



School of Computing

BT3103

Mid Semester Project

Proposal

Members:

Jeyakumar Jegan, A0217456B
Koh Li Kang Ryan, A0223809A
Ng Chee Kang, A0217939N
Cheang Chi Yan Anthony A0217898H
Mark Lim Bo-Yang A0217956R

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Introduction

Executive Summary

"The effects of human-caused global warming are happening now, are irreversible on the timescale of people alive today, and will worsen in the decades to come." (Jackson, n.d.) With climate change becoming an ever greater concern to humans across the world, corporate businesses have been put in the spotlight focusing on their efforts in minimising their environmental impacts as they continue their own business operations (*The Role of Business in Climate Change*, 2020). With regards to this, it is important for businesses to go green in their operations. (Parletta, 2019) The first step is to show clear efforts in reducing their environmental impacts via means of measurements. (Fournier, 2017) In order to measure these efforts, they will need a means of easily tracking their ecological footprint (specifically carbon emissions, water usage, and electricity usage) and automatically taking different actions to react to a high footprint. Research has shown that both reducing water usage (Rose, 2021) and reducing electricity usage (*Sources of Greenhouse Gas Emissions*, 2021) are strong contributors to carbon emissions.

Purpose

Eco-Hero acts as an ecological footprint tracker for business operations. Eco-Hero allows businesses to easily view dashboards of their ecological footprint over time, along with alerts or reminders as they cross certain footprint thresholds. These alerts prompt the business to change their operation behaviour to become more energy-saving when footprint is high. Additionally, we have added the option to view contributions on a department level, allowing company executives to easily identify the departments which are performing poorly on the ecological footprint level. Ultimately, beyond operating more sustainably in the long run, they are also able to increase cost savings in terms of lower electricity and water bills in the short run.

Scope

Despite real time tracking of footprint already being done for companies to be charged on their electrical / water bills, the potential is there to log these real time data into a database to do further real time data analysis to adjust real time strategies to operations. Such operating information requires confidentiality, thus an authentication will be required to access the account's records. Visualisation of the logged data will also be done and adjusted on a real time basis, with flags when certain user inputted thresholds are crossed.

User Stories and Acceptance Criteria

Functional Requirements

S/N	User Story	Acceptance Criteria
1	AS A new user I WANT to register with my email address and create a password SO THAT the system can remember me and my data	<ul style="list-style-type: none">GIVEN I key in a valid email and password WHEN I click on the sign up button THEN I am alerted that signup is successfulGIVEN I key in an invalid email or password WHEN I click on the sign up button THEN I am alerted that signup is unsuccessfulGIVEN I am a newly registered user WHEN I login with the email and password I registered with THEN I successfully login AND I am brought to the client homepage

2	<p>AS A registered user I WANT to login to my account SO THAT I can use the features of the website</p>	<ul style="list-style-type: none"> • GIVEN I key in a registered email and password WHEN I click on the login button THEN I successfully login AND I am brought to the client homepage • GIVEN I key in an invalid email or password WHEN I click on the login button THEN I am alerted that login is unsuccessful
3	<p>AS A registered user I WANT to reset my password SO THAT I can login despite having forgotten my password</p>	<ul style="list-style-type: none"> • GIVEN I provide a registered email WHEN I click on the Send Password Reset Link button THEN I am alerted that a reset link has been sent to my email AND I have received the link via email • GIVEN I key in my registered email, new password and confirm password correctly WHEN click on the Reset Password button THEN I am alerted that my password has been reset AND I am able to login with my new password • GIVEN I key in my registered email, new password or confirm password incorrectly WHEN click on the Reset Password button THEN I am alerted that reset password is unsuccessful
4	<p>AS A registered user I WANT to change my password SO THAT I can change my password for security reasons</p>	<ul style="list-style-type: none"> • GIVEN I key in my registered email, old password, new password and confirm new password correctly WHEN I click on the Change Password button THEN I am alerted that my password has been reset AND I am able to login with my new password • GIVEN I key in my registered email, old password, new password or confirm password incorrectly WHEN click on the Change Password button THEN I am alerted that change password is unsuccessful

5	<p>AS A registered user I WANT to be able to input data through a template CSV file provided by the website SO THAT I can view a report on my company's water consumption, electric energy consumption and carbon emissions</p>	<ul style="list-style-type: none"> • GIVEN I key in the required fields correctly into the template CSV WHEN I upload CSV file THEN I am alerted that the CSV has been successfully uploaded AND the CSV file is saved in the Data Page AND a report is generated in the Report Page AND the Home Page is updated • GIVEN I key in the required fields incorrectly into the template CSV WHEN I upload CSV file THEN I am alerted that the CSV upload is unsuccessful • GIVEN I successfully upload the CSV WHEN I choose the type of report I want to generate THEN I will see my desired report created in the Report Page • GIVEN I successfully upload the CSV file WHEN I download the file THEN I am able to view the file
6	<p>AS A registered user I WANT to be able to set limits for each metric (water consumption, electric consumption and carbon emission) SO THAT I can change the limits whenever I can</p>	<ul style="list-style-type: none"> • GIVEN I key in the values WHEN I click on the Set Limit Button THEN I am alerted that limits have been changed successfully AND my Home Page is updated

Non-functional Requirements

S/N	User Story	Acceptance Criteria
1	<p>AS A user I WANT to explore the website features with little to no latency SO THAT I do not waste time waiting for the webpages to load</p>	<p>GIVEN I have a decent internet connection WHEN I interact with the features of the website THEN I receive results within 5 seconds</p>
2	<p>AS A user I WANT the pages to be intuitive SO THAT I can use the website with ease</p>	<p>GIVEN I have a basic understanding of English AND I am familiar with the Internet WHEN I interact with the features of the website THEN I can use the website without seeking assistance</p>
3	<p>AS A user I WANT my account to be secure SO THAT my data is safe</p>	<p>GIVEN I do not share my login credentials with anyone WHEN I Login THEN my existing data remains unchanged</p>

Benefits

Eco-Hero will be beneficial as companies are often unable to work on the data collected in terms of carbon emission and water and electricity usage. Although most of them are able to track and log the data via trackers, they often find it difficult to draw meaningful conclusions from it. With regards to this, Eco-Hero will allow companies to track their footprint across time and departments, quickly allowing executives to identify problems and target them directly.

