Greater Manchester Domestic Energy Performance Analyser [2013 - 2023]

2.1 Introduction

Energy Performance Certificates (EPCs) provide valuable information about a building's energy efficiency and the environmental impact of CO_2 emissions. The energy performance of the building is derived based on a complex calculation involving a series of factors, each contributing toward the awarding of an energy rating. This is expressed on a scale from A (most efficient) to G (least efficient) and is intended to indicate to property owners, tenants, prospective buyers, and policymakers about the energy use of a building and the scope for further improvements.

An energy rating calculation will consider several key variables, such as the type of building (flat, house, or bungalow) and whether the property is detached, semi-detached, or terraced. The age of the building and its construction materials, including brick, stone, or timber frame, are some factors that go into the valuation. The calculation further includes the dimensions of the building, in terms of the number of floors and habitable rooms, any extension, and any rooms built into the roof.

Other relevant factors that add to the energy rating are types and size of glazing-the likes of single and double glazing-insulation on walls and roofs, and roof construction, which includes things like flat or pitched. The heating system and the type of fuel used will be important in giving them an idea of how much energy a particular building consumes and how much it affects the environment. Additional factors would be the number of chimneys, open flues, and whether energy-efficient technologies like solar panels are being used or not.

Understanding these components is important when analyzing EPC data for the realization of opportunities regarding energy savings, reduction of carbon footprint, and improvement of the general sustainability of a property. Such information will help stakeholders make informed decisions regarding energy-efficient upgrades and improvements in the environment. Therefore, this report examines the methodology and process used to collect and analyze the data from EPC, from importing it into an Azure SQL Database to visualizing it through a Power BI dashboard.

2.2 About the dataset

The EPC dataset for England and Wales carries key information such as energy ratings from A to G, building characteristics, insulation types, heating systems, CO2 emissions, and possible energy improvements. Such a dataset will really help the homeowners, landlords, tenants, and even the policy framers make informed choices on energy efficiency and track progress in terms of sustainability.

Link to the datasethttps://epc.opendatacommunities.org/login#local-authorit

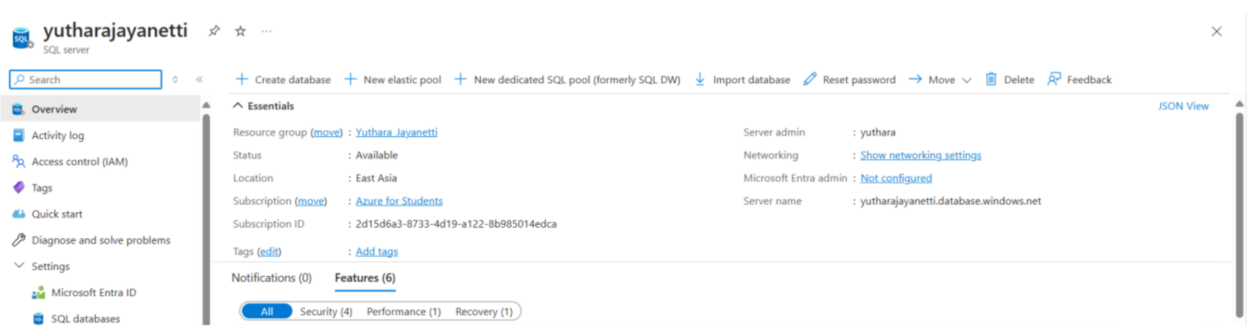
There were three Excel files in the downloaded Zip file.

1. Certificates – Which include the data of EPC calculation
2. Columns – Includes the Description of the Column headers
3. Recommendations – Includes Recommendations for further improvements.

