BizEng Team

EnergySharp

Yirui Tao, Binh Mai, Inho Kim, Joy Lai

Buildings are bountiful and bad for the environment.

Introduction

Currently, the construction and buildings industry is responsible for 40% of global energy-related emissions.
This is the highest among all emission-releasing sectors.

Heating, ventilation, and air conditioning (HVAC) systems are responsible **for 40% of office building operation energy consumption.**

Current systems are highly inefficient:
30% of energy consumption is wasted

Climate Change Implications

- Emissions contribute to the **urban heat island effect**, where temperatures in downtown cores can average up to **12C higher than surrounding areas**
- Exacerbated climate change and inequality, heat-related illnesses, extreme weather

Corporation Operations Implications

- **Rising energy costs** make building operation and management **burdensome**
- The **shift away from remote work** make building resource efficiency crucial for employee productivity, retention, and engagement

The building industry currently faces unique challenges that lead to specific opportunities.

Executive Summary

Challenges	Opportunities
80% of the buildings that will exist in 2050 have already been built. Only **20%** would have to be optimized to reach climate targets.	Prioritize optimizing resource-use **existing building stock** (often overlooked)
All offices are different: no one-size fits all solution.	Consider real and internal data sources to best use resources **specific to each building via automated workflows.**
Office vacancies have increased to an all-time high **(20% in Toronto in 2023).**	Facilitate **compliance** with regulation and promoting **ESG** makes offices **more attractive for leasing**.

To reach key climate targets and achieve cost benefits, democratizing energy optimization in existing office building stock is a must.
Inertia stems from a lack of know-how, not lack of initiative.

Current industry workflows are not optimized.

Current Industry Options

EnergyPlus (EP) – enabling Energy Optimization with data

Data Inputs

- Building Dimensions
- Appliance info

Data Outputs

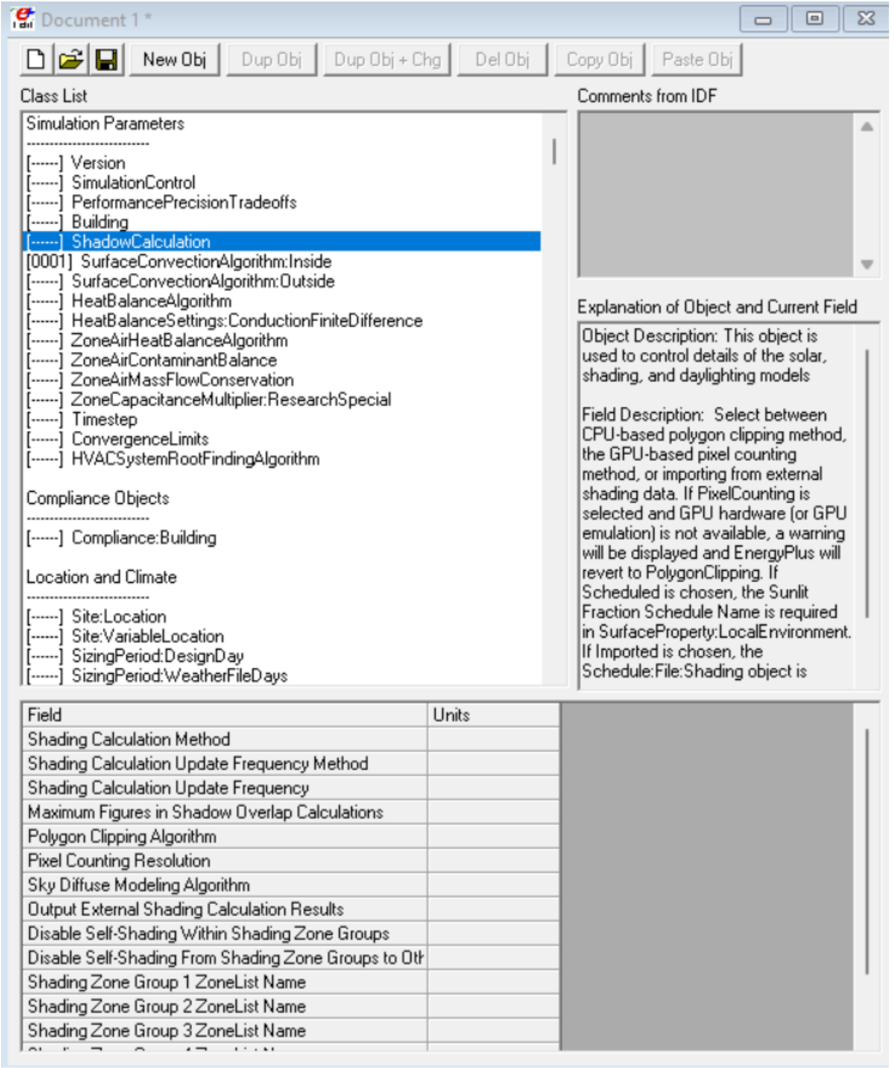
- Building and equipment (HVACs, etc) energy usage
- Zone heating energy data

Outcomes

- Track energy usage
- Simulate new designs
- Retrofit testing

However, EnergyPlus is difficult to use.

- Need to understand building blueprints to create Inputs
- Need to understand Outputs to create insightful Outcomes
- Hard to interpret results, limited talent to consult
- Time-consuming; unintuitive



Current industry workflows are not optimized.

Current Industry Options

Building Owners/Managers

Our customer currently only have two choices to receive actionable data-based insights to optimize their buildings.

Both are costly, cumbersome, and capital-intensive.

1. Learn the software themselves

Task: Study graduate-level material

Time: High—months to years

Capital: Low to Medium

2. Hire a consultant

Task: Hire an expert consultant who can use EnergyPlus.