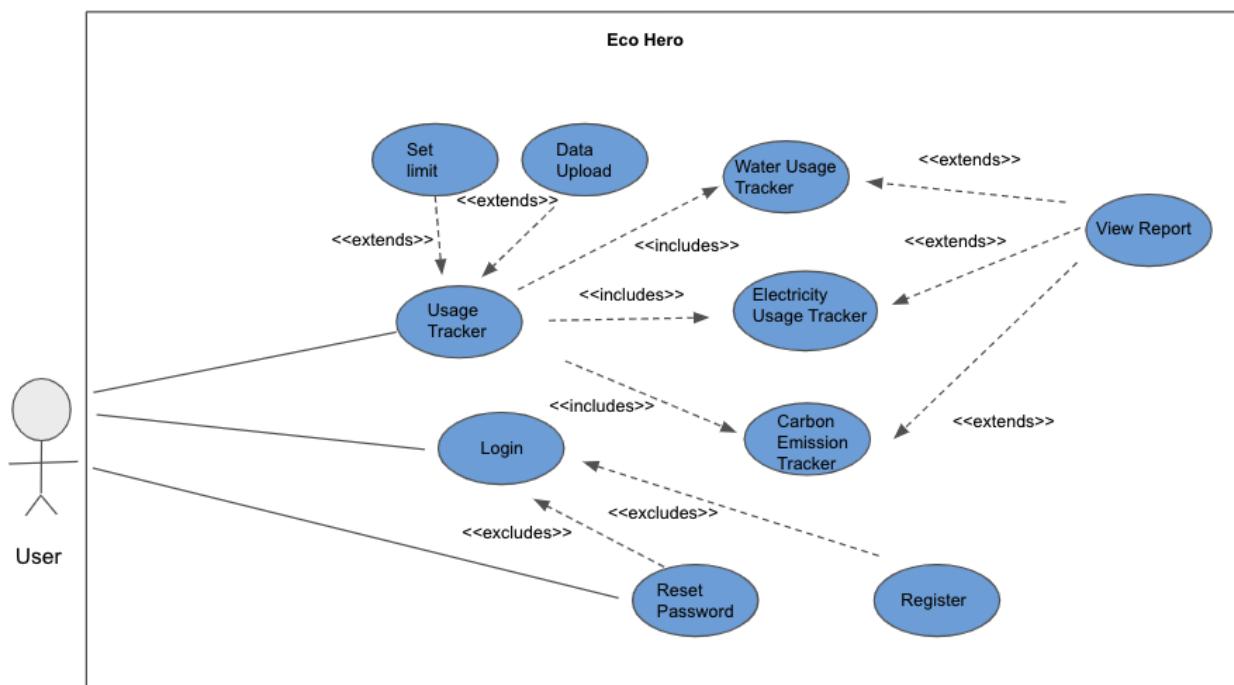
Furthermore, Eco-Hero will allow companies to set reduction targets, while also monitoring them in real time, ensuring that the company is on track to reach their own reduction targets.

Limitations

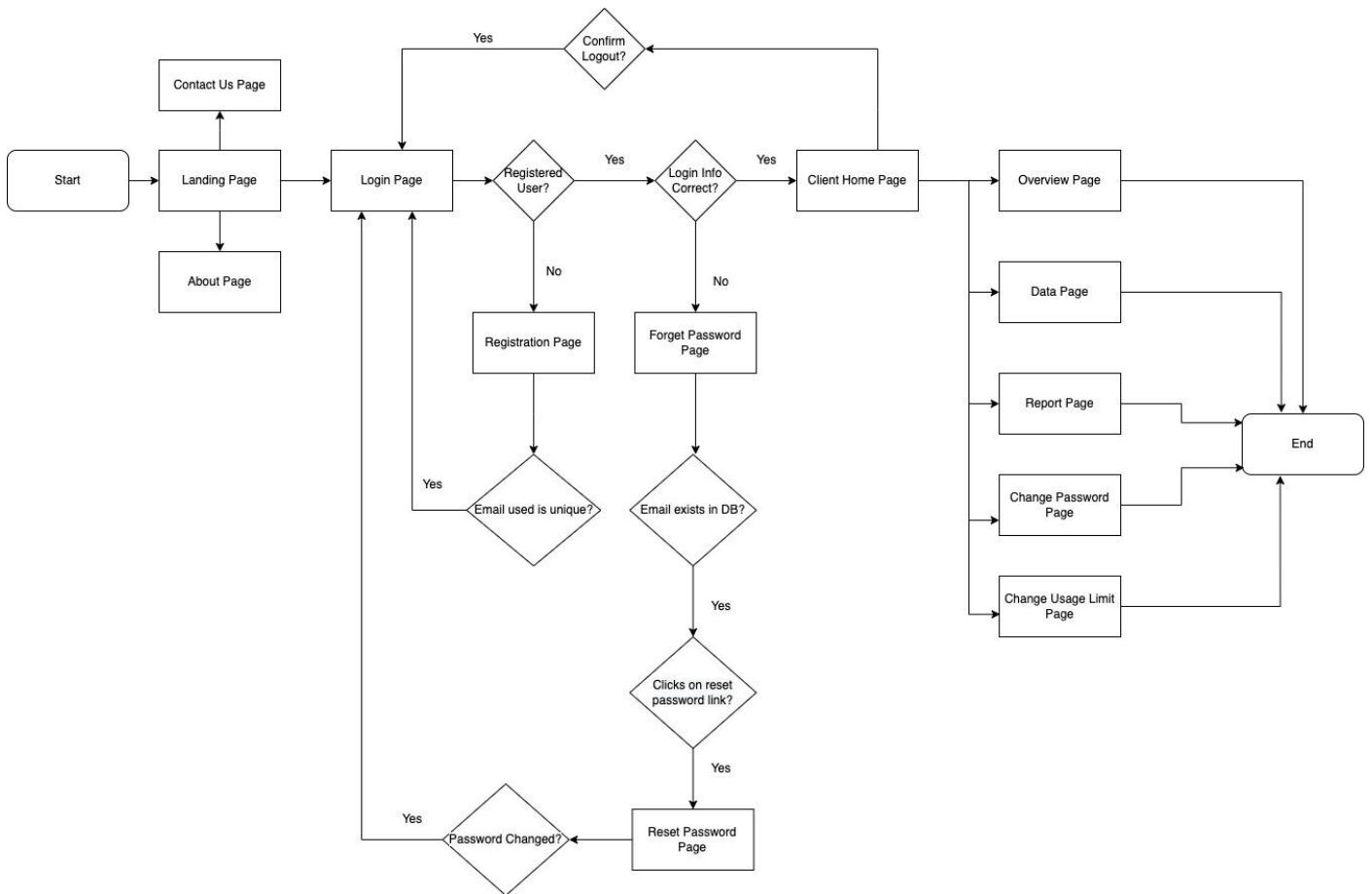
Eco-Hero depends on the company's own data input to operate. Although we have smoothed the process by just requiring a simple csv upload, all of our functions are dependent on the data input. Should the data be inaccurate or incomplete, the output of our functions could be inaccurate as well.

