

Manhattan HVAC Modernization

Engineering and Financial Assumptions Validation

Step 3 | 23 October 2026 | Independent hypothetical feasibility study

1. Executive overview

The model’s main calculations reproduce, but several assumptions remain unverified. The 500,000 ft² building is a reasonable project scale. The energy equations have consistent units, and the \$5,000,000 full and \$1,669,000 partial budgets reconcile. Primary sources support the general technologies and several tax/regulatory rules. They do not validate this building’s operating profile, equipment condition, contractor prices or owner tax position.

Base-case result	B - Full	C - Partial
HVAC electricity reduction	37.6934%	15.6727%
Year 1 pretax operating savings	\$399,440	\$190,400
10-year dated NPV at 8.5%	-\$1,754,620	\$68,531
Dated IRR	-0.38265%	9.44427%
Simple / discounted payback	Neither within 10 years	6.5096 / 9.1185 years

These are conditional model results, not measured savings or an approval recommendation. C’s positive base-case NPV can disappear with small changes to cost, savings retention or tax assumptions. B’s negative NPV describes the modeled 10-year period, which excludes remaining service value. The five highest-risk assumptions are discussed in Section 7.

Evidence standard used in this report

Verified calculation means independently reproduced from the workbook’s inputs. **Verified fact** means a value or rule confirmed in a primary source. **Benchmark** means external context, not site proof. **Estimate** and **hypothetical input** mean project assumptions requiring evidence or sensitivity testing. “Questionable” flags an important support gap; it does not automatically mean the value is wrong.

The source-to-assumption register identifies every major decision driver, all itemized initial costs, tax assumptions and emissions-screen inputs. Source links are clickable. No workbook changes or final investment recommendation were made.

2. Review scope and independent checks

The review used these exact supplied files:

Manhattan_HVAC_CapEx_Final_Validated(1).xlsx

Manhattan_HVAC_Excel_Model_Audit_Report(2).pdf

Manhattan_HVAC_Step2_Correction_Report(1).pdf

I read the Assumptions, CapEx, Energy, Tax and Sources sheets and traced their links into Cash Flow and Scenarios. I also reviewed the prior audit and correction reports. Their earlier test claims are treated as prior documentation, not as tests repeated in this step.

New verification performed: a separate Python calculation rebuilt the load-bin and auxiliary electricity totals, itemized budgets, assumed depreciation, annual incremental cash flows, dated NPV, IRR and interpolated payback. All 94 comparisons with saved workbook results passed: 3 energy totals, 16 base return measures, 22 annual cash flows, 6 scenario NPVs, 25 two-variable sensitivities, 20 one-variable sensitivities and 2 break-even results. The largest absolute comparison difference was below \$0.000001.

All three scenario cash-flow paths and returns were recalculated independently. Base results and the three scenario NPVs agree with the previous reports at their displayed precision. This step did not execute every Excel formula or rerun Step 2's invalid-input controls. Desktop Microsoft Excel was not used. No building visit, equipment measurement, energy simulation, contractor quotation or tax eligibility determination was performed.

Scenario / discount rate	B NPV (USD)	C NPV (USD)
Base / 8.5%	-\$1,754,620	\$68,531
Optimistic / 7.0%	-\$514,312	\$621,752
Downside / 11.0%	-\$3,908,537	-\$838,052
Subjective 50% / 20% / 30% weighted NPV	-\$2,152,734	-\$92,800

Trace: Scenarios!E8:F12; Cash Flow!E89:F94. The weights are judgments, not estimated event probabilities. Option A is the baseline, with zero incremental NPV; that does not mean its operating or future capital costs are zero.

Timeline and cash-flow meaning

Year 0 is December 31, 2026; Years 1-10 end on December 31, 2027-2036. NPV discounts actual days/365 and includes initial funding once. Payback uses after-tax cash flows, including avoided future capital. C first crosses at Years 7 and 10 under strict year-end receipts; 6.51 and 9.12 interpolate within those years. These are not CapEx divided by Year 1 savings. [R27]

The input workbook and both supplied PDFs were unchanged, confirmed by before-and-after SHA-256 checks. This validation establishes arithmetic consistency and evidence status, not investment certainty.

3. Engineering calculations and energy boundary

Building scale and capacity. DOE's Large Office reference has 498,588 ft², close to the hypothetical 500,000 ft². That supports the scale only. The installed capacity implies 416.7 ft²/ton and 28.8 Btu/h per ft²: 1,200 tons × 12,000 Btu/h per ton ÷ 500,000 ft². These ratios do not identify an obvious sizing impossibility, but they cannot verify the design load. [R01]

A load calculation still needs NYC design weather, glazing and envelope, occupancy, ventilation, plug loads, floor zoning and diversity. Two 600-ton units give 1,200 tons together; neither is a full spare when peak demand requires both.

Cooling energy: capacity is not annual consumption

For each bin: **tons × load fraction × hours × kW/ton = kWh**. The four bins total 3,000 operating hours and 1,950,000 ton-hours. Dividing by 1,200 tons gives 1,625 equivalent full-load hours, not 3,000 full-load hours.

Load	Hours/year	Cooling ton-hours	A / B / C kW/ton
25%	750	225,000	0.95 / 0.50 / 0.84
50%	1,250	750,000	0.80 / 0.48 / 0.73
75%	750	675,000	0.75 / 0.52 / 0.70
100%	250	300,000	0.72 / 0.585 / 0.70

Trace: Assumptions!C33:G36; Energy!C8:H13. For example, B at 50% load uses $1,200 \times 0.50 \times 1,250 \times 0.48 = 360,000$ kWh.

Annual electricity (kWh)	A - Existing	B - Full	C - Partial
Chillers	1,536,000	999,000	1,419,000
Supply/return fans	1,008,000	604,800	756,000
Water pumps	382,500	202,500	292,500
Cooling tower fans	117,000	90,000	99,000
Total modeled HVAC	3,043,500	1,896,300	2,566,500
Savings versus A	-	1,147,200	477,000

Auxiliary energy = rated electric kW × average power fraction × hours. Example: B fans = $350 \times 0.48 \times 3,600 = 604,800$ kWh. Savings ÷ A's 3,043,500 kWh gives 37.6934% and 15.6727%. Including the assumed 6 million kWh of other electricity reduces the corresponding whole-building electricity reductions to 12.6854% and 5.2745%. Neither percentage includes gas savings.

4. Engineering evidence and remaining gaps

Chiller performance: plausible curve, no equipment selection

DOE FEMP Table 3.2 lists 0.585 kW/ton full-load and 0.400 IPLV for part-load-optimized centrifugal chillers of at least 600 tons. Assumptions!F36 matches the full-load threshold. It does not prove the paired IPLV or validate F33:F35. DOE requires rating measurements under AHRI 550/590. [R02]

The four model bins are a project load-duration estimate, not an AHRI IPLV calculation. They also represent the 1,200-ton plant, while each machine is 600 tons. At 25% plant load, one unit could be at 50% load or two at 25%; these operating points can differ. Obtain manufacturer selections at actual chilled-water and condenser-water temperatures, staging logic, minimum flow and fouling allowances. The existing and rebuilt curves also need evidence; age alone is insufficient.