Time: Medium—months

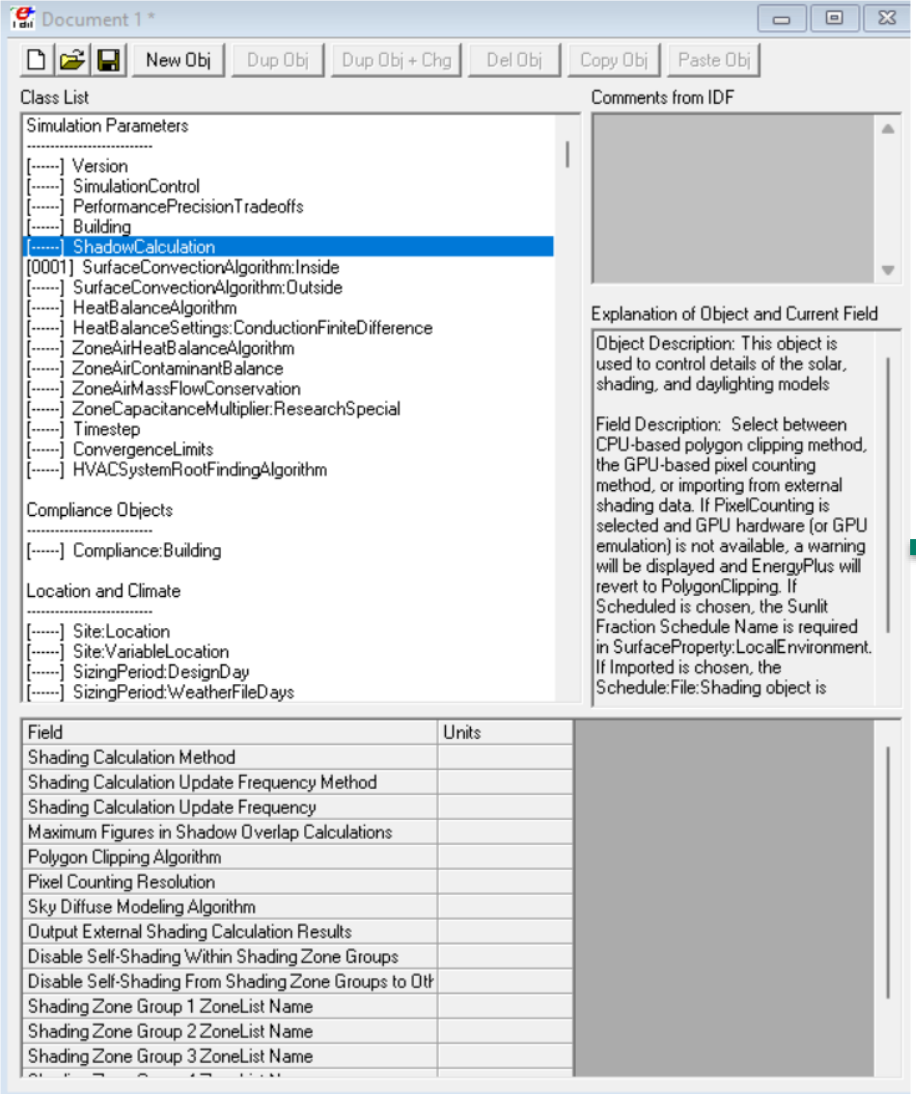
Capital: High—commercial energy audits can cost up to **$15,000+ per project** (EMS Environmental)

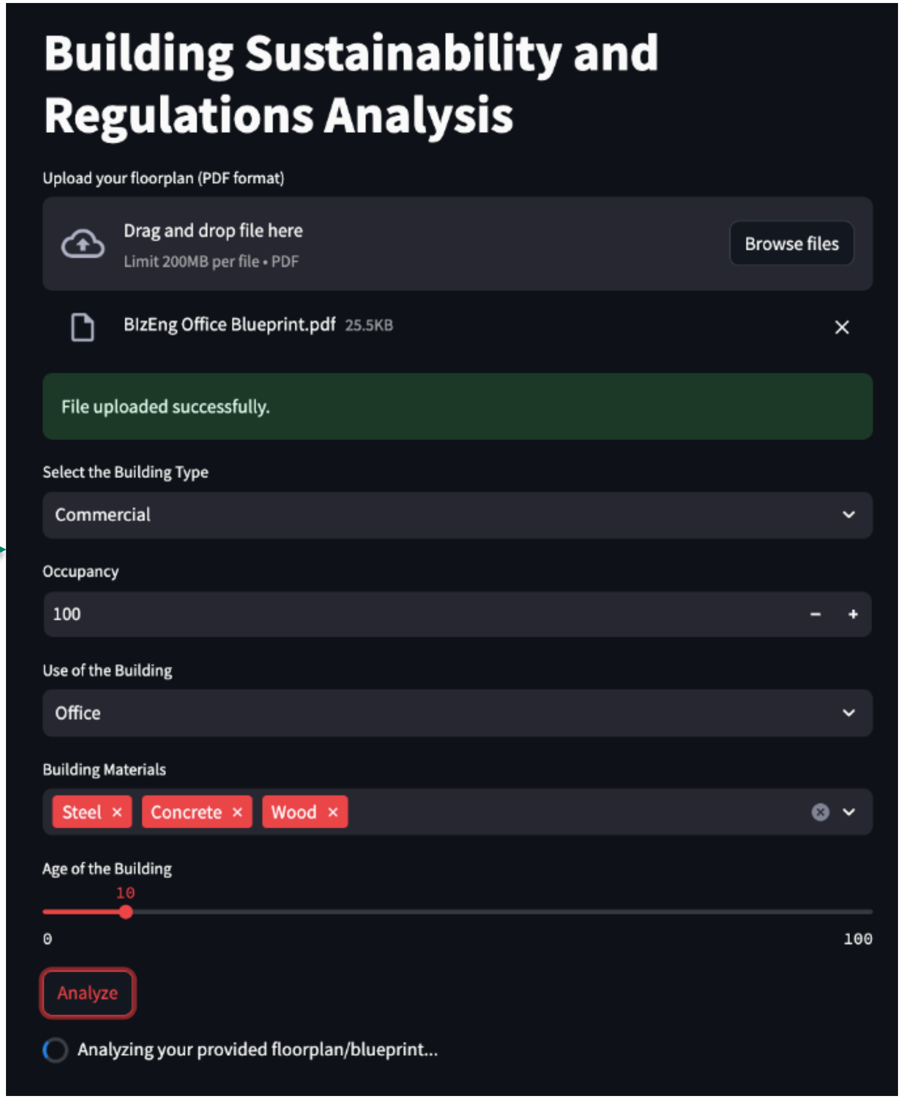
EnergySharp

Planning your building’s optimized energy usage, one scan at a time.

EnergySharp has the potential to reinvent the industry.

Enabling Mass Adoption Through an Intuitive Interface





EnergySharp has the potential to reinvent the industry.