Eco-Hero is also dependent on the limitations set by the company's own targets, if the company has a small appetite for reduction, Eco-Hero will not be able to push for greater reductions.

Use Case Diagram



User Journey



Database Architecture

Overview

In this segment, we will cover the definition of the terms used in our database, as well as our database design. Since Firebase is a NoSQL Database that does not make use of structured relations, we will focus on designing our database to be as flat as possible such that it is optimised for querying. We will also track the list of primary/foreign keys that we are using so that we can organise and reference the way we store and retrieve data.

Data Dictionary

In this segment we will list down the names of the collections that we are using, the documents in them, and the keys used in those documents. This is for tracking and consistency purposes so that during implementation, we can standardise the way we name our files. In the accompanying paragraphs, the **names of the collections we use will be bolded and italicised**, while **names of documents and keys will be bolded**.

Firstly, in our **users** collection, we have documents that store the information of registered users of our app. The document names will follow that of a custom user UID generated by Firebase. In each document, we will track the user's first name (**firstName**), last name (**lastName**), company name (**company**), **email** and **password**. By denormalising this table out from the rest, we are able to ensure that we can efficiently query for the users' personal information for transactions such as user registration, login and reset/change password. A sample of how the data will appear in Firebase is as shown below.

"users" : {

```

"userId1" : {
    "firstName": "Ryan",
    "lastName": "Koh",
    "company": "Eco Hero",
    "email": "ryankoh@bt3103.com",
    "password": 123456
},
...
}

```

Next, in our **deps** collection, we have documents that store information on the names of the departments in a particular company. Each document name is named after the UID of the user in our **users** collection, so that we can easily query for the list of departments that belong in the user's company. Thereafter, the keys in this document represent the names of the departments in the user's company. This table is necessary so that the composite keys needed to query the collections that store the user's water, electricity and carbon consumption across each individual department can be formed quickly. Sample data structure shown below:

```

"deps" : {
    "userId1" : {
        "finance" : true,
        "hr" : true,
        "transport" : true,
        ...
    },
    ...
}

```

In our **dataUploads** collection, we have documents that store information on the location and timestamp of the user's uploaded csv data files. The names of these documents follow the same UID as the user in our **users** collection. In each document, we have a subdocument that represents the data file the user uploads. These subdocument have the following naming convention: **logDDMMYYYY**, where DD, MM and YYYY represent the day, month and year the file was uploaded respectively. Finally in each subdocument, we store the relative path of the data file and the full timestamp of when the data file was uploaded. This collection was again denormalised out from our **deps** and **users** collection, so that we can efficiently query this information should the user want to remove a particular data file that was erroneously uploaded. In addition, this method of preserving the original data file, would mean that we can quickly retrieve the erroneous records tied to this file from firebase and delete them. Sample data structure shown below:

```

"dataUploads" : {
    "userId1" : {
        "log22022022" : {
            "path" : "<relative file path containing log22022022>",
            "timestamp" : "2012-04-23T18:25:43.511Z"
        },
        ...
    },
    ...
}

```

Then, in our **limits** collection, we have documents storing the limits for each resource that is set by the user. Again, this collection was separated out from the tables above so that we can efficiently query for the

limits, such that the user can view them on our home page, or add/update their values. The document names as such would follow the user's UID in the **users** collection. Sample data structure shown below.

```
"limits" : {  
    "userId1" : {  
        "electricity" : 100,  
        "water" : 100,  
        "carbon" : 100  
    },  
    ...  
}
```

Finally, in our **xUsageDaily**, **xUsageMthly** and **xUsageYrly** collections, we will store information on each individual department's usage of each resource. For example, **elecUsageDaily** would store electricity usage daily, **waterUsageMthly** would store water usage monthly and **carbonUsageYrly** would store carbon emissions yearly. Using this convention, we would have a total of 9 collections to store the user's electricity (**elecUsageDaily**, **elecUsageMthly** and **elecUsageYrly**), water (**elecUsageDaily**, **elecUsageMthly** and **elecUsageYrly**) and carbon emissions (**carbonUsageDaily**, **carbonUsageMthly** and **carbonUsageYrly**).

In the **xUsageDaily** collections, document names are composite values composed of the user's UID, followed by the name of the department and a corresponding YYYYMM timestamp. E.g.

userId1Finance202201 would be the document that holds the daily consumption of resource x for userId1's Finance Department in January 2022. Sample data structure shown below, using electricity consumption as an example.

```
"elecUsageDaily" : {  
    "userId1Finance202201" : {  
        "1" : 10,  
        ...  
    },  
    ...  
}
```

In the **xUsageMthly** collections, document names are composite values composed of the user's UID, followed by the name of the department and a corresponding YYYY timestamp. E.g. **userId1Finance2022** would be the document that holds the monthly consumption of resource x for userId1's Finance Department in 2022. The values stored here are calculated from our data in the **xUsageDaily** collections. This is done so that we can efficiently query monthly values to project on our dashboard. The sample data structure shown below, uses electricity consumption as an example.

```
"elecUsageMthly" : {  
    "userId1Finance2022" : {  
        "Jan" : 30000,  
        ...  
    },  
    ...  
},
```

Lastly, in the **xUsageYrly** collections, document names are composite values composed of the user's UID, followed by the name of the department. E.g. **userId1Finance** would be the document that holds the yearly consumption of resource x for userId1's Finance Department. The values stored here are calculated from our data in the **xUsageMthly** collections. This is done so that we can efficiently query yearly values to

project on our dashboard. The sample data structure shown below, uses electricity consumption as an example.

```
"elecUsageYrly" : {  
    "userId1Finance" : {  
        "2022" : 360000,  
        ...  
    }  
    ...  
}
```

Database Rules

Due to the denormalisation steps that we have taken to optimise our database for querying, there exists the risk of update anomalies when we add, delete or update our data. As such, the following rules (steps) have been put in place to ensure that all the necessary tables are updated during the execution of particular transactions.

