

## Energy Optimization in Buildings: Predictive Modelling for Chiller Equipment Efficiency

### System Setup

Step 1: Install Python.

- Head to Python's website, <https://www.python.org/>, and download version 3.10.16
- Follow the installation instructions, make sure to check the option to add Python to your system PATH.

Step 2: Install Visual Studio Code (VSC) and Anaconda Navigator.

- Download and install from Visual Studio Code website, <https://code.visualstudio.com/>, and Anaconda Navigator's website, <https://www.anaconda.com/products/navigator>.

Step 3: Create New Environment.

- Open Anaconda Navigator and head to the “Environments” tab and click “Create”.
- Name the environment (e.g., Streamlit) and select Python 3.10.16.

Step 4: Activate the environment.

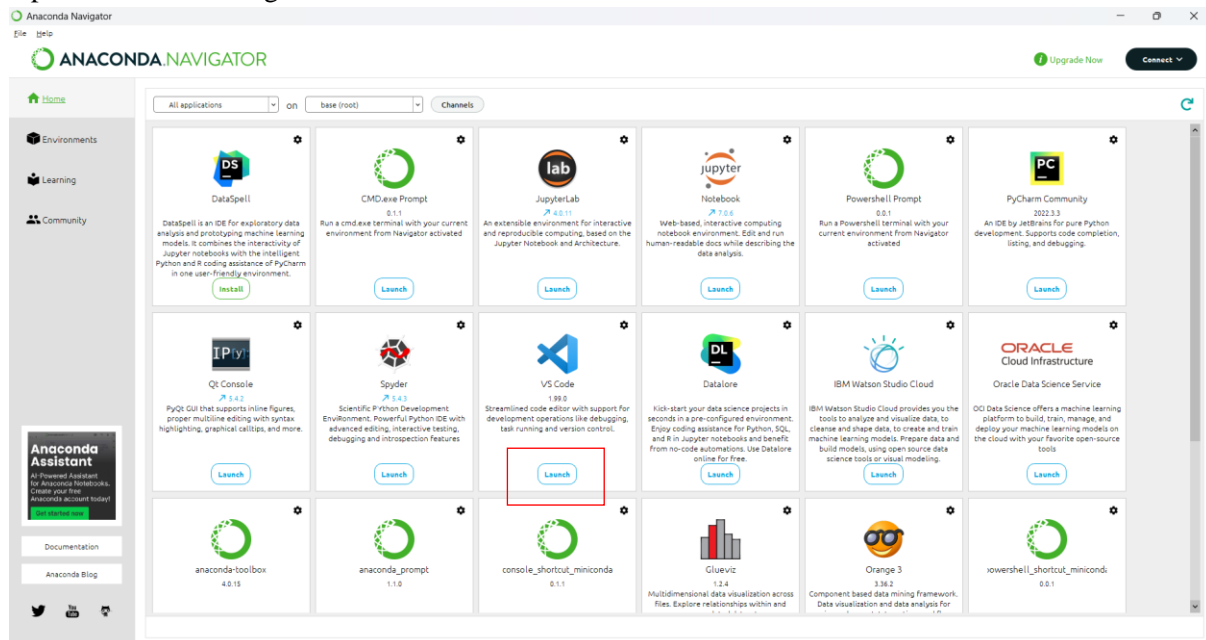
- Launch Anaconda Navigator and activate the environment with the command “conda activate Streamlit” in the integrated terminal.

Step 5: Install Necessary Libraries and Dependencies from Table 10 in the environment.

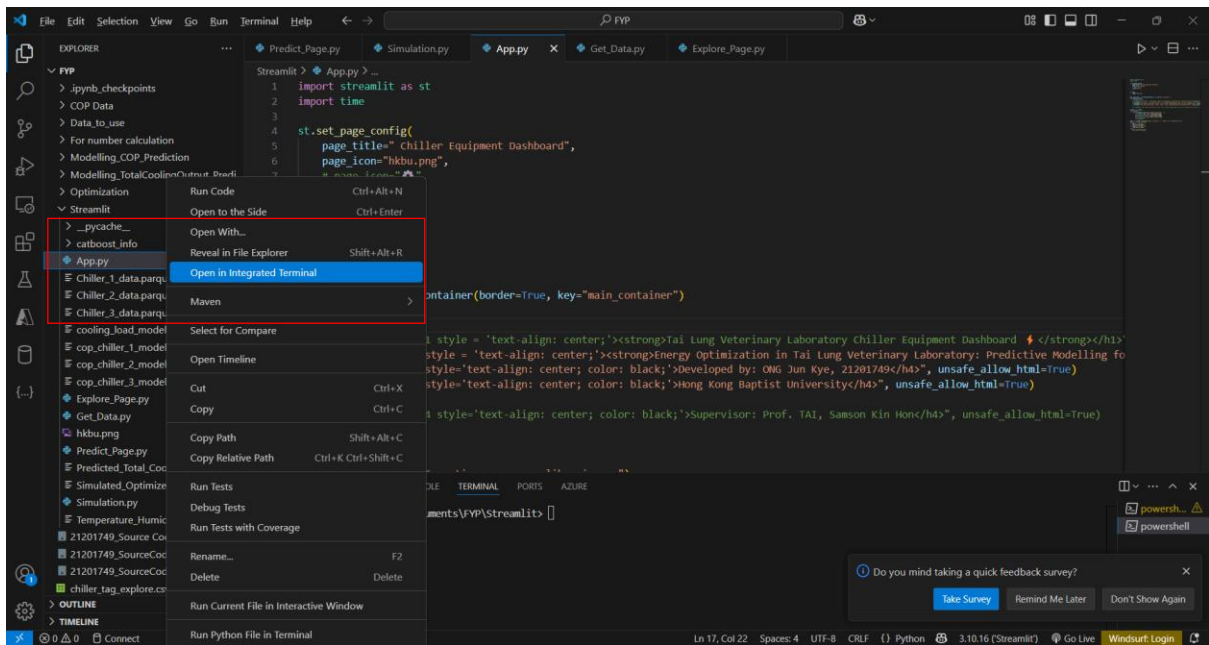
Step 6: Organize all the necessary files, scripts, machine learning model files and data files, in a single project folder.