Enabling Mass Adoption Through an Intuitive Interface

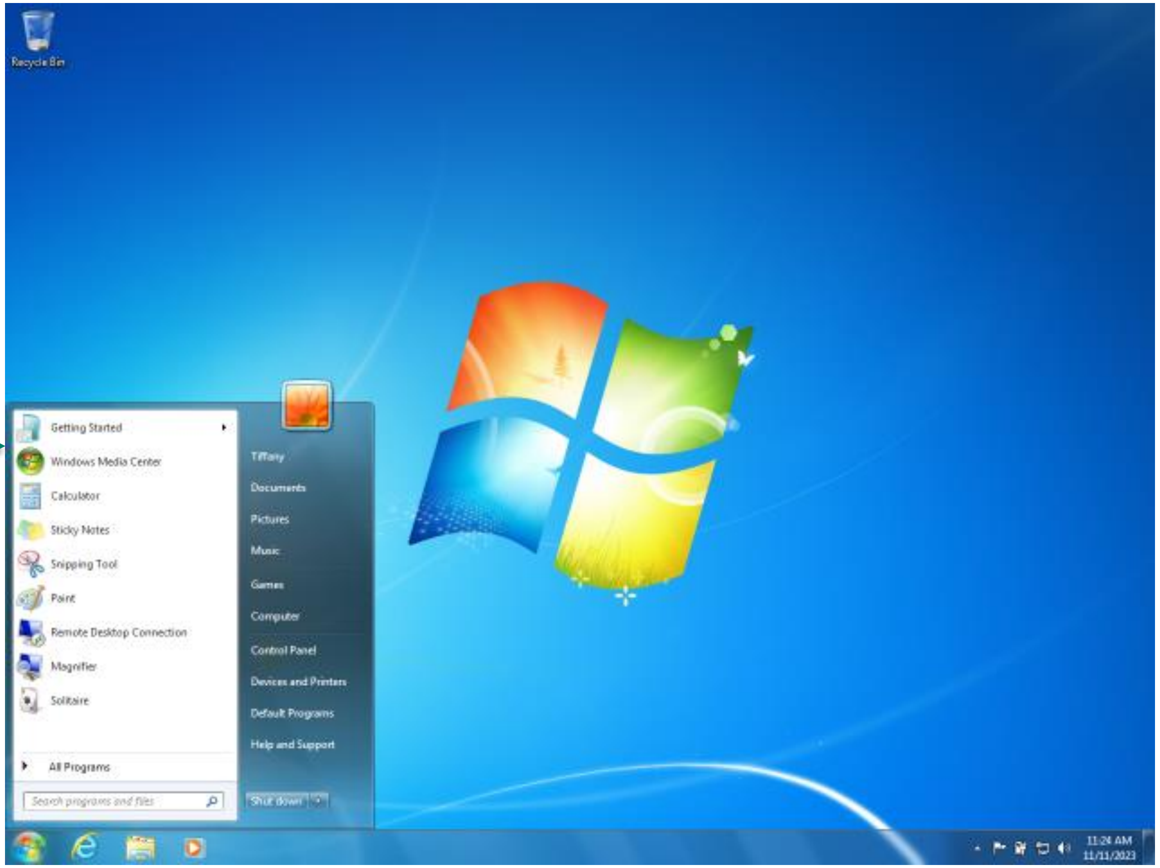


Image from: https://devblogs.microsoft.com/commandline/windows-command-line-backgrounder/ (Right)
Image from: https://en.wikipedia.org/wiki/Windows_7 (Left)

Our proposition simplifies the entire process.

Proposed Workflow.

Building Owners/Managers

Use the interface application.

Task required: Input building blueprint into a user interface. Receive actionable output.

Time required: Low

Capital required: Low

Our solution interface will enable users to directly leverage the EP system to gain actionable insights themselves.

We reduce the barriers of time and capital, facilitating the adoption of more sustainable practices.

- **Ease of use**
- **Automated**
- **Tailored**
- **Low cost, high impact**

EnergySharp's workflow is clean, clear, and functional—streamlining the EnergyPlus system.

Workflow Overview

USER

1. Upload Data
User uploads a 2D blueprint + other manual input data to the interface.

5. View Insights
User sees custom recommendations on the interface.

BACKEND CODE

2. Scraping
Computer vision scrapes the necessary input data from the uploaded blueprint and combines into idf file.

3. Input
Code uses EP APIs to input the scraped data + manual input data into EP and run it.

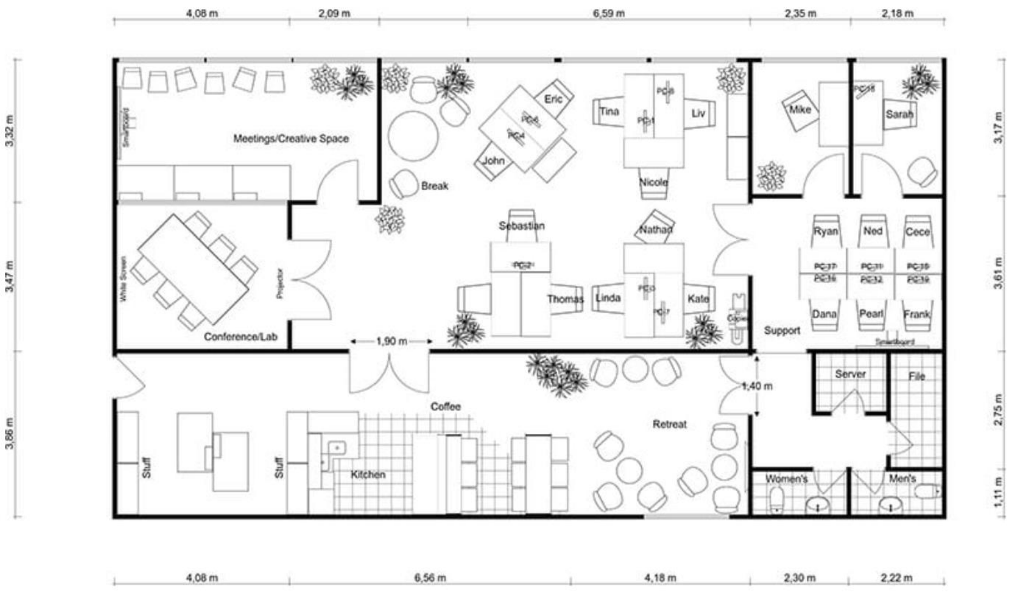
4. Output
Code converts EP outputs (.eso file) into meaningful insights and displays them on the interface.