Auxiliaries are a major source of modeled savings

Fans, pumps and towers supply 610,200 kWh, or 53.2%, of B's savings and 360,000 kWh, or 75.5%, of C's savings. The inputs in Assumptions!D41:J43 are therefore central to the result. Unchanged rated kW is consistent with a controls-driven reduction, but it does not demonstrate that reduction.

DOE's variable-speed guide explains why reducing speed can save energy, but cautions against applying affinity laws directly to systems with significant static head. The model's fractions are average electrical input fractions, not speed fractions. They need measured duty profiles, system curves and minimum ventilation/flow limits. [R03]

NREL's chiller study shows that temperature resets can increase pump or tower energy even while improving chiller performance. A design cannot independently maximize every component's saving. NYSERDA describes monitoring and fault detection as ways to identify operational improvements; it does not verify this project's savings. [R06] [R07]

Schedules, maintenance and useful life

The 3,600 fan hours and 3,000 cooling/pump/tower hours are possible schedules, but no tenant schedule, BAS trend or NYC weather model supports them. The assumed 600 extra fan hours need a clear after-hours explanation.

The 23-year reference appears in DOE's example. ASHRAE's 2023 chapter reports centrifugal-chiller survival evidence exceeding 25 years and warns that older life estimates may be outdated. Neither predicts this plant's remaining life. A/C must serve another ten years from the assumed age of 20, so condition and overhaul scope matter more than an average life. [R02] [R04]

DOE maintenance guidance supports checks on heat-transfer surfaces, water flow, refrigerant condition and operating temperatures. It does not substantiate the model's annual dollar savings. [R08]

5. Equipment and installation cost assessment

Budget reconciliation (USD)	B - Full	C - Partial
Direct line items	\$4,550,000	\$1,520,000
10% contingency on real-property items	\$450,000	\$149,000
Total initial funding	\$5,000,000	\$1,669,000
Total per building ft ²	\$10.00	\$3.338
Total per installed cooling ton	\$4,166.67	\$1,390.83

The totals reconcile to CapEx!F23:F25 and I23:I25. The \$/ton figures include the whole upgrade package, so they must not be presented as chiller-only prices. C includes rebuilding existing chillers rather than buying the same equipment as B.

What public cost evidence can and cannot establish

EIA's March 2023 reference table gives 2022-dollar centrifugal-chiller equipment costs of \$500/ton for its typical case and \$680/ton for its high-efficiency case. The model's \$650,000 per 600-ton chiller is \$1,083/ton. This is materially above those historical national figures. Differences in year, specification, taxes, access and contractor scope could explain a premium, but none is priced here. The source is a reason to investigate, not to substitute a lower cost automatically. [R05]

The two NYC procurement notices in Sources!E19:E20 concern proposed modular-chiller contracts of \$295,148 and \$134,000. Their capacity and scope are not comparable to this 1,200-ton modernization; they cannot validate either project total. [R24] [R25]

The NYC public-work schedule lists a steamfitter wage of \$61.80/hour plus \$64.89/hour supplemental benefits, totaling \$126.69 before other contractor costs. This is local context, not a compulsory wage assumption for the hypothetical private project. Without trade hours, overtime and inclusions, it cannot verify the \$750,000 / \$350,000 labor allowances. [R23]

LBNL's 2020 study reports \$0.26/ft² median existing-building commissioning cost in its 2018 sample. That is historical national context. The model combines permits and commissioning at \$0.30/ft² for B and \$0.15/ft² for C; scope and date differences prevent a direct validation. [R22]

Assessment

The budgets cover credible project categories and are usable as conceptual allowances. Their accuracy remains unverified. BAS points, equipment counts, design fees, rigging access, disposal, training and contingency require priced scopes. In particular, separate equipment, installation, electrical and piping work to prevent overlap. Clarify the unusually broad "workstation" allowance and what software/services it includes.

6. Financial and tax assumptions

Electricity price, escalation and ownership of savings

The retrieved EIA table reports a July 2026 New York commercial average of 24.18 cents/kWh, released September 24, 2026. This gives context for \$0.20/kWh, but one statewide monthly average cannot establish a building's avoidable rate. [R09]

Con Edison separates kWh energy and kW demand components on demand-billed accounts. Recalculate bills with and without the proposed interval load reduction, including supply, delivery and applicable riders. Fixed charges usually remain; demand savings require a reduction in the billed peak. Do not multiply all-in average billing cost by saved kWh and then add demand savings again. [R10]

At the current assumed rate, B saves \$229,440/year in electricity and C \$95,400. Adding maintenance/repair reductions of \$195,000 / \$110,000 and subtracting analytics costs of \$25,000 / \$15,000 gives \$399,440 / \$190,400 before tax. No source independently establishes these maintenance budgets.

The 2.5% escalation rates and 8.5% base discount rate are financial assumptions. Nominal cash flows and a nominal discount rate are consistent; NIST's methodology does not validate these private-investment rates. The owner needs a documented hurdle rate and separate escalation evidence. [R12]

Assumptions!E22 gives the owner 100% of net operating savings. That can fit a gross lease, but expense pass-throughs and tenant billing may change it. DOE identifies lease incentives as a practical barrier. No lease was supplied. [R13]

Tax treatment is a conditional model, not verified eligibility

The 39-year real-property schedule and 5-year computer schedule reproduce. IRS Publication 946 supports 39-year GDS for nonresidential real property, mid-month timing, and five-year computer treatment. Some interior improvements may qualify differently, and eligible HVAC improvements can be Section 179 property. Classification requires asset-level facts. [R14]

Current Form 4562 instructions provide 100% bonus depreciation for qualifying property acquired and placed in service after January 19, 2025. The model's no-bonus treatment needs an explicit election-out or ineligibility assumption, particularly for the computer. Do not apply bonus automatically to all HVAC expenditures. [R15]

The 28% rate is illustrative. The IRS identifies a 21% federal corporate rate; NYS guidance separately identifies state, MTA and city taxes with entity-specific treatment. These do not establish 28% for this owner. The assumed January 2027 service year also requires checking then-applicable rules and elections. [R17] [R18]

6. Financial scope and compliance - continued

The model assumes all deductions can be used immediately. It also assumes zero existing tax basis, capitalizes future work using 39-year recovery, and deducts training in Year 1 although funded in Year 0. Obtain the owner's asset register and accounting dates. IRS repair/improvement guidance requires a facts-and-circumstances assessment of the HVAC system; not every annual repair or overhaul has identical tax treatment. [R16]

The book lives of 20 years and 5 years are educational references, not cash expenses. Tax depreciation affects the tax calculation. Remaining tax basis at Year 10 is not sale proceeds or an automatic deduction. These distinctions are correctly preserved in the workbook.

