with height while wind speeds increase. Tall buildings have more exposure to the elements, which may explain the findings. Energy efficiencies can be increased with high-density buildings of lesser height.

Another academic study, prepared by researchers at the Illinois Institute of Technology in Chicago and Tongji University in Shanghai, compared energy use in urban and suburban locations, including both life-cycle energy use for buildings and transportation.[2] Again, it has been commonly accepted that high-density urban centers, with mid and high-rise buildings and public transit are more energy efficient than low-rise single-family suburban areas that depend on automobiles. However, the study concluded that downtown high-rise living in Chicago has 25% more life-cycle energy use than suburban living, on average. The study was based on a comparison of recently-built buildings and considered both embodied and operational energy use (defined above).

These averages included the following components and estimates, on a per person, per year basis
-building embodied and operational energy
-vehicle embodied and operational energy
-infrastructure embodied and operational energy.

[1] "High-rise buildings much more energy intensive than low-rise", by University College London, Phy.org, June 29, 2017.
[2] "Life-Cycle Energy Implications of Downtown High-Rise vs. Low-Rise Living: An Overview and Quantitative Case Study for Chicago", Peng Du, Anthony Wood, Brent Stephens and Xiaoyu Song, buildings, www.mdpi.com/journal/buildings/

A few reasons for this conclusion:

--Low-rise buildings use more energy for heat but less energy for other uses, including cooling, fans, lighting and water systems.

--Typically, embodied energy (including energy used for construction) contributes less to energy use through-out the life-cycle of a building than operational energy consumption. However, to build high rise buildings (defined in this case as buildings of seven or more stories) requires about 50% more embodied energy per person than low-rise construction, on average.

--Regarding transportation, urban residents use much more infrastructure-related energy than do suburban residents, who rely more on vehicle energy. So urban residents travel more efficiently. However, the advantage is not as great as we might expect. Transportation energy use for the average suburbanite was estimated at only about 1.3 times that of the Chicago downtown resident.

In addition an architect and neighbor has pointed out that brick, stone or concrete clad buildings retain heat more efficiently than do glass-clad structures and that high-rises are built to sway, which necessitates looser or wider gaps in the façade.

Energy use in specific Manhattan buildings

The attached Excel spreadsheet compares the costs of energy use in four Manhattan pre-war an high rise residential buildings. These figures are from recent financial statements or from offering plans that show actual or projected energy use.

These results summarize heat, gas, electricity and water/sewer expenses, which serve as an estimate of total common area energy expenses. The estimates are used to calculate a square foot cost per building, based on total square foot area or residential zoning area as indicated in the public record. These are common area expense, shared by residential owners. They do not include the expenses of individual unit owners, within their separately occupied units.

This very limited sample indicates annual common area expenses of $1.63 and $1.28 per square foot in the older buildings and $5.55 and $4.62 (projected) per square foot in the new West 57th Street high rises.

New York City requirements

The city's Local Law 33 builds on New York State and City Energy Conservation Codes and Local Laws which require increased energy efficiency. Another ordinance, Local Law 97 of May 2019 includes ambitious climate legislation. It requires 40% citywide reductions by 2030 (relative to baseline 2005) and 80% reductions by 2050. Building study and implementation plans must be submitted by 2021. Carbon emission caps begin in 2024.

The city's Local Law 33, builds on Local Law 84 of 2009, which required submission of energy and water use data and the Energy Star benchmarks. Although Law 84 did not yet give this data a letter grade or require public display, the information has theoretically been available on-line.

The advantages of the benchmark data are clear. It compares each building to other buildings in its category; it focuses on energy use, independent of the varying cost of energy, and it incorporates the entire energy use of each building, not just common area energy use. (However, in mixed use buildings, the data incorporates the energy use of both the residential and non-residential portions of the buildings (the residential condo budgets do not.)

Referencing again the attached spreadsheet, we consulted the city's data (see https://www1.nyc.gov/html/gbee/html/plan/ll84_scores.shtml) for each of the same four buildings for which we have budget data. Most of the data has not been reported. Perhaps we could simply not find it using the city's Building Identification Number or the property's reported street address—hopefully this will improve. However, for the Park Avenue cooperative, the 2016 Energy Star Rating was 29; and for 157 West 57th Street, the 2016 Energy Star Rating was a mere 2.

Summary

This analysis reviews some of the information available to buyers who wish to consider the relative energy use of buildings. We have considered budget data available to us and have supplemented that with benchmark data available from the city.

An interesting preliminary outcome, supported by the literature, is that older, pre-war buildings have an energy-use advantage over newly-developed high rises.

These changes, both the reporting/grading and the requirements for improving energy efficiency, are extremely important and now, with Local Law 33, will be increasingly visible.

Larry Sicular and Caroline Guthrie

ENERGY RELATED OPERATING EXPENSES

Address	West Village co-op	Park Avenue co-op	157 West 57th St.	217 West 57th Street
Building Type	loft co-op, circa 1900	pre-war co-op, 1930	high rise condo, 2009	high rise condo, 2017
Gross Sq. Ft.	30,345	216,186	483,052 res. zoning area	695,277 res. zoning area
# of residential units	12	44	95 tower units, rental unit	179
Source of Data	2018 financials, REBNY	2018, financials REBNY	27th amend., 2018 budget	offering plan 12/19-11/20 budget
Heat	$ 28,830	$ 154,236	$ 1,295,678	$ 354,792
Heat/SF	$ 0.95	$ 0.71	$ 2.68	$ 0.51
Common area utilities	$ 9,492	$ 52,025		
Utilities/SF	$ 0.31	$ 0.24		
Gas			$ 4,000	$ 221,694
Gas/SF			$ 0.01	$ 0.32
Electricity			$ 1,107,250	$ 2,326,193
Electricity/SF			$ 2.29	$ 3.35
Water/Sewer	$ 11,182	$ 71,467	$ 275,000	$ 311,538
Water/Sewer/SF	$ 0.37	$ 0.33	$0.57	$ 0.45
Annual Energy Expenses	$ 49,504	$ 277,728	$ 2,681,928	$ 3,214,217
	$ 1.63	$ 1.28	$ 5.55	$ 4.62

Energy Star Scores as Reported to NYC

2017 consumption	not reported	not reported	not reported	not reported
2016 consumption	not reported	29	2	not reported