Key Takeaway

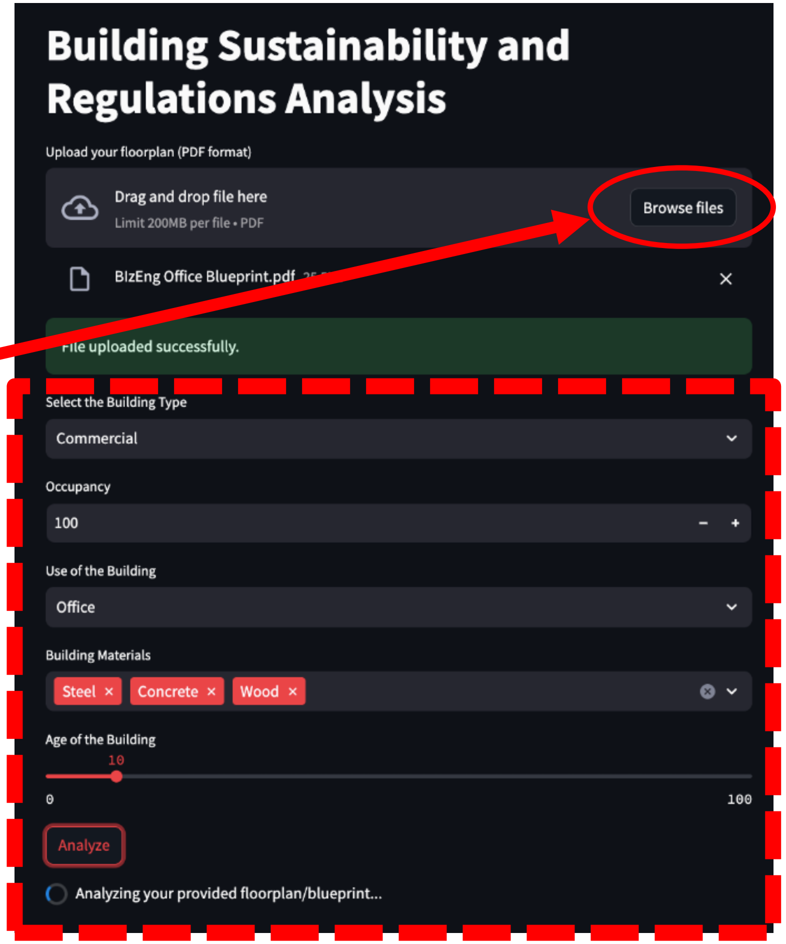
Our solution **removes the technical barriers** that end users have in **analyzing** their infrastructure energy consumption behaviors.

1. User – Upload Data

2D Floor Plan or Blueprint upload



Manual input of building information and usage (dotted)