Step 7: Launch Visual Studio Code

- Open Anaconda Navigator and launch Visual Studio Code from there.

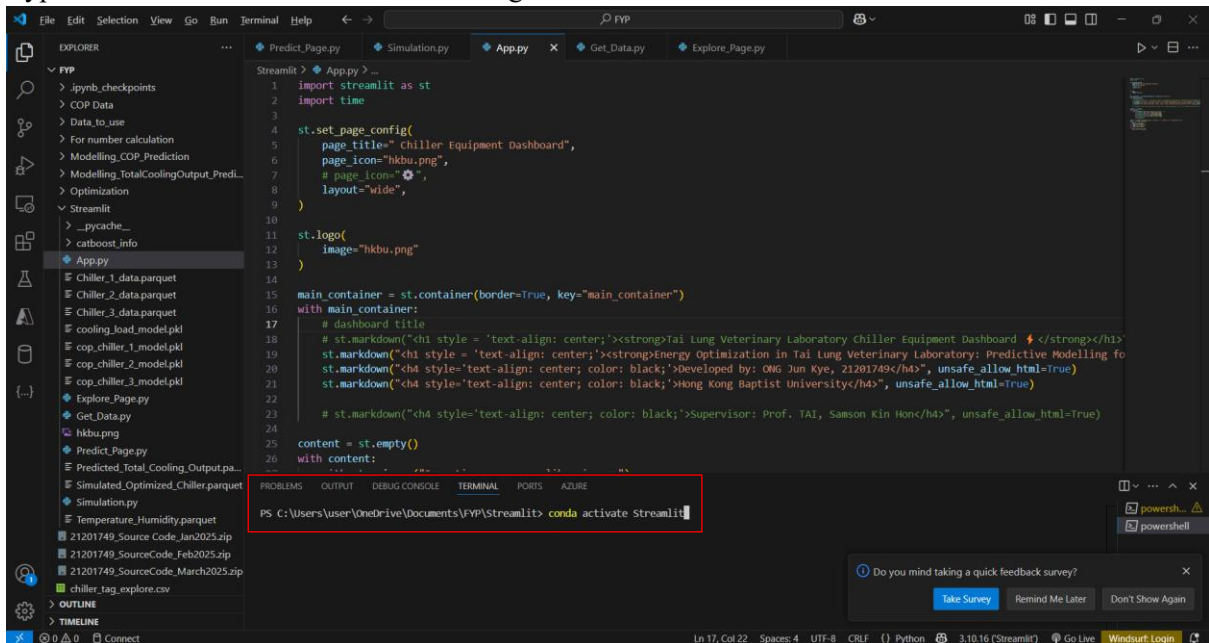


Step 8: Open project and right click on “App.py” and click on “Open in Integrated Terminal”



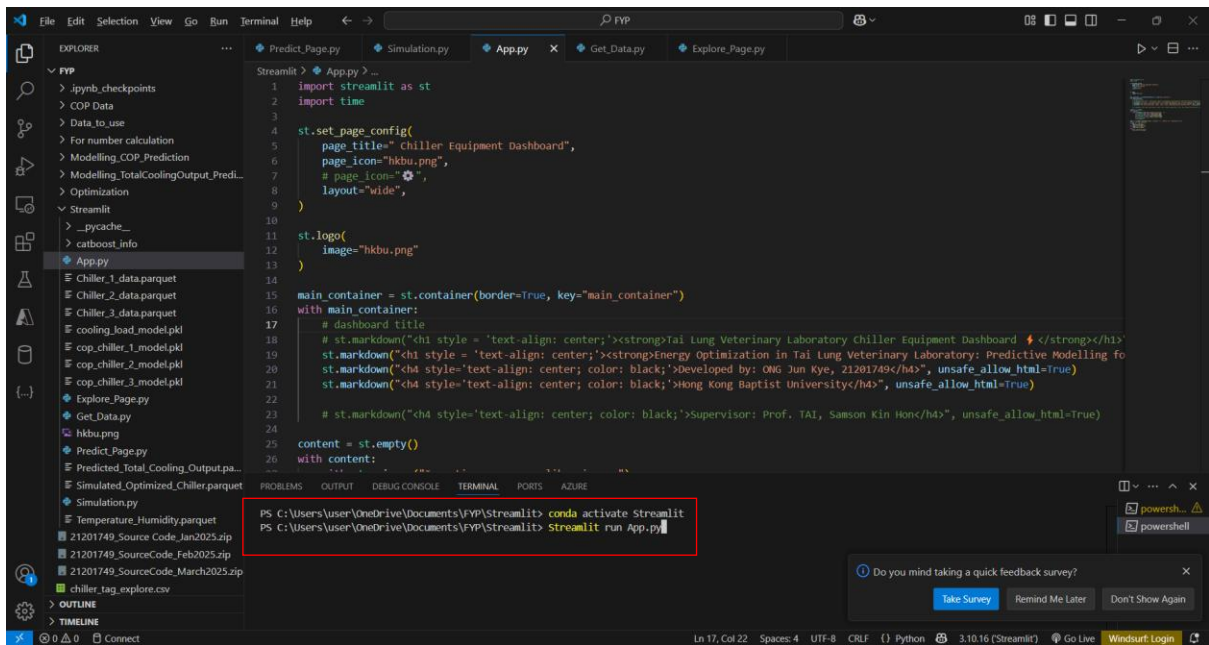
Step 9: Activate Python Environment in the integrated terminal.

