Belfast Climate Data Platform

ASU AI Cloud Innovation Center

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Section 1: Project Overview

Belfast City Council partnered with Amazon Web Services and Arizona State University Cloud Innovation Center to design the Belfast Climate Data (BCD) Platform, a platform to help the City Council analyze and simulate data to reach their net zero goal by 2030. BCD platform provides a data hub with a suite of custom designed data analytics and visualizations that align to the city's climate priority initiatives. BCD makes it possible for users in and out of the city to share data through a collection tool as all climate data is included in a single space. BCD platform also provides a simulation engine to allow users to model scenarios and see the impacts of changes over time.

Also known as the AI CIC, the ASU Artificial Intelligence Cloud Innovation Center, powered by AWS, harnesses the capabilities of artificial intelligence (AI) to help global government agencies, education institutions, and nonprofits address mission-related challenges.

The information provided in this report includes flow diagrams, and a High Fidelity user interface. The content is based on the current state of the Belfast Climate Data (BCD) Platform project and may be subject to updates, changes, or improvements in the future.

Section 1.1: Problem Statement

Currently, the city of Belfast faces challenges in effectively measuring, understanding, and communicating progress towards its climate goals, including achieving net-zero emissions by 2030. The lack of a centralized and trusted source of climate data results in difficulties related to accuracy, completeness, and timeliness of information. In response to these challenges, Belfast City Council has introduced the Belfast Climate Data (BCD) platform.

Section 1.2: Approach

Belfast Climate Data Platform is an open-source, cloud based, software application users can access from any connected computer or smart device. The application is accessible to the public without a login where data can be uploaded.

Users can access raw data and build their own simulations using a variety of methods harnessing the power of artificial intelligence through a chat tool and machine learning. Users can also register and get access to upload and share data and content. Belfast Climate Data Platform has a facility to allow data producers to share data, but keep control.

Section 2: User Interface

BCD platform is a standalone platform that could be integrated into a larger data platform. It leverages the cloudscape design library to create a high fidelity functioning prototype to showcase how AWS and cloudscape can potentially be used to create a climate data platform. The approach used to create the prototype was to work using flows. The flows targeted some of the issues that Belfast Council staff faced in keeping track of their goals towards net zero emissions. Once the flows were finalized, they were used to direct the user interface.

# 2.1: Simulate a Scenario

Flow Diagram

Belfast Council Member

Simulate a scenario and request recommendations

As a Belfast council member, I want to be able to see how we are tracking towards our target goals. I want to be able to see where we will be in the future based on our current projects, and receive recommendations from AI on how where we can improve to meet our goals.
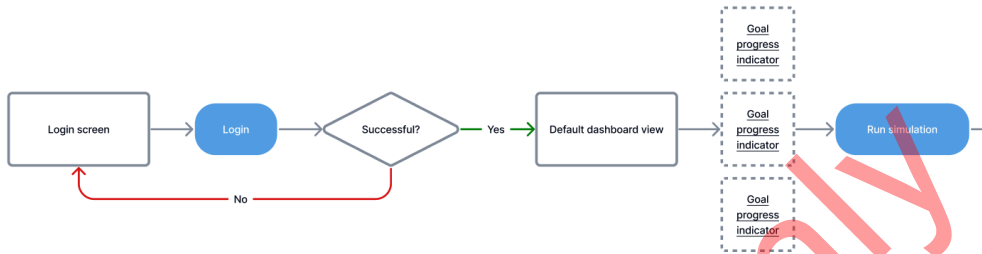
Key
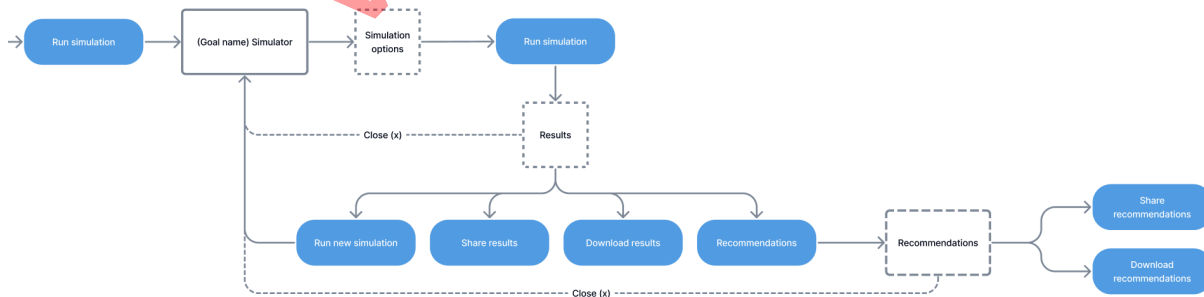
User Interface

The default dashboard allows users to view the data for the certain municipality, divided by year and category in the table view, and by jurisdiction in the map view.

Greenhouse gas emissions estimates
Data below related to C02e in Kilotons

Table view | Map view

Year	Industry Total	Commercial Total	Public Sector Total	Transport Total	LULUCF Net Emissions	Waste Management Total	Grand Total
2021	281.1	80.2	127.5	293.9	84.5	272.8	1,766.3
2020	231.0	87.4	121.7	263.3	84.4	258.6	1,647.1
2019	276.3	120.6	138.8	332.8	82.1	266.0	1,854.1
2018	311.9	114.4	138.6	341.3	83.4	256.7	1,882.5
2017	195.4	143.1	211.9	348.4	86.0	227.4	1,815.9

Grand Total Emissions — 2021
Grand total emissions, in kilotons of carbon dioxide
1766.3 kt CO2e ↓ 7% YOY

LULUCF Net Emissions — 2021
Total LULUCF net emissions, in kilotons of carbon dioxide
84.5 kt CO2e — 0% YOY

Roadway Emissions — 2021
Total roadway emissions, in kilotons of carbon dioxide
286.2 kt CO2e ↑ 12% YOY

Public Sector Emissions — 2021
Total public sector emissions, in kilotons of carbon dioxide
127.5 kt CO2e ↓ 5% YOY

Waste Management Emissions — 2021
Total waste management emissions, in kilotons of carbon dioxide
272.8 kt CO2e ↑ 5% YOY

Commercial Emissions — 2021
Total emissions by commercial, in kilotons of carbon dioxide
80 kt CO2e ↓ 8% YOY

Industry Emissions — 2021
Total industry emissions, in kilotons of carbon dioxide
2741 kt CO2e ↑ 3% YOY

Domestic Emissions — 2021
Total domestic emissions, in kilotons of carbon dioxide
3819 kt CO2e ↓ 3% YOY

