Nationwide Prospector — Definitive Technical Guide

Data sources, analytics methods, formulas, and definitions (v1.0)

This guide documents the end-to-end **Nationwide Prospector** methodology: what data is used, how it is transformed, the exact formula chain behind every major output, and the definitions/units you need to audit or re-implement the system.

It is organized to mirror the pipeline:

1. **Inputs & data sources** →
2. **Canonical building record / schema** →
3. **Derived energy + cost** →
4. **HVAC attribution (by fuel)** →
5. **ODCV savings model** →
6. **Carbon & BPS fines** →
7. **Total OpEx avoided & valuation impact** →
8. **Portfolio identification (account rollups)** →
9. **Quality controls & limitations** →
10. **Glossary**

> Dataset structure and column naming conventions come from the project data dictionary.

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1) What "Nationwide Prospector" produces

1.1 Output artifact

The core output is a **building-level table** (commonly `portfolio_data.csv`) with **one row per building** and a standardized set of column groups (location, building characteristics, energy, costs, HVAC %, occupancy, ODCV savings, carbon, BPS fines, combined savings, valuation, metadata).

1.2 Intended use

Nationwide Prospector is designed for **portfolio-scale screening**:

- Identify buildings likely wasting HVAC energy due to **vacancy + under-utilization**

- Quantify **annual HVAC utility savings** from occupancy-driven ventilation controls (ODCV)
- Quantify **year-1 regulatory penalty avoidance** (where Building Performance Standards apply)
- Translate annual OpEx avoided into **property valuation uplift** using cap rates
- Roll buildings up into **portfolio organizations** for account-based targeting

This is explicitly a **screening model**, not a replacement for an engineering audit (details in §9).

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2) Nationwide Prospector data sources

Nationwide Prospector combines **measured/declared building energy** with **modeled enrichment layers** (rates, HVAC end-use splits, occupancy proxies, emissions factors, BPS rule parameters, cap rates).

2.1 Building energy & benchmarking disclosure data

Primary source class:

- **EPA ENERGY STAR Portfolio Manager** and/or **local benchmarking disclosure laws** (city/municipal public disclosure datasets). These provide building-reported annual consumption and (often) ENERGY STAR score and floor area.

Key fields pulled/derived from this layer:

- Electricity consumption (`energy_elec_kwh`, and/or kBtu equivalent)
- Fuel consumption (`energy_gas_kbtu`, `energy_steam_kbtu`, `energy_fuel_oil_kbtu`)
- Site EUI (`energy_site_eui`) and building type median benchmark (`energy_eui_benchmark`)
- ENERGY STAR score (`energy_star_score`) when available

2.2 Utility rates (for cost estimation)

Energy cost estimation uses a mix of:

- **EIA commercial electricity data** + local tariff analysis (electricity)
- **EIA natural gas data** + local tariff analysis (gas)
- **ConEd steam schedules** / utility filings (steam)
- **EIA heating oil data** / regional price surveys (fuel oil)
- Multipliers calibrated from sample commercial bills and research

2.3 HVAC end-use split (by fuel type)

HVAC attribution depends on **CBECS 2018 microdata** (Commercial Buildings Energy Consumption Survey) with additional adjustments and special-case handling.

Output of this module includes:

- `hvac_pct_elec`, `hvac_pct_gas`, `hvac_pct_steam`, `hvac_pct_fuel_oil`
- A method tag indicating the lookup/approach used

2.4 Occupancy proxies (vacancy & utilization)

ODCV needs an estimate of how "empty" the building is:

- **Office vacancy**: market vacancy estimates (e.g., CBRE / Cushman & Wakefield)
- **Office utilization**: badge-swipe utilization proxies (Kastle Systems "Back to Work")
- **Hotel occupancy**: market occupancy (STR / CoStar)
- **School calendar utilization**: instructional days / operating schedules (NCES and state calendars)

2.5 Carbon emission factors

Carbon is calculated from **raw energy** by fuel:

- City-specific electricity factors (grid region / BPS-specific definitions)
- Standard combustion factors for gas
- Steam factors (varies by system)
- A national default when a city-specific factor is not defined