- Type “conda activate Streamlit” in the integrated terminal.



Step 10: Run the Streamlit Application

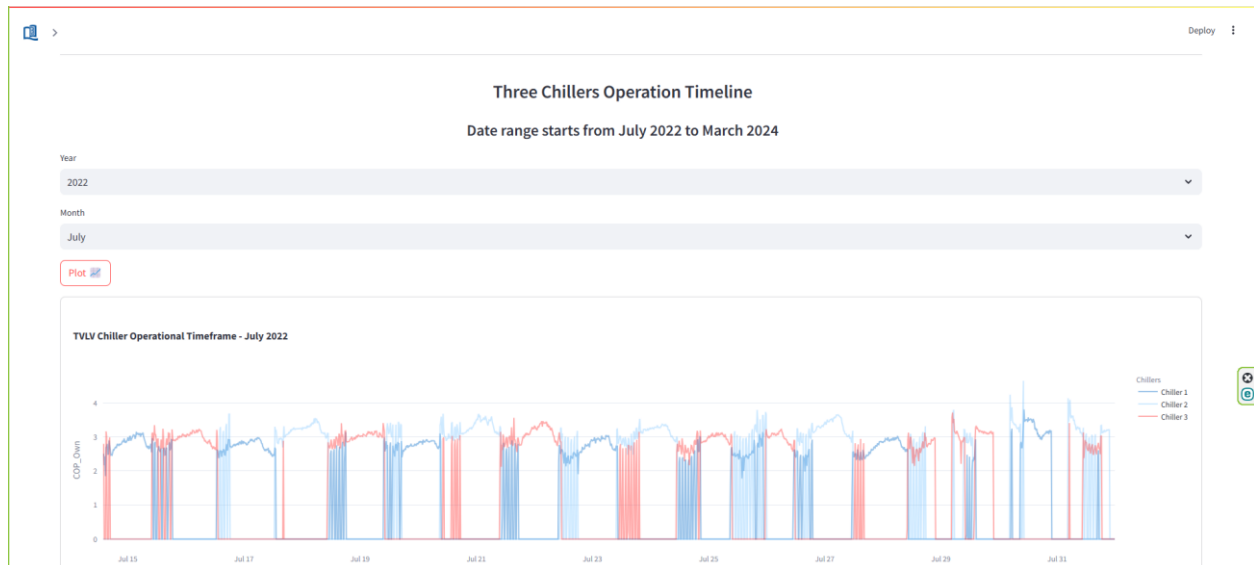
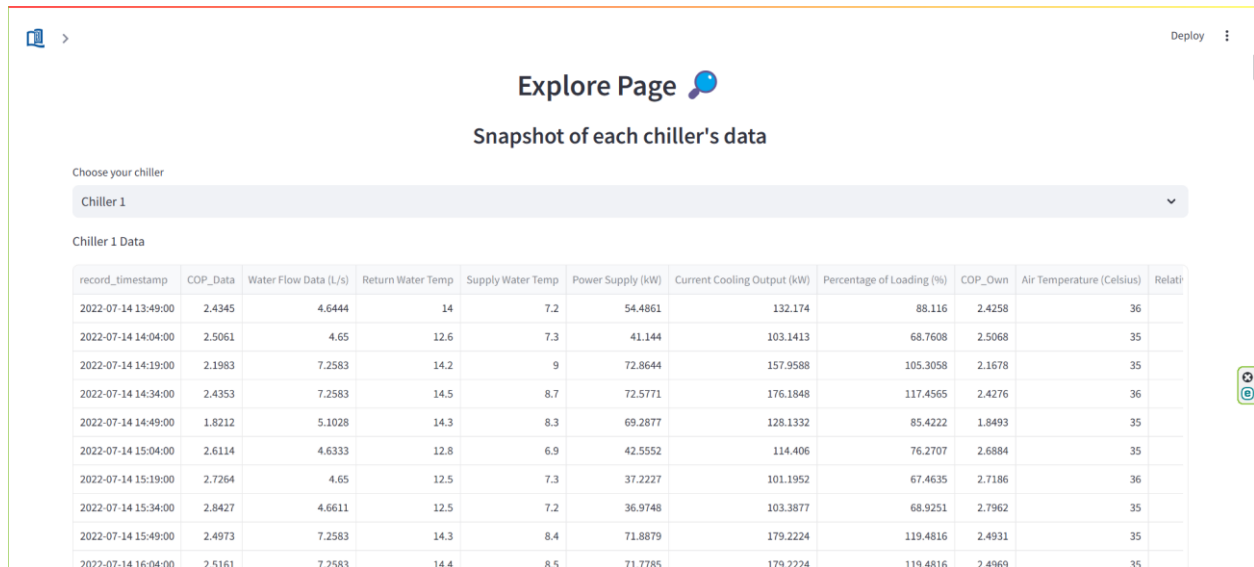
- Type “streamlit run App.py” in the integrated terminal.