Ten years is an evaluation choice, not the equipment's whole life

The model ends in 2036 without terminal proceeds, remaining service value or later tax shields. NIST emphasizes residual value when a study ends before asset life. A later comparison should treat remaining value and replacements consistently across A, B and C; do not insert book value as cash. Scenarios!E53 indicates that B would need about \$3.970 million of additional net Year 10 value to reach zero base NPV. That is a threshold, not an appraisal. [R12]

Local Law 97: verified coefficients, incomplete compliance screen

The cited NYC rule supports the Office limits of 0.00758 and 0.002690852 tCO₂e/ft² for 2024-2029 and 2030-2034. The electricity coefficients and gas factor also match the cited law/rule. The \$268/tCO₂e figure is a maximum excess-emissions penalty rate, not an assured annual bill. Applicability, adjustments and mitigation still require building-specific review. [R19] [R20] [R21]

Using the workbook's hypothetical energy quantities, A/B/C 2030 emissions are 2,373.51 / 2,207.16 / 2,304.34 tCO₂e against a 1,345.43-tCO₂e limit. All exceed the screen. B/C show potential annual avoided penalties of \$44,580 / \$18,536, but these are excluded from financial cash flows and are not verified savings. Trace: Energy!E69:G72.

The financial horizon includes 2035-2036, while the emissions screen omits them. The rule provides a 2035-2039 Office limit of 0.001652340 tCO₂e/ft². A later compliance study must address those years and the applicable energy coefficients, rather than carrying the 2030 screen forward. [R19]

Incentives

Con Edison's 2026 manual includes HVAC/control and custom pathways, but requires project evidence and pre-inspection/Notice to Proceed before work begins. Program year and project timing matter. Keep the current \$0 incentive assumption until eligibility and an offer are established. A cooling modernization with unchanged gas use is not automatically a heating-electrification project. [R11]

7. Five highest-risk assumptions

This is a qualitative priority ranking based on financial exposure and missing evidence, not a statistical probability ranking. The diagnostics below are independent calculations with other assumptions held fixed. They did not change the workbook.

1. Existing equipment condition and future capital plan

Why it matters: avoiding A's future work is a major benefit. Its \$800,000 Year 3 and \$600,000 Year 7 allowances escalate to \$840,500 and \$695,816. B/C have different future expenditure schedules.

Impact: removing only A's two future capital events and their depreciation changes C's base NPV from \$68,531 to -\$950,575. This deliberately severe diagnostic is not a proposed baseline. It shows that the avoided spending must be substantiated.

Model coverage: events are included, but their timing/scope is fixed across scenarios and the initial-cost multiplier does not stress them. No failure probability, downtime or post-overhaul efficiency change is modeled.

Needed: condition assessment, asset ages, failure/service history, overhaul scope, remaining-life opinion and quotes. Reconcile annual repairs with capital work. Cells: Assumptions!E53:G56 and E47:G48.

2. Initial installed cost and completeness of scope

Impact: C breaks even at \$1,741,161 of initial funding, only \$72,161 or 4.32% above \$1,669,000, when related initial tax basis scales consistently. A 20% increase produces -\$248,475 NPV. The full upgrade's equipment allowance also needs explanation against the older national benchmark.

Model coverage: initial cost is tested in scenarios and sensitivities, but the 10% contingency is assumed fully spent, not probabilistic. Package allowances do not show scope overlap or site access risk.

Needed: comparable budget proposals, equipment selections, quantity takeoffs, trade hours, rigging plan, schedule and itemized contingency. Cells: CapEx!D8:I24; Scenarios!E52; H63:I63.

3. Avoidable tariff and owner retention of savings

Impact: C's break-even electricity price is \$0.1724/kWh. At \$0.15/kWh its NPV is -\$55,595. Retaining 50% of net operating savings gives -\$426,932; break-even retention is approximately 93.08% under the current scaling convention.

Model coverage: rate sensitivity exists; retention is editable but absent from the standard scenario table. Demand and lease recoveries are not separately modeled.

Needed: 12-24 months of complete bills, supply contract, interval demand and lease expense clauses. Cells: Assumptions!E22, E61:E63; Scenarios!E51, H61:I61.

7. Highest-risk assumptions - continued

4. Delivered energy savings, especially fans and pumps

Impact: at 70% of assumed savings, C's NPV is -\$80,421; at 115% it is \$143,006. Its break-even realization is approximately 86.20% when other inputs stay at base. Most C savings come from auxiliaries, so a verified chiller rating alone cannot validate the investment.

Model coverage: a single multiplier stresses all electricity savings together. It does not capture weather, staging, ventilation constraints, component interactions or deterioration separately.

Needed: chiller kW/ton trends, flows and temperatures, fan/pump interval power, BAS schedules, manufacturer selections and a calibrated hourly simulation or measurement plan. Cells:

Assumptions!C33:J43, E66:E68; Scenarios!H62:I62.

5. Maintenance and repair savings

Impact: C assumes \$110,000/year of maintenance/repair reductions before \$15,000 analytics cost. At 60% realization, NPV is -\$160,465; at 120% it is \$183,028. Break-even realization is about 88.03%, with analytics unchanged.

Model coverage: maintenance realization is stressed, but repair frequency, staffing reductions and contract commitments are not. Savings may be overstated if labor cannot actually be removed or if the same repair is counted in both O&M; and capital.

Needed: service invoices, labor deployment, warranty scope, repair logs and recurring software proposals. Cells: Assumptions!E47:G49, E76:E78; Scenarios!H64:I64.

Other assumptions that can still change the result

Tax and evaluation scope remain important even though they are outside this five-item ranking. Holding schedules fixed and changing only the illustrative tax rate from 28% to 35% reduces C's NPV to about -\$12,117. This is a diagnostic, not a recommended tax rate. At a 12% discount rate, the workbook's C sensitivity is -\$165,733. Terminal value, tax classification, tax capacity and construction timing need separate challenges.

Existing one-variable test	C low-input NPV	C high-input NPV
Price: \$0.15 / \$0.25 per kWh	-\$55,595	\$192,657
Energy realization: 0.70 / 1.15	-\$80,421	\$143,006
Initial cost: 0.90 / 1.20 × base	\$227,034	-\$248,475
Maintenance realization: 0.60 / 1.20	-\$160,465	\$183,028
Discount rate: 6% / 12%	\$272,450	-\$165,733

Trace: Scenarios!H61:I65. "Low-input" does not always mean downside: a lower cost or discount rate helps NPV. These tests are conditional comparisons, not prediction intervals.

8. Source-to-assumption validation register

Each entry gives the current input, exact workbook location, evidence, publication date, classification, assessment and next action. A linked source title opens its URL; Section 9 prints the full URLs. MODEL means the supplied workbook and independent arithmetic, not an external source. A contextual source does not substantiate an estimate just because it appears next to it.

