FORM BREAKDOWN AND PLAN

Data Point Classification Based on Formulas:

1. CRITICAL VALUES (Required for basic calculations):

- Power consumption (P)
- Time duration (t)
- Surface area (A)
- Temperature differences (ΔT)
- Volume of space (V)
- Current energy consumption (Ebefore)

2. DERIVED VALUES (Can be calculated/estimated):

- Heat transfer coefficient (U)
- Air density (ρ)
- Specific heat capacity (Cp)
- HVAC efficiency (η)
- Performance ratio (PR)
- Emission factor (EF)

3. OBSERVABLE VALUES (Can be gathered through inspection):

- Number and type of lighting fixtures
- Solar panel array area potential
- Basic temperature readings
- Visible surface areas

4. DOCUMENTED VALUES (From bills/documentation):

- Current energy consumption
- Cost of upgrades
- Annual savings

1. Initial User Classification Questions We should start with a brief pre-questionnaire to determine:

- Property Access Level (owner, renter, property manager)
- Technical Knowledge Level (basic, intermediate, expert)
- Physical Access Capabilities (full access, limited access)
- Data Access Level (has bills/documentation, limited documentation)

2. Section Classification Strategy:

TIER 1 - Universal Access

- Basic property information
- Observable features
- Bill information they have access to
- Usage patterns they can describe

TIER 2 - Limited Technical

- Basic measurements
- Simple observations about systems
- General condition assessments
- Basic energy usage patterns

TIER 3 - Advanced Technical

- Detailed measurements
- Technical specifications
- Professional-level assessments
- Complex calculations

1. SECTION 1: Property Information

[SCREENING QUESTION]

[BASIC - Required]

1.1 Property Type
□ Single-family detached
□ Townhouse/Rowhome
□ Duplex/Condo
□ Mobile home
[Used for: Basic calculations and defaults]

1.2 Construction Period
□ Before 1980
□ 1980-2000
□ After 2000
[Used for: Default values and construction standards]

1.3 Size Category

□ Small (under 1,500 sq ft)
□ Medium (1,500-2,500 sq ft)
□ Large (over 2,500 sq ft)
[Used for: Volume and area estimates]

[ADVANCED]

1. What type of homeowner are you?
   □ Homeowner
   □ Renter
   □ Property Manager
   □ Other: _____

2. Property Type:
   □ Single-family detached
   □ Townhouse/Rowhome
   □ Duplex
   □ Condominium
   □ Mobile home
   □ Other: _____
   [Used for: Default U-values, standard volume calculations]

3. Construction Period:
   When was your home built? (Best estimate)
   □ Before 1940
   □ 1940-1959
   □ 1960-1979
   □ 1980-1999
   □ 2000-2019
   □ 2020 or newer
   [Used for: Default U-values, construction material assumptions]

4. Basic Dimensions:
   Number of Stories:
   □ One
   □ Two
   □ Three
   □ Split-level
   [Used for: Volume (V) calculations]

   Ceiling Height (if known):
   □ 8 feet (standard)
   □ 9 feet
   □ 10 feet or higher

□ Not sure
[Used for: Volume (V) calculations]

5. Living Space:
   Approximate Square Footage:
   □ Under 1,000 sq ft
   □ 1,000-1,499 sq ft
   □ 1,500-1,999 sq ft
   □ 2,000-2,499 sq ft
   □ 2,500-2,999 sq ft
   □ 3,000+ sq ft
   [Used for: Area (A) calculations, Volume (V) calculations]

   [ADVANCED - Optional]

6. Detailed Measurements (if available):
   Length of home: _____ feet
   Width of home: _____ feet
   [Used for: Precise A and V calculations]

7. Foundation Configuration:
   □ Full Basement
   □ Partial Basement
   □ Crawl Space
   □ Slab on Grade
   [Used for: Heat transfer calculations, volume adjustments]

8. Attic Configuration:
   □ Full attic
   □ Partial attic
   □ Cathedral ceiling
   □ Flat roof
   [Used for: Heat transfer calculations, volume adjustments]

BACKEND INFORMATION:

Derived Values:

1. Default U-values based on:

   - Construction period
   - Building type
   - Region Formula: Standard U-value × Age Factor × Regional Factor

2. Standard volume ratios for different home types:

    - Single-family: Length: Width ratio = 1.5:1
    - Townhouse: Length: Width ratio = 2.5:1
    - Duplex: Length: Width ratio = 1.2:1

Reference Tables Needed:

1. Standard U-values by construction period and building type
2. Regional building code requirements by year
3. Standard ceiling heights by construction period
4. Typical floor area ratios by home type

Calculations:

1. Volume (V):
   V = Floor Area × Height × Stories

    - Include basement if heated
    - Adjust for cathedral ceilings: V + (Peak Height - Standard Height) × Floor Area/2

2. Surface Area (A):
   A = (2 × L × W) + (2 × L × H) + (2 × W × H)

   Where:
    - L = Length W = Width H = Height

    - Reduce by shared wall area for attached homes

3. Heat Transfer Coefficient (U):
   U = Base U-value × Age Factor × Regional Factor

   Where:
    - Base U-value from reference table
    - Age Factor from construction period
    - Regional Factor based on location

2. SECTION 2: Current Home Conditions

[Purpose: Establish ∆T (temperature difference) patterns and refine U-values through observable conditions]

[BASIC - Required]

2.1 Temperature Consistency
□ Very consistent throughout home
□ Some noticeable variations
□ Large variations between areas
[Used for: Comfort assessment and system efficiency]

2.2 Window Assessment
□ Few windows (less than 10)
□ Average number (10-20)
□ Many windows (more than 20)
[Used for: Heat loss estimates]

2.3 Comfort Issues (select all)
□ Cold/hot spots
□ Drafty areas
□ Humidity issues
□ No major issues
[Used for: Problem identification]

[ADVANCED]

2.1 Temperature Consistency Do you notice temperature differences between:

Floors:
□ No difference
□ 1-3 degrees
□ 4-7 degrees
□ More than 7 degrees
□ Not sure
[Used for: ΔT calculations, heat stratification analysis]

Rooms on same floor:
□ No difference
□ 1-3 degrees
□ 4-7 degrees
□ More than 7 degrees
□ Not sure
[Used for: ΔT calculations, heat distribution analysis]

[ADVANCED - Optional]

2.2 Window Assessment Approximate number of windows:

□ Small (1-6)
□ Medium (7-12)
□ Large (13-18)
□ Very Large (19+)
[Used for: Surface area (A) adjustments]

Observable window issues (select all):
□ Condensation between panes
□ Visible drafts (curtain movement)
□ Ice or frost in winter
□ Excessive heat gain in summer
□ No issues
[Used for: U-value adjustments]

2.3 Insulation Indicators Observable signs (select all):
□ Snow melts quickly from roof
□ Icicles form on roof edges
□ Walls cold to touch in winter
□ Rooms heat up quickly in summer
□ None of these issues
[Used for: U-value adjustments]

2.4 If known, window types:
□ Single pane
□ Double pane
□ Triple pane
□ Low-E coating
□ Not sure
[Used for: Precise U-value calculations]