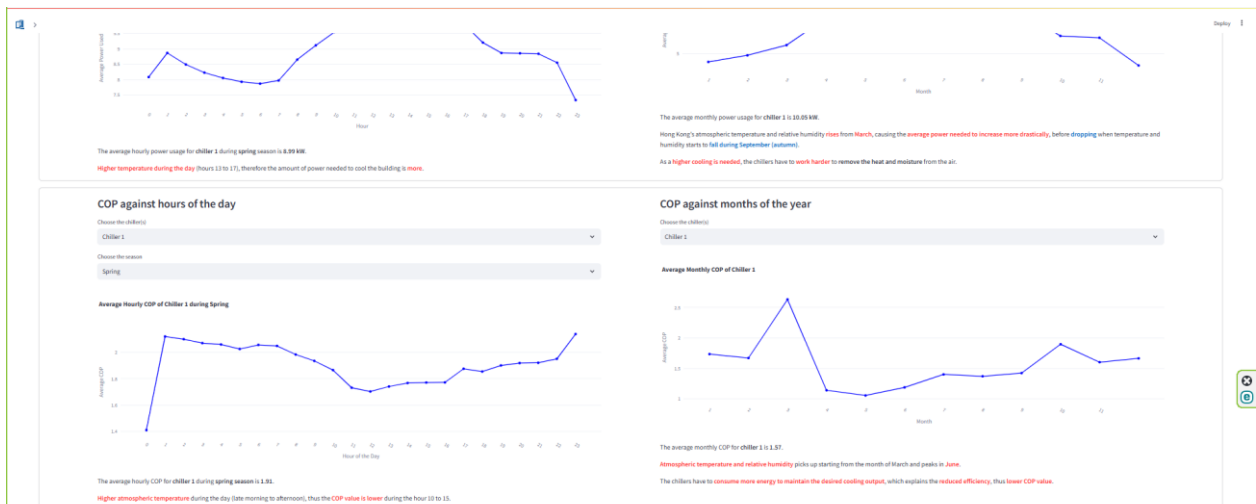
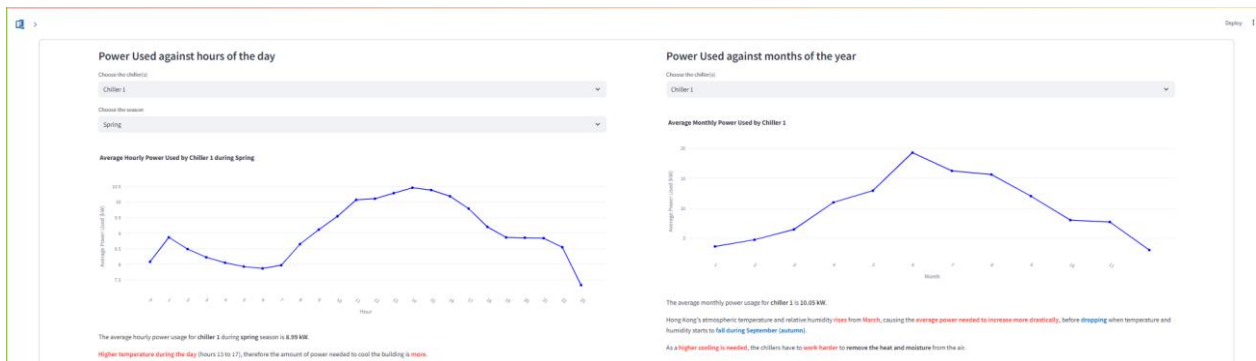
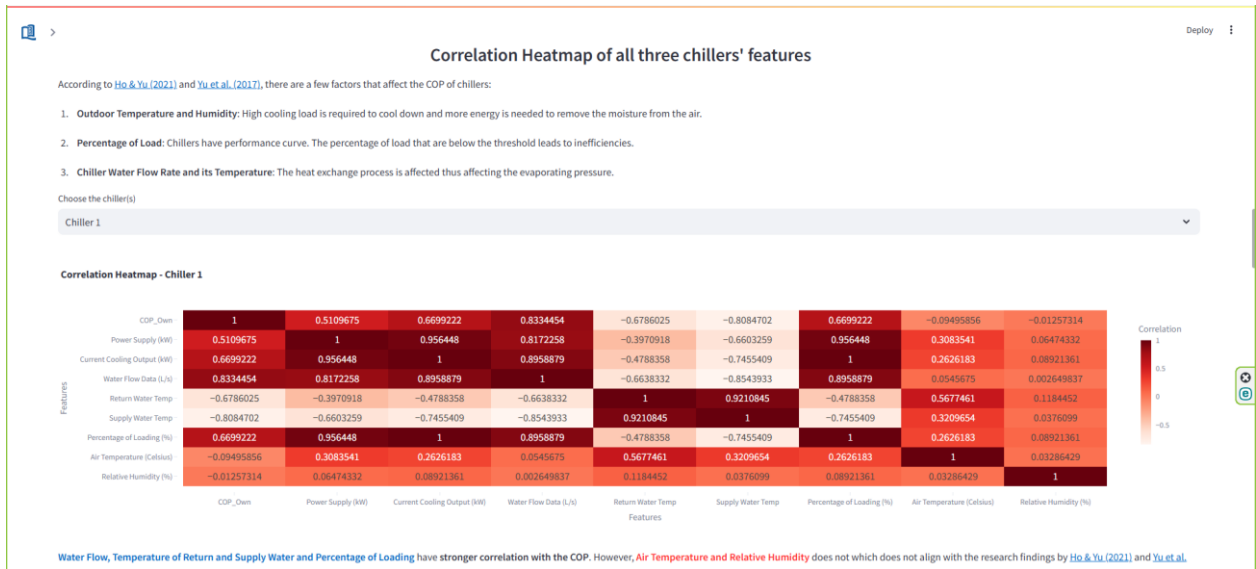


Step 11: Dashboard is ready to be used.

