

## Manhattan HVAC Model - Step 2 Correction Report

23 October 2026 | Existing workbook corrections only

**Result:** The requested control corrections are complete. The Base, Optimistic and Downside financial results remain unchanged within \$0.01. The original nine worksheets, numeric assumptions, investment costs and depreciation methods were retained.

The changes address page 5 of *Manhattan\_HVAC\_Excel\_Model\_Audit\_Report(2).pdf*. This report documents spreadsheet corrections and tests. It does not close the engineering, tax or source-evidence gaps reserved for Step 3.

### Before and after: dated investment returns

| Case / option  | Original NPV (USD) | Revised NPV (USD) | XIRR (both versions) | Payback years simple / discounted |
|----------------|--------------------|-------------------|----------------------|-----------------------------------|
| Base - B       | (1,754,620.45)     | (1,754,620.45)    | -0.38265%            | >10 / >10                         |
| Base - C       | 68,530.64          | 68,530.64         | 9.44427%             | 6.5096 / 9.1185                   |
| Optimistic - B | (514,311.94)       | (514,311.94)      | 4.57213%             | 7.4863 / >10                      |
| Optimistic - C | 621,751.70         | 621,751.70        | 15.02844%            | 3.7038 / 6.5600                   |
| Downside - B   | (3,908,536.78)     | (3,908,536.78)    | -9.46959%            | >10 / >10                         |
| Downside - C   | (838,052.22)       | (838,052.22)      | -0.88656%            | >10 / >10                         |

NPVs use each case's discount rate: Base 8.5%, Optimistic 7.0%, Downside 11.0%. ">10" means no first cumulative recovery within the modeled horizon. Payback and XIRR in this table are unchanged. Trace: Cash Flow!E89:F93 and Scenarios!E8:F10.

### Base-case figures preserved

| Measure                               | B Full       | C Partial    |
|---------------------------------------|--------------|--------------|
| Initial funding (USD)                 | \$5,000,000  | \$1,669,000  |
| Year 1 pretax operating savings (USD) | \$399,440    | \$190,400    |
| Annual HVAC electricity saved (kWh)   | 1,147,200    | 477,000      |
| HVAC electricity reduction            | 37.6934%     | 15.6727%     |
| Year 1 after-tax cash flow (USD)      | \$330,054.49 | \$153,404.88 |

The recommendation is unchanged: Option C has a small positive base-case NPV, while Option B has negative NPV in all three scenarios. Option A ranks highest in the Downside case. The analysis still covers Year 0 plus 10 operating years, ending 31 December 2036.

## 2. Corrections and verification

| Location                                            | Correction                                                                                                                                                                                                                |
|-----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Assumptions!E66:E68; E76:E78                        | Replaced the 0-100 realization limits with custom rules that require numeric, nonnegative values and nonnegative modeled electricity and maintenance/repair costs for both upgrades. No savings are silently capped.      |
| Assumptions!G6, G60:G83, G87, G91; Scenarios!I8:I10 | Added visible input status checks. Invalid pasted or missing inputs suppress affected results. Price, capital and discount inputs also have explicit checks. Invalid unselected cases do not block a valid selected case. |
| Audit!D10:D11, D16:D17; E8:E21                      | Changed four reconciliations to the sum of absolute annual residuals. E18:E19 use 1E-8 for fractional totals. Monetary checks retain \$0.01. Unavailable calculations show INPUT ERROR.                                   |
| Scenarios!E23:N23; E30:N30                          | Calculated initial tax benefits directly from the unscaled CapEx classifications. Removed division by the active capital multiplier, preserving the original tax method.                                                  |
| Cash Flow!E87:F97; Summary; Scenarios               | Retained valid-case calculations inside input guards. ROI requires positive funding. IRR requires both cash-flow signs; a failed root solve is reported as unavailable. Invalid sensitivity inputs show n.a.              |
| Summary!C13:C14, C45:C46                            | Clarified interpolated after-tax cash-flow payback. Base C crosses at Years 7 / 10 under strictly year-end receipts, versus 6.5096 / 9.1185 with interpolation.                                                           |

### Tests actually performed

**Independent calculation:** A separate Python model rebuilt the budgets, energy use, depreciation and cash flows from the original inputs. All 249 comparisons passed, covering both upgrades in all three cases, annual cash flows, returns, all 25 two-variable sensitivity cells and all 20 one-variable outputs in each case. The largest absolute difference was below \$0.000001.