Workflow Overview – Step 2

Scraping input data from the building blueprints

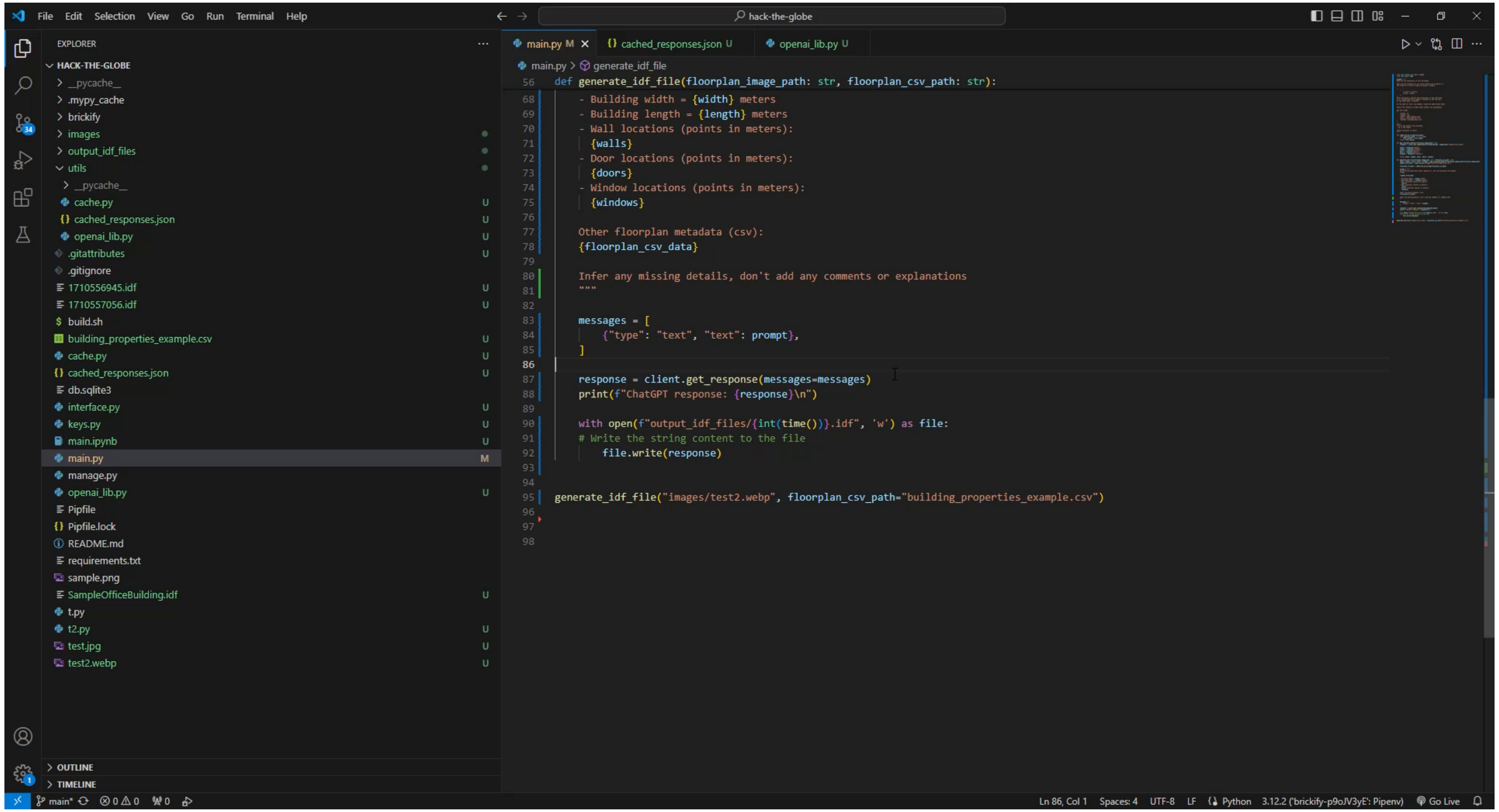
2. Backend – Scraping

Blueprint input from interface

OpenAI API with GPT4 on Python with Few Shot Prompting

Output:
IDF formatted text file suitable for EnergyPlus Simulation

Recorded demonstration of running the OpenAI API and receiving the output



3. Backend – Input

Created Sample IDF File

```
!-Generator IDFEditor 1.51
!-Option SortedOrder

!-NOTE: All comments with '!-' are ignored by the IDFEditor and are generated automa
!-      Use '!' comments if they need to be retained when using the IDFEditor.


!-   ===========  ALL OBJECTS IN CLASS: VERSION ===========

Version,
    9.3;                     !- Version Identifier


!-   ===========  ALL OBJECTS IN CLASS: SIMULATIONCONTROL ===========

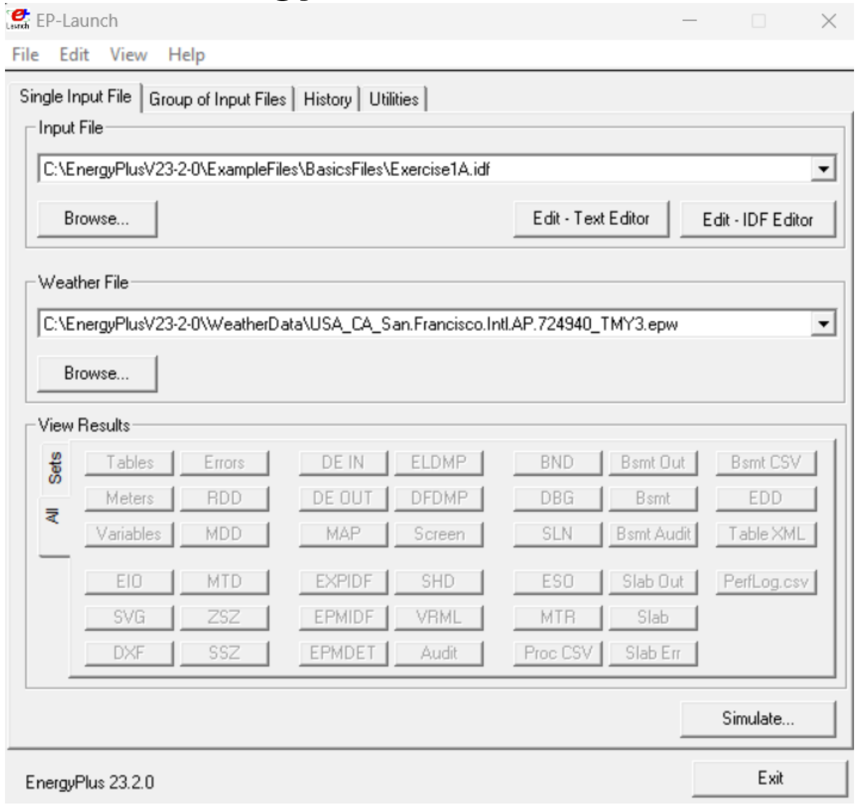
SimulationControl,
    No,                      !- Do Zone Sizing Calculation
    No,                      !- Do System Sizing Calculation
    No,                      !- Do Plant Sizing Calculation
    Yes,                     !- Run Simulation for Sizing Periods
    Yes,                     !- Run Simulation for Weather File Run Periods
    No;                      !- Do HVAC Sizing Simulation for Sizing Periods


!-   ===========  ALL OBJECTS IN CLASS: BUILDING ===========

Building,
    Building 1,              !- Name
    -0,                      !- North Axis {deg}
    ,                        !- Terrain
    ,                        !- Loads Convergence Tolerance Value {W}
    ,                        !- Temperature Convergence Tolerance Value {deltaC}
    ,                        !- Solar Distribution
    ,                        !- Maximum Number of Warmup Days
    ;                        !- Minimum Number of Warmup Days

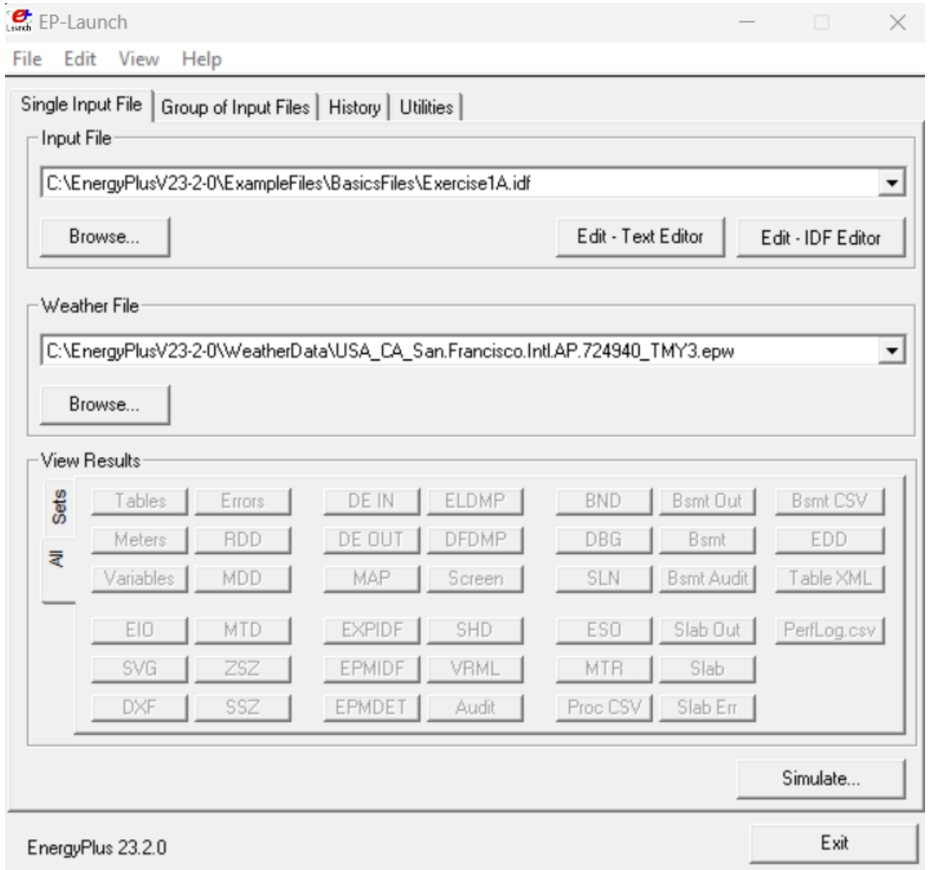

!-   ===========  ALL OBJECTS IN CLASS: SHADOWCALCULATION ===========
```