All external references were accessed on October 23, 2026. “Undated” means a publication date was not established from the source; access date is not substituted for publication date. A/B/C mean existing/full/partial throughout.

8A. Engineering and energy

Assumption / Excel reference / current value	Source / publication date	Classification / assessment / next action
E01. Office size / use Assumptions!E9; G9 500,000 ft ² ; hypothetical commercial office	[R01] DOE Commercial Reference Buildings Undated webpage	Class: Hypothetical input Assessment: Plausible but unverified Action: Retain the stated scale. Establish gross versus conditioned area, floors, tenants and occupancy; the DOE prototype is not this site.
E02. Cooling plant capacity Assumptions!E10; G10 1,200 tons; two 600-ton chillers	[R01] DOE Commercial Reference Buildings Undated webpage [R02] DOE FEMP Electric Chillers October 2024 update	Class: Hypothetical input Assessment: Plausible but unverified Action: Retain for screening. Complete a design-load calculation and staging/redundancy plan; no source proves this sizing.
E03. Existing age / reference life Assumptions!E11; E13 20 years old; reference life 23 years	[R02] DOE FEMP Electric Chillers October 2024 update [R04] ASHRAE Owning / Operating Costs 2023	Class: Hypothetical age; benchmark life Assessment: Plausible but unverified Action: Treat 23 years as a reference, not a retirement deadline. Obtain condition and overhaul records.
E04. Fan operating schedule Assumptions!E12; J41 3,600 h/year = $12 \times 5 \times 50 + 600$	[R01] DOE Commercial Reference Buildings Undated webpage	Class: Hypothetical input Assessment: Plausible but unverified Action: Research tenant/after-hours schedules and BAS runtime logs. DOE building size does not substantiate these hours.
E05. Cooling load-duration bins Assumptions!C33:D36 25%, 50%, 75%, 100%; 750, 1,250, 750, 250 h/year	[R06] NREL Chiller Replacement August 2025	Class: Engineering estimate Assessment: Plausible but unverified Action: Research NYC weather, ventilation and loads. The 3,000 h and 1,625 equivalent full-load h reproduce; they are not measured.

Assumption / Excel reference / current value	Source / publication date	Classification / assessment / next action
E06. Existing chiller curve Assumptions!E33:E36 0.95, 0.80, 0.75, 0.72 kW/ton	[R02] DOE FEMP Electric Chillers October 2024 update [R08] DOE / PNNL O&M Best Practices August 2010	Class: Engineering estimate Assessment: Plausible but unverified Action: Measure kW, water flow and temperatures at load. Age alone cannot establish these efficiencies.
E07. Full-upgrade chiller curve Assumptions!F33:F36 0.50, 0.48, 0.52, 0.585 kW/ton	[R02] DOE FEMP Electric Chillers October 2024 update [R06] NREL Chiller Replacement August 2025	Class: Engineering estimate; rating benchmark Assessment: Plausible but unverified Action: Obtain certified full/part-load ratings and site-condition selections. F36 matches a benchmark; the four-bin curve is not verified.
E08. Partial-upgrade chiller curve Assumptions!G33:G36 0.84, 0.73, 0.70, 0.70 kW/ton	[R06] NREL Chiller Replacement August 2025 [R08] DOE / PNNL O&M Best Practices August 2010	Class: Engineering estimate Assessment: Plausible but unverified Action: Link each gain to rebuild/control work and a performance guarantee or measured model. Test realization below base.
E09. Fan power / average fraction Assumptions!D41:J41 A/B/C: 350 kW each; fractions 0.80 / 0.48 / 0.60; 3,600 h/year	[R03] DOE / HI / Europump Variable Speed Pumping May 2004 [R06] NREL Chiller Replacement August 2025	Class: Engineering estimate Assessment: Plausible but unverified Action: Research fan inventory, airflow/static pressure, minimum ventilation and electric input profiles. Fractions describe power, not speed.
E10. Pump power / average fraction Assumptions!D42:J42 A/B/C: 150 kW each; fractions 0.85 / 0.45 / 0.65; 3,000 h/year	[R03] DOE / HI / Europump Variable Speed Pumping May 2004 [R06] NREL Chiller Replacement August 2025	Class: Engineering estimate Assessment: Plausible but unverified Action: Separate chilled/condenser pumps; obtain flow/head curves and control sequence. Test actual input power, including drive losses.
E11. Tower fan power / fraction Assumptions!D43:J43 A/B/C: 60 kW each; fractions 0.65 / 0.50 / 0.55; 3,000 h/year	[R06] NREL Chiller Replacement August 2025 [R08] DOE / PNNL O&M Best Practices August 2010	Class: Engineering estimate Assessment: Plausible but unverified Action: Research wet-bulb conditions, approach and fan control. Lower condenser temperature may increase tower power.

Assumption / Excel reference / current value	Source / publication date	Classification / assessment / next action
E12. Energy reduction arithmetic Energy!F13:H22 A/B/C: 3,043,500 / 1,896,300 / 2,566,500 kWh/year; B 37.6934%, C 15.6727%	MODEL: supplied workbook, reviewed 23 Oct 2026; arithmetic only.	Class: Verified calculation, conditional inputs Assessment: Supported mathematically Action: Retain formulas. Describe as calculated HVAC-electricity reductions; do not claim verified annual building performance.
E13. Other electricity / gas Assumptions!E14:E15; Energy!E63:G64 6,000,000 kWh/year; 200,000 therm/year, unchanged in all options	[R01] DOE Commercial Reference Buildings Undated webpage [R21] NYC DOB LL97 Guidance Undated webpage	Class: Hypothetical input Assessment: Plausible but unverified Action: Obtain whole-building bills and submetering. Include heating/reheat interactions in a later engineering study.
E14. Savings persistence / equal service Energy!C3; E40:N58; Assumptions!E65:E68 Same cooling load; 1.00 / 1.15 / 0.70 energy realization; no explicit degradation	[R06] NREL Chiller Replacement August 2025 [R07] NYSERDA Real Time Energy Management Undated webpage [R08] DOE / PNNL O&M Best Practices August 2010	Class: Engineering estimate Assessment: Plausible but unverified Action: Retain stress tests, but document comfort/ventilation constraints, commissioning and annual verification. Multipliers are not measured probabilities.