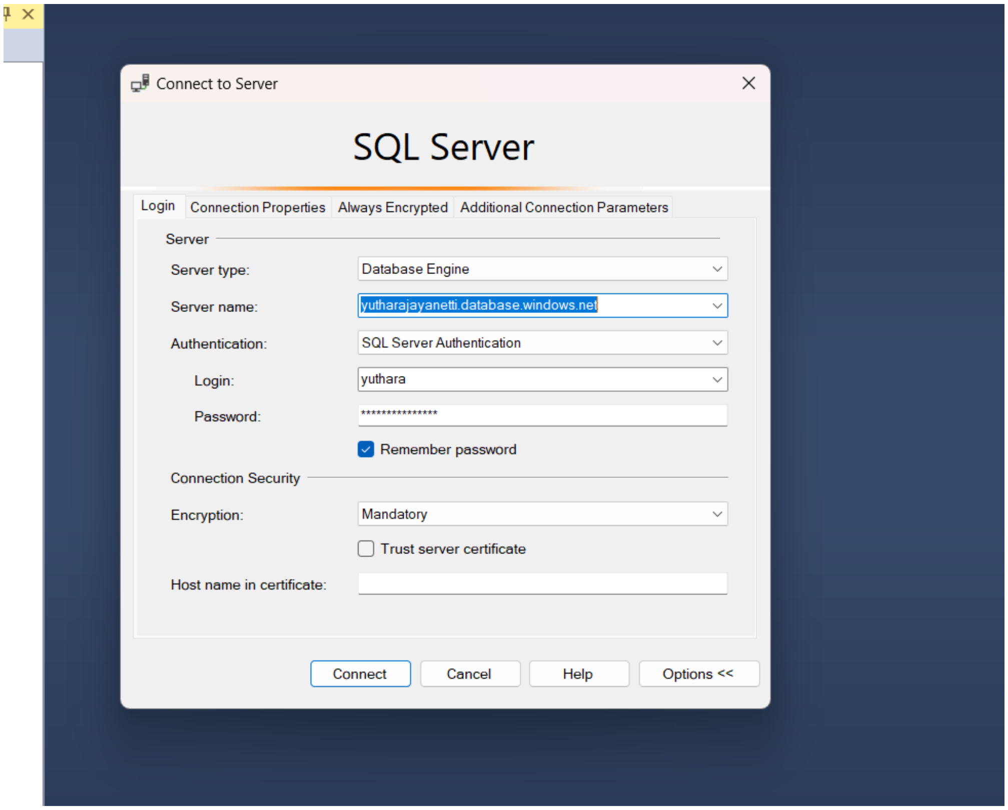
2.3 Database Utilization

The Database was created using **Microsoft Azure**. For the creation of this we followed the steps given in this file [dp900-01-sql-lab.md](dp900-01-sql-lab.md) .

Following is the dataset Created.



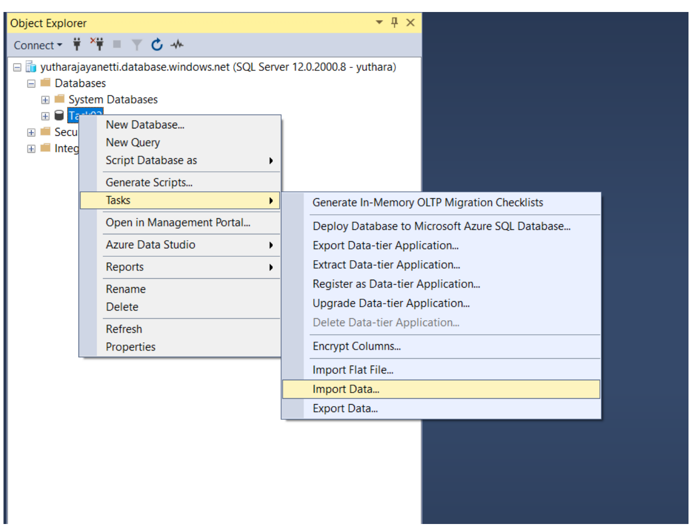
Next, we connected the Azure database to the SQL Server Management Studio using the authentications needed.