1) When adding in a daily entry:

- a) Add it into corresponding **xUsageDaily** collection
 - i) If year & month exist: Add entry into corresponding year & month
 - ii) If year / mth does not exist: Make new key, add entry in
- b) Update corresponding **xUsageMthly** collection
 - i) If year & month exist: Add new value to current total value
 - ii) If year / mth does not exist: Make new entry and increment from 0
- c) Update corresponding **xUsageYrly** collection
 - i) If year & month exist: Add new value to current total value
 - ii) If year does not exist: Make new key and increment from 0

2) For each daily entry updated:

- a) Update corresponding **xUsageDaily** collection
 - i) Store old value in a temporary (temp) variable
 - ii) Update old value with new value
- b) Update corresponding **xUsageMthly** collection
 - i) Subtract current monthly value by the old val (using temp variable)
 - ii) Add new value to current monthly value
- c) Update corresponding **xUsageYrly** collection
 - i) Subtract current yearly value by the old val (using temp variable)
 - ii) Add new value to current yearly value

3) For each daily entry deleted:

- a) Update corresponding **xUsageDaily** collection
 - i) Delete old value
 - ii) If document storing old value is empty, delete document
- b) Update corresponding **xUsageMthly** collection
 - i) Subtract current monthly value by the old value
 - ii) If monthly value is 0, delete entry
 - iii) If document storing monthly value is empty, delete document
- c) Update corresponding **xUsageYrly** collection
 - i) Subtract current yearly value by the old value
 - ii) If yearly value is 0, delete entry
 - iii) If document storing yearly value is empty, delete document

Prototype

ECO-HERO
SAVE THE WORLD, SAVE YOUR BILLS

HOMEPAGE ABOUT CONTACT US

Eco-Hero

All your bills at the tip of your fingers

Your email address

GET STARTED

Watch Video

About Us

This app is a passion project of ours, designed so that we can help bring out the inner Eco Hero in everyone. Going green is a habit, which takes time to inculcate. However, the rewards that come after developing this habit is tremendous. Our tracker is designed to be easy to use, so that you can monitor your electricity, water and carbon emissions at one glance.

We provide dashboards and simple insights so that you know which departments contribute the most to your company's overall emissions. At the same time, the smallest contributors will also be highlighted, so that they can be recognised for their eco saving habits! So what are you waiting for?

Come give our app a try and unleash the inner Eco Hero in you! Here at Eco Hero, **YOU** are the **HERO**.

ECO-HERO PTE LTD
About Us | Contact Us

Landing Page

ECO-HERO
SAVE THE WORLD, SAVE YOUR BILLS

HOMEPAGE ABOUT CONTACT US

Contact Us

We would love to hear from you!