8B. Initial capital costs

Assumption / Excel reference / current value	Source / publication date	Classification / assessment / next action
C01. Chillers: replacement / rebuild CapEx!D8:I8 B: $2 \times \$650,000 = \$1,300,000$; C: $2 \times \$110,000 = \$220,000$	[R05] EIA / Guidehouse Equipment Costs March 2023 [R24] NYC DCAS 22 Reade Notice April 9, 2025 [R25] NYC DCAS Queens Notice April 9, 2025	Class: Cost estimate Assessment: Questionable without scope evidence Action: Research budget quotes for two 600-ton machines and defined rebuild work. Explain the premium over historical national equipment costs.
C02. Cooling tower refurbishment CapEx!D9:I9 B \$300,000; C \$75,000; quantity 1 allowance each	[R08] DOE / PNNL O&M Best Practices August 2010	Class: Cost estimate Assessment: Plausible but unverified Action: No direct price evidence. Specify cells, fill, fans, water treatment, structural work and access; obtain an allowance breakdown.
C03. Pumps and VFDs CapEx!D10:I10 B \$250,000; C \$120,000; quantity 1 package each	[R03] DOE / HI / Europump Variable Speed Pumping May 2004	Class: Cost estimate Assessment: Plausible but unverified Action: No direct price evidence. Price pump counts, flow/head duties, motor sizes, drives, piping and wiring separately.
C04. AHU fans / drives / dampers CapEx!D11:I11 B \$350,000; C \$150,000; quantity 1 package each	[R06] NREL Chiller Replacement August 2025	Class: Cost estimate Assessment: Plausible but unverified Action: No direct price evidence. Inventory air handlers and define reused equipment, fan upgrades and balancing scope.
C05. BAS / sensors / automation CapEx!D12:I12 B \$450,000; C \$250,000; quantity 1 package each	[R07] NYSERDA Real Time Energy Management Undated webpage	Class: Cost estimate Assessment: Plausible but unverified Action: No direct price evidence. Obtain point counts, integration, programming, licensing and control-sequence scope.
C06. Installation labor CapEx!D13:I13 B \$750,000; C \$350,000; quantity 1 allowance each	[R23] NYC Comptroller Wage Schedule July 1, 2026	Class: Cost estimate Assessment: Plausible but unverified Action: Research crew hours, trades, shifts and contractor burdens. A public-work wage benchmark is not a project bid.
C07. Engineering / design CapEx!D14:I14 B \$200,000; C \$75,000; quantity 1 allowance each	[R04] ASHRAE Owning / Operating Costs 2023	Class: Cost estimate Assessment: Plausible but unverified Action: No direct fee proposal. Define survey, design, load model, structural review and construction administration deliverables.

Assumption / Excel reference / current value	Source / publication date	Classification / assessment / next action
C08. Electrical modifications CapEx!D15:I15 B \$250,000; C \$75,000; quantity 1 allowance each	[R23] NYC Comptroller Wage Schedule July 1, 2026	Class: Cost estimate Assessment: Plausible but unverified Action: No priced takeoff. Verify feeders, starters, panels, service capacity, shutdowns and labor inclusions.
C09. Mechanical piping changes CapEx!D16:I16 B \$200,000; C \$25,000; quantity 1 allowance each	[R23] NYC Comptroller Wage Schedule July 1, 2026	Class: Cost estimate Assessment: Plausible but unverified Action: No priced takeoff. Specify pipe sizes/lengths, valves, insulation, flushing and connections; avoid labor overlap.
C10. Permits / commissioning CapEx!D17:I17 B \$150,000; C \$75,000; quantity 1 allowance each	[R22] LBNL Commissioning Costs November 2020	Class: Cost estimate Assessment: Plausible but unverified Action: Separate permit costs from functional testing, balancing and seasonal commissioning. Historical commissioning data is context only.
C11. Operator training CapEx!D18:I18 B \$25,000; C \$15,000; quantity 1 allowance each	[R07] NYSEDA Real Time Energy Management Undated webpage	Class: Cost estimate Assessment: Plausible but unverified Action: No direct quote. Define staff, hours and deliverables; confirm training timing and any overlap with controls supplier fees.
C12. Removal / disposal CapEx!D19:I19 B \$125,000; C \$25,000; quantity 1 allowance each	[R04] ASHRAE Owning / Operating Costs 2023 [R24] NYC DCAS 22 Reade Notice April 9, 2025 [R25] NYC DCAS Queens Notice April 9, 2025	Class: Cost estimate Assessment: Plausible but unverified Action: No comparable quote. Establish access, dismantling, refrigerant recovery, hazardous materials and disposal scope.
C13. Rigging / temporary cooling CapEx!D20:I20 B \$175,000; C \$50,000; quantity 1 allowance each	[R04] ASHRAE Owning / Operating Costs 2023 [R24] NYC DCAS 22 Reade Notice April 9, 2025 [R25] NYC DCAS Queens Notice April 9, 2025	Class: Cost estimate Assessment: Plausible but unverified Action: Research crane/access plan, permits and temporary cooling duration; local notices do not price this scope.

Assumption / Excel reference / current value	Source / publication date	Classification / assessment / next action
C14. Monitoring workstation CapEx!D21:I21 B \$25,000; C \$15,000; quantity 1 package each	[R07] NYSERDA Real Time Energy Management Undated webpage	Class: Cost estimate Assessment: Questionable without breakdown Action: Clarify hardware versus software/services and avoid BAS overlap; this is much more than an unspecified desktop computer.
C15. Contingency / total funding Assumptions!E25; CapEx!F23:F28; I23:I28 10% of real items: \$450,000 / \$149,000. B \$5,000,000; C \$1,669,000	MODEL: supplied workbook, reviewed 23 Oct 2026; arithmetic only. [R04] ASHRAE Owning / Operating Costs 2023	Class: Estimated allowance; verified totals Assessment: Supported totals; unverified adequacy Action: Retain reconciliation. A fully spent 10% allowance is not a confidence interval. Build a scope/risk-based contingency.
C16. Cost basis / overhead / sales tax CapEx!C3; C35:C38 Year 0 USD; sales/use tax and overhead assumed included; contingency spent	[R04] ASHRAE Owning / Operating Costs 2023 [R16] IRS Tangible Property Rules Undated webpage	Class: Financial estimate Assessment: Plausible but unverified Action: Obtain itemized inclusions, exclusions and tax treatment. Do not add a second blanket installation/overhead allowance without reconciliation.