2.6 Building Performance Standards (BPS) rules

The national BPS calculator uses city program parameters and official references for:

- NYC LL97
- Boston BERDO 2.0
- Cambridge BEUDO
- Washington DC BEPS
- Denver Energize
- Seattle BEPS
- St. Louis BEPS
- (San Francisco EBEPO is treated as reporting-only: no fine modeled)

2.7 Cap rates & valuation assumptions

Valuation uplift uses:

- **Cap rate medians by building type**
- An income capitalization approach where annual OpEx avoided increases NOI dollar-for-dollar

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3) Canonical schema: column groups & definitions

Nationwide Prospector uses consistent prefixes:

3.1 Location (`loc_`)

Includes address and geo fields:

- `loc_address`, `loc_city`, `loc_state`, `loc_zip`, `loc_lat`, `loc_lon`

3.2 Building characteristics (`bldg_`)

- `bldg_type`, `bldg_vertical`, `bldg_year_built`, `bldg_sqft`, plus simplified filter/benchmark type

3.3 Organizations (`org_`)

- `org_owner`, `org_manager`, `org_tenant`, `org_tenant_subunit`

3.4 Energy (`energy_`)

- `energy_site_eui`, `energy_total_kbtu`, fuel totals by type, ENERGY STAR score, climate zone

3.5 Utility costs (`cost_`)

Rates and annual costs:

- Electric: rate_kwh, demand_kw, load factor, peak kW, energy charges, demand charges, total
- Gas/steam/oil annual costs and rates
- Utility name + notes on estimation

3.6 HVAC attribution (`hvac_`)

- Fuel-by-fuel HVAC fractions plus totals:
    - `hvac_energy_total_kbtu = Σ(fuel_kbtu × hvac_pct_fuel)`

    - `hvac_cost_total_annual = Σ(fuel_cost × hvac_pct_fuel)`

3.7 Occupancy (`occ_`)

- `occ_vacancy_rate` (0–1)
- `occ_utilization_rate` (0–1)

3.8 ODCV savings (`odcv_`)

- `odcv_hvac_savings_pct` (bounded by type; applied to HVAC only)
- `odcv_hvac_savings_annual_usd = hvac_cost_total_annual × odcv_hvac_savings_pct`
- `odcv_carbon_reduction_yr1_mt` from fuel reductions × emissions factors

3.9 BPS fines (`bps_`)

- `bps_law_name`
- baseline year-1 fine, post-ODCV year-1 fine, and year-1 avoided fine

3.10 Combined savings (`savings_`) and valuation (`val_`)

- `savings_opex_avoided_annual_usd = odcv_hvac_savings_annual_usd + bps_fine_avoided_yr1_usd`
- `val_odcv_impact_usd = savings_opex_avoided_annual_usd / (cap_rate/100)`
- `val_current_usd` and `val_post_odcv_usd` are derived as described in §8

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4) Energy normalization & unit conventions

4.1 Core units

- **kWh**: electricity consumption
- **kBtu**: thermal energy unit used for aggregating across fuels
- **therm**: gas billing unit (1 therm = 100 kBtu)
- **Mlb steam**: “thousand pounds of steam”
- **MMBtu**: 1,000 kBtu

4.2 EUI definition

Site EUI is energy per floor area:

$$
\text{Site EUI} = \frac{\text{Total site energy (kBtu)}}{\text{Gross floor area (sqft)}}
$$

Nationwide Prospector commonly computes total site energy from disclosed fuel quantities:

$$
\text{Total kBtu} = (\text{kWh} \times 3.412) + (\text{therms} \times 100) + (\text{steam MMBtu} \times 1000) + (\text{fuel oil gallons} \times 138.5)
$$

$$
\text{EUI} = \frac{\text{Total kBtu}}{\text{sqft}}
$$

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5) Utility cost calculation module

5.1 Purpose

Convert annual energy consumption + rate assumptions into annual utility costs for:

- Electricity (energy + demand)
- Natural gas
- District steam
- Fuel oil

5.2 Electricity: demand estimation via load factor

If peak demand is not directly known, it is estimated using **load factor**:

$$
\text{Load factor} = \frac{\text{Average demand}}{\text{Peak demand}}
$$

$$
\text{Peak kW} = \frac{\text{Annual kWh}}{8760 \times \text{Load factor}}
$$

Typical ranges by building type and a default assumption of **0.45** are documented.