2.5 If accessible, insulation type:
□ Fiberglass batts
□ Blown-in cellulose
□ Spray foam
□ No visible insulation
□ Not sure
[Used for: Precise U-value calculations]

BACKEND INFORMATION:

Derived Values:

1. Window U-value adjustments:

- Based on observed issues
- Window type (if known)
- Installation period Formula: Standard Window U-value × Condition Factor

2. Wall U-value adjustments:

    - Based on observed temperature issues
    - Insulation type (if known)
    - Observable signs Formula: Base Wall U-value × Condition Factor

Reference Tables Needed:

1. Standard U-values for window types:

    - Single pane: 5.8 W/m²K
    - Double pane: 2.8 W/m²K
    - Triple pane: 1.8 W/m²K
    - With Low-E: Multiply by 0.8

2. Condition Factors:

    - No issues: 1.0
    - Minor issues: 1.2
    - Major issues: 1.5
    - Severe issues: 2.0

3. Temperature Difference Multipliers:

    - Based on observed temperature variations
    - Adjusts heat transfer calculations

Calculations:

1. Adjusted Heat Transfer (Q):
    $$Q = (U \times A \times \Delta T) \times \text{Condition Factor}$$

    Where:
    - U = Base U-value from Section 1
    - A = Surface area from Section 1
    - ΔT = Observed temperature differences
    - Condition Factor from observed issues

2. Temperature Difference (∆T):
   ∆T = Base Temperature Difference × Stratification Factor

   Where:
   - Base Temperature = Thermostat setting - Outside temperature
   - Stratification Factor based on observed floor-to-floor differences

3. Total Window Heat Loss:
   Qwindows = (Uwindow × Awindow × ∆T) × Number of Windows × Window Condition Factor

SECTION 3: HVAC Systems

[Purpose: Establish η (system efficiency), refine ∆T calculations, and determine system characteristics for HVAC energy consumption]

[BASIC - Required]

3.1 Heating/Cooling Type
□ Central system (heats/cools whole house)
□ Individual units (window/portable units)
□ Mixed system
[Used for: System efficiency baseline]

3.2 System Performance
□ Works well (no issues)
□ Some problems (occasional issues)
□ Needs attention (frequent issues)
[Used for: Improvement priorities]

3.3 Temperature Control
□ Manual thermostat
□ Programmable thermostat
□ Smart/WiFi thermostat
[Used for: Control capabilities]

[ADVANCED]

3.1 Heating System Type:

Primary heating method:
□ Forced air (vents in floors/walls)
□ Radiators or baseboards

□ Heat pump
□ Portable heaters
□ Not sure
[Used for: System efficiency (η) baseline]

3.2 Cooling System Type:

Primary cooling method:
□ Central air conditioning
□ Window units
□ Portable units
□ None
□ Not sure
[Used for: System efficiency (η) baseline]

3.3 System Performance Indicators Heating issues (select all):
□ Takes long time to heat up
□ Frequent on/off cycling
□ Some rooms never reach desired temperature
□ System runs constantly
□ No issues
[Used for: η adjustments]

Cooling issues (select all):
□ Takes long time to cool
□ Frequent on/off cycling
□ Some rooms never reach desired temperature
□ System runs constantly
□ No issues
[Used for: η adjustments]

3.4 Temperature Settings Winter thermostat setting:
□ Below 65°F
□ 65-68°F
□ 69-72°F
□ Above 72°F
[Used for: ΔT calculations]

Summer thermostat setting:
□ Above 78°F
□ 75-78°F
□ 72-74°F
□ Below 72°F
[Used for: ΔT calculations]

[ADVANCED - Optional]

3.5 System Details (if known):
System age: _____ years
Last maintenance: _____ months ago
SEER rating (if known): _____
AFUE rating (if known): _____
[Used for: Precise η calculations]

BACKEND INFORMATION:

Derived Values:

1. System Efficiency (η): Base efficiency adjusted by:

    - System type
    - Observed issues
    - Age (if known)
    - Maintenance status Formula: Base Efficiency × Age Factor × Maintenance Factor × Performance Factor

2. Air Distribution Efficiency: Based on:

    - System type
    - Reported temperature consistency
    - Home layout (from Section 1)

Reference Tables Needed:

1. Base Efficiency Values: Heating Systems:

    - Forced air: 0.85
    - Radiators: 0.80
    - Heat pump: 0.95
    - Portable: 0.99

    Cooling Systems:

    - Central air: 0.85
    - Window units: 0.75
    - Portable: 0.70

2. Performance Adjustment Factors:

    - No issues: 1.0
    - Minor issues: 0.9
    - Major issues: 0.7
    - Severe issues: 0.5

Calculations:

1. HVAC Energy Consumption (EHVAC):
   $EHVAC = (V \times \rho \times Cp \times \Delta T)/\eta$

   Where:
    - V = Volume from Section 1
    - $\rho = 1.225$ kg/m³ (standard air density)
    - Cp = 1.005 kJ/kg·K (specific heat capacity of air)
    - ΔT = Temperature difference from settings
    - η = Calculated system efficiency

2. Seasonal Energy Efficiency:
   Winter: EHVAC-winter = EHVAC × HDDs × Usage Factor
   Summer: EHVAC-summer = EHVAC × CDDs × Usage Factor

   Where:
    - HDDs = Heating Degree Days
    - CDDs = Cooling Degree Days
    - Usage Factor based on thermostat settings

3. System Performance Score:
   SPS = η × Distribution Efficiency × Usage Pattern Factor

SECTION 4: Water Heating System

[Purpose: Calculate water heater energy consumption and heat loss, establish usage patterns for time (t)]

[BASIC - Required]

4.1 Water Heater Type
□ Standard tank
□ Tankless

□ Don't know
[Used for: Efficiency baseline]

4.2 Hot Water Usage
□ Low (1-2 people)
□ Medium (3-4 people)
□ High (5+ people)
[Used for: Consumption estimates]

4.3 System Performance
□ Works well
□ Some issues
□ Frequent problems
[Used for: Improvement needs]

[ADVANCED]

4.1 Water Heater Type:
□ Standard tank
□ Tankless (on-demand)
□ Heat pump water heater
□ Part of boiler system
□ Not sure
[Used for: Power (P) baseline, efficiency factors]

4.2 Hot Water Usage Patterns Daily shower usage:
□ 1-2 showers
□ 3-4 showers
□ 5+ showers
□ Not sure
[Used for: Time (t) calculations]

Weekly laundry loads:
□ 1-3 loads
□ 4-7 loads
□ 8+ loads
□ Not sure
[Used for: Time (t) calculations]

Dishwasher usage:
□ Daily
□ Every other day
□ Weekly
□ Never/No dishwasher

[Used for: Time (t) calculations]

4.3 Temperature Settings (if known):
□ Low (120°F or less)
□ Medium (121-130°F)
□ High (131-140°F)
□ Very High (above 140°F)
□ Not sure
[Used for: ΔT calculations]

[ADVANCED - Optional]

4.4 System Details (if known):
Tank size: _____ gallons
System age: _____ years
Energy Factor (EF): _____
First Hour Rating: _____ gallons
[Used for: Precise power calculations]