**Workbook calculation:** The spreadsheet engine passed 28 test groups. Tests included E66=3, E76=3, zero/negative/missing capital multipliers, blanks, text, an invalid selector, and an invalid unselected case. Zero realization remained valid; values just below and above each physical limit were tested.

**Control challenges:** E86=0.505 and D90=0.205 triggered fractional warnings. Opposing +\$100 / -\$100 annual errors produced \$200 differences and REVIEW in each of the four corrected reconciliations. Invalid sensitivity inputs became n.a.

**Saved-file checks:** Reopened the delivered XLSX and recalculated all three cases. All 14 original audit checks and four added input checks passed. 210 saved-file comparisons passed, along with three invalid-input tests and an IRR-sign/ROI-prerequisite test. The valid Base error scan was clear.

### 3. Formula change record: validation and audits

Formulas below are exact representative formulas from the corrected workbook. Repeated annual terms are kept explicit to avoid an array-evaluation limitation in the calculation engine.

#### Assumptions!E66 validation - original

Decimal between 0 and 100

#### Assumptions!E66 validation - revised

```
=IFERROR(AND(ISNUMBER(E66),E66>=0,INDIRECT("'"&Energy!$F$18"'")-MAX(INDIRECT("'"&Energy!$G$19:$H$19"'"))*E66>=0),FALSE)
```

#### Assumptions!E76 validation - revised

```
=IFERROR(AND(ISNUMBER(E76),E76>=0,SUM($E$47:$E$48)-MAX(SUM($E$47:$E$48)-SUM($F$47:$F$48),SUM($E$47:$E$48)-SUM($G$47:$G$48))*E76>=0),FALSE)
```

The same rules apply to E67:E68 and E77:E78 with their own input references. With the current inputs, energy realization must not exceed about 2.652981x and maintenance realization must not exceed about 1.846154x. These are mathematical ceilings, not supported engineering performance estimates. The formulas recalculate the limits when the underlying inputs change.

#### Audit!E18 - original

```
=IF(ABS(D18)<=0.01,"PASS","REVIEW")
```

#### Audit!E18 - revised (E19 uses the corresponding D19 reference)

```
=IF(ISNUMBER(D18),IF(ABS(D18)<=1E-8,"PASS","REVIEW"),"INPUT ERROR")
```

#### Audit!D10 - original

```
=SUM('Cash Flow'!D27:N27)-SUM('Cash Flow'!D16:N16)-SUM('Cash Flow'!D54:N54)
```

#### Audit!D10 - revised

```
=IF('Assumptions'!$G$6="Inputs valid",SUM(ABS('Cash Flow'!D27-'Cash Flow'!D16-'Cash Flow'!D54),ABS('Cash Flow'!E27-'Cash Flow'!E16-'Cash Flow'!E54),ABS('Cash Flow'!F27-'Cash Flow'!F16-'Cash Flow'!F54),ABS('Cash Flow'!G27-'Cash Flow'!G16-'Cash Flow'!G54),ABS('Cash Flow'!H27-'Cash Flow'!H16-'Cash Flow'!H54),ABS('Cash Flow'!I27-'Cash Flow'!I16-'Cash Flow'!I54),ABS('Cash Flow'!J27-'Cash Flow'!J16-'Cash Flow'!J54),ABS('Cash Flow'!K27-'Cash Flow'!K16-'Cash Flow'!K54),ABS('Cash Flow'!L27-'Cash Flow'!L16-'Cash Flow'!L54),ABS('Cash Flow'!M27-'Cash Flow'!M16-'Cash Flow'!M54),ABS('Cash Flow'!N27-'Cash Flow'!N16-'Cash Flow'!N54)), "n.a.")
```

#### Audit!D16 - original

```
=SUM('Scenarios'!D25:N25)-SUM('Cash Flow'!D54:N54)
```

#### Audit!D16 - revised

```
=IF('Assumptions'!$G$6="Inputs valid",SUM(ABS('Scenarios'!D25-'Cash Flow'!D54),ABS('Scenarios'!E25-'Cash Flow'!E54),ABS('Scenarios'!F25-'Cash Flow'!F54),ABS('Scenarios'!G25-'Cash Flow'!G54),ABS('Scenarios'!H25-'Cash Flow'!H54),ABS('Scenarios'!I25-'Cash Flow'!I54),ABS('Scenarios'!J25-'Cash Flow'!J54),ABS('Scenarios'!K25-'Cash Flow'!K54),ABS('Scenarios'!L25-'Cash Flow'!L54),ABS('Scenarios'!M25-'Cash Flow'!M54),ABS('Scenarios'!N25-'Cash Flow'!N54)), "n.a.")
```

D11 uses the D10 structure with absolute cash row 38 and incremental row 76. D17 uses the D16 structure with scenario row 32 and incremental row 76. All four cover every annual column from D through N, including Year 0. Their input guard returns n.a. when the selected inputs are invalid.