- Once the command is executed, your default browser will open and display the Streamlit dashboard. It should consist of 3 pages: Explore, Predict and Simulation.


## Explore Page





## Predict page

Deploy

Total Cooling Output and Coefficient of Performance Prediction  G9

Real-Time/Custom Input Strategy Prediction

Please input relevant information for prediction. Date range starts from 2022-07-01 00:00:00 to 2025-04-06 13:00:00

Date

2025/04/02

Time

21:15

Temperature (°C)

18.40

-


+

Humidity (%)

64

-

+

Predict 

Deploy

Total Cooling Output and Coefficient of Performance Prediction  G9

Real-Time/Custom Input Strategy Prediction

Please input relevant information for prediction. Date range starts from 2022-07-01 00:00:00 to 2025-04-06 13:00:00

Date

2025/04/02

Time

21:15

Temperature (°C)

18.40

-

+

Humidity (%)

64

-

+

Predict 

Amount of Cooling Output needed (kW): 65.05

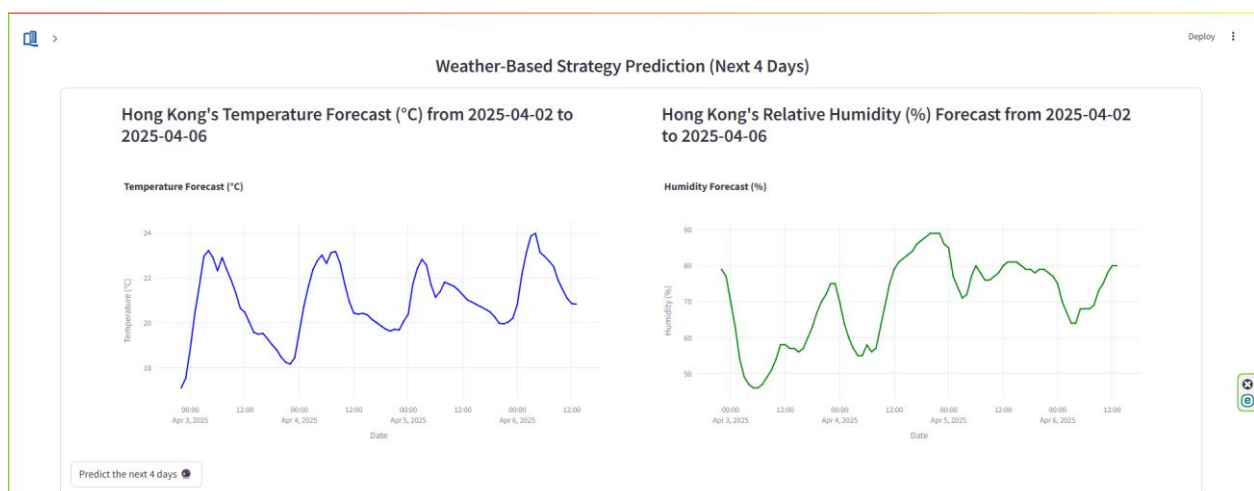
Best Strategy: Chiller 2

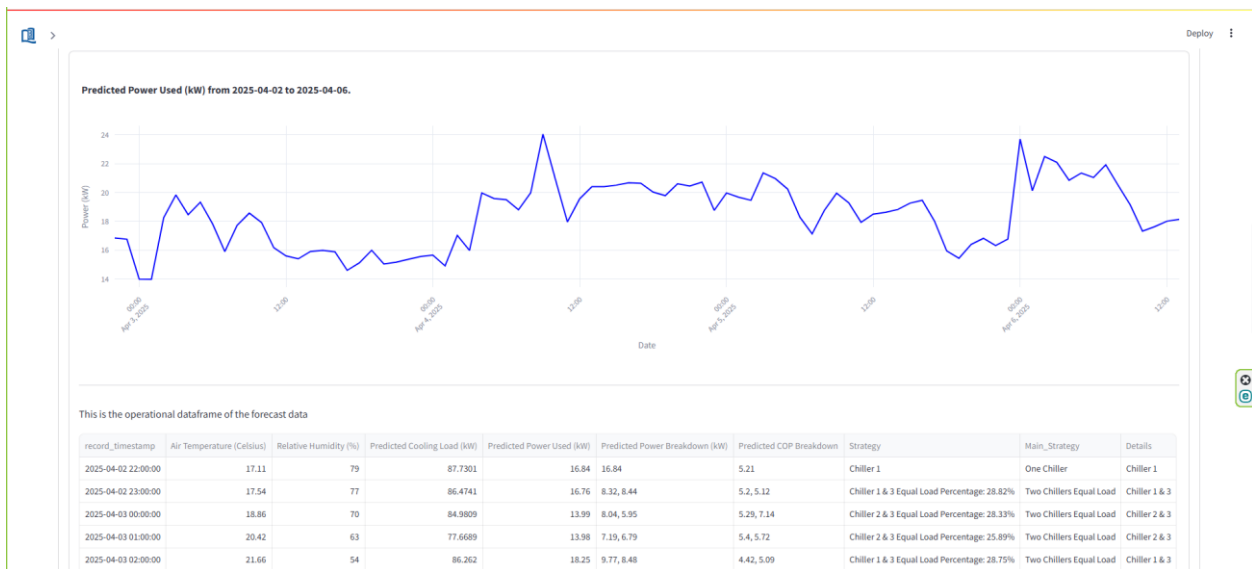
Estimated Total Power Used (kW): 11.72

Estimated Power Breakdown (kW): 11.72

Estimated COP Breakdown: 5.55

Estimated Cost (HK\$ per hour): 17.85





This is the strategy summary of the forecast data

| Main_Strategy           | Details       | count | avg_power |
|-------------------------|---------------|-------|-----------|
| One Chiller             | Chiller 1     | 8     | 16.98     |
| One Chiller             | Chiller 2     | 3     | 21.44     |
| Two Chillers Equal Load | Chiller 1 & 2 | 5     | 16.32     |