5.3 Electricity annual cost formula (energy + demand)

Electricity has:

- **Energy charges** based on kWh
- **Demand charges** based on peak kW, billed monthly

Implemented formula set:

```
None
peak_kw = energy_elec_kwh / (8760 × load_factor)

cost_elec_energy_annual = energy_elec_kwh × rate_kwh × 1.10

cost_elec_demand_annual = peak_kw × rate_demand_kw × 12 × 1.265

cost_elec_total_annual = cost_elec_energy_annual +
cost_elec_demand_annual
```

The multipliers (why 1.10 and 1.265 exist)

- **1.10** is an “all-in adder” to approximate delivery charges, taxes/surcharges, and fixed customer charges when the rate field is commodity-only.
- **1.265** adjusts demand charges for ratchets, seasonal demand premiums, and other demand-related bill structures.

5.4 Natural gas annual cost

Convert kBtu to therms, then apply the all-in multiplier:

```
None
therms = energy_gas_kbtu / 100
cost_gas_annual = therms × rate_therm × 1.10
```

5.5 District steam annual cost

Steam uses a kBtu ↔ Mlb conversion and does **not** apply the 1.10 adder (steam rates are treated as all-inclusive):

```
None
mlb = energy_steam_kbtu / 909
cost_steam_annual = mlb × rate_mlb
```

5.6 Fuel oil annual cost

Convert kBtu to MMBtu and apply the all-in multiplier:

```
None
mmbtu = energy_fuel_oil_kbtu / 1000
cost_fuel_oil_annual = mmbtu × rate_mmbtu × 1.10
```

5.7 Assumptions & limitations (cost module)

Key stated constraints include constant blended rates, flat pricing (no TOU blocks), load factor defaults, and regional variation in multipliers.

5.8 Validation

Cost formulas were validated against **23,882 buildings** with known costs; match rates are essentially exact (steam deviations are floating-point precision).

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6) HVAC percentage by fuel type (end-use attribution)

6.1 Purpose

ODCV savings apply to **HVAC only**, so we must estimate how much of each fuel is HVAC-driven:

- `hvac_pct_elec`: fraction of electricity attributable to HVAC
- `hvac_pct_gas`: fraction of gas attributable to HVAC
- `hvac_pct_steam`: fraction of steam attributable to HVAC
- `hvac_pct_fuel_oil`: fraction of fuel oil attributable to HVAC

6.2 Data backbone

The method is grounded in **CBECS 2018 microdata** with building portfolio join keys and additional refinements.

6.3 Core adjustment logic

HVAC percentages are not taken as a single static number. Adjustments incorporate:

- **ENERGY STAR score thresholds** (absolute bands) that shift expected HVAC share to reflect efficiency/waste signals
- **Year-built adjustments** (older buildings often have less optimized systems)
- **EUI vs peer median adjustments** (EUI ratio bands)
- A combined adjustment cap (±12%)

6.4 Electricity HVAC minimum floor

Electric HVAC share has a documented minimum of **15%** to account for fans, pumps, and controls that run broadly across operating hours.

6.5 Fuel-heated vs all-electric handling

Electric HVAC share is adjusted depending on whether the building appears fuel-heated vs all-electric, and by climate region (to reflect electric heat prevalence).

6.6 Special cases

Some building types have fundamentally different end-use splits:

- **Hotels:** gas is mostly DHW + cooking; HVAC is a smaller fraction with intensity-tier logic
- **Restaurants:** gas dominated by cooking; HVAC fraction fixed and dampened
- **Data centers:** treated as special (no direct CBECS category) and assigned distinct HVAC shares

6.7 HVAC totals (energy & cost)

Once fuel HVAC fractions exist:

$$
\text{hvac_energy_total_kbtu}=\sum_f (\text{fuel_kbtu}_f \times \text{hvac_pct}_f)
$$
$$
\text{hvac_cost_total_annual}=\sum_f (\text{fuel_cost}_f \times \text{hvac_pct}_f)
$$

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7) ODCV savings model (the Prospector “engine”)

ODCV = **Occupancy-Driven Control Ventilation** (ventilate/condition based on real occupancy rather than fixed schedules).