Next, we imported the dataset to the database

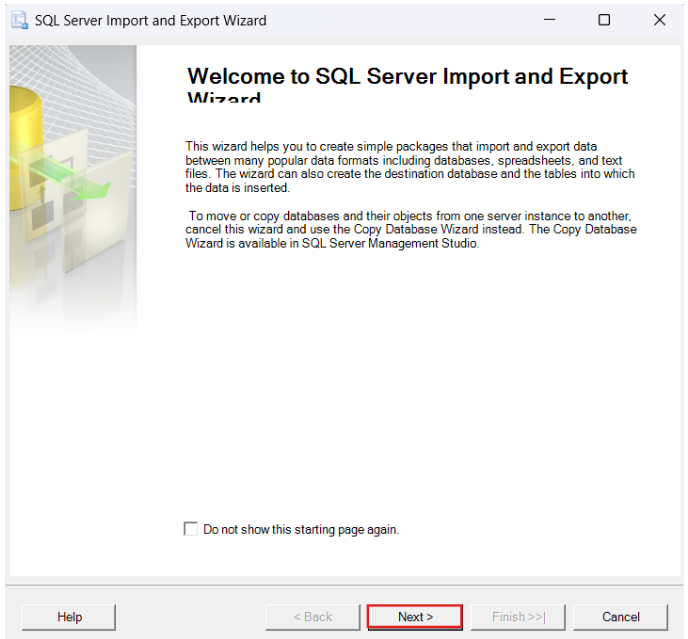
Steps:

- Right click the database and select Tasks.

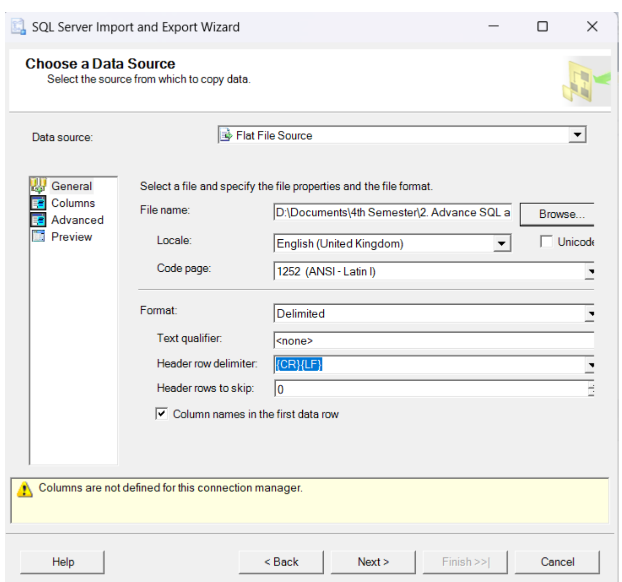


- Move to Import Data.

- Now Click next on Import data and Export Wizard welcome page.