4.5 Tank Location:
□ Conditioned space (living area)
□ Unconditioned space (garage/basement)
□ Outside
[Used for: Heat loss calculations]

BACKEND INFORMATION:

Derived Values:

1. Daily Hot Water Demand: Based on:
    - Number of showers
    - Laundry frequency
    - Dishwasher usage Formula: Base Usage × Activity Factors
2. System Power Rating: Based on:
    - System type
    - Tank size (if known)
    - Usage patterns

Reference Tables Needed:

1. Standard Power Ratings:

    - Tank (40 gal): 4500W
    - Tank (50 gal): 5500W
    - Tankless: 18000W
    - Heat Pump: 2500W

2. Usage Multipliers: Shower:

    - 1-2 per day: 1.0
    - 3-4 per day: 1.5
    - 5+ per day: 2.0

    Laundry:

    - 1-3 loads: 1.0
    - 4-7 loads: 1.3
    - 8+ loads: 1.6

Calculations:

1. Daily Energy Consumption:
    $E = P \times t$

    Where:
    - P = Rated power × Efficiency factor
    - t = Daily runtime based on usage patterns

2. Heat Loss (for storage tanks):
    $Q = U \times A \times \Delta T$

    Where:
    - U = Tank insulation value
    - A = Tank surface area
    - ΔT = Tank temp - Ambient temp

3. Total Water Heating Energy:
    E_{total} = (Daily Consumption × Usage Factor) + Standby Loss

    Where:

- Usage Factor from activity patterns
- Standby Loss from heat loss calculation

4. Annual Energy Cost:
   Cost = Etotal × 365 × Energy Rate

SECTION 5: Heat Transfer Analysis

[Purpose: Detailed analysis of heat transfer through building envelope, refining U, A, and ∆T values]

[BASIC - Required]

5.1 Temperature Balance
□ Home heats/cools evenly
□ Some areas heat/cool differently
□ Very uneven heating/cooling
[Used for: Distribution assessment]

5.2 Problem Areas (select all)
□ Windows feel drafty
□ Walls feel cold/hot
□ Floors feel cold
□ Rooms heat/cool slowly
□ No major issues
[Used for: Heat loss identification]

5.3 Sun Exposure
□ Strong sun exposure
□ Moderate sun exposure
□ Limited sun exposure
[Used for: Solar heat gain]

5.4 Weather Impact
□ Home stays comfortable in extreme weather
□ Somewhat affected by weather
□ Significantly affected by weather
[Used for: Envelope performance]

[ADVANCED]

5.1 Room Temperature Variations

During heating season:
Warmest room typically: _____°F
Coldest room typically: _____°F
□ Not sure
[Used for: ΔT calculations, heat distribution analysis]

5.2 Surface Temperature Indicators
Cold surfaces in winter (select all):
□ Exterior walls
□ Windows
□ Floors
□ Ceilings
□ None noticed
[Used for: U-value adjustments]

5.3 Sun Exposure
Which sides get direct sunlight:

Morning:
□ Front
□ Back
□ Left
□ Right
□ Not sure

Afternoon:
□ Front
□ Back
□ Left
□ Right
□ Not sure
[Used for: Solar heat gain calculations]

5.4 Wind Exposure
Which walls experience strongest winds:
□ Front
□ Back
□ Left
□ Right
□ Not sure
[Used for: Heat transfer coefficient adjustments]

[ADVANCED - Optional]

5.5 Wall Construction (if known):
□ Brick
□ Wood frame with siding
□ Stone
□ Stucco
□ Other: _____
[Used for: Precise U-value calculations]

5.6 Detailed Measurements:
Wall heights: _____ feet
Wall lengths: _____ feet
Window areas: _____ sq ft
Door areas: _____ sq ft
[Used for: Precise area calculations]

BACKEND INFORMATION:

Derived Values:

1. Effective U-values: Based on:

    - Construction type
    - Observed temperature patterns
    - Wind exposure Formula: Base U-value × Exposure Factor × Condition Factor

2. Solar Heat Gain: Based on:

    - Orientation
    - Window area
    - Sun exposure patterns Formula: Solar Factor × Window Area × Exposure Time

Reference Tables Needed:

1. U-values by Construction:

    - Brick: 0.7-2.0 W/m²K
    - Wood frame: 0.3-0.5 W/m²K
    - Stone: 1.5-2.5 W/m²K

- Stucco: 0.4-0.7 W/m²K

2. Solar Heat Gain Coefficients:

    - By orientation
    - By time of day
    - By season

3. Wind Exposure Factors:

    - Sheltered: 0.8
    - Normal: 1.0
    - Exposed: 1.2

Calculations:

1. Total Heat Transfer:
    $Q_{total} = \Sigma(U \times A \times \Delta T)$ for each surface type

    Where:
    - U = Effective U-value by surface
    - A = Surface area
    - ΔT = Temperature difference

2. Solar Heat Gain:
    $Q_{solar} = SHGC \times A \times \text{Solar Radiation}$

    Where:
    - SHGC = Solar Heat Gain Coefficient
    - A = Window area
    - Solar Radiation from local weather data

3. Net Heat Transfer:
    $Q_{net} = Q_{total} - Q_{solar} + Q_{infiltration}$

    Where:
    - $Q_{infiltration}$ based on air leakage assessment

4. Surface-Specific Heat Loss:

    For each surface:
    $Q_{surface} = U \times A \times \Delta T \times \text{Exposure Factor}$

SECTION 6: Lighting Assessment

[Purpose: Calculate lighting efficiency and energy consumption, establish usage patterns]

[BASIC - Required]

6.1 Light Bulb Types
□ Mostly LED/Efficient bulbs
□ Mix of bulb types
□ Mostly older bulb types
[Used for: Efficiency baseline]

6.2 Natural Light
□ Good natural light
□ Moderate natural light
□ Limited natural light
[Used for: Lighting needs]

6.3 Lighting Controls
□ Basic switches only
□ Some advanced controls
□ Smart/automated lighting
[Used for: Usage patterns]

[ADVANCED]

6.1 Primary Light Bulb Types

Estimate percentage of each:
□ LED: ____%
□ CFL: ____%
□ Incandescent: ____%
□ Not sure
[Used for: Power (P) calculations, efficiency baseline]

6.2 Lighting Usage Patterns

Weekday lights typically on:
Morning (5am-9am):
□ Most lights
□ Some lights
□ Few lights
□ No lights

Day (9am-5pm):
□ Most lights
□ Some lights
□ Few lights
□ No lights

Evening (5pm-10pm):
□ Most lights
□ Some lights
□ Few lights
□ No lights

Night (10pm-5am):
□ Most lights
□ Some lights
□ Few lights
□ No lights
[Used for: Time (t) calculations]

6.3 Natural Light Availability

Rooms with good natural light:
□ Living Room
□ Kitchen
□ Bedrooms
□ Bathroom
□ Office
□ None
[Used for: Usage pattern adjustments]

[ADVANCED - Optional]