8C. Financial and tax inputs

Assumption / Excel reference / current value	Source / publication date	Classification / assessment / next action
F01. Avoidable electricity rate Assumptions!E60:E63 Base \$0.20; optimistic \$0.25; downside \$0.15 per kWh	[R09] EIA Electric Power Monthly 5.6.A July 2026 data; Sept. 24, 2026 release [R10] Con Edison Rates FAQs Undated webpage	Class: Financial estimate Assessment: Plausible but unverified Action: Test sensitivity and rebuild avoided bills from tariff/supply contract and interval loads. No separate demand saving is booked.
F02. Electricity escalation Assumptions!E19; Energy!E37:N37 2.5%/year nominal; starts in Year 2	[R12] NIST Life Cycle Costing August 2025	Class: Financial estimate Assessment: Plausible but unverified Action: Retain as a stated scenario assumption, not an EIA forecast. Test flat and alternative escalation paths.
F03. O&M / capital escalation Assumptions!E20; Tax!D14:N18 2.5%/year nominal; future capital in Year 1 USD	[R12] NIST Life Cycle Costing August 2025	Class: Financial estimate Assessment: Plausible but unverified Action: Separate labor, parts and construction inflation when evidence exists. Scenarios do not change this escalation rate.
F04. Owner retention Assumptions!E22; Cash Flow!E45:N48; E67:N70 100% of net operating savings	[R13] DOE Green Lease Leaders May 21, 2021	Class: Hypothetical input Assessment: Plausible but unverified Action: Research gross/net leases and expense recoveries. Test retention separately; it also scales analytics costs in this model.
F05. Annual planned maintenance Assumptions!E47:G47 A \$260,000; B \$140,000; C \$190,000 per year	[R04] ASHRAE Owning / Operating Costs 2023 [R08] DOE / PNNL O&M Best Practices August 2010	Class: Cost estimate Assessment: Plausible but unverified Action: Obtain 3-5 years of service invoices, staffing and scope. Separate HVAC-only costs from general building maintenance.
F06. Annual unplanned repairs Assumptions!E48:G48 A \$100,000; B \$25,000; C \$60,000 per year	[R08] DOE / PNNL O&M Best Practices August 2010 [R16] IRS Tangible Property Rules Undated webpage	Class: Cost estimate Assessment: Plausible but unverified Action: Research failure history and expected repair frequency; distinguish deductible repairs from scheduled capital overhauls.
F07. Recurring analytics expense Assumptions!E49:G49 A \$0; B \$25,000; C \$15,000 per year	[R07] NYSERDA Real Time Energy Management Undated webpage	Class: Cost estimate Assessment: Plausible but unverified Action: No subscription quote supports these amounts. Define monitoring, tuning, staffing and renewal terms.

Assumption / Excel reference / current value	Source / publication date	Classification / assessment / next action
F08. Future capital events Assumptions!E53:G56; Tax!E14:N18, E30:N34, E46:N50 A \$800,000 in Y3 + \$600,000 in Y7; B \$150,000 in Y7; C \$500,000 in Y5; Year 1 USD	[R04] ASHRAE Owning / Operating Costs 2023 [R08] DOE / PNNL O&M Best Practices August 2010 [R16] IRS Tangible Property Rules Undated webpage	Class: Cost/timing estimate Assessment: Questionable without condition evidence Action: Highest-priority research: define each event and remaining life, prevent double counting, and update post-overhaul efficiency assumptions if warranted.
F09. Timing / evaluation horizon Assumptions!E21; E26:E28; Cash Flow!D7:N8 Funding 12/31/2026; 10 years ending 12/31/2036; initial service January; sustaining service December	[R12] NIST Life Cycle Costing August 2025 [R27] Microsoft XIRR Function Undated support page	Class: Hypothetical input Assessment: Supported timeline; unverified schedule Action: Retain 10-year screening scope. Validate construction downtime and commissioning dates; compare longer life consistently in a later phase.
F10. Discount rate Assumptions!E80:E83 Base 8.5%; optimistic 7%; downside 11%, nominal	[R12] NIST Life Cycle Costing August 2025	Class: Financial estimate Assessment: Plausible but unverified Action: Research owner hurdle rate/cost of capital. It is neither a verified WACC nor a property capitalization rate.
F11. Tax rate / tax capacity Assumptions!E18; G18; Tax!C60 28% combined marginal rate; immediate use of deductions	[R17] NYS Tax Dept. Corporate Taxes Updated May 13, 2026 [R18] IRS IRM 21.7.4 Updated; section dates vary	Class: Hypothetical input Assessment: Questionable without owner profile Action: Establish entity, jurisdiction, income, losses and state conformity. Test tax rate and delayed deduction use separately.
F12. Real-property tax class CapEx!J8:J17; J19:J20; F30; I30; Assumptions!E24 39-year straight-line; bases B \$4,950,000 / C \$1,639,000; initial mid-month	[R14] IRS Publication 946 2025 edition [R16] IRS Tangible Property Rules Undated webpage	Class: Classification estimate Assessment: Questionable without asset review Action: Research each component and allocated soft cost; do not assume all HVAC scope shares one tax class or that all repairs are capital.
F13. Computer MACRS CapEx!J21; Assumptions!D90:I90; Tax!E28:J28; E44:J44 5-year half-year: 20%, 32%, 19.2%, 11.52%, 11.52%, 5.76%; bases \$25,000 / \$15,000	[R14] IRS Publication 946 2025 edition [R15] IRS Form 4562 Instructions 2025 edition	Class: Rule benchmark; eligibility estimate Assessment: Supported schedule; unverified application Action: Confirm standalone asset, convention and bonus election. Percentages sum to 100%; services/software may need separate treatment.

Assumption / Excel reference / current value	Source / publication date	Classification / assessment / next action
F14. No Section 179 / bonus CapEx!C38; Tax!C58:C59 No accelerated deduction modeled	[R14] IRS Publication 946 2025 edition [R15] IRS Form 4562 Instructions 2025 edition	Class: Hypothetical tax election Assessment: Questionable without documentation Action: Document election-out or ineligibility. Evaluate qualified interior improvements and eligible HVAC separately; do not expense the entire budget automatically.
F15. Existing basis / training timing Tax!D11:N13; C59:C60; E29; E45; CapEx!C36 Existing basis \$0; training funded Y0 and deducted Y1 (\$25,000 / \$15,000)	[R14] IRS Publication 946 2025 edition [R16] IRS Tangible Property Rules Undated webpage	Class: Hypothetical tax input Assessment: Questionable without records Action: Research existing asset register, retirement basis and service/accounting dates. Age 20 does not prove zero tax basis.
F16. Book lives Assumptions!E23; E29; Tax!E38:N38; E54:N54 Real assets 20 years; computer 5 years; straight-line reference	[R04] ASHRAE Owning / Operating Costs 2023	Class: Accounting estimate Assessment: Plausible but unverified Action: Retain as educational schedules; they do not drive cash flows. They are not tax recovery periods or physical-life guarantees.
F17. Scenario multipliers / weights Assumptions!E66:E68; E71:E73; E76:E78; E86:G86 Energy 1 / 1.15 / 0.70; capital 1 / 0.95 / 1.20; maintenance 1 / 1.20 / 0.60; weights 50% / 20% / 30%	MODEL: supplied workbook, reviewed 23 Oct 2026; arithmetic only.	Class: Hypothetical stress inputs Assessment: Plausible but unverified Action: Retain as stress tests, not probabilities. Add independent challenges to future capital, leases, tax, timing and residual value later.
F18. Terminal / financing / other benefits Cash Flow!C100:C103; D53:N54; D75:N76 No terminal proceeds, debt, working capital, rebates, penalty savings or rental premium	[R11] Con Edison C&I Program Manual July 1, 2026 [R12] NIST Life Cycle Costing August 2025 [R21] NYC DOB LL97 Guidance Undated webpage	Class: Scope assumption Assessment: Supported as disclosed boundary Action: Retain exclusions until evidenced. Report unlevered project returns; consider net incremental terminal service value and construction cash timing in the next phase.