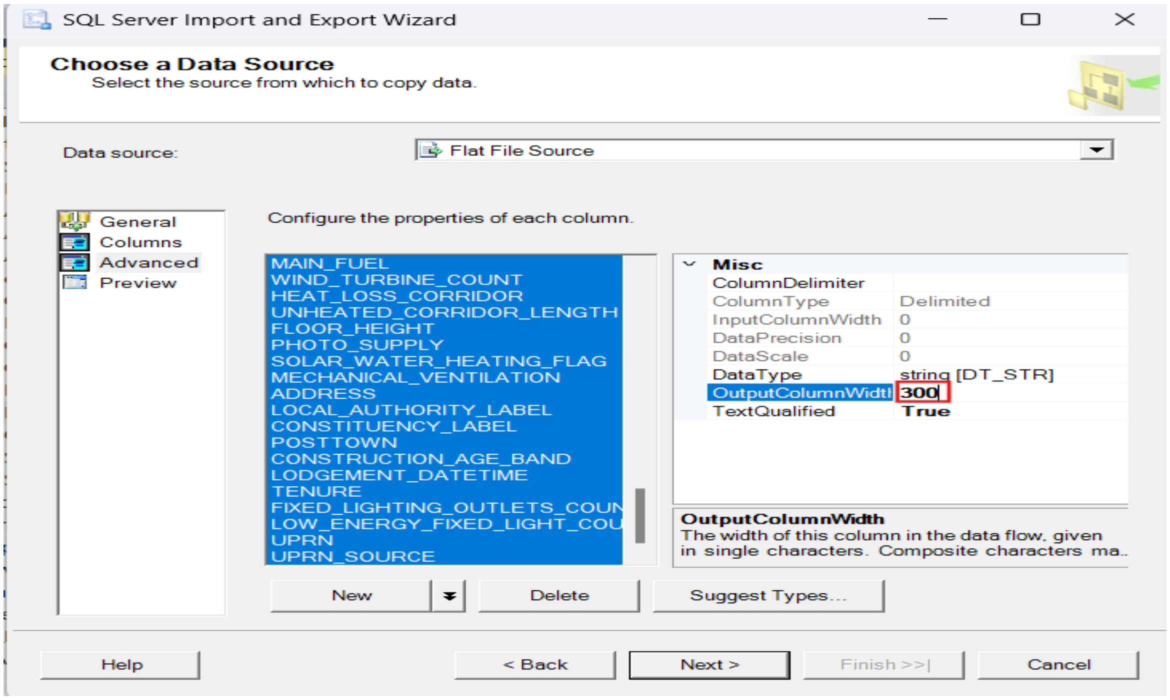


- Select flat file source as the data source and enter or browse for the file.

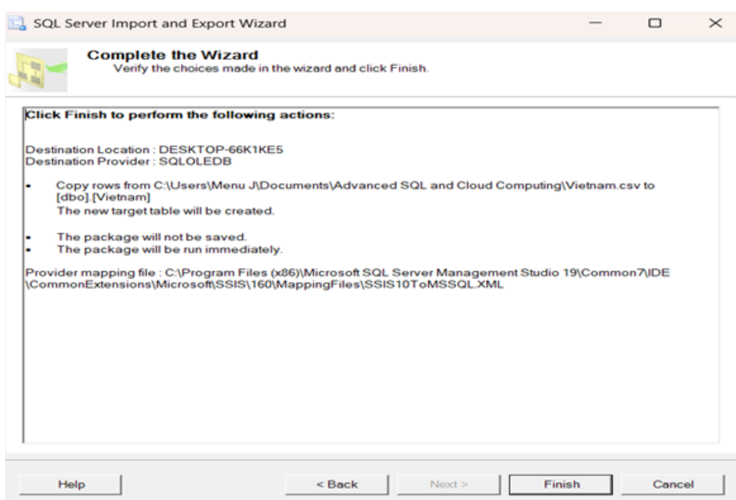


- Selecting the datasets to be imported.

Go to Advanced and change all the column widths from 50 to 300.



- Click Next to move forward.
- Click Next and Accept the default.



- Click Finish.

- The execution dialog box appears, if all the data has loaded and the execution was successful click close.

Next open a new query and explore the dataset and understand the dataset. (Identify anomalies, Missing Values)