6.4 Fixture Details (if known):

Total number of:
Fixed ceiling fixtures: _____
Wall fixtures: _____
Lamps/portable lights: _____
[Used for: Precise power calculations]

6.5 Control Types:
□ Standard switches
□ Dimmer switches

□ Motion sensors
□ Smart controls/timers
□ None of above
[Used for: Usage pattern adjustments]

BACKEND INFORMATION:

Derived Values:

1. Average Luminous Efficiency: Based on:

    - Bulb type distribution
    - Fixture types Formula: Weighted average of bulb efficiencies

2. Daily Usage Hours: Based on:

    - Reported patterns
    - Natural light availability
    - Control types

Reference Tables Needed:

1. Bulb Efficiency Values:

    - LED: 80-100 lm/W
    - CFL: 60-70 lm/W
    - Incandescent: 10-17 lm/W

2. Standard Wattage by Bulb Type: LED:

    - 60W equivalent: 9W
    - 75W equivalent: 11W
    - 100W equivalent: 15W

    CFL:

    - 60W equivalent: 14W
    - 75W equivalent: 19W
    - 100W equivalent: 23W

3. Usage Pattern Multipliers:

- Most lights: 1.0
- Some lights: 0.6
- Few lights: 0.3
- No lights: 0

Calculations:

1. Daily Energy Consumption:
   $E = \Sigma(P \times t)$

   Where:
   - P = Bulb wattage × number of fixtures
   - t = Usage hours per period For each usage period

2. Lighting Efficiency:
   $E_{lighting} = \Sigma(\text{Luminous flux})/\Sigma(\text{Wattage})$

   Where:
   - Luminous flux from bulb specifications
   - Wattage from actual power consumption

3. Annual Energy Usage:
   $E_{annual} = (\text{Weekday total} \times 260) + (\text{Weekend total} \times 105)$

   Where:
   - Weekend usage typically 15% higher

4. Potential Savings:
   $\text{Savings} = \text{Current Usage} - \text{LED Equivalent Usage}$

   Where:
   - LED Equivalent = Current lumens ÷ LED efficiency

SECTION 7: Appliance Inventory

[Purpose: Calculate total appliance energy consumption and establish usage patterns]

[BASIC - Required]

7.1 Major Appliances Age
□ Mostly newer (under 5 years)

□ Mix of ages
□ Mostly older (over 10 years)
[Used for: Efficiency estimates]

7.2 Key Energy Users (select all)
□ Extra refrigerator/freezer
□ Pool/spa equipment
□ Large entertainment systems
□ Home office equipment
[Used for: Usage assessment]

7.3 Usage Patterns
□ Heavy daily use
□ Moderate use
□ Light/occasional use
[Used for: Consumption estimates]

[ADVANCED]

7.1 Major Appliances Present

Select all that apply:
□ Refrigerator
□ Washing Machine
□ Dryer
□ Dishwasher
□ Range/Oven
□ Microwave
[Used for: Base power load calculations]

7.2 Usage Patterns Laundry:
□ Daily
□ 2-3 times per week
□ Weekly
□ Less than weekly
[Used for: Time (t) calculations]

Dishwasher:
□ Daily
□ 2-3 times per week
□ Weekly
□ Less than weekly
□ Never
[Used for: Time (t) calculations]

Cooking:
□ Multiple times daily
□ Once daily
□ Few times per week
□ Rarely
[Used for: Time (t) calculations]

7.3 Additional Appliances

Select all that apply:
□ Second Refrigerator
□ Freezer (separate unit)
□ Dehumidifier
□ Space Heater
□ Window AC
□ Pool Pump
□ Hot Tub
[Used for: Additional power load calculations]

[ADVANCED - Optional]

7.4 Appliance Details (if known):

For each major appliance:
Age: _____ years

Energy Star rated?
□ Yes
□ No
□ Not sure

Size/Capacity: _____ (cu.ft/loads)
[Used for: Precise power calculations]

BACKEND INFORMATION:

Derived Values:

1. Base Power Consumption: Based on:

- Appliance type
- Age (if known)
- Energy Star status
- Usage patterns Formula: Standard Power × Age Factor × Efficiency Factor

2. Operating Time: Based on:

    - Reported usage patterns
    - Household size (from earlier sections)
    - Typical cycle durations

Reference Tables Needed:

1. Standard Power Ratings: Refrigerator:

    - Standard: 150-200W
    - Energy Star: 100-150W

    Washer:

    - Standard: 500W
    - Energy Star: 400W

    Dryer:

    - Electric: 3000W
    - Gas: 200W + gas

    Dishwasher:

    - Standard: 1800W
    - Energy Star: 1300W

2. Usage Duration Standards:

    - Dishwasher cycle: 45-60 mins
    - Washer cycle: 30-60 mins
    - Dryer cycle: 45-60 mins
    - Cooking: 20-40 mins/meal

3. Age Adjustment Factors:

- 0-2 years: 1.0
- 3-5 years: 1.1
- 6-10 years: 1.2
- 10+ years: 1.3

Calculations:

1. Daily Energy Consumption:
   For each appliance:
   $$E = P \times t \times \text{Usage Factor}$$

   Where:
   - P = Rated power × Age factor
   - t = Operating time
   - Usage Factor based on frequency

2. Standby Power:
   $$E_{standby} = \text{Base standby} \times 24 \text{ hours}$$

   Where:
   - Base standby from reference tables

3. Monthly Consumption:
   $$E_{monthly} = \Sigma(\text{Daily consumption} \times \text{Days of use}) + (\text{Standby} \times \text{Days in month})$$

1. Annual Operating Cost:
   $$\text{Cost} = E_{annual} \times \text{Energy Rate}$$

   Where:
   - E_{annual} = Monthly consumption × 12
   - Energy Rate from utility data

SECTION 8: Baseline Energy Consumption

[Purpose: Establish baseline energy usage and patterns for comparison and savings calculations]

[BASIC - Required]

8.1 Typical Energy Bills

□ Low ($100 or less/month)
□ Medium ($101-250/month)
□ High (over $250/month)
[Used for: Cost baseline]

8.2 Seasonal Patterns
□ Highest in summer
□ Highest in winter
□ Fairly consistent
[Used for: Usage patterns]

8.3 Energy Types Used
□ Electricity only
□ Electricity + Gas
□ Multiple fuel types
[Used for: Energy source analysis]

[ADVANCED]

8.1 Energy Bill Access

Do you have access to your energy bills?
□ Yes, full year of bills
□ Yes, partial year
□ No access to bills
[Used for: Baseline consumption data]

8.2 Monthly Electricity Usage

If bills available, enter monthly kWh:
□ Winter (Dec-Feb): _____ kWh/month
□ Spring (Mar-May): _____ kWh/month
□ Summer (Jun-Aug): _____ kWh/month
□ Fall (Sep-Nov): _____ kWh/month
□ Not sure
[Used for: Seasonal consumption patterns]

8.3 Additional Energy Sources

Select all used:
□ Natural Gas
□ Propane
□ Heating Oil

□ Wood
□ None
[Used for: Total energy calculations]