8D. Emissions screening

Assumption / Excel reference / current value	Source / publication date	Classification / assessment / next action
L01. Office emissions limits Assumptions!E94:E95 2024-2029: 0.00758; 2030-2034: 0.002690852 tCO ₂ e/ft ² /year	[R19] NYC DOB 1 RCNY 103-14 Undated consolidated rule	Class: Verified rule values; hypothetical use Assessment: Supported values; applicability unverified Action: Retain screening values for Office. Verify property type and floor-area allocation; Financial Office has different limits.
L02. Grid electricity factors Assumptions!E96:E97 0.000288962 (2024-2029); 0.000145 (2030-2034) tCO ₂ e/kWh	[R19] NYC DOB 1 RCNY 103-14 Undated consolidated rule [R20] NYC Local Law 97 2019	Class: Verified rule values Assessment: Supported for stated periods Action: Retain for this simplified screen. These are regulatory accounting coefficients, not a forecast of marginal grid emissions.
L03. Gas factor / conversion Assumptions!E98; E100 0.00005311 tCO ₂ e/kBtu; 100 kBtu/therm	[R19] NYC DOB 1 RCNY 103-14 Undated consolidated rule [R20] NYC Local Law 97 2019	Class: Verified rule value / unit definition Assessment: Supported Action: Retain units and factor for stated periods. Gas quantity remains hypothetical and unchanged.
L04. Potential penalty Assumptions!E99; Energy!E67:G72 Up to \$268 per excess tCO ₂ e; cash-flow benefit \$0	[R20] NYC Local Law 97 2019 [R21] NYC DOB LL97 Guidance Undated webpage	Class: Verified maximum; eligibility estimate Assessment: Supported as a screen only Action: Retain financial exclusion. Actual penalty depends on compliance, adjustments and mitigation; no avoided penalty is guaranteed.
L05. 2035-2036 / compliance coverage Energy!C75:C77; Cash Flow!C100 No 2035+ emissions forecast although finance ends in 2036	[R19] NYC DOB 1 RCNY 103-14 Undated consolidated rule [R21] NYC DOB LL97 Guidance Undated webpage	Class: Scope assumption Assessment: Questionable if used for compliance Action: Research and document the omitted years. Rule has a 2035-2039 Office limit of 0.001652340 tCO ₂ e/ft ² ; do not extrapolate 2030 factors blindly.

9. References and source-quality review

These are primary organizational sources. They establish the specific facts or benchmarks described here; they are not supplier quotations for the hypothetical building. Access date for every entry: October 23, 2026. Dates below are publication/edition dates unless explicitly identified as webpage updates.

Primary reference / publication date / scope / URL

[R01] DOE - Commercial Reference Buildings

Date: Undated webpage

Large Office row: 498,588 ft², 12 floors. Supports scale only.

<https://www.energy.gov/cmei/buildings/commercial-reference-buildings>

[R02] DOE FEMP - Purchasing Energy-Efficient Electric Chillers

Date: October 2024 update

Table 3.2 and calculation assumptions. Equipment ratings and illustrative 23-year life, not this building's performance.

<https://www.energy.gov/cmei/femp/purchasing-energy-efficient-electric-chillers>

[R03] DOE / Hydraulic Institute / Europump - Variable Speed Pumping: A Guide to Successful Applications, Executive Summary

Date: May 2004

Printed pp. 3-5; PDF pp. 4-6. Affinity laws and the limitation caused by static head.

https://www1.eere.energy.gov/manufacturing/tech_assistance/pdfs/variable_speed_pumping.pdf

[R04] ASHRAE - 2023 HVAC Applications Handbook, Chapter 38: Owning and Operating Costs

Date: 2023

Tables 3-4 and Service Life discussion. Distinguishes older 23-year estimate from later survival evidence exceeding 25 years.

https://handbook.ashrae.org/Handbooks/A23/IP/A23_ch38/A23_Ch38_ip.aspx

[R05] EIA / Guidehouse - Updated Buildings Sector Appliance and Equipment Costs and Efficiencies

Date: March 2023; released March 23

Reference-case printed pp. 125-126 (PDF pp. 129-130), 2022-dollar centrifugal chiller costs. Full PDF downloaded and read locally because web extraction exceeded its size limit.

<https://www.eia.gov/analysis/studies/buildings/equipcosts/pdf/full.pdf>

[R06] NREL, Kim and CaraDonna - ComStock Measure Scenario Documentation: Chiller Replacement, NREL/TP-5500-95003

Date: August 2025

Sections 3.2 and 4; printed pp. 13-14 and 20-22. Control, pump and tower interactions. Working replacement for Sources!E17.

<https://docs.nlr.gov/docs/fy25osti/95003.pdf>

[R07] NYSEDA - Real Time Energy Management

Date: Undated webpage

How it works / predictive analytics. Monitoring and controls methodology; no support for this project's dollar allowances.

<https://www.nyserda.ny.gov/PutEnergyToWork/Energy-Technology-and-Solutions/Building-Operations-and-Performance/Real-Time-Energy-Management>

[R08] DOE FEMP / PNNL - Operations & Maintenance Best Practices: A Guide to Achieving Operational Efficiency, Release 3.0

Date: August 2010

Sections 9.4.5-9.4.10, printed pp. 9.50-9.57. Chiller performance and maintenance. Historical technical guidance, not 2026 labor pricing.

https://www.energy.gov/sites/prod/files/2020/04/f74/omguide_complete_w-eo-disclaimer.pdf

[R09] EIA - Electric Power Monthly, Table 5.6.A

Date: July 2026 data; September 24, 2026 release

Retrieved table reports New York commercial electricity at 24.18 cents/kWh. Monthly statewide average, not the marginal avoided tariff.

https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_5_6_a

[R10] Con Edison - Rates and Tariffs FAQs

Date: Undated webpage

Demand-billed service discussion: separate kWh energy and kW demand supply components. English version of workbook source S03.

<https://www.coned.com/en/rates-tariffs/rates/electric-rates-schedule/faqs>

[R11] Con Edison - Commercial & Industrial Energy Efficiency and Electrification Program Manual, Version 1.1

Date: July 1, 2026

Sections 1.1, 1.4, 2.2 and 2.6. Eligibility, pre-inspection, Notice to Proceed and custom savings evidence. No award is assumed.

<https://www.coned.com/-/media/files/coned/documents/save-energy-money/rebates-incentives-tax-credits/rebates-incentives-tax-credits-for-commercial-industrial-buildings-customers/commercial-and-industrial-program/program-manual.pdf>

[R12] NIST, Kneifel and Webb - Life Cycle Costing Manual for the Federal Energy Management Program, HB 135e2025

Date: August 2025

Sections 3.3 and 4.5.3: nominal/real consistency and residual value. Federal methodology reference; does not establish a private owner's discount rate.

<https://nvlpubs.nist.gov/nistpubs/hb/2025/NIST.HB.135e2025.pdf>

[R13] DOE - DOE Announces 2021 Green Lease Leaders Awardees

Date: May 21, 2021

Lease provisions and split incentives. Supports the need to establish who receives savings, not the model's 100% retention.