Input into EnergyPlus Simulation via APIs

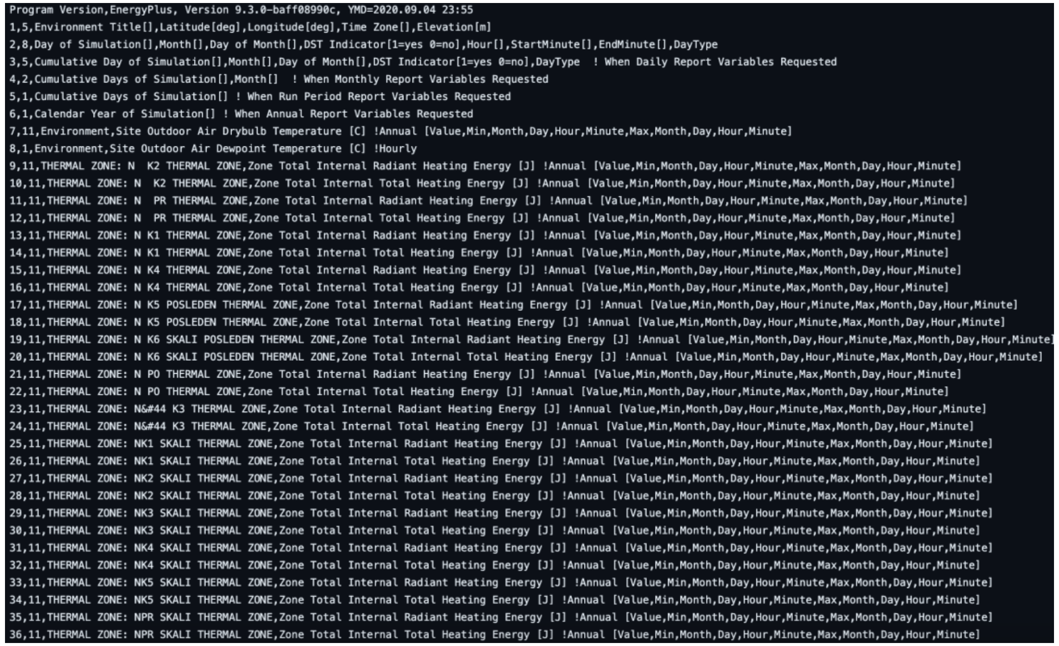


3. Backend – Input

EnergyPlus Simulation



Complex EnergyPlus Output File



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8,1,Environment,Site Outdoor Air Dewpoint Temperature [C] !Hourly
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Workflow Overview – Step 4

Creating actionable outcomes from EnergyPlus outputs

4. Backend - Output

Complex EnergyPlus Output File

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Program Version,EnergyPlus, Version 9.3.0-baff08990c, YMD=2020.09.04 23:55
1,5,Environment Title[],Latitude[deg],Longitude[deg],Time Zone[],Elevation[m]
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```

OpenAI API
on Python with Zero
Shot Prompting

GPT4 Output in Terminal: Key Insights for User

```
Based on the provided .eso file, here are three key insights and actionable steps for retrofitting the building:

1. **Insight:** The .eso file contains data on the total internal radiant heating energy and total internal total heating energy for various thermal zones in the bui
lding. This data can be used to identify which zones are consuming the most energy for heating.

   **Action:** Conduct an energy audit to identify the zones with the highest energy consumption. Once identified, consider retrofitting these areas with more energy
-efficient heating systems or improving insulation to reduce heat loss.

2. **Insight:** The file also provides information on the outdoor air drybulb temperature and dewpoint temperature. These can give an indication of the external envi
ronmental conditions the building is subjected to.

   **Action:** If the building is located in a region with extreme temperatures, consider implementing passive design strategies such as shading devices for windows,
 green roofs, or high-performance glazing to reduce the reliance on mechanical heating and cooling systems.

3. **Insight:** The data shows the energy consumption at different times of the day, month, and year. This can help identify patterns in energy use.

   **Action:** Use this information to implement energy management strategies. For example, if certain zones are not in use at specific times, consider adjusting the
 heating schedule or use occupancy sensors to control the heating system. This can significantly reduce energy consumption and costs.
```

5. User – View Insights

The User can view summarized customized **insights and actionable steps** on the interface.
Below is a sample output we can get from OpenAI APIs with reading EP data:

ChatGPT

Based on the provided EnergyPlus simulation output, here are three key insights for retrofitting the building to improve energy efficiency, along with actionable steps:

1. Optimize Thermal Zone Heating Energy Use

- **Insight**: The detailed zone heating energy data (e.g., Zone Total Internal Radiant Heating Energy and Zone Total Internal Total Heating Energy) indicate potential inefficiencies in space heating across various thermal zones.
- **Actionable Steps**:
  1. Conduct a detailed audit of thermal insulation in each zone to identify areas of heat loss.
  2. Upgrade insulation in walls, roofs, and floors where necessary to reduce heat loss.
  3. Install or upgrade to high-efficiency heating systems that adjust dynamically to occupancy and weather conditions.
  4. Consider implementing zone-specific heating controls to reduce energy waste in unoccupied spaces.

2. Improve Lighting Efficiency

- **Feasible**
- **Data-based**
- **Specific**
- **Holistic**
- **Actionable**

We target the right people, at the right time.

Customer Analysis

Building Managers

Before EnergySharp

- Often **excluded/does not understand** the energy optimization process
- **Confused** and thus **unwilling** to improve energy efficiency

After EnergySharp

- Given incentive as the ultimate **decision-maker** to optimize energy efficiency
- **Given actionable steps** to take to easily enhance their building operations practices

Existing Building Stock

Before EnergySharp:

- Often **overlooked** when discussing improving sustainability in the building industry
- In a **policy "blind spot"** where new regulations do not apply

After EnergySharp:

- **Targeted,** easily implementable solutions that are not cumbersome (eg. demolishing)
- Potential to create the most change in **impact and magnitude** due to the large amount of existing buildings

EnergySharp will operate with a self-supportive financing model.

Business Model

Project-based Pricing (2025-)

- Partner with building managers to develop customized software
- Provide action plans for managers

Subscription Pricing (2025-)

- Continue usage of software with access to impact measurements (e.g., cost savings, Carbon emissions reductions, KPIs, etc.)
- Tiered-pricing models based on office size

Features Bundles Pricing (2027-)

- Continued developing software based on customers feedback, testing, introducing new features that customized customer experiences

Sources of funding: Venture Capitalist, Government Grants, Partnerships with sustainability-focused groups (long-term)

EnergySharp will be created and implemented over a 5-year period.