8.4 Peak Usage Periods

Highest energy usage typically occurs:
□ Morning (5am-9am)
□ Midday (9am-3pm)
□ Evening (3pm-8pm)
□ Night (8pm-5am)
□ Not sure
[Used for: Usage pattern analysis]

[ADVANCED - Optional]

8.5 Detailed Usage Data

If smart meter/monitoring system:
Peak demand: _____ kW
Average daily usage: _____ kWh
Power factor: _____ (if known)
[Used for: Precise consumption calculations]

BACKEND INFORMATION:

Derived Values:

1. Baseline Energy Profile:
   Based on:
   - Reported consumption
   - Home characteristics
   - Occupancy patterns
   Formula: Base Load + Variable Load × Usage Factors

2. Seasonal Adjustment Factors:
   Based on:
   - Climate zone
   - Reported seasonal usage
   - HVAC system type

Reference Tables Needed:

1. Regional Average Consumption:
   By home type and size:
   - Small (< 1500 sq ft): X kWh/month
   - Medium (1500-2500 sq ft): Y kWh/month
   - Large (> 2500 sq ft): Z kWh/month

2. Seasonal Multipliers:
   - Winter: 1.2-1.8
   - Spring: 0.8-1.0
   - Summer: 1.3-1.6
   - Fall: 0.8-1.0

3. Energy Source Conversion Factors:
   - Natural Gas: 29.3 kWh/therm
   - Propane: 7.1 kWh/gallon
   - Heating Oil: 43.5 kWh/gallon
   - Wood: 3,000 kWh/cord

Calculations:

1. Total Annual Energy Consumption:
   $E_{total} = \Sigma(\text{Monthly Electric} \times 12) + \Sigma(\text{Other Sources} \times \text{Conversion Factors})$

Where:
   - Monthly Electric = Reported or estimated kWh
   - Other Sources converted to kWh equivalent

2. Baseline Load:
   $E_{baseline} = \text{Minimum monthly usage} \times 12$

Where:
   - Minimum typically spring/fall months

3. Variable Load:
   $E_{variable} = E_{total} - E_{baseline}$

Categorized by:
   - HVAC
   - Water Heating
   - Other seasonal loads

4. Energy Use Intensity (EUI):

EUI = Etotal ÷ Conditioned Floor Area

Where:
- EUI in kWh/sq ft/year
- Used for benchmarking

5. Cost Analysis:

Annual Cost = Σ(Monthly Usage × Rate)

Where:
- Rate includes tiered pricing if applicable
- Separate calculations for each energy source

SECTION 9: Energy Consumption Analysis

[**Purpose: Analyze consumption patterns and identify efficiency opportunities]**

[BASIC - Required]

9.1 Peak Usage Time
□ Morning peak
□ Evening peak
□ Consistent all day
[Used for: Usage patterns]

9.2 Biggest Energy Users
□ Heating/Cooling
□ Water Heating
□ Appliances/Other
[Used for: Consumption focus]

9.3 Recent Changes
□ Usage increasing
□ Usage decreasing
□ Staying about the same
[Used for: Trend analysis]

[ADVANCED]

9.1 Occupancy Patterns

Weekday home occupancy:
□ All day (20-24 hours)
□ Most of day (13-19 hours)
□ Half day (7-12 hours)
□ Limited (<6 hours)
[Used for: Occupancy Factor calculations]

9.2 Peak Usage Activities

Select typical high-energy activities:

Morning (5am-9am):
□ Shower/Bath
□ Cooking
□ Laundry
□ Space Heating/Cooling
□ None

Evening (5pm-10pm):
□ Cooking
□ Laundry
□ Entertainment
□ Space Heating/Cooling
□ None
[Used for: Peak load calculations]

9.3 Seasonal Variations

Energy usage increases notably during:
□ Very cold days
□ Very hot days
□ Rainy/cloudy days
□ No notable change
□ Not sure
[Used for: Weather normalization]

[ADVANCED - Optional]

9.4 Load Distribution

If known, percentage of total energy used by:
HVAC: _____%
Water Heating: _____%
Appliances: _____%

Lighting: _____%
Other: _____%
[Used for: Detailed consumption analysis]

9.5 Smart Meter Data

If available:
Average daily minimum: _____ kW
Average daily maximum: _____ kW
Time of peak usage: _____
[Used for: Load profile analysis]

BACKEND INFORMATION:

Derived Values:

1. Occupancy Factor:
   Based on:
   - Reported occupancy hours
   - Activity patterns
   - Number of occupants
   Formula: Base Factor × Activity Multiplier × Occupancy Hours

2. Load Factor:
   Based on:
   - Peak to average ratio
   - Usage distribution
   - Seasonal patterns

Reference Tables Needed:

1. Activity Power Requirements:
   Morning Activities:
   - Shower: 4.5 kWh/hour
   - Cooking: 2.3 kWh/hour
   - Laundry: 3.8 kWh/hour

   Evening Activities:
   - Cooking: 2.3 kWh/hour
   - Entertainment: 0.5 kWh/hour

- Laundry: 3.8 kWh/hour

2. Occupancy Multipliers:
   - All day: 1.0
   - Most of day: 0.8
   - Half day: 0.5
   - Limited: 0.3

3. Seasonal Adjustment Factors:
   By climate zone and season:
   - Heating season
   - Cooling season
   - Shoulder season

Calculations:

1. Energy Efficiency Score (EES):

$$EES = \text{Total Consumption}/(\text{Intervention Savings} \times \text{Occupancy Factor})$$

Where:
- Total Consumption from Section 8
- Intervention Savings = Potential savings identified
- Occupancy Factor from occupancy patterns

2. Peak Load Analysis:

$$\text{Peak Load Ratio} = \text{Peak Demand}/\text{Average Demand}$$

Where:
- Peak Demand = Highest recorded kW
- Average Demand = Total kWh/hours in period

3. Weather Normalized Usage:

$$Enorm = Eactual \times (HDDnorm/HDDactual + CDDnorm/CDDactual)$$

Where:
- HDD = Heating Degree Days
- CDD = Cooling Degree Days

4. Usage Pattern Score:

$$UPS = (\text{Off-Peak Usage}/\text{Total Usage}) \times \text{Efficiency Factor}$$

Where:
- Off-Peak Usage = Non-peak hour consumption
- Efficiency Factor based on load distribution

5. Potential Savings Analysis:

For each end use:
Potential Savings = Current Usage × (1 - Efficiency Factor)

Where:
- Efficiency Factor from reference standards

SECTION 10: Energy Provider Information

[Purpose: Establish utility rates, emission factors, and available programs for savings calculations]

[BASIC - Required]

10.1 Utility Type
□ Single provider (electric only)
□ Dual fuel (electric + gas)
□ Multiple providers
[Used for: Rate analysis]

10.2 Rate Structure
□ Standard flat rate
□ Time-of-use rate
□ Don't know
[Used for: Cost calculations]

10.3 Utility Programs
□ Currently participating
□ Interested in programs
□ Not participating
[Used for: Program opportunities]

[ADVANCED]

10.1 Primary Utility Provider

Select your electric utility:
[Dropdown of local providers]
□ Not listed/Not sure
[Used for: Rate structure and EF calculations]