1 Science Park Drive

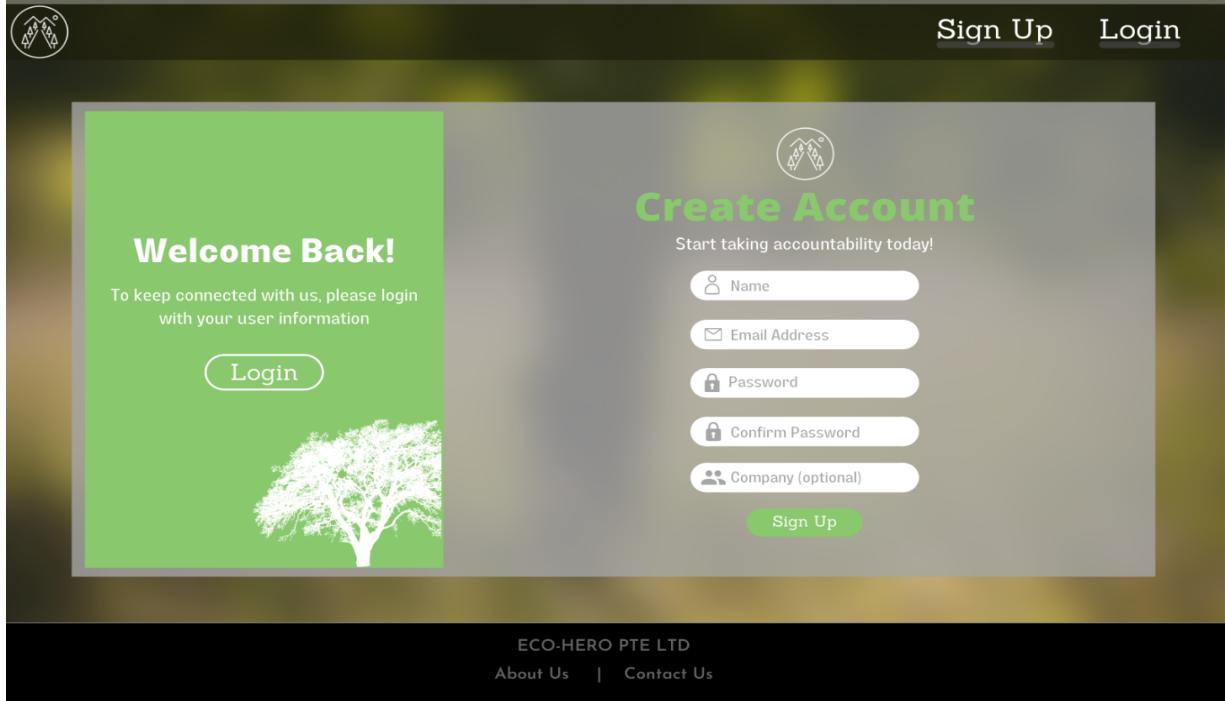
+65 6321 5678

admin@ecohero.com

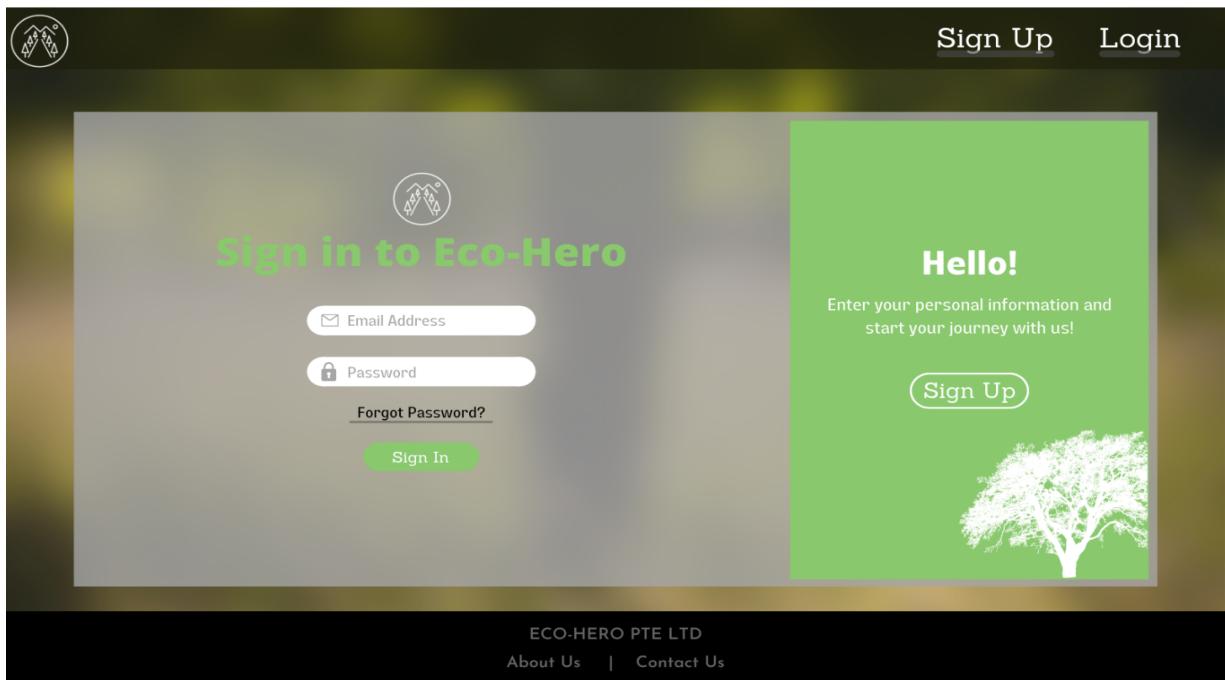
ECO-HERO PTE LTD
About Us | Contact Us

Contact Us Page

Registration Page



The screenshot shows the registration page for ECO-HERO PTE LTD. At the top right, there are "Sign Up" and "Login" buttons. On the left, a green box displays a "Welcome Back!" message and a "Login" button. On the right, a "Create Account" section features a "Start taking accountability today!" message and five input fields for Name, Email Address, Password, Confirm Password, and Company (optional). A "Sign Up" button is located below these fields. The background features a large tree silhouette.



The screenshot shows the login page for ECO-HERO PTE LTD. At the top right, there are "Sign Up" and "Login" buttons. The main area has a "Sign in to Eco-Hero" heading and two input fields for Email Address and Password. Below these is a "Forgot Password?" link and a "Sign In" button. To the right, a green box displays a "Hello!" message, an "Enter your personal information and start your journey with us!" message, and a "Sign Up" button. The background features a large tree silhouette.

Login Page



[Sign Up](#) [Login](#)

Forgot Password

Enter your email and we will send you a link to reset your password

Email Address

Submit

[Back to login](#)

ECO-HERO PTE LTD

[About Us](#) | [Contact Us](#)

Forget Password Page



[Sign Up](#) [Login](#)

Reset Password

Old Password

New Password

Confirm New Password

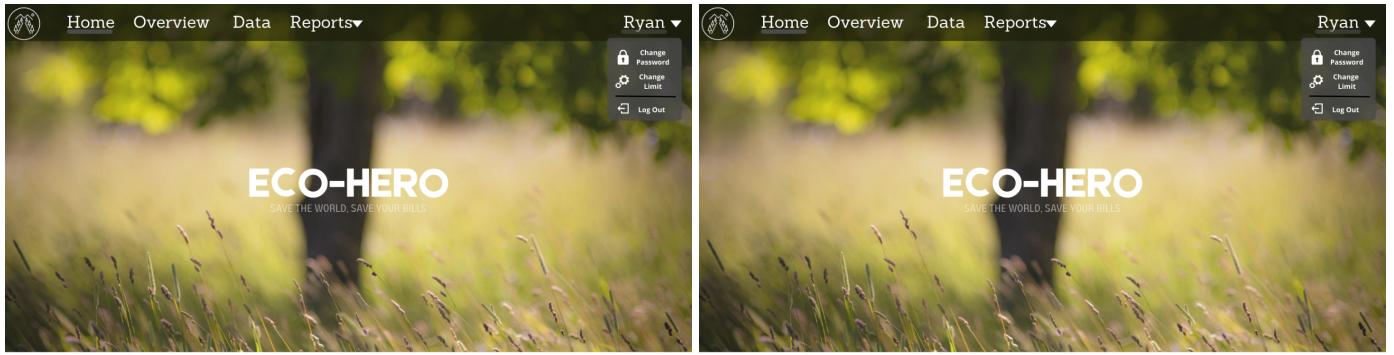
Submit

[Back to login](#)

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Reset Password Page



Welcome Ryan!