| Two Chillers Equal Load | Chiller 1 & 3 | 26    | 17.9      |
| Two Chillers Equal Load | Chiller 2 & 3 | 46    | 19.01     |

**Most Used Strategy: Two Chillers Equal Load Chiller 2 & 3**  
Average Power Used: 19.01 kW

**Most Cost Saving Strategy: Two Chillers Equal Load Chiller 1 & 2**  
Average Power Used: 16.32 kW

**Least Used Strategy: One Chiller Chiller 2**  
Average Power Used: 21.44 kW

**Least Cost Saving Strategy: One Chiller: Chiller 2**  
Average Power Used: 21.44 kW

### File Upload Prediction

Upload CSV or Excel file with date, time, temperature and humidity to see the optimised operations

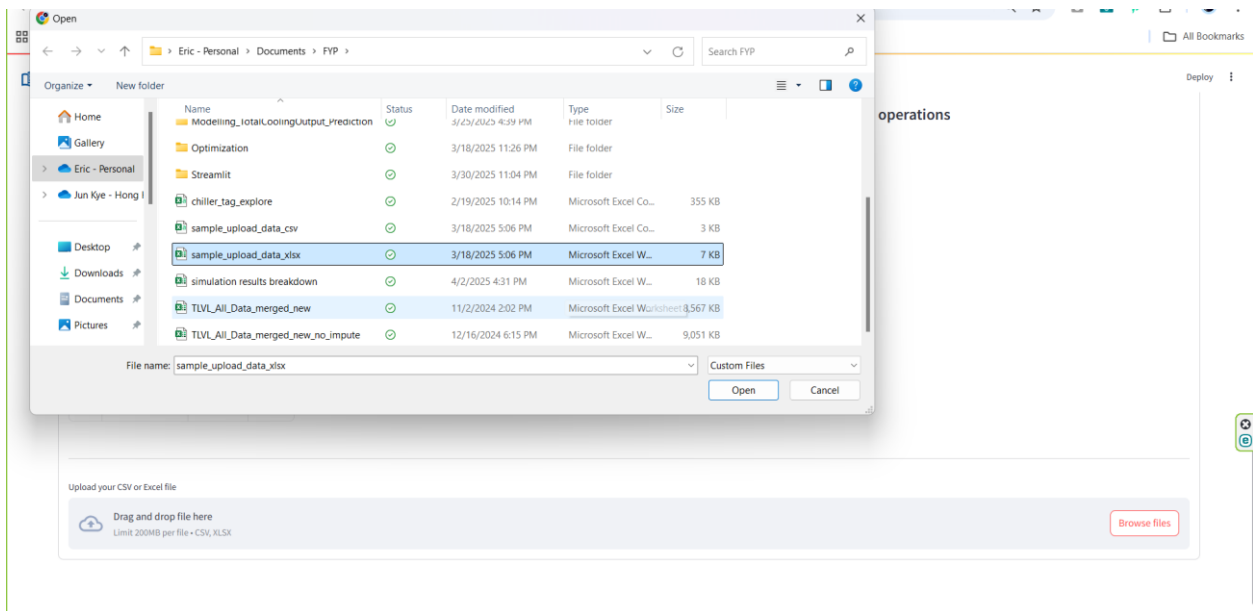
Here is a sample data file. You may download it for reference.

|   | record_timestamp    | Temperature | Humidity |
|---|---------------------|-------------|----------|
| 0 | 2024-04-01 00:00:00 | 27          | 83       |
| 1 | 2024-04-01 00:10:00 | 27          | 83       |
| 2 | 2024-04-01 00:20:00 | 27          | 83       |
| 3 | 2024-07-19 14:40:00 | 29          | 92       |
| 4 | 2024-07-19 14:50:00 | 29          | 91       |
| 5 | 2024-08-06 03:40:00 | 29          | 87       |
| 6 | 2024-08-06 03:50:00 | 28          | 87       |
| 7 | 2024-08-06 04:00:00 | 28          | 88       |
| 8 | 2024-08-06 04:10:00 | 28          | 88       |
| 9 | 2025-01-31 23:10:00 | 18          | 83       |

Upload your CSV or Excel file

Drag and drop file here  
Limit 200MB per file • CSV, XLSX

Browse files



sample\_upload\_data.xlsx 6.7 KB

This is the operational dataframe of the uploaded data file.