7.1 What the ODCV % represents

`odcv_hvac_savings_pct` is the **fraction of HVAC costs saved** by ODCV, applied to HVAC-only costs, and bounded by building-type ranges.

7.2 The master formula

The model uses a **floor + scaled opportunity** structure:

$$
\text{ODCV}_{base} = \text{Floor} + (\text{Opportunity} \times \text{Automation} \times (\text{Ceiling}-\text{Floor}))
$$

Then applies multiplicative modifiers:

$$
\text{ODCV}_{final} = \text{ODCV}_{base} \times \text{EfficiencyModifier} \times \text{ClimateModifier}
$$

…and clamps to building-type bounds. (Example calculation below.)

7.3 Opportunity score (vacancy + utilization logic)

This is explicitly building-type dependent:

A) Multi-tenant commercial (office, medical office, mixed use, strip mall)

Opportunity captures both:

- space that is **vacant but still ventilated**, plus
- leased space that is **under-utilized**

$$
\text{Opportunity} = V + (1-V)\times(1-U)
$$

where:

- (V) = vacancy rate
- (U) = utilization rate

B) Single-operator buildings (schools, hotels, retail, etc.)

No “vacancy” concept; it’s purely utilization-driven:

$$
\text{Opportunity} = 1-U
$$

C) Limited-opportunity (hospitals, labs, etc.)

Opportunity is discounted with a multiplier (only a portion of theoretical savings is capturable):

$$
\text{Opportunity} = (1-U)\times 0.3
$$

D) Data centers

$$
\text{Opportunity}=0
$$

7.4 Automation score (can the building implement it?)

Automation is modeled as an average of:

- a **year-built score**
- a **size score**

$$
\text{Automation}=\frac{\text{YearScore}+\text{SizeScore}}{2}
$$

Size-score bands are explicit (e.g., under 50k sqft → 0.25; over 250k sqft → 1.0).

7.5 Efficiency modifier (where is the waste?)

If ENERGY STAR score exists:

ENERGY STAR band	Modifier
90+	0.85
75–89	0.95
50–74	1.00
25–49	1.05
<25	1.10

If ENERGY STAR is missing, EUI ratio vs median is used as fallback (modifier table).

7.6 Climate modifier (cost of outdoor air)

By climate zone:

Zone	Modifier
Northern	1.10
North-Central	1.05
South-Central	1.00
Southern	0.95

7.7 Building-type floors and ceilings (range bounds)

Each building type has an allowed savings range (floor/ceiling) and a primary opportunity formula. The reference table begins:

Examples:

- Office: 20%–40%, uses (V+(1-V)(1-U))
- K-12 School: 20%–45%, uses (1-U)
- Hotel: 15%–35%, uses (1-U)
- Inpatient hospital: limited range, rationale documented

7.8 Worked example: ODCV % computation (office)

A complete example (Chicago office) is documented:

- Vacancy = 28%
- Utilization = 52%
- Opportunity = 0.626
- Automation = 0.875
- Floor/Ceiling = 20% / 40%
- Climate modifier (North-Central) = 1.05
  → Final ODCV ≈ 32.6%

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8) Applying ODCV to dollars, energy, carbon, BPS, and valuation

This is where “Prospector” becomes a business case.