Agriculture Emissions — 2021
Total agriculture emissions, in kilotons of carbon dioxide
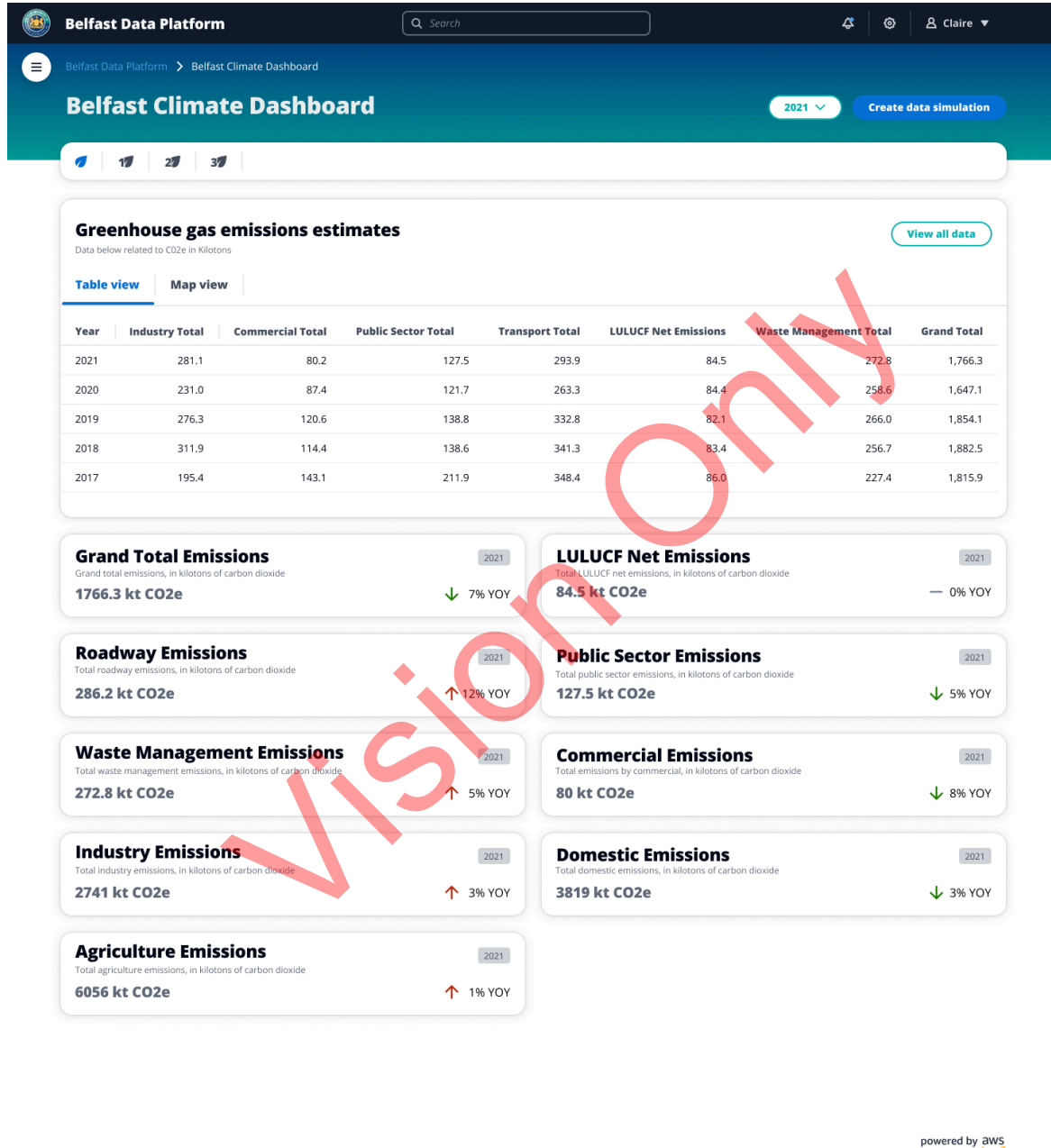**6056 kt CO2e** ↑ 1% YOY

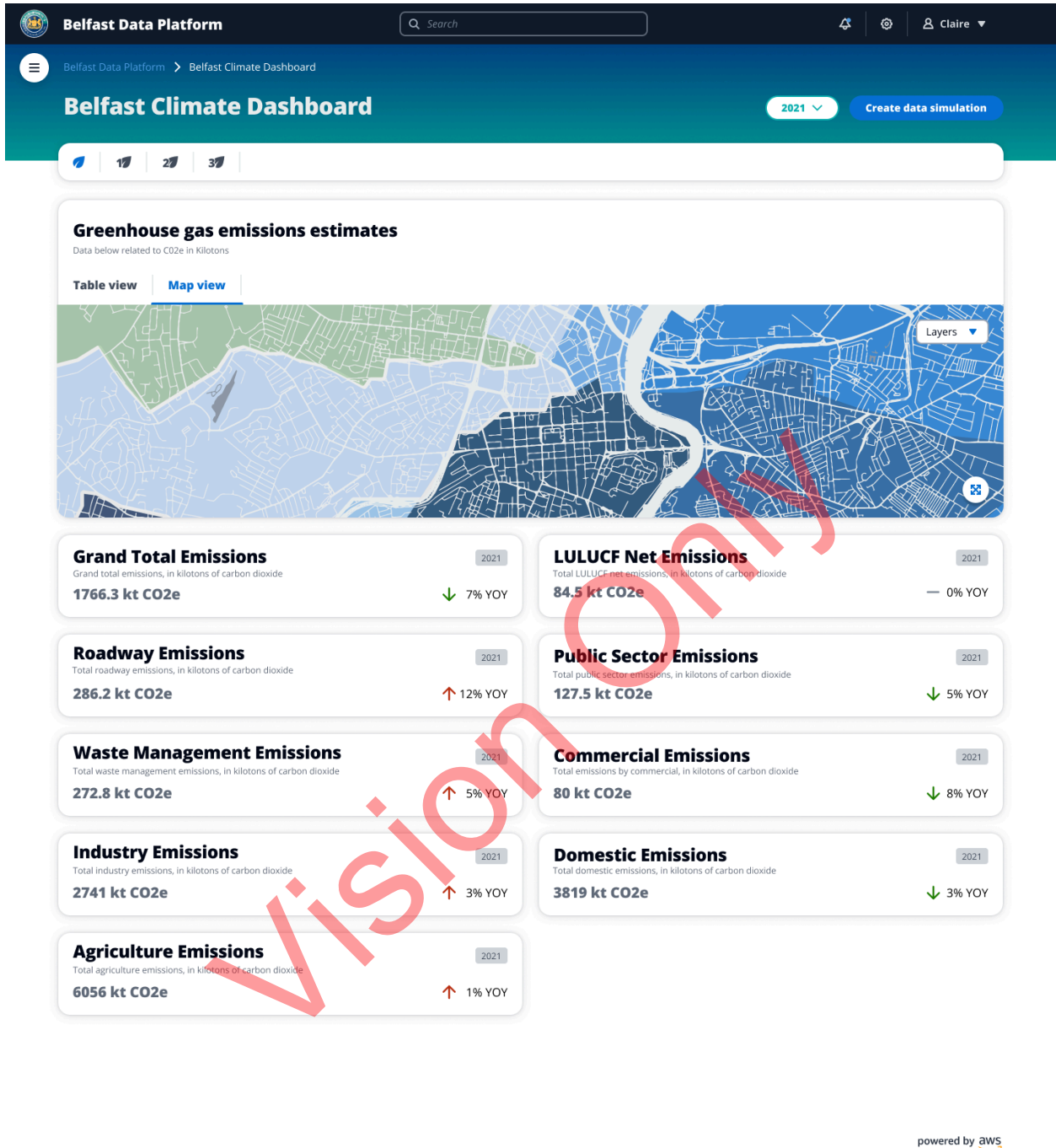*Figure X: Belfast Data Dashboard Table View*

Figure X: Belfast Data Dashboard Map View

From there, the user can create a manual or rapid simulation, based on their use case and preferences. The rapid simulation is a chat-based conversation with the machine learning software that can help the user fire off quick asks and demands of the data and receive an answer to their specific query immediately.

Figure X: Pop-up for creating a data simulation

The user can ask the simulation to perform a very specific projection of a certain category or categories over a given timeframe, in order to receive a specific result for this mitigation effort. The result can be shared and downloaded in PDF format.