Limit has not been set. Please set your limits.
[Click here](#)

Electricity:
75 000 out of
100 000kWh used

75%

Water:
30 000 out of
100 000m³ used

30%

Carbon Emission:
90 000 out of
100 000t used

90%

Welcome Ryan!

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Home page when User is logged in

When a user is logged in, if the limit has already been set, the site on the right will show current usage against the limits set by the user. If the limits are not set yet, the user is prompted to set limits, as seen in the left display.



Home Overview Data Reports▼

Ryan ▼

Change
Password
Change
Limit
Log Out

ECO-HERO

SAVE THE WORLD, SAVE YOUR BILLS

Change Limit

Electricity

Water

Carbon Emissions

Enter Limit Here

Enter Limit Here

Enter Limit Here

ECO-HERO PTE LTD
[About Us](#) | [Contact Us](#)

[Change Usage Limit Page](#)



Change
Password
Change
Limit
Log Out

ECO-HERO

SAVE THE WORLD, SAVE YOUR BILLS

Change Password

Old Password

New Password

Confirm New Password

Submit

ECO-HERO PTE LTD

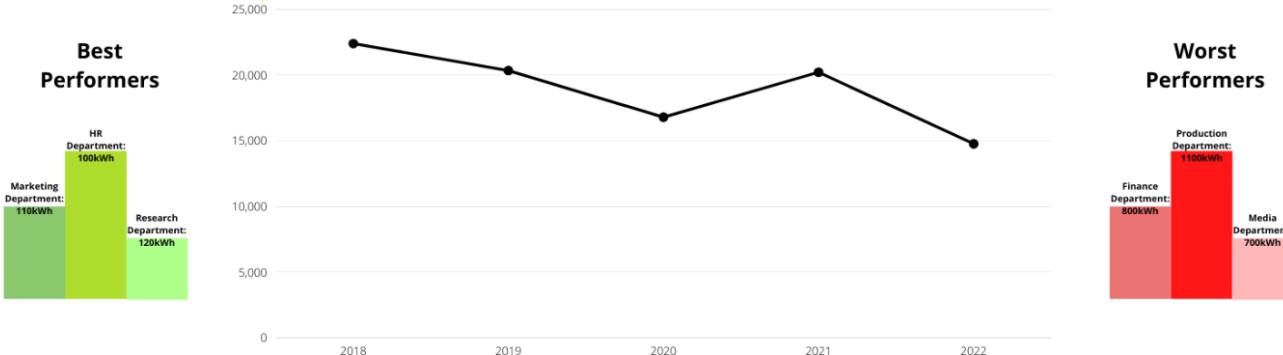
About Us | Contact Us

Change Password Page



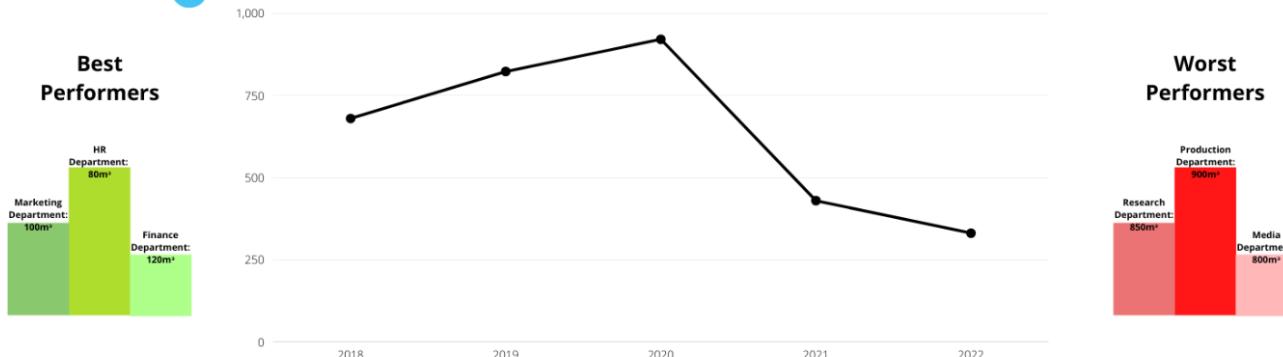
Electricity:

All time electricity



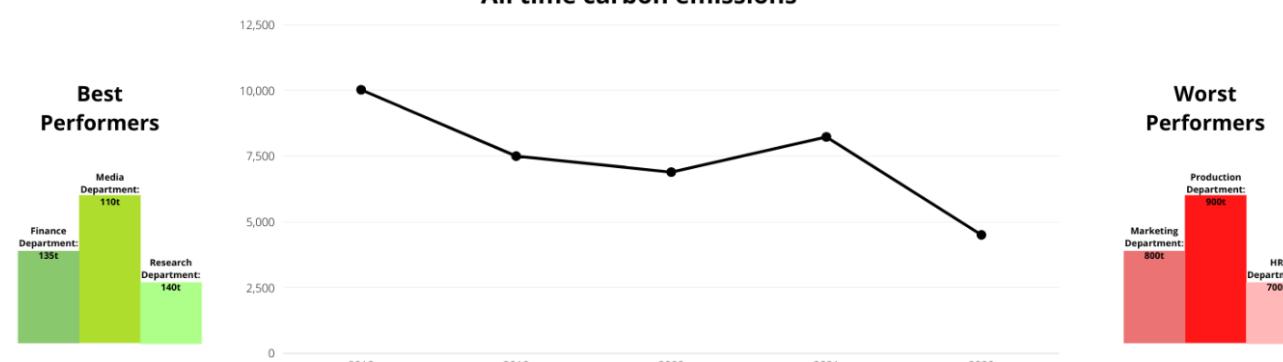
Water:

All time water



Carbon Emissions:

All time carbon emissions

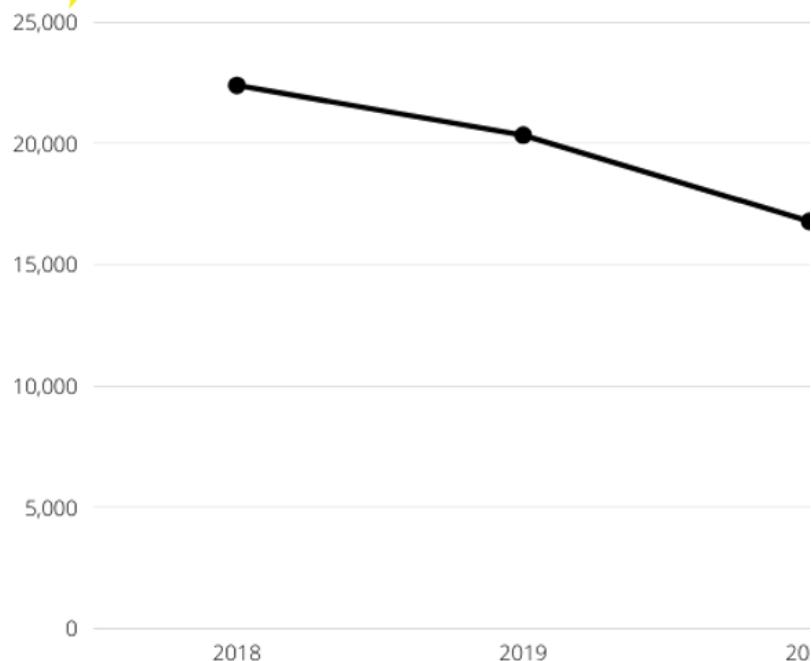
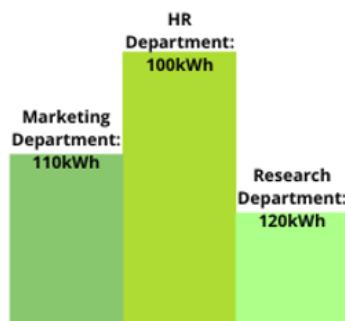


Electricity:



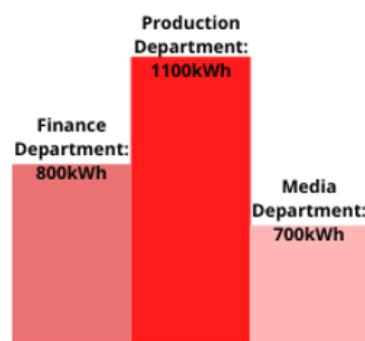
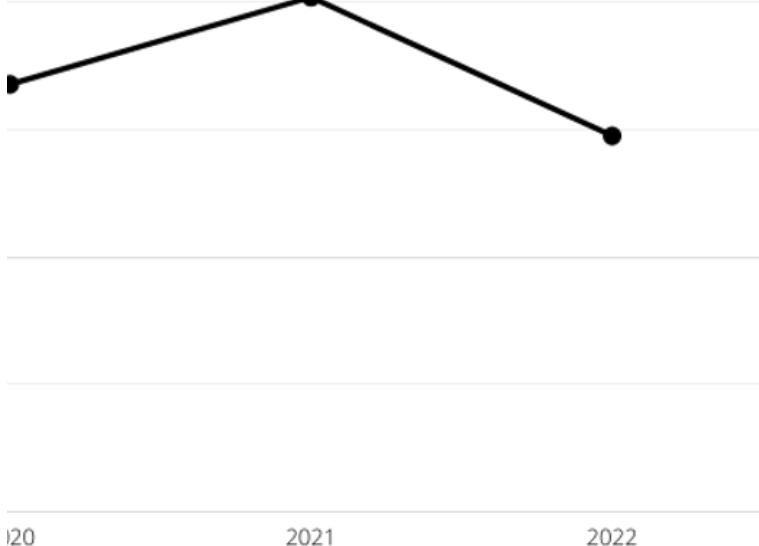
All time ele

Best Performers



Electricity

Worst Performers



Overview Page

In the overview page, we have a summary of all time usage information for the company. For example, as seen in the diagram, the top 3 departments with the least electricity usage will be on the left and top 3 departments with the most usage will be on the right. The best and worst performers are chosen based off the same logic for water usage and carbon emissions.



Excel Uploads



Upload Excel

Drag and drop or [browse your computer](#)

Support File types: .xls

Previous Uploads

[Download Excel template \(.xls\)](#)

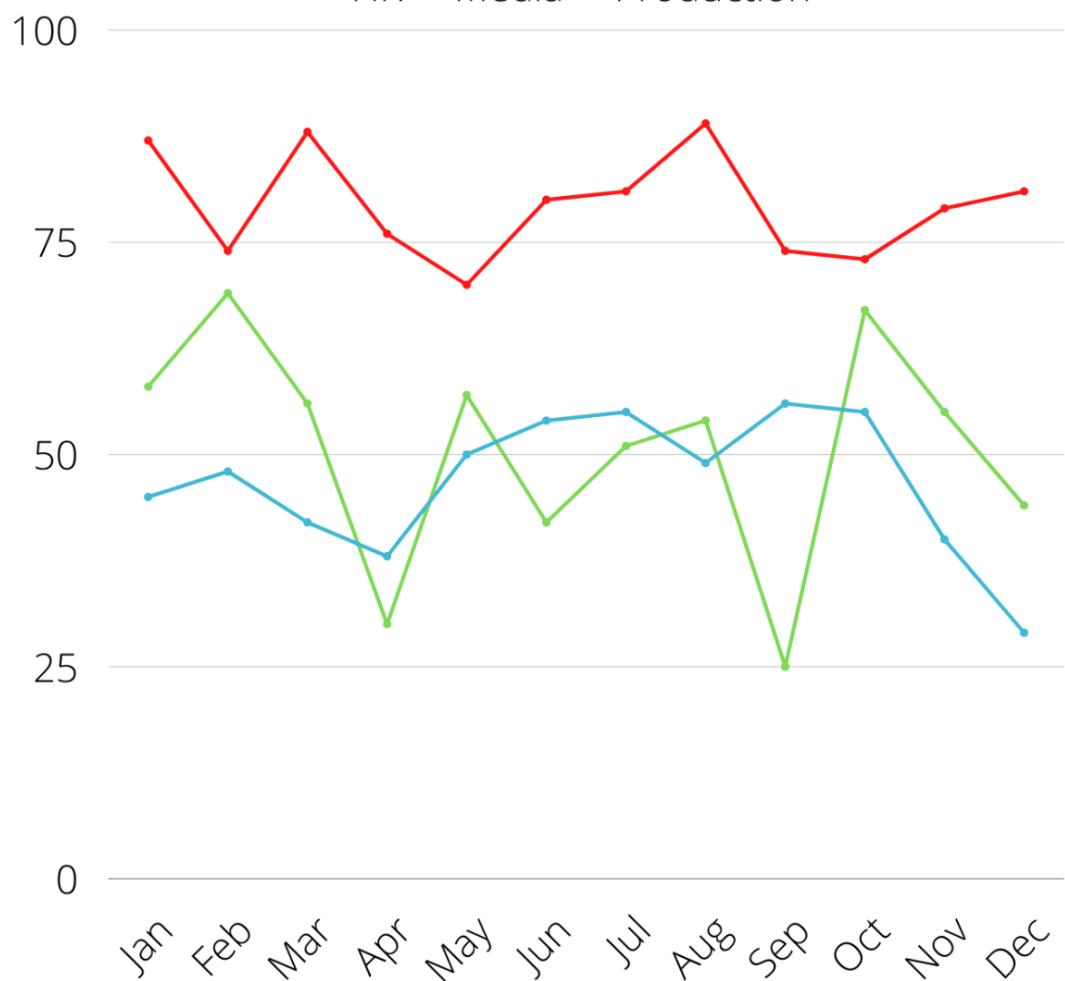
File Name	Date Uploaded	Status	Actions
Feb 2022 Data	01/03/2022	Uploaded	
Jan 2022 Data	02/02/2022	Uploaded	
Dec 2021 Data	03/01/2022	Uploaded	
Dec 2021 Data	03/01/2022	Unsuccessful	