8.1 Apply ODCV to HVAC energy by fuel

ODCV savings apply to **HVAC portion** of each fuel:

```
None
Electricity HVAC Savings = Electricity Use × %Electric HVAC × ODCV%
Gas HVAC Savings         = Gas Use × %Gas HVAC × ODCV%
Steam HVAC Savings       = Steam Use × %Steam HVAC × ODCV%
Fuel Oil HVAC Savings    = Fuel Oil Use × %Fuel Oil HVAC × ODCV%
```

8.2 Annual HVAC utility savings (USD)

Primary dollar output:

[
\text{odcv_hvac_savings_annual_usd}=\text{hvac_cost_total_annual}\times \text{odcv_hvac_savings_pct}
]

8.3 Carbon emissions (baseline and post-ODCV)

A) Baseline emissions

Emissions are computed from **raw energy kBtu** using city-specific factors:

[
E_{base}=kBtu_{elec}\cdot f_{elec} + kBtu_{gas}\cdot f_{gas} + kBtu_{steam}\cdot f_{steam}
]

A table of factors (tCO2e per kBtu) includes city-specific electricity factors plus standard gas/steam factors, and a default.

B) Apply ODCV reductions per fuel

Fuel reductions are calculated using HVAC % and ODCV %:

```
None
elec_reduction_kbtu  = elec_kbtu  × hvac_pct_elec  × odcv_pct
```

```
gas_reduction_kbtu   = gas_kbtu   × hvac_pct_gas   × odcv_pct
steam_reduction_kbtu = steam_kbtu × hvac_pct_steam × odcv_pct
```

C) Carbon reduction output

Year-1 reduction is derived from the fuel reductions × emission factors and stored as:

- `odcv_carbon_reduction_yr1_mt`

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9) Building Performance Standards (BPS) fine methodology (year 1)

Nationwide Prospector computes:

- baseline year-1 fine (no ODCV)
- post-ODCV year-1 fine
- year-1 avoided fine (difference)

9.1 General “fine avoided” definition

[
\text{bps_fine_avoided_yr1}=\text{fine}_{\textit{baseline}}-\text{fine}_{\textit{postODCV}}
]

9.2 Emissions-cap laws (NYC LL97, Boston BERDO, Cambridge BEUDO)

NYC LL97 (year-1 / 2024-2029 period in the methodology)

- Cap = sqft × coefficient
- Overage = max(0, emissions − cap)
- Fine = overage × 268 ($/tCO2e)

Boston BERDO 2.0

- Similar structure; penalty rate = 234 ($/tCO2e)

Cambridge BEUDO

- Mirrors BERDO for modeling purposes; penalty rate = 234 ($/tCO2e)

9.3 DC BEPS (ENERGY STAR score target)

Modeled as:

- Target score = 71
- Fine = sqft × $10 × (gap / target_score)
- Cap = $7.5M

Important constraint: buildings without ENERGY STAR score cannot be fined under this modeled pathway and are excluded from the DC fine calculation.

9.4 Energize Denver (EUI target)

Modeled as:

- Target EUI (example office target: 48.3)
- Overage kBtu = max(0, (EUI − target) × sqft)
- Fine = overage_kBtu × 0.30

9.5 Seattle BEPS (emissions intensity)

Modeled as:

- target GHGI = 0.0023 tCO2e/sqft (commercial)
- Cap = sqft × target
- Fine = (emissions over cap) × penalty_rate

9.6 St. Louis BEPS (daily fine style)

Modeled rule:

- If EUI > 72, apply $500/day for 15 days → $7,500 year-1 fine
- Otherwise $0

9.7 San Francisco EBEPO

Explicitly treated as reporting-only (no fine avoidance calculated).

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10) Total Annual OpEx Avoidance (combined business benefit)

10.1 Definition

Total Annual OpEx Avoidance is strictly the sum of:

- annual HVAC utility savings, plus
- year-1 BPS fine avoidance

$$
\text{total_annual_opex_avoidance}=\text{odcv_hvac_savings_annual_usd}+\text{bps_fine_avoided_yr1_usd}
$$

10.2 Why valuation is NOT included in OpEx Avoidance

Valuation increase is a downstream capitalization of OpEx avoided; it is not itself an annual operating expense.

10.3 Reference summary statistics

The OpEx Avoidance module documents:

- total buildings, total utility savings, total fine avoidance, and totals by BPS program category.

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11) Valuation impact methodology (income capitalization)

11.1 Core concept

If a building avoids $1 in annual operating expense, NOI increases by $1; value increase is NOI uplift divided by cap rate.