Figure X: Rapid Simulation, Close Ended Query

However, the machine learning software can also answer open-ended questions. For example, if the user wondered how to lower emissions if their net zero goals have gotten off track, the simulation can put forth some mitigation efforts and strategies in order to help get back on track. Of course, there can be back and forth between the user and the simulation in order to further drill down and specify certain questions.
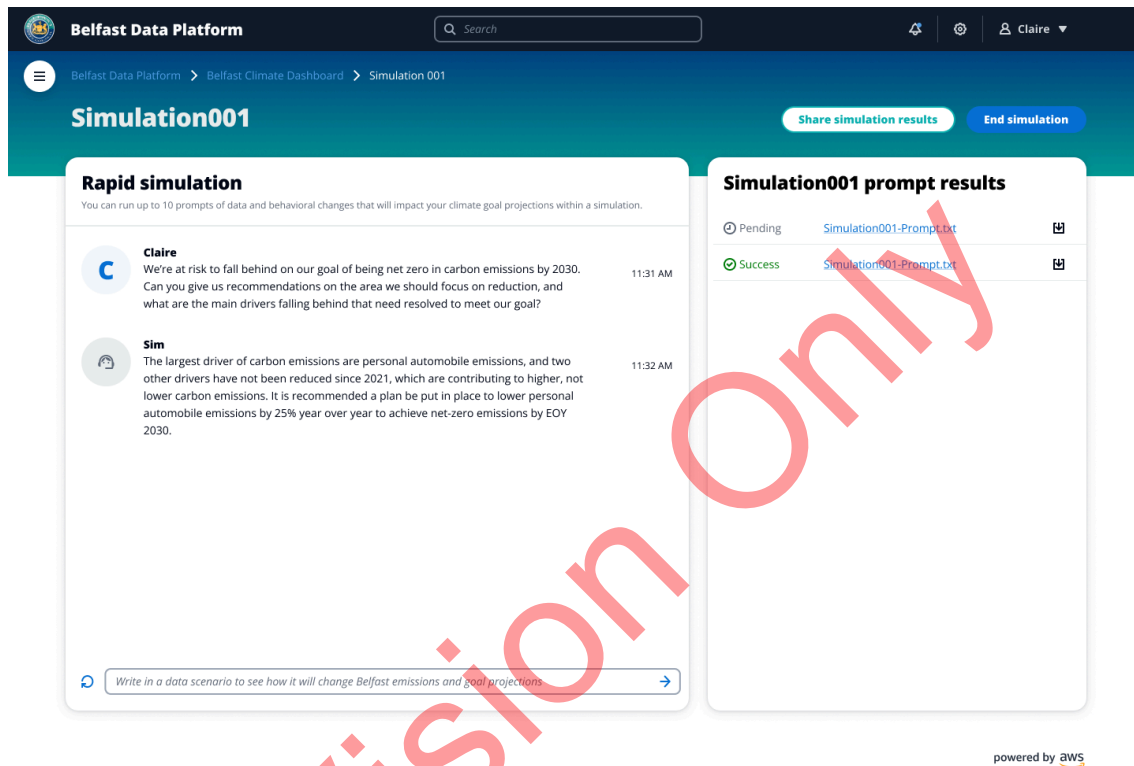
Figure X: Rapid Simulation, Open Ended Query

However, the user can also experiment themselves using the manual simulation in which they can set a target date for the attainment of net zero emissions and then alter each emissions category until they have reached their target date. This way, the user can see in real time how specific changes to various emissions categories affect the emissions of the municipality, using past data and trend forecasting to determine what effect lowering each emissions category will have on the overall target date.

Q Search

🔔 ⚙️ 👤 Claire ▼

Simulation002

Share simulation results

Manual simulation ⓘ

Adjust emissions percentage YoY to simulate scenarios on how to achieve net-zero emissions by your desired date.

Net zero date
Enter the desired date of achieving net zero emissions

31/12/2030   📅

9/1/2031
⊗ Off track by 9 days
Projected date of achieving net-zero emissions based on current simulation

---

Scope 1 emissions 441.3 kt CO2e
Grand total Tier 1 emissions, in kilotons of carbon dioxide

⊖   0 %   ⊕
YoY in kt CO2e

Scope 2 emissions 630.6 kt CO2e
Grand total Tier 2 emissions, in kilotons of carbon dioxide

⊖   0 %   ⊕
YoY in kt CO2e

Scope 3 emissions 253.1 kt CO2e
Grand total Tier 3 emissions, in kilotons of carbon dioxide

⊖   0 %   ⊕
YoY in kt CO2e

Grand Total Emissions   1325 kt CO2e
Grand total emissions, in kilotons of carbon dioxide

⊖   0%   ⊕
YoY in kt CO2e

LULUCF Net Emissions   84.50 kt CO2e
Total LULUCF Net emissions, in kilotons of carbon dioxide

⊖   0%   ⊕
YoY in kt CO2e

Roadway Emissions   286.20 kt CO2e
Total roadway emissions, in kilotons of carbon dioxide

⊖   0%   ⊕
YoY in kt CO2e

Public Sector Emissions   127.50 kt CO2e
Total public sector emissions, in kilotons of carbon dioxide

⊖   0%   ⊕
YoY in kt CO2e

Waste Management Emissions   272.80 kt CO2e
Total waste management emissions, in kilotons of carbon dioxide

⊖   0%   ⊕
YoY in kt CO2e

Commercial Emissions   80 kt CO2e
Total commercial emissions, in kilotons of carbon dioxide

⊖   0%   ⊕
YoY in kt CO2e

Industry Emissions   2741 kt CO2e
Total industry emissions, in kilotons of carbon dioxide

⊖   0%   ⊕
YoY in kt CO2e

Domestic Emissions   3819 kt CO2e
Total domestic emissions, in kilotons of carbon dioxide

⊖   0%   ⊕
YoY in kt CO2e

Agriculture Emissions   6056 kt CO2e
Total agriculture emissions, in kilotons of carbon dioxide

⊖   0%   ⊕
YoY in kt CO2e

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Figure X: Manual Simulation before any changes to categories

Belfast Data Platform > Belfast Climate Dashboard > Simulation 002

Simulation002

Share simulation results

Manual simulation ⓘ

Adjust emissions percentage YoY to simulate scenarios on how to achieve net-zero emissions by your desired date.