## 4. Scenario safeguards and remaining limits

### Scenarios!E23 - original

=SUM('Tax'!E27:E29)/Assumptions'!\$E\$70\*Assumptions'!\$E\$18

### Scenarios!E23 - revised

=(((SUMIFS('CapEx'!\$F\$8:\$F\$21,'CapEx'!\$J\$8:\$J\$21,"Real")+CapEx'!\$F\$24)/Assumptions'!\$E\$24\*IF(E\$17=1,(12-'Assumptions'!\$E\$27+0.5)/12,MAX(0,MIN(1,'Assumptions'!\$E\$24-(12-'Assumptions'!\$E\$27+0.5)/12-(E\$17-2)))))+(IF(E\$17<=6,SUMIFS('CapEx'!\$F\$8:\$F\$21,'CapEx'!\$J\$8:\$J\$21,"Computer")\*INDEX('Assumptions'!\$D\$90:\$I\$90,1,E\$17),0))-(SUMIFS('CapEx'!\$F\$8:\$F\$21,'CapEx'!\$J\$8:\$J\$21,"Expense")))\*Assumptions'!\$E\$18

This is the original Year 1 real-property depreciation, computer MACRS and training tax benefit evaluated on unscaled budget amounts. F23:N23 retain the corresponding annual timing. E30:N30 use the same approach for the partial-upgrade budget in CapEx column I. Future capital and depreciation schedules are unchanged.

### Cash Flow!E90 - original

=XIRR(D54:N54,\$D\$8:\$N\$8,0.1)

### Cash Flow!E90 - revised (F90 uses row 76)

=IF('Assumptions'!\$G\$6="Inputs valid",IF(AND(COUNTIF(D54:N54,">0")>0,COUNTIF(D54:N54,"<0")>0),IFERROR(XIRR(D54:N54,\$D\$8:\$N\$8,0.1),"n.a. - no converged IRR"),"n.a. - cash-flow signs"),"n.a.")

### Cash Flow!E91 - original

=SUM(D54:N54)/E87

### Cash Flow!E91 - revised

=IF(AND('Assumptions'!\$G\$6="Inputs valid",ISNUMBER(E87),E87>0),SUM(D54:N54)/E87,"n.a.")

## Preservation and presentation checks

The final workbook contains 1,660 functioning formulas across the same nine worksheets. No original numeric hardcoded assumptions changed. CapEx, Energy, Tax and Sources formulas were preserved. The single chart retains its original source ranges: Summary!C51:C61 and D51:E61. Its linked values were checked in every scenario. Populated cells and chart text use Times New Roman.

Merged ranges, frozen panes, print areas, repeated print titles, paper settings and margins were preserved. The original workbook's SHA-256 hash is unchanged. The report and changed worksheet views were rendered for readability checks. Original print metadata was restored after export; no financial cells were changed in that restoration.

## Limits that remain open

Desktop Microsoft Excel was not used. Validation rules and Stop alerts were inspected in the XLSX, and their logic was challenged by direct input changes. Excel dialog behavior and native print pagination were not tested. Invalid inputs deliberately produce #N/A in dependent calculation areas, while the main outputs show n.a. and a clear warning. Pasting can bypass Excel entry validation, so the formula guards are also necessary.

Step 3 still needs to address equipment and tariff evidence, engineering load profiles, maintenance estimates, lease retention, tax eligibility and source-to-input mapping. Passing controls establish calculation consistency, not investment readiness. IRR root uniqueness under arbitrary changes is not proven; retain NPV as the primary decision measure.

**Files reviewed:** Manhattan\_HVAC\_CapEx\_Revised(2).xlsx;

Manhattan\_HVAC\_Excel\_Model\_Audit\_Report(2).pdf, especially pages 1, 2 and 5. No new external research or changes to the investment assumptions were made in Step 2.