10.2 Rate Structure

Current electricity rate plan:
□ Fixed rate
□ Time-of-use
□ Tiered pricing
□ Not sure
[Used for: Cost calculations]

10.3 Average Monthly Cost

Electric bill typically ranges:
□ Under $100
□ $100-200
□ $201-300
□ Over $300
□ Not sure
[Used for: Cost baseline]

10.4 Additional Energy Providers

Select all that apply:
□ Natural Gas: [Provider name]
□ Propane: [Provider name]
□ Heating Oil: [Provider name]
□ None
[Used for: Total energy cost calculations]

[ADVANCED - Optional]

10.5 Rate Details (if known):
Base rate: $_____/kWh
Peak rate: $_____/kWh
Off-peak rate: $_____/kWh
Demand charges: $_____/kW
[Used for: Precise cost calculations]

10.6 Utility Programs

Currently enrolled in:
□ Budget billing
□ Demand response
□ Time-of-use
□ Green power
□ None/Not sure

[Used for: Program savings calculations]

BACKEND INFORMATION:

Derived Values:

1. Effective Rate:
   Based on:
   - Provider base rates
   - Usage patterns
   - Program participation
   Formula: Base Rate × Time Factor × Program Adjustments

2. Emission Factor:
   Based on:
   - Utility generation mix
   - Regional grid factors
   - Green power participation

Reference Tables Needed:

1. Utility Rate Structures:
   By provider:
   - Base rates
   - Time-of-use periods
   - Tier thresholds
   - Demand charges

2. Emission Factors:
   By generation source:
   - Coal: 0.94 kg CO2/kWh
   - Natural Gas: 0.44 kg CO2/kWh
   - Nuclear: 0.012 kg CO2/kWh
   - Renewable: 0 kg CO2/kWh

3. Program Savings Factors:
   - Demand response: 5-15%
   - Time-of-use: 10-20%
   - Green power: Varies by program

Calculations:

1. Monthly Cost Analysis:
   Cost = (Base Usage × Base Rate) +
   (Peak Usage × Peak Rate) +
   (Demand × Demand Rate)

Where:
- Usage from Section 8
- Rates from utility data

2. Carbon Emissions:
   Creduced = S × EF

Where:
- S = Energy savings (kWh)
- EF = Weighted emission factor

3. Program Savings:
   Annual Savings = Base Cost × Program Factor

Where:
- Program Factor from enrollment type

4. Total Energy Cost:
   For all energy sources:
   Total Cost = Σ(Usage × Rate × Conversion Factor)

Where:
- Conversion Factor for non-electric sources

5. Cost Projection:
   Future Cost = Current Cost ×
   (1 + Rate Escalation) ^ Years

Where:
- Rate Escalation from utility forecasts

SECTION 11: Renewable Energy Potential

[Purpose: Calculate solar potential and evaluate renewable energy opportunities]

[BASIC - Required]

11.1 Solar Access
□ Good sun exposure
□ Partial sun exposure
□ Limited sun exposure
[Used for: Solar potential]

11.2 Installation Interest
□ Actively interested
□ Maybe in future
□ Not interested
[Used for: Planning purposes]

11.3 Property Suitability
□ No major barriers
□ Some possible issues
□ Significant barriers
[Used for: Feasibility assessment]

[ADVANCED]

11.1 Roof Characteristics

Roof condition:
□ New (0-5 years)
□ Good (6-10 years)
□ Fair (11-15 years)
□ Poor (15+ years)
□ Not sure
[Used for: Installation feasibility]

11.2 Solar Access Shade on roof

during day:
□ No shade
□ Partial morning shade
□ Partial afternoon shade
□ Heavy shade
□ Not sure
[Used for: Solar radiation calculations]

11.3 Tree Coverage

Trees shading roof:

□ None
□ 1-2 trees
□ 3-5 trees
□ Heavy tree coverage
□ Not sure
[Used for: Shading factor calculations]

11.4 Current/Planned Systems

Select all that apply:
□ Solar PV installed
□ Solar thermal installed
□ Planning installation
□ No current plans
[Used for: System integration analysis]

[ADVANCED - Optional]

11.5 Roof Details (if known):
Total roof area: _____ sq ft
South-facing area: _____ sq ft
Roof pitch: _____ degrees
Roof material: _____
[Used for: Precise solar calculations]

11.6 Existing System Details:

If solar installed:
System size: _____ kW
Annual production: _____ kWh
Installation year: _____
[Used for: System performance analysis]

BACKEND INFORMATION:

Derived Values:

1. Available Roof Area: Based on:

    - Home size
    - Roof type
    - Obstructions Formula: Total Area × Usable Factor × Orientation Factor

2. Solar Access Factor: Based on:

    - Reported shading
    - Tree coverage
    - Orientation Formula: Base Solar × Shade Factor × Seasonal Adjustment

Reference Tables Needed:

1. Solar Radiation Data: By location:

    - Annual average (kWh/m²/day)
    - Seasonal variations
    - Peak sun hours

2. System Performance Ratios:

    - Optimal orientation: 0.85
    - East/West facing: 0.80
    - Partial shade: 0.75
    - Heavy shade: 0.60

3. Installation Cost Factors: By system size:

    - Small (< 6kW): $3.00/W
    - Medium (6-10kW): $2.80/W
    - Large (> 10kW): $2.60/W

Calculations:

1. Solar Energy Potential:
   Esolar = A × r × H × PR Where:

    - A = Available roof area (m²)
    - r = Panel efficiency (typically 0.15-0.22)
    - H = Annual solar radiation (kWh/m²)
    - PR = Performance ratio (0.7-0.9)

2. Annual Production Estimate:
   Production = Esolar × System Size × Efficiency Where:

    - System Size in kW
    - Efficiency includes inverter and system losses

3. Financial Analysis:
   Payback Period = Total Cost/(Annual Production × Rate) Where:

   - Rate = Current electricity rate
   - Total Cost includes installation and equipment

4. Carbon Reduction:
   CO_2 Reduction = Annual Production × Grid EF Where:

   - Grid EF = Local grid emission factor

5. Roof Capacity:
   Maximum System Size = Available Area/Panel Area Where:

   - Panel Area ≈ 17.5 sq ft per kW
   - Adjusted for spacing and setbacks

SECTION 12: Usage Patterns and Normalization

[Purpose: Establish normalized usage patterns and weather impacts for accurate comparisons]

[BASIC - Required]

12.1 Home Occupancy
□ Home most of the day
□ Home evenings/nights only
□ Varies significantly
[Used for: Usage pattern baseline]

12.2 Temperature Preference
□ Prefer cooler temperatures
□ Average comfort range
□ Prefer warmer temperatures
[Used for: Comfort settings]

12.3 Seasonal Adjustments
□ Same settings year-round
□ Adjust for seasons
□ Use programmable thermostat
[Used for: Energy usage patterns]

[ADVANCED]

12.1 Occupancy Schedule

Typical weekday occupancy:
Morning (5am-9am):
□ Full occupancy
□ Partial occupancy
□ Minimal occupancy