Net zero date
Enter the desired date of achieving net zero emissions

31/12/2030   📅

21/12/2030
⊘ On track by 10 days
Projected date of achieving net-zero emissions based on current simulation

---

Scope 1 emissions 441.3 kt CO2e
Grand total Tier 1 emissions, in kilotons of carbon dioxide

⊖   **0 %**   ⊕
YoY in kt CO2e

Scope 2 emissions 630.6 kt CO2e
Grand total Tier 2 emissions, in kilotons of carbon dioxide

⊖   **0 %**   ⊕
YoY in kt CO2e

Scope 3 emissions 253.1 kt CO2e
Grand total Tier 3 emissions, in kilotons of carbon dioxide

⊖   **0 %**   ⊕
YoY in kt CO2e

Grand Total Emissions   1325 kt CO2e
Grand total emissions, in kilotons of carbon dioxide

⊖   **0%**   ⊕
YoY in kt CO2e

LULUCF Net Emissions   84.50 kt CO2e
Total LULUCF Net emissions, in kilotons of carbon dioxide

⊖   **0%**   ⊕
YoY in kt CO2e

Roadway Emissions   169.00 kt CO2e
Total roadway emissions, in kilotons of carbon dioxide

⊖   **-50%**   ⊕
YoY in kt CO2e

Public Sector Emissions   127.50 kt CO2e
Total public sector emissions, in kilotons of carbon dioxide

⊖   **0%**   ⊕
YoY in kt CO2e

Waste Management Emissions   272.80 kt CO2e
Total waste management emissions, in kilotons of carbon dioxide

⊖   **0%**   ⊕
YoY in kt CO2e

Commercial Emissions   80 kt CO2e
Total commercial emissions, in kilotons of carbon dioxide

⊖   **0%**   ⊕
YoY in kt CO2e

Industry Emissions   2741 kt CO2e
Total industry emissions, in kilotons of carbon dioxide

⊖   **0%**   ⊕
YoY in kt CO2e

Domestic Emissions   3819 kt CO2e
Total domestic emissions, in kilotons of carbon dioxide

⊖   **0%**   ⊕
YoY in kt CO2e

Agriculture Emissions   6056 kt CO2e
Total agriculture emissions, in kilotons of carbon dioxide

⊖   **0%**   ⊕
YoY in kt CO2e
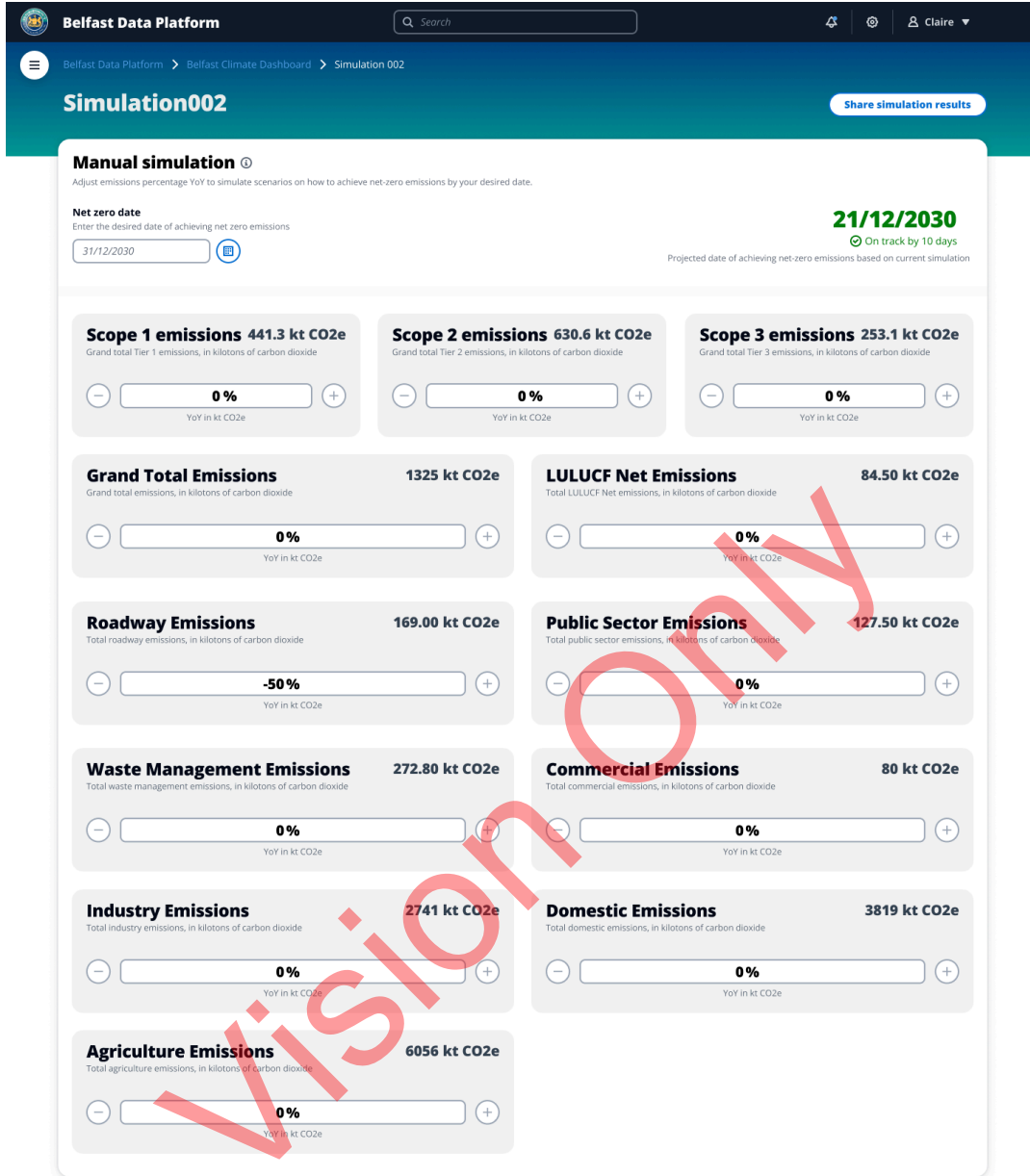
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Figure X: Manual Simulation, after categories have been modified
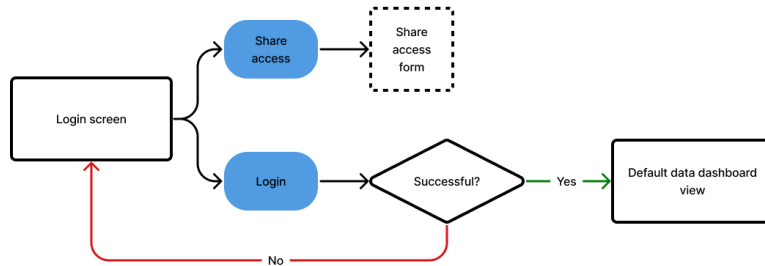
2.1 Login/ share access to dashboard

Flow Diagram

[1] Belfast Climate Council Staff

Login/ share access to dashboard

As a Belfast council member, I need to be able to easily login to view my climate data dashboard, even if the owner of my dashboard is out or away.