11.2 Valuation uplift formula

$$
\text{val_odcv_impact_usd}=\frac{\text{savings_opex_avoided_annual_usd}}{\text{cap_rate}/100}
$$

A value multiplier table by cap rate (e.g., 7% → 14.29×) is provided.

11.3 Cap rates by building type

A median cap-rate table is documented (e.g., Office 7.50%, Hotel 8.00%, Retail Store 6.25%, etc.).

11.4 Estimating current value (when true valuation is unknown)

The methodology includes a “back-of-envelope” current valuation estimator:

```
None
Estimated Gross Income = Total Energy Cost / 0.12
Estimated NOI = Estimated Gross Income × 0.60
val_current_usd = Estimated NOI / (cap_rate / 100)
```

Then:

$$
\text{val_post_odcv_usd}=\text{val_current_usd}+\text{val_odcv_impact_usd}
$$

11.5 Valuation example (illustrative)

Example in the OpEx methodology:

- Utility savings: $300k/year
- Fine avoidance: $800k/year
- Total OpEx avoided: $1.1M/year
- At 7% cap rate → ~$15.7M valuation impact

11.6 Limitations (valuation)

Valuation estimates are indicative; cap rates vary; BPS programs evolve; and savings are modeled (not audited).

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12) Estimated post-ODCV ENERGY STAR score

12.1 What an ENERGY STAR score is (technical)

Energy Star is based on an **efficiency ratio**:

$$
\text{Efficiency Ratio}=\frac{\text{Actual Source EUI}}{\text{Predicted Source EUI}}
$$

Lower ratio → higher score; mapping uses a gamma distribution per building type.

12.2 How Prospector estimates post-ODCV score

Steps:

1. Weighted HVAC fraction across fuels:

$$
hvac\_total\_pct = \frac{\sum_f(hvac\_pct_f \cdot energy_f)}{total\_energy}
$$

2. Total energy reduction:

$$
total\_energy\_reduction = odcv\_pct \cdot hvac\_total\_pct
$$

3. New EUI:

$$
new\_eui = current\_eui \cdot (1-total\_energy\_reduction)
$$

4–6) Convert score↔ratio using gamma inverse CDF/CDF with building-type parameters

Gamma parameters (shape/scale) are provided by building type.

12.3 Example improvement

A worked example shows score rising from 65 → 73 after ODCV-driven EUI reduction.

12.4 Limitations

This is an approximation; actual EPA score calculations rely on proprietary tables and source-energy normalization; site EUI is used as a proxy (estimated 5–10% error).

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13) Portfolio identification methodology (account rollups)

Nationwide Prospector supports account-based prospecting by defining a **portfolio organization** as an owner/manager/tenant name that appears across at least **3 separate building rows**.

13.1 Normalization rules (name cleaning)

Organization names are normalized by:

- lowercasing
- stripping punctuation
- removing corporate suffixes (LLC, Inc, LP, etc.)
- collapsing whitespace
- filtering generic/common single-word entities (e.g., “Church”, “School”, etc.)

13.2 Matching & rollup

- Organization columns searched: owner / manager / tenant
- Portfolio threshold: ≥ 3 buildings
- Output includes a portfolio org label and building counts for targeting workflows.

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14) Data quality controls & edge-case handling

14.1 City parsing and BPS city assignment

City is extracted from the address using deterministic parsing and is measured to be highly accurate (reported ~99.996%).

14.2 Emissions computed from raw energy (not precomputed emissions)

BPS modeling explicitly computes emissions from raw energy kBtu to match the original LL97 calculator style.

14.3 Known “back-calculated energy” records

A documented data-quality patch: **249 records** had energy back-calculated from cost using median rates.