| record_timestamp    | Air Temperature (Celsius) | Relative Humidity (%) | Predicted Cooling Load (kW) | Predicted Power Used (kW) | Predicted Power Breakdown (kW) | Predicted COP Breakdown | Strategy  | Main_Strategy | Details   |
|---------------------|---------------------------|-----------------------|-----------------------------|---------------------------|--------------------------------|-------------------------|-----------|---------------|-----------|
| 2025-03-18 10:00:00 | 18.66                     | 41                    | 29.118                      | 7.35                      | 7.35                           | 3.96                    | Chiller 1 | One Chiller   | Chiller 1 |
| 2025-03-18 11:00:00 | 18.46                     | 44                    | 24.6158                     | 7.01                      | 7.01                           | 3.51                    | Chiller 1 | One Chiller   | Chiller 1 |
| 2025-03-18 12:00:00 | 18.36                     | 46                    | 27.0125                     | 7.37                      | 7.37                           | 3.66                    | Chiller 1 | One Chiller   | Chiller 1 |
| 2025-03-18 13:00:00 | 18.31                     | 48                    | 30.3793                     | 7.3                       | 7.3                            | 4.16                    | Chiller 1 | One Chiller   | Chiller 1 |
| 2025-03-18 14:00:00 | 17.54                     | 54                    | 33.3405                     | 7.48                      | 7.48                           | 4.46                    | Chiller 1 | One Chiller   | Chiller 1 |
| 2025-03-18 15:00:00 | 16.86                     | 59                    | 43.2371                     | 8.19                      | 8.19                           | 5.28                    | Chiller 1 | One Chiller   | Chiller 1 |
| 2025-03-18 16:00:00 | 16.57                     | 63                    | 43.598                      | 8.61                      | 8.61                           | 5.07                    | Chiller 1 | One Chiller   | Chiller 1 |
| 2025-03-18 17:00:00 | 16.31                     | 66                    | 37.7218                     | 7.02                      | 7.02                           | 5.37                    | Chiller 1 | One Chiller   | Chiller 1 |
| 2025-03-18 18:00:00 | 16.14                     | 68                    | 34.6332                     | 6.64                      | 6.64                           | 5.22                    | Chiller 1 | One Chiller   | Chiller 1 |
| 2025-03-18 19:00:00 | 16.04                     | 69                    | 26.1376                     | 6.05                      | 6.05                           | 4.32                    | Chiller 2 | One Chiller   | Chiller 2 |

This is the strategy summary of the uploaded data file.

| Main_Strategy           | Details       | count | avg_power |
|-------------------------|---------------|-------|-----------|
| One Chiller             | Chiller 1     | 66    | 6.96      |
| One Chiller             | Chiller 2     | 22    | 6.36      |
| Two Chillers Equal Load | Chiller 1 & 2 | 4     | 1.53      |
| Two Chillers Equal Load | Chiller 1 & 3 | 4     | 1.79      |

2025-03-19 10:00:00

| record_timestamp    | Air Temperature (Celsius) | Relative Humidity (%) | Predicted Cooling Load (kW) | Predicted Power Used (kW) | Predicted Power Breakdown (kW) | Predicted COP Breakdown | Strategy  | Main_Strategy | Details   |
|---------------------|---------------------------|-----------------------|-----------------------------|---------------------------|--------------------------------|-------------------------|-----------|---------------|-----------|
| 2025-03-19 10:00:00 | 18.59                     | 51                    | 25.78                       | 6.67                      | 6.67                           | 3.86                    | Chiller 1 | One Chiller   | Chiller 1 |

This is the strategy summary of the uploaded data file.

| Main_Strategy           | Details       | count | avg_power |
|-------------------------|---------------|-------|-----------|
| One Chiller             | Chiller 1     | 66    | 6.96      |
| One Chiller             | Chiller 2     | 22    | 6.36      |
| Two Chillers Equal Load | Chiller 1 & 2 | 4     | 1.53      |
| Two Chillers Equal Load | Chiller 1 & 3 | 4     | 1.79      |

**Most Used Strategy: One Chiller Chiller 1**  
Average Power Used: 6.96 kW

**Most Cost Saving Strategy: Two Chillers Equal Load Chiller 1 & 2**  
Average Power Used: 1.53 kW

**Least Used Strategy: Two Chillers Equal Load Chiller 1 & 3**  
Average Power Used: 1.53 kW

**Least Cost Saving Strategy: One Chiller: Chiller 1**  
Average Power Used: 6.96 kW

## Simulation page



# Modeling for Smart Equipment Systems

Developed by: ONG Jun Kye, 21201749

Hong Kong Baptist University

## Simulation and Visualization

Please select the desired month for simulation

Date range starts from 07/2022 to 03/2024

Which period would you like to simulate?

Whole period

Run simulation

Deploy

Run simulation

Running simulation for the whole period (2022 July to 2024 March)!