User Interface

Currently, only the council facing side of the BCD platform has been prototyped. As a staff of Belfast City Council, you would be required to sign into the platform. Once signed in, the staff would be able to view other data platforms as well. The idea was that the Climate dashboard can be integrated to be a part of a much larger data platform. Once the user clicks on the "Go to Dashboard" button, they will be directed to the main climate dashboard.
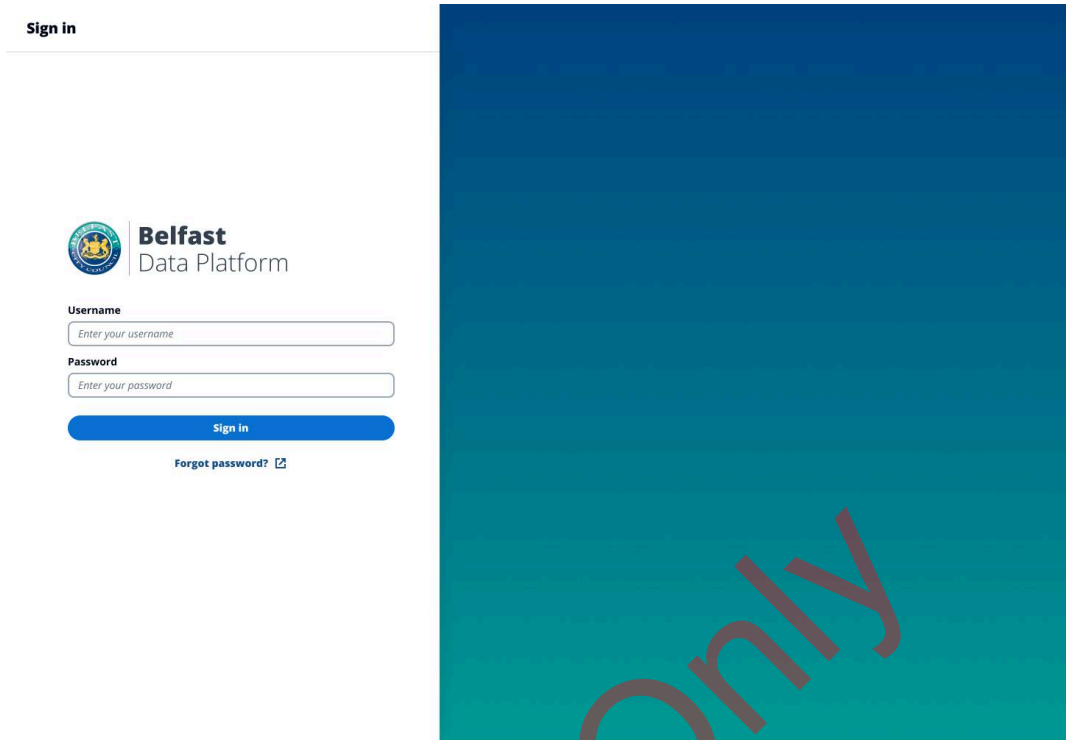
Sign in

Belfast
Data Platform

Username
Enter your username

Password
Enter your password

Sign in

Forgot password? 🔗

Figure X: Belfast Data Platform Sign In Page

Belfast Data Platform   🔍 Search   🔔 ⚙️ 👤 Claire ▼

Belfast Data Platform   ‹

Belfast Data Platform

Belfast Climate Dashboard

Voting
Climate
Healthcare
Citizenship
Crime
Traffic

Messages 1
Documentation 🔗

Climate Data   (Go to dashboard)
Last updated 12/03/2023 11:23AM GMT

Inclusive Growth   (Go to dashboard)
Last updated 09/23/2023 4:30PM GMT

Belfast Agenda   (Go to dashboard)
Last updated 12/13/2023 10:30AM GMT

**General Monitoring
Indicators**   (Go to dashboard)
Last updated 12/12/2023 3:19PM GMT

Alerts   ⌄

Data updates log   ⌄

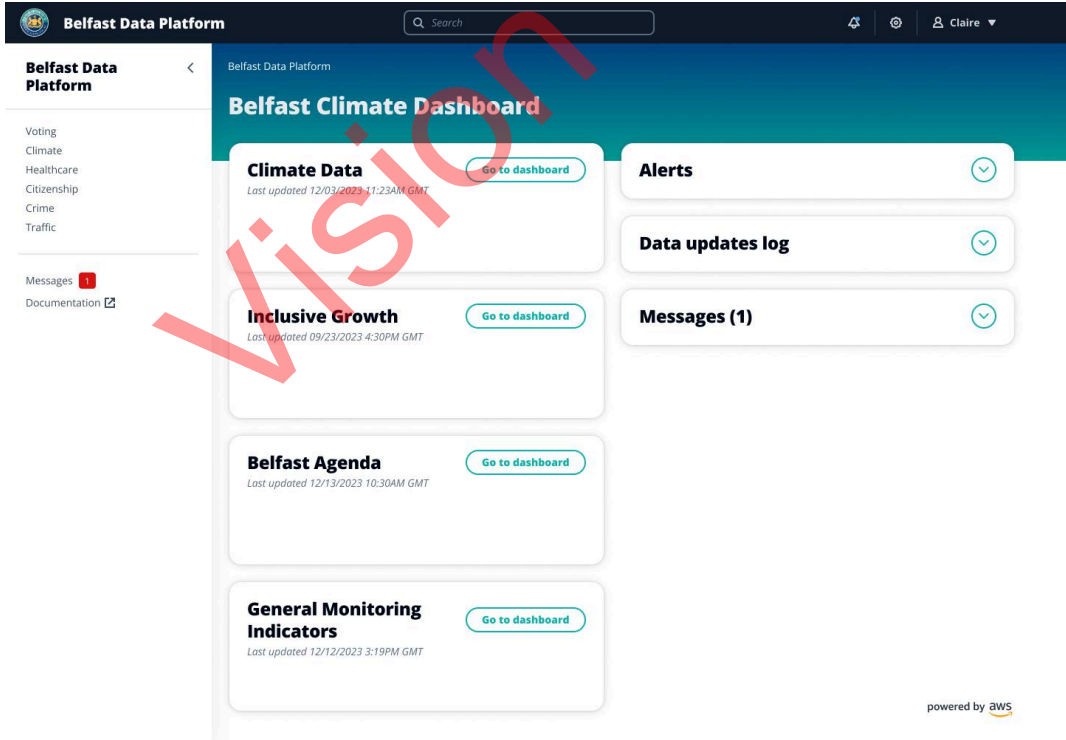**Messages (1)**   ⌄

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Figure X: Belfast Data Platform Main Page

2.2 Simulate a scenario and request recommendations

Flow Diagram

Belfast Council Member

Simulate a scenario and request recommendations

As a Belfast council member, I want to be able to see how we are tracking towards our target goals. I want to be able to see where we will be in the future based on our current projects, and receive recommendations from AI on how where we can improve to meet our goals.
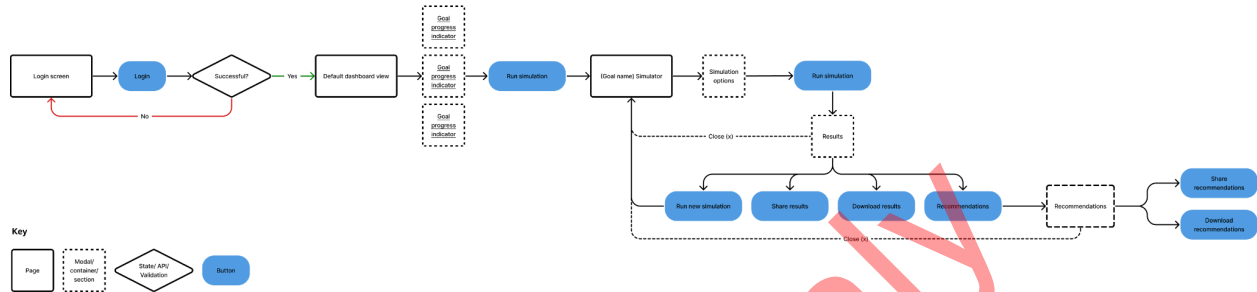
User Interface

For the simulation of a scenario, the user can manipulate past climate data in order to produce visualizations of future scenarios and pathways towards the goal of net zero for the City of Belfast.