Business Model

Timeline

2025 - 2026

R&D (6 months)	Conduct market research, Develop AI model for HVAC optimization & interface
Beta Testing (6 months)	Small group pilot testing, Gather feedback & iterate on product based on user experience

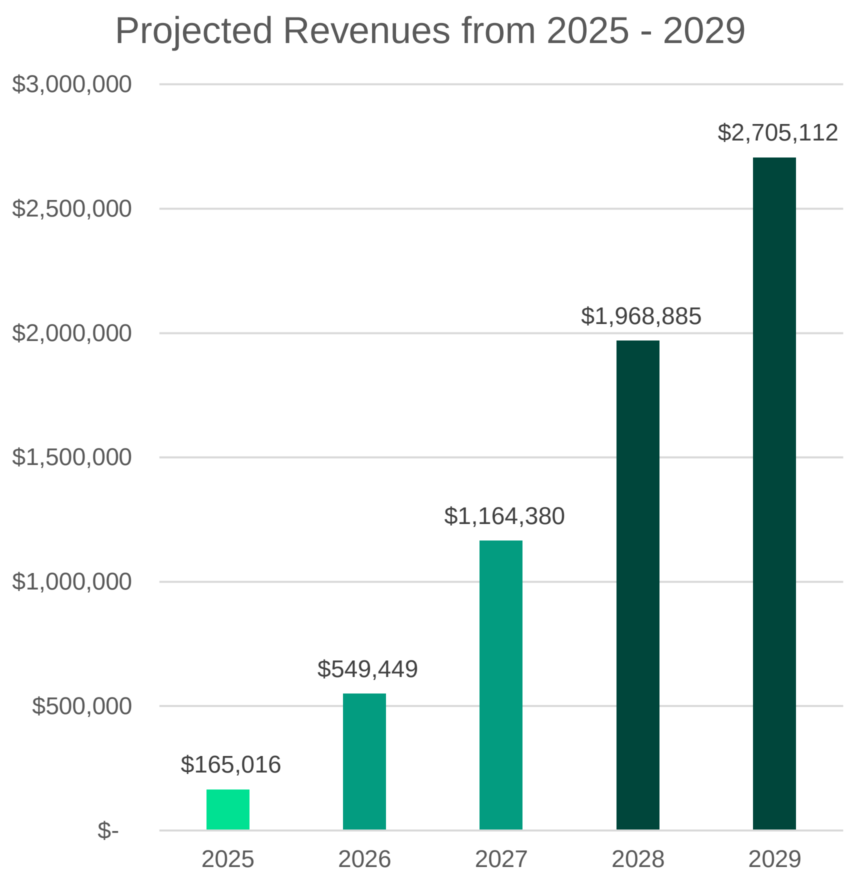
2026 - 2027

Adoption Stage (6 months)	Launch full version of EnergySharp, Implement marketing & sales strategies to attract new customers
Scaling (18 months)	Increase customer base while improving the product based on user feedback Expand marketing efforts to reach wider audience

2027 - 2029

Growth Phase (12 months)	Introducing new features bundle, upselling
Optimization (18 months)	More customizable features and impact measurement metrics

5-year Costs & Revenue Projections



EnergySharp is scalable - Expansion Strategies

Business Model

Increase Use Cases

Vertical expansion to different types of sustainable action plans (eg. retrofit, energy reduction, airflow optimization) based on specific customer feedback and inputs.

Potential Horizontal expansion to automate more legacy systems through leveraging AI.

Expert Consultations

Consultation with experts to constantly improve software development.

Develop custom AI models to interpret more other diagrams (mechanical, structural, HVAC).

Aggregate user data and feedback to refine app workflows.

User Expansion

Target, scope, and expand user base through streamlined marketing and customer engagement workflows. Increase mass adoption of sustainable data-based practices.

EnergySharp optimizes building energy use such that all stakeholders are satisfied

Impact Summary

EnergySharp offers a tailored, scalable, and intuitive system that disrupts existing inertia in addressing a "hard-to-reach" and historically neglected emissions sector. All impacts will only expand as ENERGYSHARP reaches its full potential.

Addressing Climate Change

40+% REDUCTION in carbon emissions (Brainbox AI)

50+% INCREASE in energy efficiency (Brainbox AI)

3000+ BUILDINGS OPTIMIZED over the next 5 years with sustainable HVAC (Projected Numbers)

45+% DECREASE in future energy demand (IEA)

Addressing Building Management/Owner Challenges

Up to **$15,000+ SAVED** in consulting costs per project

20-40+% REDUCTION in energy usage and costs (Chiller&Cooling Best Practices)

10+% BOOST in worker productivity and attendance records due to ideal temperatures, air quality, and comfort (Alford Mechanical).

Save **MONTHS** worth of time: ENERGYSHARP does in seconds what consultants do in months.

Appendix

Buildings are bountiful and bad for the environment.

Introduction

Currently, the construction and buildings industry is responsible for

40%

of global energy-related emissions **(the highest among all sectors)**

30% is from operation energy consumption.

- Heating, ventilation, and air conditioning (HVAC) systems are responsible **for 40% of office building energy consumption**
- Current systems are highly inefficient: **30% of energy consumption is wasted**

- Emissions contribute to the **urban heat island effect**, where temperatures in downtown cores can average up to **12C higher than surrounding areas**
- Increased pollution and air temperatures create a **positive feedback loop** that intensify **UHIs**
- Exacerbated climate change and inequality, heat-related illnesses, extreme weather

Major cities around the world are home to large stocks of inefficient office buildings.

Introduction

Most buildings that have the most egregious energy performance already exist—and they are offices.

80% of the buildings that will exist in 2050 have already been built

Existing building stock needs to be a priority in creating strategies toward sustainability. **This area is currently often overlooked.**

In urban areas, buildings account for 60% of overall carbon emissions.

Building energy use inefficiencies must be identified and eliminated to optimize resource use. **This area is currently lagging in reaching Paris Agreement outlines.**

Established models for improving existing building stock centers on demolishing and rebuilding. This is costly, inefficient, and hard to justify.

Buildings must focus on compiling and processing data to optimize performance using their existing resources. **These opportunities are often nebulous and hard to envision.**

To reach key climate targets and achieve cost benefits, energy optimization in existing office building stock is a must.

Major cities around the world are home to large stocks of inefficient office buildings.