Daytime (9am-5pm):
□ Full occupancy
□ Partial occupancy
□ Minimal occupancy

Evening (5pm-10pm):
□ Full occupancy
□ Partial occupancy
□ Minimal occupancy
[Used for: Usage pattern calculations]

12.2 Weather Sensitivity

Energy usage increases with:
□ Hot weather
□ Cold weather
□ Both hot and cold
□ No notable change
□ Not sure
[Used for: Weather normalization]

12.3 Seasonal Behaviors

Select all that apply:
□ Change thermostat seasonally
□ Use windows for cooling
□ Use ceiling fans
□ Use space heaters
□ Use window AC units
[Used for: Behavior adjustment factors]

[ADVANCED - Optional]

12.4 Detailed Occupancy

If known:
Number of occupants: _____
Hours occupied per day: _____
Days occupied per week: _____
Weeks vacant per year: _____
[Used for: Precise usage calculations]

12.5 Temperature Preferences

Winter thermostat:
Daytime: _____ °F
Nighttime: _____ °F

Summer thermostat:
Daytime: _____ °F
Nighttime: _____ °F
[Used for: Temperature-based normalization]

BACKEND INFORMATION:

Derived Values:

1. Occupancy Factor:
   Based on:
   - Reported schedules
   - Number of occupants
   - Vacancy periods
   Formula: Base Occupancy × Schedule Factor × Seasonal Adjustment

2. Weather Sensitivity Factor:
   Based on:
   - Reported sensitivity
   - HVAC system type
   - Building envelope (from Section 5)

Reference Tables Needed:

1. Occupancy Multipliers:
   - Full occupancy: 1.0
   - Partial occupancy: 0.6
   - Minimal occupancy: 0.2

2. Weather Normalization Factors:

By climate zone:
- Heating degree days (HDD)
- Cooling degree days (CDD)
- Normal year data
- Current year data

3. Behavior Adjustment Factors:
- Natural ventilation: -5% to -15%
- Ceiling fans: -3% to -8%
- Space heaters: +10% to +20%
- Window AC: +15% to +25%

Calculations:

1. Normalized Annual Consumption:

$$E_{norm} = E_{actual} \times [(HDD_{norm}/HDD_{actual}) + (CDD_{norm}/CDD_{actual})]$$

Where:
- HDD = Heating Degree Days
- CDD = Cooling Degree Days
- norm = Normal year
- actual = Current year

2. Occupancy-Adjusted Usage:

$$E_{adj} = E_{base} \times OF \times BF$$

Where:
- OF = Occupancy Factor
- BF = Behavior Factor

3. Daily Load Profile:
For each time period:

$$Load = Base\ Load + Variable\ Load \times OF$$

Where:
- Base Load from minimum usage
- Variable Load from occupancy patterns

4. Weather Impact Score:

$$WIS = (Peak\ Weather\ Usage)/(Average\ Usage)$$

Where:
- Peak Weather = Highest seasonal usage
- Average = Annual average daily usage

5. Behavior Impact:
BI = Σ(Behavior Factor × Usage Hours)

Where:
- Behavior Factor from reference table
- Usage Hours from schedule

SECTION 13: Energy Improvement Planning

[Purpose: Identify and prioritize energy improvements based on cost-effectiveness and impact]

[BASIC - Required]

13.1 Primary Goal (choose one)
□ Reduce energy bills
□ Improve comfort
□ Fix specific issues
□ Environmental impact
[Used for: Priority setting]

13.2 Budget Category
□ Low (under $2,000)
□ Medium ($2,000-$10,000)
□ High (over $10,000)
□ Not determined yet
[Used for: Improvement options]

13.3 Timeline
□ Want to start soon (within 6 months)
□ Planning for future (6+ months)
□ No specific timeline
[Used for: Project planning]

[ADVANCED]

13.1 Improvement Priorities

Rank your priorities (1-5):
__ Lower energy bills
__ Improve comfort
__ Reduce carbon footprint
__ Address specific issues

__ Increase home value
[Used for: Strategy prioritization]

13.2 Budget Range

Available for improvements:
□ Under $1,000
□ $1,000-$5,000
□ $5,001-$10,000
□ Over $10,000
□ Not sure yet
[Used for: Investment planning]

13.3 Timeline Preferences

Planned implementation:
□ Immediate (0-3 months)
□ Short-term (3-12 months)
□ Long-term (1-3 years)
□ As needed/No timeline
[Used for: Project scheduling]

13.4 Implementation Constraints

Select all that apply:
□ Limited budget
□ Need financing
□ Seasonal restrictions
□ Occupancy disruption concerns
□ HOA/Building restrictions
□ None
[Used for: Feasibility analysis]

[ADVANCED - Optional]

13.5 Specific Improvements Interest
Rate interest (1-5) in:
__ HVAC upgrade
__ Insulation
__ Window replacement
__ Solar installation
__ Smart thermostats
__ LED lighting
__ Appliance upgrades

[Used for: Detailed planning]

13.6 Financial Preferences

Desired payback period:
□ Under 2 years
□ 2-5 years
□ 5-10 years
□ Over 10 years
□ No specific requirement
[Used for: ROI calculations]

BACKEND INFORMATION:

Derived Values:

1. Improvement Priority Score:
   Based on:
   - Ranked priorities
   - Budget availability
   - Timeline preferences
   Formula: Priority Weight × Budget Factor × Timeline Factor

2. Project Feasibility Score:
   Based on:
   - Constraints
   - Technical requirements
   - Implementation complexity

Reference Tables Needed:

1. Improvement Costs:
   HVAC:
   - Basic tune-up: $200-500
   - New system: $5,000-12,000

   Insulation:
   - Attic: $1,500-3,000
   - Walls: $3,000-8,000

   Windows:
   - Per window: $500-1,000

- Whole house: $8,000-15,000

2. Energy Savings Estimates:
   - HVAC upgrade: 20-40%
   - Insulation: 15-30%
   - Windows: 10-20%
   - LED lighting: 5-10%
   - Smart thermostats: 10-15%

3. Implementation Complexity:
   - Low: 1-2 days
   - Medium: 3-5 days
   - High: 1+ weeks

Calculations:

1. Payback Period:
   P = C/Sannual
   Where:
   - C = Project cost
   - Sannual = Annual savings
   For each improvement option

2. Return on Investment:
   ROI = (Lifetime Savings - Cost)/Cost × 100
   Where:
   - Lifetime Savings = Annual Savings × Expected Life
   - Cost includes installation

3. Project Priority Score:
   PPS = (Savings/Cost) × Priority Weight × Feasibility
   Where:
   - Priority Weight from user rankings
   - Feasibility from constraint analysis

4. Implementation Schedule:
   For each project:
   Start Date = Current + Lead Time + Dependencies
   Where:
   - Lead Time from complexity table
   - Dependencies from project sequencing

5. Budget Allocation:
   For prioritized projects:

Available per Project = Total Budget × Priority Score
Where:
- Priority Score normalized to total 100%

SECTION 14: Carbon Impact Goals

[Purpose: Establish carbon reduction targets and track emissions impact]

[BASIC - Required]