14.4 Module-specific limitations you must preserve if re-implementing

- Cost module limitations (no TOU, tiering, DR credits; rate/multiplier assumptions)
- ODCV limitations (no real occupancy feeds; automation is a proxy; ranges are conservative; validate for proposals)
- BPS limitations (only year-1 caps, office/commercial assumptions, DC needs ENERGY STAR score)
- Valuation limitations (cap rates are market dependent; BPS programs change)

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15) End-to-end formula chain (single-building)

This is the “audit trail” you can use to reproduce Prospector outputs:

1. **Normalize energy**
    - Convert fuel quantities to kBtu; compute total kBtu and EUI
2. **Compute annual utility costs**
    - Electricity (energy + demand, load-factor peak estimate, multipliers)
    - Gas / steam / fuel oil conversions and costs
3. **Estimate HVAC fuel shares**
    - CBECS-based with adjustments and special cases
4. **Compute total HVAC cost**
    - Sum fuel_cost × hvac_pct
5. **Compute ODCV savings %**
    - Floor + (Opportunity × Automation × Range) × modifiers; clamp to type bounds
6. **Compute ODCV annual HVAC savings (USD)**
    - hvac_cost_total_annual × odcv_pct
7. **Compute emissions baseline + post-ODCV**
    - Use city-specific factors; reduce fuels by hvac_pct × odcv_pct
8. **Compute year-1 BPS fines (if applicable)**
    - Apply city’s law-type formula; compute avoided fine
9. **Total annual OpEx avoided**
    - utility savings + year-1 fine avoidance
10. **Valuation uplift**

- OpEx avoided ÷ (cap_rate/100)

11. **Optional: post-ODCV ENERGY STAR score estimate**

- Weighted HVAC %, EUI reduction, gamma mapping

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16) Glossary (definitions you’ll see in formulas)

Energy & power

- **kWh**: kilowatt-hour (electric energy)
- **kW**: kilowatt (electric demand / instantaneous power)
- **kBtu**: thousand BTU (energy unit for cross-fuel aggregation)
- **EUI (kBtu/sqft-year)**: annual energy per square foot (site basis in Prospector)
- **Load factor**: average demand ÷ peak demand; used to infer peak kW from annual kWh

HVAC attribution

- **hvac_pct_fuel**: fraction (0–1) of a fuel attributable to HVAC end use

- **hvac_cost_total_annual**: sum over fuels of (annual fuel cost × hvac_pct_fuel)

Occupancy

- **Vacancy (V)**: fraction of rentable space vacant (0–1)
- **Utilization (U)**: fraction of occupied space actually in use during business hours (0–1)

ODCV

- **ODCV savings percent**: % of HVAC costs saved (bounded by building-type floor/ceiling)
- **Opportunity score**: how much “empty-time waste” exists; building-type specific formulas
- **Automation score**: proxy for whether the building can implement advanced control; derived from year and size scoring

Carbon & BPS

- **tCO2e**: metric tons of CO2-equivalent
- **Emission factor**: tCO2e per kBtu (electricity varies by city/grid)
- **BPS fine (year 1)**: modeled penalty exposure under the applicable city program, baseline vs post-ODCV

Finance

- **OpEx avoided**: annual operating expenses not paid (utility + fines)
- **Cap rate**: NOI ÷ value; used to capitalize annual OpEx avoided into value uplift
- **Valuation impact**: OpEx avoided ÷ cap_rate

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17) Practical implementation notes (if you are rebuilding this)

If you want to reproduce Nationwide Prospector programmatically, implement modules in this order:

1. **Ingest building master + disclosure/Portfolio Manager energy**
2. **Compute EUI + fuel kBtu**
3. **Compute costs** (electric first, then gas/steam/oil) using the documented scripts/formulas
4. **Compute HVAC % by fuel** (CBECS + adjustments + special cases)
5. **Compute ODCV %** (Opportunity × Automation × modifiers; clamp)
6. **Apply ODCV to compute**:

    - HVAC savings ($)
    - fuel reductions (kBtu)
    - carbon reductions (tCO2e)
7. **Compute BPS fines** (baseline and post; year-1) and avoided fine
8. **Compute total OpEx avoided**
9. **Compute valuation uplift + current/post values**
10. **Compute portfolio org rollups** (≥3 buildings)

If you want, I can also turn this into a downloadable **DOCX or PDF** formatted as a formal methodology document (with a table of contents, numbered equations, and a complete column-by-column appendix).