<https://www.energy.gov/cmei/buildings/articles/doe-announces-2021-green-lease-leaders-awardees>

[R14] IRS - Publication 946: How To Depreciate Property

Date: 2025 edition

Chapters 2 and 4; Table A-1. Recovery periods, conventions, eligible Section 179 real property and qualified improvements. Apply only after asset/taxpayer review.

<https://www.irs.gov/publications/p946>

[R15] IRS - Instructions for Form 4562

Date: 2025 edition

Part II, line 14; qualified property acquired after January 19, 2025. Current bonus rules; eligibility and elections for 2027 service remain unverified.

<https://www.irs.gov/instructions/i4562>

[R16] IRS - Tangible Property Final Regulations

Date: Webpage; publication date not stated

Facts-and-circumstances analysis of building systems, betterments, restorations and adaptations. Relevant to repairs versus capital improvements.

<https://www.irs.gov/businesses/small-businesses-self-employed/tangible-property-final-regulations>

[R17] NYS Department of Taxation and Finance - Corporate Taxes

Date: Updated May 13, 2026

Corporate tax tables as of January 1, 2026 and S-corporation discussion. State, MTA and NYC treatment depends on taxpayer facts.

<https://www.tax.ny.gov/data/stats/taxfacts/corporation-tax.htm>

[R18] IRS - Internal Revenue Manual 21.7.4: Income Taxes / Information Returns

Date: Continuously updated; section dates vary

Corporate income tax discussion identifies the flat 21% federal rate. Not evidence of a 28% combined rate for this owner.

https://www.irs.gov/irm/part21/irm_21-007-004r

[R19] NYC Department of Buildings - 1 RCNY §103-14: Annual Greenhouse Gas Emissions for Covered Buildings

Date: Consolidated rule; edition date not printed

PDF pp. 6-8 and 12. Office property-type limits and 2030-2034 utility coefficients. Current retrieved rule, not a building compliance determination.

https://www.nyc.gov/assets/buildings/rules/1_RCNY_103-14.pdf

[R20] NYC - Local Law 97 of 2019

Date: 2019

Sections 28-320.3.1.1 and 28-320.6, PDF pp. 10 and 15. 2024-2029 coefficients and maximum excess-emissions penalty; read with later rules.

https://www.nyc.gov/assets/buildings/local_laws/ll97of2019.pdf

[R21] NYC Department of Buildings - LL97 Greenhouse Gas Emissions Reduction

Date: Undated webpage

Covered buildings and applicability. A real property needs its BIN, occupancy/use allocation and applicable compliance pathway.

<https://www.nyc.gov/site/buildings/codes/ll97-greenhouse-gas-emissions-reductions.page>

[R22] Lawrence Berkeley National Laboratory, Crowe et al. - Building Commissioning Costs and Savings Across Three Decades and 1,500 North American Buildings

Date: November 2020

2018 sample: existing-building median commissioning cost \$0.26/ft². Historical national benchmark, not a Manhattan project quote.

<https://bies.lbl.gov/publications/building-commissioning-costs-and>

[R23] NYC Comptroller - Construction Worker Prevailing Wage Schedule

Date: July 1, 2026; effective through June 30, 2027

PDF pp. 1 and 85. Steamfitter wage and supplemental benefit. Public-work schedule; not automatically binding on this hypothetical private project.

https://comptroller.nyc.gov/wp-content/uploads/2026/07/Construction_Worker_Schedule-2026-2027.pdf

[R24] NYC DCAS / City Record - MWBE Chiller Replacement 22 Reade

Date: April 9, 2025

Proposed \$295,148 contract for supply/delivery of seven modular chillers. Different and incomplete comparable scope.

<https://a856-cityrecord.nyc.gov/RequestDetail/20250407022>

[R25] NYC DCAS / City Record - MWBE Chillers Replacement 120-55 Queens

Date: April 9, 2025

Proposed \$134,000 modular-chiller supply/delivery/positioning contract. Capacity not stated; not an installed \$/ton benchmark.

<https://a856-cityrecord.nyc.gov/RequestDetail/20250407025>

[R26] DOE - Energy Conservation Standards for Electric Motors, prepublication direct final rule

Date: May 2023 posting

Workbook S13 exists, but motor regulation does not establish the assumed average fan/pump power fractions.

<https://www.energy.gov/sites/default/files/2023-05/em-ecs-dfr.pdf>

[R27] Microsoft - XIRR Function

Date: Undated support page

365-day discount basis and cash-flow sign requirements. Method reference only; no desktop Excel testing performed in Step 3.

<https://support.microsoft.com/en-us/excel/functions/xirr-function>

10. Unresolved questions and next-phase actions

Evidence needed before relying on the investment result

- 1. Define the actual engineering case.** Record the floor-area basis, use, occupancy, design weather, envelope and internal loads. Explain the plant's staging and peak-load redundancy. Document comfort and minimum ventilation requirements.
- 2. Measure and calibrate energy use.** Collect bills, BAS operating hours, chiller power/flow/temperatures and auxiliary power. Obtain manufacturer performance selections. Build an hourly model or a measurement plan that tests the current bins and component interactions.
- 3. Substantiate costs and remaining life.** Obtain comparable budget proposals and a condition-based capital plan. Resolve BAS/workstation overlap, installation inclusions, shutdowns, temporary cooling, maintenance commitments and repair versus capital scope.
- 4. Establish owner economics.** Review supply/demand billing, expense recoveries, the hurdle rate, entity tax profile, asset classification, tax capacity and elections. Test the retention, tax and future-capital cases absent from the standard scenario set.
- 5. Complete scope comparisons.** Consider a consistent longer-life or residual-value comparison, construction delays and 2035-2036 emissions. Verify incentive eligibility before adding benefits. Keep cash savings separate from unpriced reliability or strategic benefits.

Source register changes recommended for the next authorized phase

Sources!E17 should use the working NREL link [R06]. Its current www.nlr.gov link could not be retrieved. Sources!E18 also failed retrieval; do not claim its content was verified. Use the accessible DOE O&M; guide [R08] for maintenance principles, while retaining estimated dollar budgets. The English Con Edison FAQ [R10] is easier to review than the current Spanish URL.

Sources!E19:E20 should remain clearly labeled non-comparable notices. Sources!E21 is a motor-standard document, not evidence for assumed fan/pump power fractions; add the system-level sources [R03] and [R06]. Sources!E8 names a reconstruction PDF and is provenance, not independent research. Add publication/access dates and exact input mappings only in a later authorized workbook update.

Step 3 boundary

The workbook remains unchanged. The report closes the arithmetic and primary-reference checks described above, while leaving site evidence, priced scope, lease/tax applicability and final investment judgment open. Step 4 has not been started.

Preserved workbook SHA-256:

11b873d72e4da5c49ce35e011be28aae870c5cd9ebcae056a6cc8e2b2c10af1c