14.1 Environmental Priority
□ High priority - willing to invest
□ Medium priority - balance with cost
□ Low priority - focus on savings
[Used for: Goal setting]

14.2 Reduction Target
□ Moderate (up to 25%)
□ Significant (26-50%)
□ Maximum possible
[Used for: Planning scope]

[ADVANCED]

14.1 Carbon Reduction Interest

Primary motivation:
□ Environmental concern
□ Regulatory compliance
□ Cost savings
□ Property value
□ Not sure
[Used for: Goal setting approach]

14.2 Current Awareness

Knowledge of carbon footprint:
□ Track regularly
□ General idea
□ Limited understanding
□ No knowledge
[Used for: Education needs]

14.3 Reduction Timeline

Preferred reduction period:
□ 1 year
□ 2-3 years
□ 4-5 years
□ 5+ years
□ No specific timeline
[Used for: Target setting]

14.4 Target Range

Desired reduction:
□ 0-25%
□ 26-50%
□ 51-75%
□ 76-100%
□ Not sure
[Used for: Goal calculations]

[ADVANCED - Optional]

14.5 Specific Targets

If known:
Current emissions: _____ kg CO2/year
Target emissions: _____ kg CO2/year
Target date: _____
[Used for: Precise reduction planning]

14.6 Carbon Offset Interest

Select all that apply:
□ Renewable energy credits
□ Carbon offset purchases
□ Tree planting
□ Not interested
□ Need more information
[Used for: Offset strategy]

BACKEND INFORMATION:

Derived Values:

1. Base Carbon Footprint:
   Based on:
   - Energy consumption
   - Fuel mix
   - Utility emission factors
   Formula: Energy Use × EF × Fuel Mix Factor

2. Reduction Potential:
   Based on:
   - Planned improvements
   - Timeline
   - Technical feasibility

Reference Tables Needed:

1. Emission Factors (EF):
   By energy source:
   - Electricity: [Regional grid factor]
   - Natural gas: 0.18 kg CO2/kWh
   - Propane: 0.21 kg CO2/kWh
   - Heating oil: 0.25 kg CO2/kWh

2. Reduction Potential by Improvement:
   - HVAC upgrade: 20-40%
   - Insulation: 15-30%
   - Solar PV: 40-100%
   - LED lighting: 5-10%
   - Smart controls: 10-15%

3. Carbon Offset Options:
   - REC cost per ton CO2
   - Offset program rates
   - Tree planting impact factors

Calculations:

1. Current Carbon Emissions:
   $CE = \Sigma(\text{Energy Source} \times EF)$

Where:
- Energy Source in kWh
- EF = Source-specific emission factor

2. Carbon Reduction Target:

CRT = Current Emissions × Target Percentage

Where:
- Target Percentage from user selection

3. Annual Reduction Need:

ARN = (Current - Target)/Years

Where:
- Years = Timeline selection

4. Project Impact Assessment:

For each improvement:

Carbon Reduction = Energy Savings × EF

Where:
- Energy Savings from Section 13
- EF from utility data

5. Gap Analysis:

Remaining Gap = Target - Planned Reductions

Where:
- Planned Reductions = Sum of project impacts

6. Offset Requirements:

If gap exists:

Offset Needed = Remaining Gap × Safety Factor

Where:
- Safety Factor = 1.1 for uncertainty

7. Progress Tracking:

Reduction Progress = (Initial - Current)/Initial × 100

Where:
- Initial = Baseline emissions
- Current = Latest measurement

SECTION 15: Energy Monitoring and Verification

[Purpose: Establish monitoring protocols and verify energy savings]

[BASIC - Required]

15.1 Preferred Tracking Method
□ Simple bill comparison
□ Basic energy monitoring
□ Professional verification
[Used for: Monitoring approach]

15.2 Success Indicators (select all)
□ Lower bills
□ Better comfort
□ Fewer issues
□ Environmental impact
[Used for: Performance metrics]

[ADVANCED]

15.1 Current Monitoring

How do you track energy use:
□ Monthly bills only
□ Smart meter readings
□ Energy monitoring system
□ Don't currently track
[Used for: Monitoring protocol selection]

15.2 Preferred Tracking Method

Interest in monitoring:
□ Simple monthly comparison
□ Detailed daily tracking
□ Real-time monitoring
□ Annual review only
□ Not sure
[Used for: System recommendations]

15.3 Verification Preferences

Preferred verification method:
□ Bill comparison
□ Usage patterns
□ Temperature comfort
□ All of the above
□ Not sure
[Used for: Success metrics]

15.4 Reporting Frequency

Preferred updates:
□ Monthly
□ Quarterly
□ Annually
□ On-demand
□ Not sure
[Used for: Reporting schedule]

[ADVANCED - Optional]

15.5 Monitoring Details

If monitoring system present:
System type: _____
Data frequency: _____
Parameters tracked: _____
[Used for: Advanced monitoring]

15.6 Success Metrics

Priority metrics (select all):
□ kWh reduction
□ Cost savings
□ Carbon reduction
□ Comfort improvement
□ ROI
[Used for: Performance tracking]

BACKEND INFORMATION:

Derived Values:

1. Monitoring Protocol:

Based on:
- Current capabilities
- Preferred method
- System complexity
Formula: Base Protocol × Complexity Factor

2. Verification Requirements:
Based on:
- Improvement types
- Investment level
- Reporting needs

Reference Tables Needed:

1. Monitoring System Types:
- Basic (bills): Monthly data
- Smart meter: Hourly data
- Real-time: Minute-by-minute
- Sub-metering: Circuit-level

2. Success Metric Baselines:
- Energy use: kWh/month
- Cost: $/month
- Carbon: kg CO2/month
- Temperature: °F variance

3. Verification Methods:
By improvement type:
- HVAC: Runtime + temperature
- Insulation: Temperature differential
- Solar: Production monitoring
- Lighting: Usage patterns

Calculations:

1. Energy Savings Verification:

$$S = E_{before} - E_{after}$$

Where:
- E_{before} = Baseline consumption
- E_{after} = Post-improvement consumption
Normalized for weather and occupancy

2. Cost Savings Verification:

$$CS = S \times Rate$$

Where:
- S = Verified energy savings
- Rate = Current utility rate

3. Performance Index:

$$PI = \text{Actual Savings/Predicted Savings} \times 100$$

Where:
- Actual from monitoring
- Predicted from Section 13

4. Comfort Improvement:

$$CI = (T1 - T2)/T1 \times 100$$

Where:
- T1 = Initial temperature variance
- T2 = Current temperature variance

5. ROI Verification:

$$\text{Actual ROI} = (\text{Verified Savings} \times \text{Years})/\text{Cost} \times 100$$

Where:
- Verified Savings = Annual confirmed savings
- Years = Time since implementation

6. Monitoring Score:

$$MS = (\text{Data Points} \times \text{Frequency} \times \text{Accuracy})/100$$

Where:
- Data Points = Number of parameters
- Frequency = Updates per day
- Accuracy = Calibration factor

7. Reporting Metrics:

Monthly Report:
- Energy use vs. baseline
- Cost savings to date
- Carbon reduction
- Comfort metrics
- ROI status