When a user clicks "Go to Dashboard" on the landing page, the user will be directed to the Belfast Climate Data home page, where the user
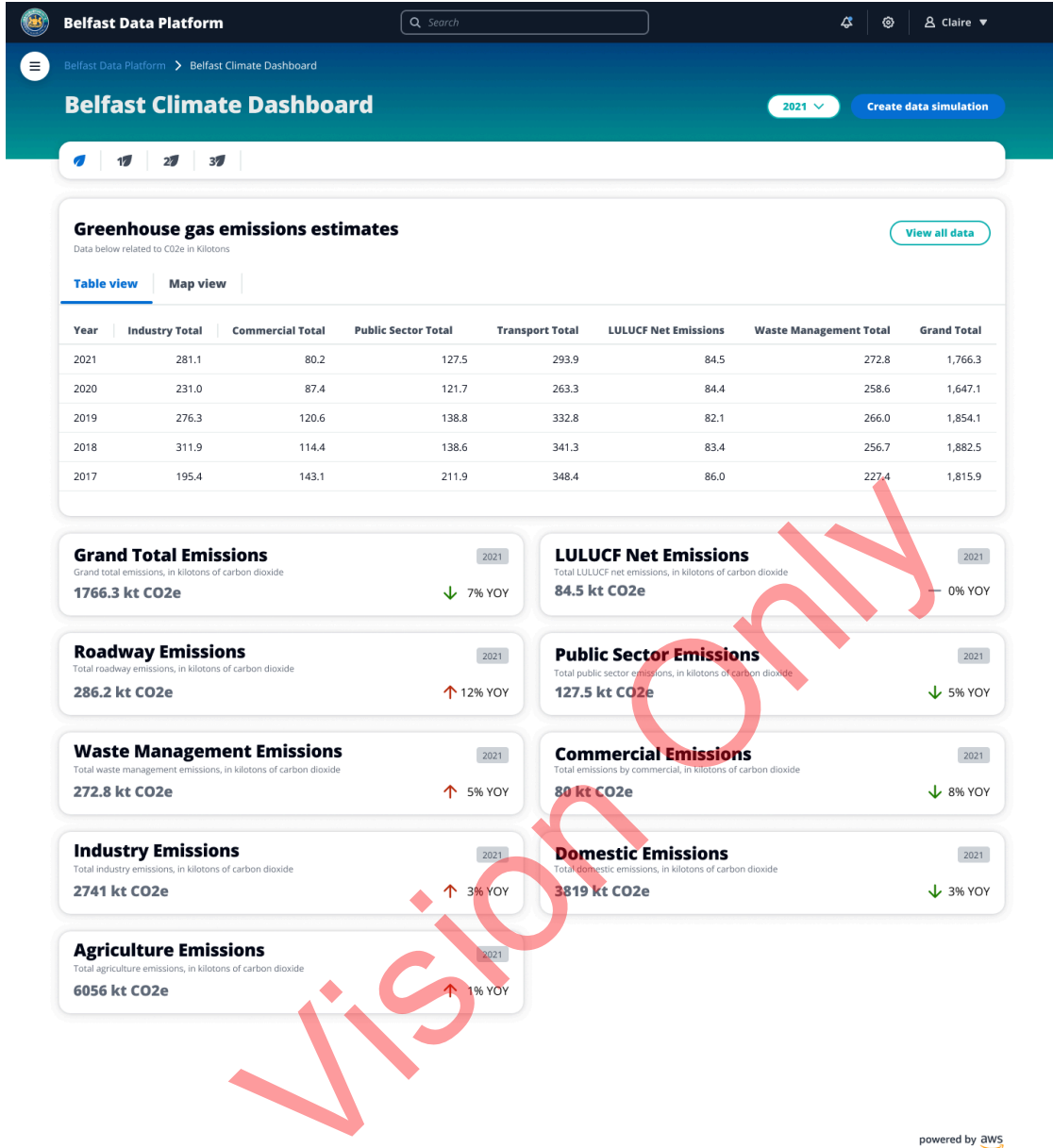
Belfast Data Platform

Belfast Data Platform > Belfast Climate Dashboard

Belfast Climate Dashboard

2021 ⌄   **Create data simulation**

Greenhouse gas emissions estimates

Data below related to C02e in Kilotons

View all data

Table view   Map view

Year	Industry Total	Commercial Total	Public Sector Total	Transport Total	LULUCF Net Emissions	Waste Management Total	Grand Total
2021	281.1	80.2	127.5	293.9	84.5	272.8	1,766.3
2020	231.0	87.4	121.7	263.3	84.4	258.6	1,647.1
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Grand Total Emissions   2021
Grand total emissions, in kilotons of carbon dioxide
1766.3 kt CO2e   ↓ 7% YOY

LULUCF Net Emissions   2021
Total LULUCF net emissions, in kilotons of carbon dioxide
84.5 kt CO2e   — 0% YOY

Roadway Emissions   2021
Total roadway emissions, in kilotons of carbon dioxide
286.2 kt CO2e   ↑ 12% YOY

Public Sector Emissions   2021
Total public sector emissions, in kilotons of carbon dioxide
127.5 kt CO2e   ↓ 5% YOY

Waste Management Emissions   2021
Total waste management emissions, in kilotons of carbon dioxide
272.8 kt CO2e   ↑ 5% YOY

Commercial Emissions   2021
Total emissions by commercial, in kilotons of carbon dioxide
80 kt CO2e   ↓ 8% YOY

Industry Emissions   2021
Total industry emissions, in kilotons of carbon dioxide
2741 kt CO2e   ↑ 3% YOY

Domestic Emissions   2021
Total domestic emissions, in kilotons of carbon dioxide
3819 kt CO2e   ↓ 3% YOY

Agriculture Emissions   2021
Total agriculture emissions, in kilotons of carbon dioxide
6056 kt CO2e   ↑ 1% YOY

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*Figure X: Belfast Climate Dashboard home page*

2.3 Download a data set contributing to a climate goal

Flow Diagram

Belfast Council Member

Download a data set contributing to a climate goal

As a Belfast council member, I want to be able to see the data that is contributing to tracking the progress towards our climate goals, and download the files so I can use them in reports and presentations to my constituents.
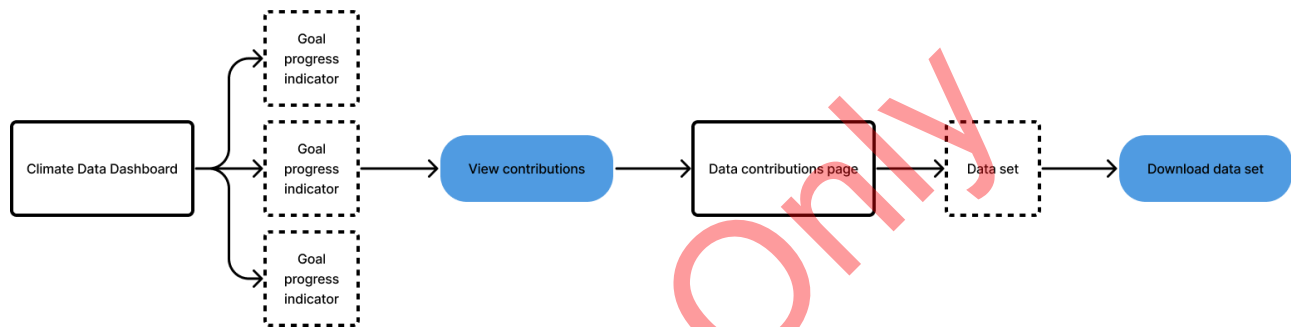
User Interface

When a user clicks on the "View all data" on the main climate dashboard, they are redirected to the climate data dashboard. Whereas the main dashboard gives an overarching view of the emissions in numbers, the climate dashboard displays visualizations of the emissions based on the underlying data. It also showcases goal progress indicators that help in the goal towards net zero by 2030.