Introduction

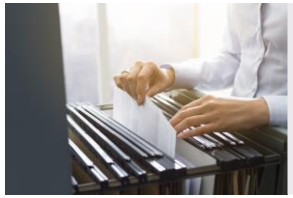
There is an increasing interest in enhancing building energy performance.

Rapidly rising **energy prices** make office spaces **costly and burdensome** for corporations and managers.

Vacancy rates in offices are **soaring: Toronto's reached a high of 20% in 2023.** Especially with the transition away from remote work, **offices want to lower costs and become more attractive.**

Increased **government regulation** means that corporate emphasis on **CSR and ESG** make a sustainable building the **most attractive option.**

Multiple stakeholders would benefit from building energy efficiency.



Office workers benefit from increased productivity due to optimized HVAC.

Building managers will save costs and meet regulation/ESG goals.

Real estate companies reduce vacancy by making their buildings more attractive.

Workflow Overview – Step 5: Video Demonstration

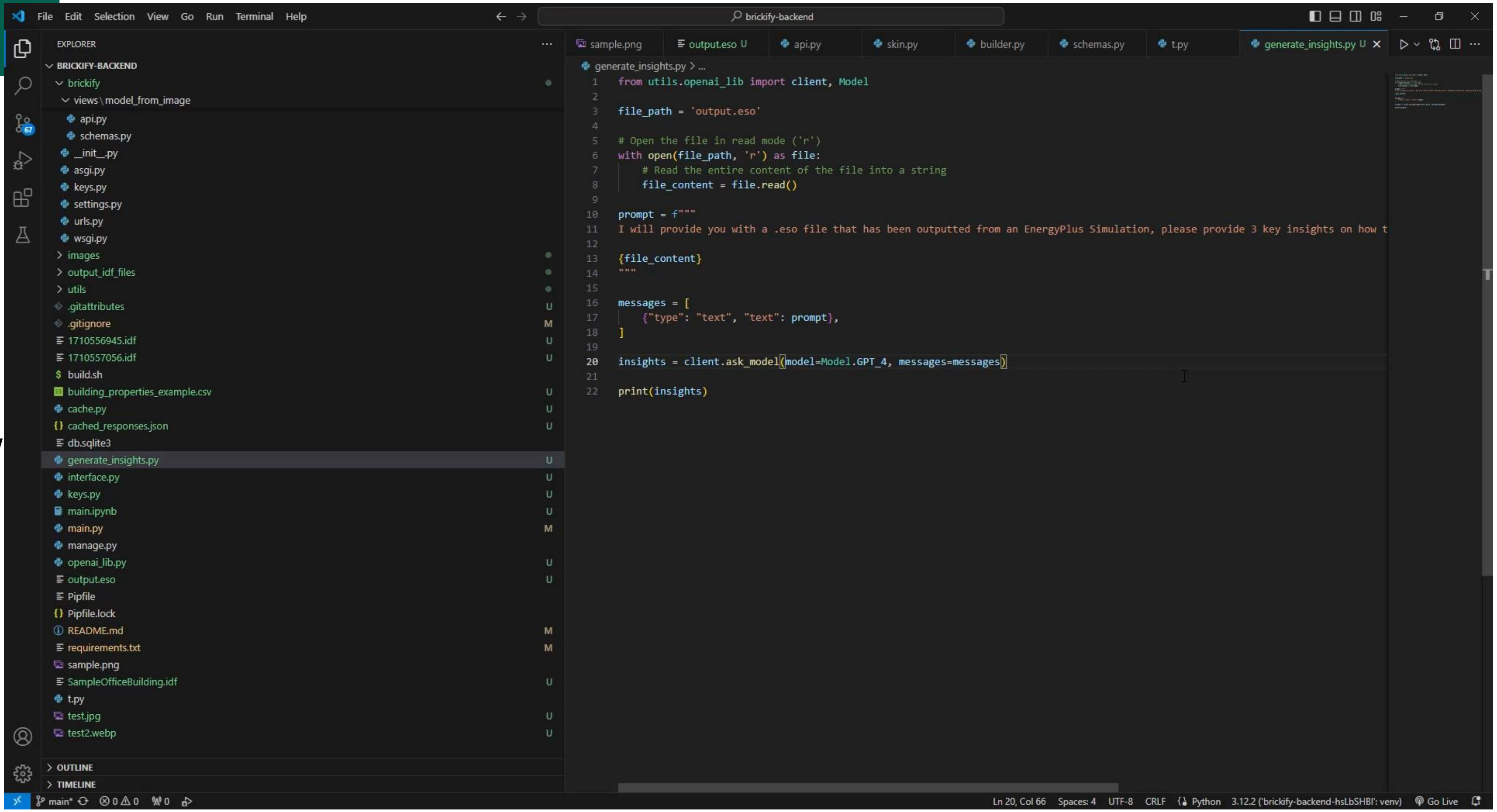
Displaying insights and actionable steps on an interface

5. User – View Insights

USER INPUT
(office building floor plan, basic parameters including building materials, occupancy, etc.

OpenAI API on Python with Few Shot Prompting

Output:
IDF formatted text file suitable for EnergyPlus Simulation



Costs & Revenues Schedules 2024 - 2029

Excel included in GitHub

	2025	2026	2027	2028	2029
Project-based revenue	$ 151.000	$ 480.000	$ 925.500	$ 1.397.600	$ 1.611.600
Subscription revenue	$ 14.016	$ 68.558	$ 168.703	$ 337.819	$ 551.758
Bundle revenue	$ -	$ 891	$ 70.178	$ 233.467	$ 541.754
Total Annual Revenue	**$ 165.016**	**$ 549.449**	**$ 1.164.380**	**$ 1.968.885**	**$ 2.705.112**

Costs Structures	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**
Research & Development	$ 180.000	$ 200.000	$ 200.000	$ 250.000	$ 270.000	$ 300.000
Marketing & Sales	$ -	$ 180.000	$ 120.000	$ 84.000	$ 60.000	$ 60.000
Operations	$ 160.000	$ 320.000	$ 320.000	$ 320.000	$ 320.000	$ 320.000
Total Annual Expeneses	**$ 340.000**	**$ 700.000**	**$ 640.000**	**$ 654.000**	**$ 650.000**	**$ 680.000**
Net Income	***$ (340.000)***	***$ (534.984)***	***$ (90.551)***	***$ 510.380***	***$ 1.318.885***	***$ 2.025.112***
Break-even	$ (340.000)	$ (874.984)	$ (965.535)	$ (455.155)	$ 863.730	$ 2.888.842