✅ About Model Inputs

This is a machine learningmodel trained on building performance data to predict monthly total energy consumption and Energy Use Intensity (EUI). It evaluates how different building features, envelope properties, and operational factors influence energy usage.

📌 Building Type

The model uses numeric encoding for building type:

0 – Bungalow

1 – Detached

2 – Semi-Detached

3 – Terraced

📌 Input Parameters & Valid Ranges

The model accepts 13 building features, each with a defined and validated range:

Floor Insulation U-Value: 0.15 – 1.60

Door Insulation U-Value: 0.81 – 5.70

Roof Insulation U-Value: 0.07 – 2.28

Window Insulation U-Value: 0.73 – 5.75

Wall Insulation U-Value: 0.10 – 2.40

HVAC Efficiency (COP): 0.30 – 4.50

Domestic Hot Water Usage: 0.50 – 3.50

Lighting Density: 1 – 9

Occupancy Level: 1 – 6

Equipment Density: 1 – 21

Window-to-Wall Ratio (WWR): 0 – 70%

Total Building Area: 85.91 – 130.81 m^2

📌 How to Calculate U-Values (for Insulation Inputs)

Step 1 — Calculate thermal resistance of each layer

For every building material in the element (brick, plaster, insulation, etc.):

$$R = d / k$$

Where: -
d = thickness of the material (meters) -
k = thermal conductivity (W/m·K)
Compute **R** for each layer individually.

Step 2 — Add internal & external surface resistances

Add surface resistances to obtain total thermal resistance:

$$Rt = Rsi + R1 + R2 + \ldots + Rse$$

Where: -
Rsi = internal surface resistance
Rse = external surface resistance

Step 3 — Compute U-Value (Thermal Transmittance)

Take the reciprocal of the total thermal resistance:

$$U = 1 / Rt$$

Unit: **W/(m²·K)**

U-Values directly impact predicted building energy consumption —

better insulation generally results in
lower monthly energy usage and improved performance category.

✅ How the Model Works

Feature Extraction:

The user-provided input values are validated against the model's expected ranges.

Energy Prediction:

The machine learning model computes:

Monthly Total Energy Consumption (kWh)

Energy Use Intensity (EUI) in kWh/m²

Performance Classification:

Based on the EUI value, the system assigns a performance category:

Excellent

Moderate

Poor

Impact Analysis:

The model identifies factors contributing to high energy usage—such as poor insulation, low HVAC efficiency, or high internal loads.
Personalized Recommendations:

The system provides targeted suggestions:

Improve insulation U-values

Reduce lighting/equipment density

Optimize HVAC systems

Adjust WWR or shading strategies

📌 Benefits

Understand your building's monthly energy performance
Find inefficiencies quickly
Receive tailored recommendations
Lower energy bills & operational costs
Make evidence-based decisions for retrofits and improvements they give me