The visualizations on this page are scrollable, which means they not only showcase visualizations based on the data of the previous year, they also create projections of what the emissions could look like in the future years based on the underlying dataset.
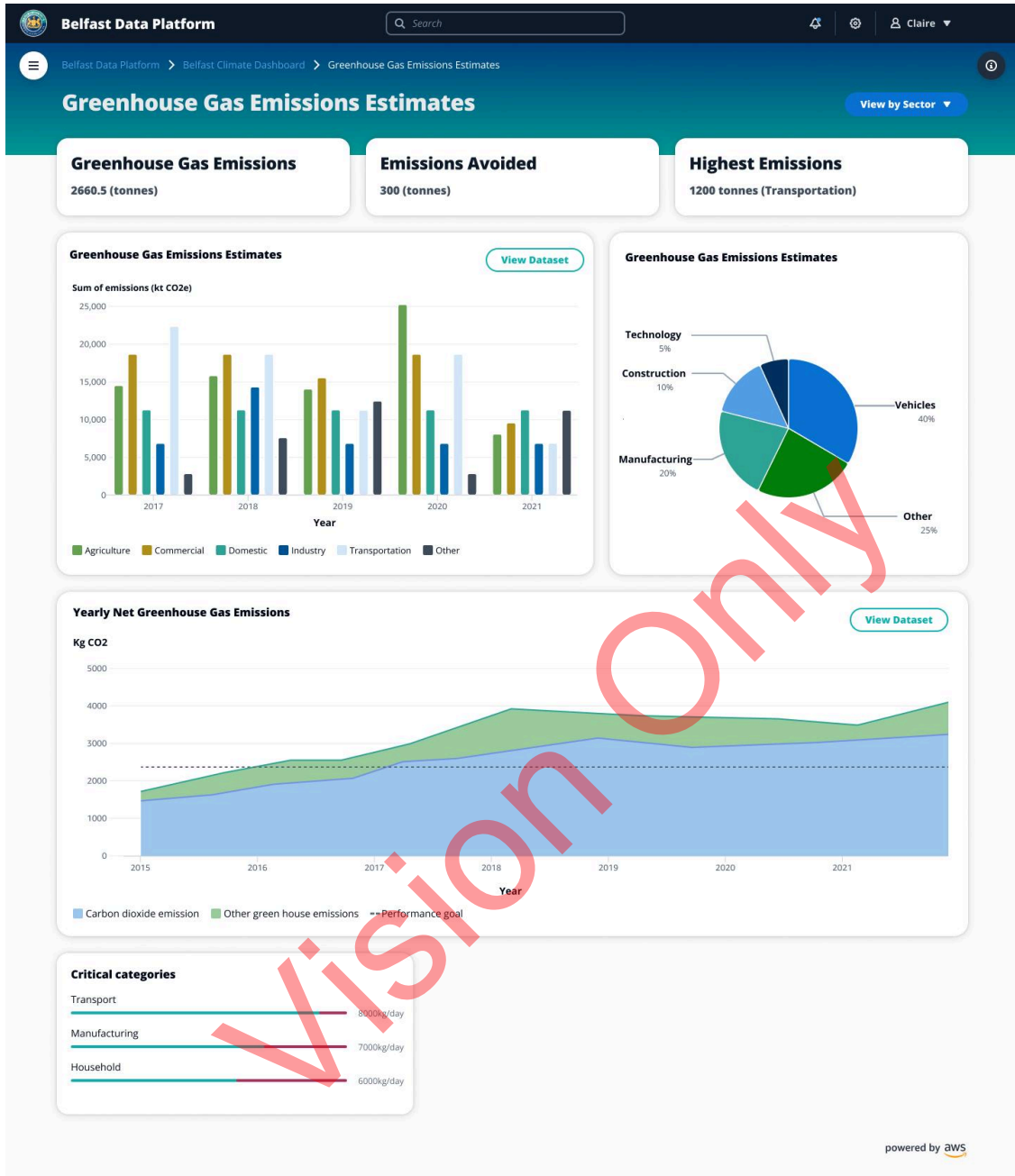
Figure X: Climate emissions graphical dashboard

Since there are several sectors within the Belfast City Council, each of them might require their own graphical representations of the emissions by the sector. In order to assist this, the main page has a "View by Sector" button which opens a dropdown where a user can click and view emissions by sector. The emissions by sector page displays gas emissions and goal progress indicators for that specific sector.

Figure X: Climate emissions graphical dashboard - by sector

Each visualization created is from an underlying dataset. If the user wants to view the dataset for that specific visualization, they can do so by clicking on the "View Dataset" button. Once on the dataset page, the user has the option to leave comments, edit, filter and export the dataset.
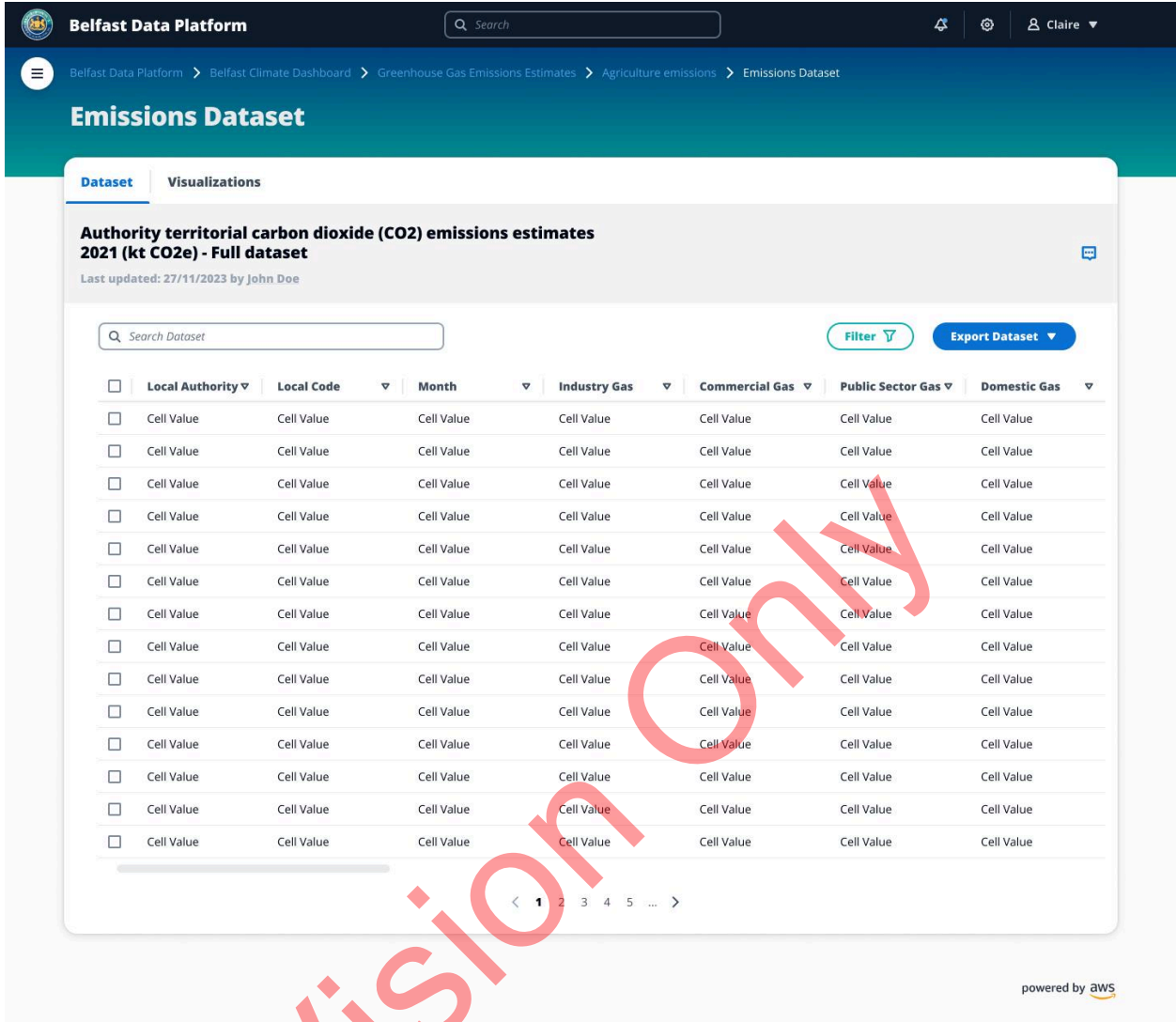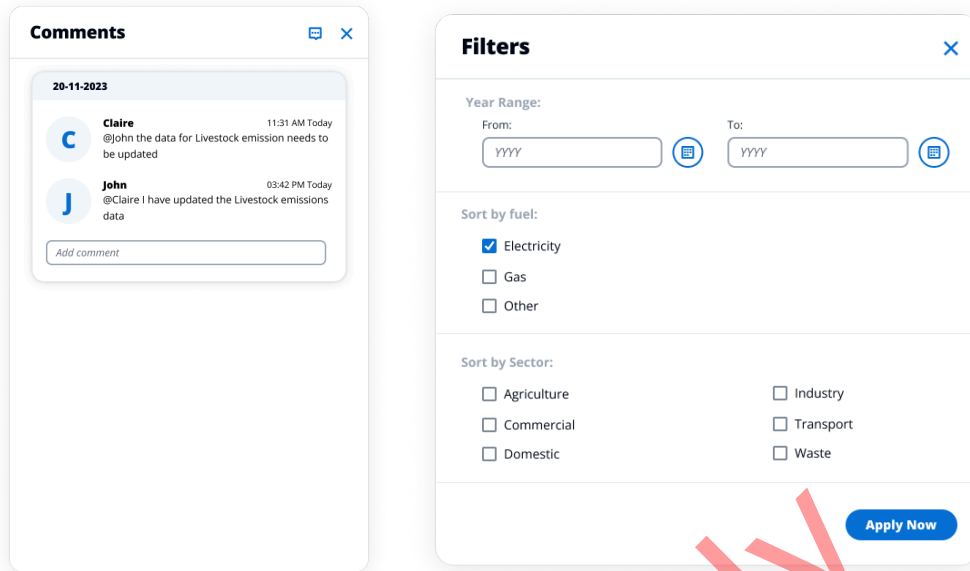
Figure X: Data set page

