

Manhattan Commercial Office Building

\$5 Million HVAC Modernization Feasibility Study

Independent Mechanical Engineering Technology and Financial Analysis Project

Project Objective

Evaluate whether HVAC savings justify capital spending over ten years for a hypothetical 500,000 ft² Manhattan office with 1,200 tons of cooling. This student study is not an actual building investment proposal.

Engineering Approach

Cooling load bins and fan, pump and tower electricity estimates link equipment performance to costs at an illustrative \$0.20/kWh. Reductions below cover HVAC electricity only.

Investment Alternatives

A retains the system. B replaces chillers and upgrades plant equipment and controls. C rebuilds chillers with selective upgrades. Base, Optimistic and Downside are assumption scenarios.

Financial Results Comparison

Base financial scenario	A - Existing	B - Full	C - Partial
Initial capital investment (USD)	\$0	\$5,000,000	\$1,669,000
Annual HVAC electricity saved (kWh)	0	1,147,200	477,000
HVAC electricity reduction	0%	37.7%	15.7%
Year 1 net operating savings (USD, pretax)	\$0	\$399,440	\$190,400
10-year NPV at 8.5% (USD)	\$0	-\$1,754,620	+\$68,531
Dated IRR (XIRR)	n/a	-0.38%	9.44%
Simple payback (years)	n/a	Not within 10	6.51
Discounted payback at 8.5% (years)	n/a	Not within 10	9.12

Net operating savings = electricity + maintenance/repair reductions - analytics; owner retains 100%.
A is the incremental baseline; it still has operating and future capital costs. n/a = not applicable.
NPV/IRR use dated after-tax cash flows. Paybacks interpolate after-tax recovery (C: Years 7/10 at year-end).

Key Risks

Verify baseline repair and replacement needs, installation costs, energy and maintenance savings, tariffs, ownership of savings and tax treatment. C’s positive NPV is erased by roughly 4.32% higher initial costs, other inputs fixed. Both upgrades have negative Downside NPV. Scenario weights are judgments, not measured probabilities.

Final Recommendation

Advance C for further evaluation; withhold approval of either upgrade. NPV is primary because it measures discounted after-tax dollar value. C leads, but its IRR barely exceeds 8.5% and discounted recovery is late. B’s extra \$3.331 million is not justified by modeled benefits: its NPV is \$1.823 million below C’s. Verify costs, condition, savings, leases and tax treatment before funding.

Project Limitations

Ten years (2027-2036) provides a consistent planning window, not a full equipment-life assessment. No site measurements or bids validate the inputs. Excluded terminal value and later tax benefits may particularly affect B; negative 10-year NPV does not imply no value afterward.