### Actual vs Simulation Comparison

Actual Power Supply (2022 July to 2024 March)  
1274785.51 kW

Predicted Power Supply (2022 July to 2024 March)  
1007756.63 kW

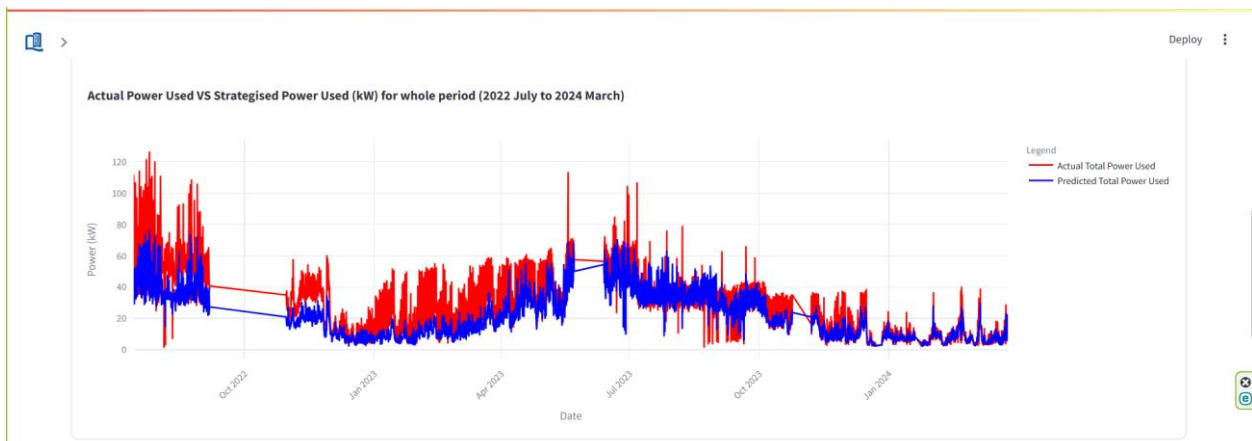
### Power Savings

Amount of Power Saved: 267028.88 kW

Percentage of Power Saved: 20.95%

Estimated Savings: HK\$ 101671.25

Deploy



This is the operational dataframe of the simulated data

| record_timestamp    | Air Temperature (Celsius) | Relative Humidity (%) | Total Cooling Output (kW) | Predicted Total Cooling Output (kW) | Total Power Supply (kW) | Predicted Total Power Used (kW) | Predicted Power Break |
|---------------------|---------------------------|-----------------------|---------------------------|-------------------------------------|-------------------------|---------------------------------|-----------------------|
| 2022-07-14 13:49:00 | 36                        | 53                    | 264.9806                  | 173.7402                            | 111.7019                | 43.79                           | [21.45, 22.34]        |
| 2022-07-14 14:04:00 | 35                        | 51                    | 210.5584                  | 172.8172                            | 79.5526                 | 46.52                           | [23.49, 23.03]        |
| 2022-07-14 14:19:00 | 35                        | 51                    | 157.9588                  | 172.8172                            | 72.8644                 | 46.52                           | [23.49, 23.03]        |
| 2022-07-14 14:34:00 | 36                        | 52                    | 176.1848                  | 176.9406                            | 72.5771                 | 44.89                           | [21.58, 23.31]        |
| 2022-07-14 14:49:00 | 35                        | 53                    | 128.1332                  | 172.2929                            | 69.2877                 | 46.02                           | [23.26, 22.76]        |
| 2022-07-14 15:04:00 | 35                        | 57                    | 236.715                   | 189.7381                            | 81.2118                 | 45.78                           | [20.33, 25.45]        |
| 2022-07-14 15:19:00 | 36                        | 55                    | 204.5829                  | 199.7827                            | 71.7194                 | 51.94                           | [21.93, 30.01]        |
| 2022-07-14 15:34:00 | 35                        | 57                    | 103.3877                  | 189.7381                            | 36.9748                 | 45.78                           | [20.33, 25.45]        |
| 2022-07-14 15:49:00 | 35                        | 55                    | 179.2224                  | 186.0482                            | 71.8879                 | 45.52                           | [21.33, 24.19]        |
| 2022-07-14 16:04:00 | 35                        | 55                    | 179.2224                  | 190.3498                            | 71.7785                 | 46.38                           | [20.1, 26.28]         |

Deploy

Deploy

This is the strategy summary of the simulated data

| Main_Strategy                             | Details                        | count  | avg_power |
|---|--------------------------------|--------|-----------|
| One Chiller                               | Chiller 1                      | 4,011  | 6.94      |
| One Chiller                               | Chiller 2                      | 8,611  | 12.44     |
| One Chiller                               | Chiller 3                      | 9,098  | 8.94      |
| Three Chillers Equal Load                 | Chiller 1, 2 & 3               | 1,953  | 37.35     |
| Two Chillers Equal Load                   | Chiller 1 & 2                  | 2,250  | 28.12     |
| Two Chillers Equal Load                   | Chiller 1 & 3                  | 3,443  | 20.79     |
| Two Chillers Equal Load                   | Chiller 2 & 3                  | 16,745 | 32.33     |
| Two Chillers One Full Load, One Part Load | Chiller 1 Full, Chiller 2 Part | 107    | 41.98     |
| Two Chillers One Full Load, One Part Load | Chiller 1 Full, Chiller 3 Part | 75     | 41.66     |
| Two Chillers One Full Load, One Part Load | Chiller 1 Part, Chiller 2 Full | 502    | 38.92     |

Deploy

|   |                                |     |       |
|---|--------------------------------|-----|-------|
| Two Chillers One Full Load, One Part Load | Chiller 1 Full, Chiller 2 Part | 107 | 41.98 |
| Two Chillers One Full Load, One Part Load | Chiller 1 Full, Chiller 3 Part | 75  | 41.66 |
| Two Chillers One Full Load, One Part Load | Chiller 1 Part, Chiller 2 Full | 502 | 38.92 |

**Most Used Strategy (2022 July to 2024 March): Two Chillers Equal Load Chiller 2 & 3**

Average Power Used: 32.33 kW

**Most Cost Saving Strategy (2022 July to 2024 March): One Chiller Chiller 1**

Average Power Used: 6.94 kW

**Least Used Strategy (2022 July to 2024 March): Two Chillers One Full Load, One Part Load Chiller 1 Part, Chiller 3 Full**

Average Power Used: 54.18 kW

**Least Cost Saving Strategy (2022 July to 2024 March): Two Chillers One Full Load, One Part Load: Chiller 1 Part, Chiller 3 Full**

Average Power Used: 54.18 kW