Figure X: Filter and Comments Modals to filter the dataset and leave comments on the dataset

The dataset page is a tab-like page where one tab consists of the dataset and the other tab consists of the visualizations feature. The Visualization tab allows users to create their own graphs and visualization based on the data of the underlying dataset. These graphs can then be exported as a pdf or png to be used in reports and presentations. Additionally, the graphs can also be exported to the climate dashboard page.
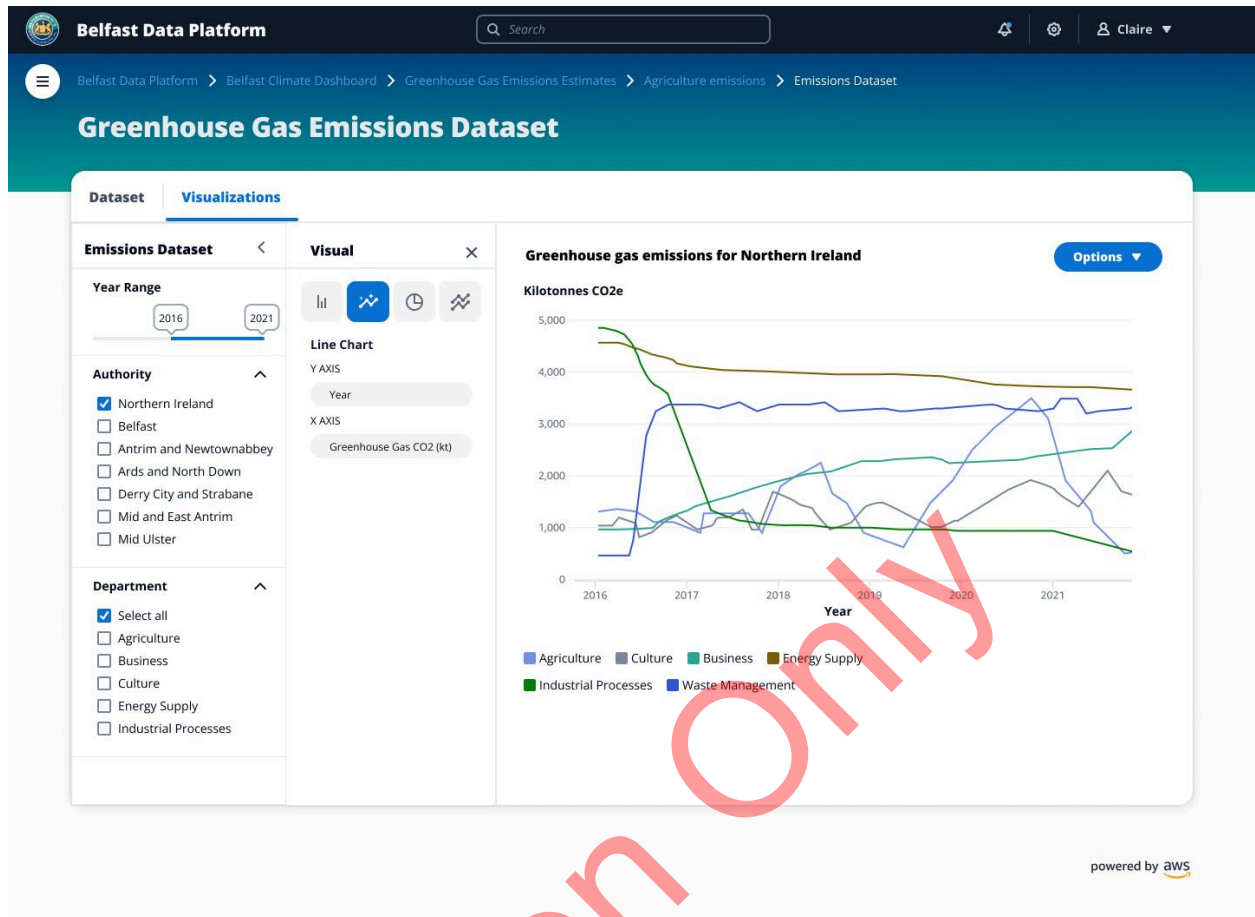
Figure X: Create Visualisations page

Section 3: Future Enhancements

The work of the ASU Cloud Innovation Center is comprehensive but not exhaustive. The current work focused on creating a prototype based on the flows approved by the client. However, there are several future enhancements that can be added to the BCD Platform. A few of them would be:

- Adding a public facing side to the BCD platform
- Prototyping how the data would be uploaded on the platform
- Prototyping how the Belfast council staff would interact with each other using the platform

Section 4: Concluding Remarks

Additional information regarding the project or other collaborations of the Arizona State University Cloud Innovation Center can be found at https://cic.asu.edu/.