A user can download the excel template that we have provided for them (Example above). The user can fill up the template and upload the data onto the site. Data can also be deleted by the user should there be any change. If data upload is unsuccessful, the user should reupload.

Department Level
Company Level

Department Level

■ HR ■ Media ■ Production





Company Level

Select one... ▲

- ✓ Jan
- Feb
- Mar
- Apr

Select one... ▲

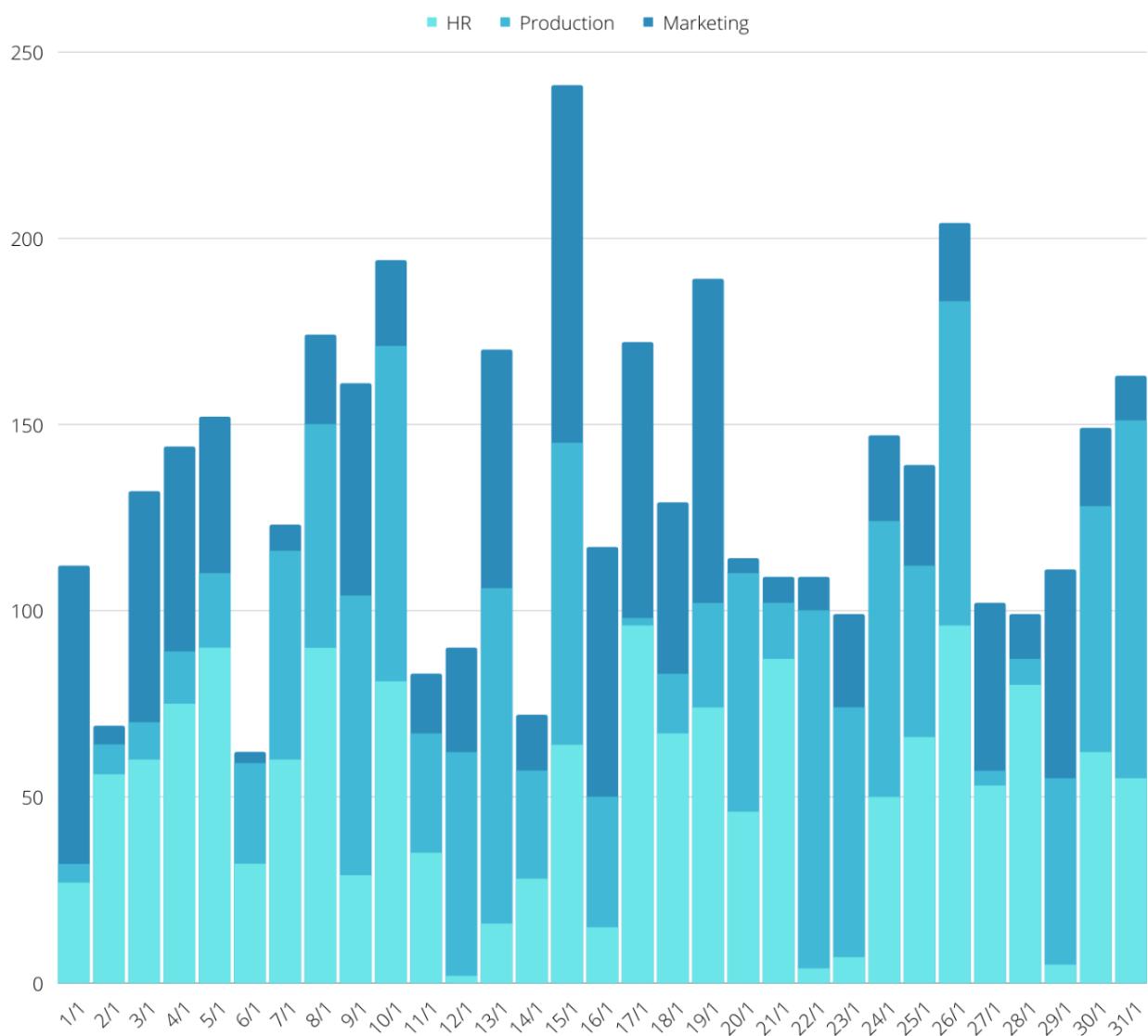
- 2018
- 2019
- 2020
- ✓ 2021

Select one... ▲

- ✓ Electricity
- Water
- Carbon

Total Electricity Usage Jan 2021	Average Electricity Usage per month 2021
4235kWh	3050kWh

Electricity usage for Jan 2021



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