2.3 Create View

As the next step we created Views that are needed to are analysis. We filtered data the dataset where Inspection date is between 2013 to 2023.

```
-- Created a View for Energy Performance
CREATE VIEW Vw_Energy_Data AS
SELECT
    ISNULL(NULLIF(LMK_KEY, ''), 'NA') AS LMK_KEY,
    ISNULL(NULLIF(POSTCODE, ''), 'NA') AS POSTCODE,
    ISNULL(NULLIF(CONSTITUENCY, ''), 'NA') AS CONSTITUENCY,
    ISNULL(NULLIF(COUNTY, ''), 'NA') AS COUNTY,
    ISNULL(NULLIF(LOCAL_AUTHORITY, ''), 'NA') AS LOCAL_AUTHORITY,
    ISNULL(NULLIF(BUILDING_REFERENCE_NUMBER, ''), 'NA') AS BUILDING_REFERENCE_NUMBER,
    ISNULL(NULLIF(CURRENT_ENERGY_RATING, ''), 'NA') AS CURRENT_ENERGY_RATING,
    ISNULL(NULLIF(POTENTIAL_ENERGY_RATING, ''), 'NA') AS POTENTIAL_ENERGY_RATING,
    ISNULL(NULLIF(CURRENT_ENERGY_EFFICIENCY, ''), 'NA') AS CURRENT_ENERGY_EFFICIENCY,
    ISNULL(NULLIF(POTENTIAL_ENERGY_EFFICIENCY, ''), 'NA') AS POTENTIAL_ENERGY_EFFICIENCY,
    ISNULL(NULLIF(ENVIRONMENT_IMPACT_CURRENT, ''), 'NA') AS ENVIRONMENT_IMPACT_CURRENT,
    ISNULL(NULLIF(ENVIRONMENT_IMPACT_POTENTIAL, ''), 'NA') AS ENVIRONMENT_IMPACT_POTENTIAL,
    ISNULL(NULLIF(ENERGY_CONSUMPTION_CURRENT, ''), 'NA') AS ENERGY_CONSUMPTION_CURRENT,
    ISNULL(NULLIF(ENERGY_CONSUMPTION_POTENTIAL, ''), 'NA') AS ENERGY_CONSUMPTION_POTENTIAL,
    ISNULL(NULLIF(CO2_EMISSIONS_CURRENT, ''), 'NA') AS CO2_EMISSIONS_CURRENT,
    ISNULL(NULLIF(CO2_EMISS_CURR_PER_FLOOR_AREA, ''), 'NA') AS CO2_EMISS_CURR_PER_FLOOR_AREA,
    ISNULL(NULLIF(CO2_EMISSIONS_POTENTIAL, ''), 'NA') AS CO2_EMISSIONS_POTENTIAL,
    ISNULL(NULLIF(HOT_WATER_ENERGY_EFF, ''), 'NA') AS HOT_WATER_ENERGY_EFF,
    ISNULL(NULLIF(HOT_WATER_ENV_EFF, ''), 'NA') AS HOT_WATER_ENV_EFF,
    ISNULL(NULLIF(FLOOR_ENERGY_EFF, ''), 'NA') AS FLOOR_ENERGY_EFF,
    ISNULL(NULLIF(FLOOR_ENV_EFF, ''), 'NA') AS FLOOR_ENV_EFF,
    ISNULL(NULLIF(WINDOWS_ENERGY_EFF, ''), 'NA') AS WINDOWS_ENERGY_EFF,
    ISNULL(NULLIF(WINDOWS_ENV_EFF, ''), 'NA') AS WINDOWS_ENV_EFF,
    ISNULL(NULLIF(WALLS_ENERGY_EFF, ''), 'NA') AS WALLS_ENERGY_EFF,
    ISNULL(NULLIF(WALLS_ENV_EFF, ''), 'NA') AS WALLS_ENV_EFF,
    ISNULL(NULLIF(ROOF_ENERGY_EFF, ''), 'NA') AS ROOF_ENERGY_EFF,
    ISNULL(NULLIF(ROOF_ENV_EFF, ''), 'NA') AS ROOF_ENV_EFF,
    ISNULL(NULLIF(MAINHEAT_ENERGY_EFF, ''), 'NA') AS MAINHEAT_ENERGY_EFF,
    ISNULL(NULLIF(MAINHEAT_ENV_EFF, ''), 'NA') AS MAINHEAT_ENV_EFF,
    ISNULL(NULLIF(MAINHEATC_ENERGY_EFF, ''), 'NA') AS MAINHEATC_ENERGY_EFF,
    ISNULL(NULLIF(MAINHEATC_ENV_EFF, ''), 'NA') AS MAINHEATC_ENV_EFF,
    ISNULL(NULLIF(LIGHTING_ENERGY_EFF, ''), 'NA') AS LIGHTING_ENERGY_EFF,
    ISNULL(NULLIF(LIGHTING_ENV_EFF, ''), 'NA') AS LIGHTING_ENV_EFF
FROM [dbo].[certificates]
WHERE  CAST(INSPECTION_DATE AS DATE) BETWEEN '2013-01-01' AND '2023-12-31'; -- Filter for date range
```

```sql
--Created View For Calender Data
Create VIEW Vw_Calender_Data AS
SELECT
    ISNULL(NULLIF(LMK_KEY, ''), 'NA') AS LMK_KEY,
    ISNULL(NULLIF(POSTCODE, ''), 'NA') AS POSTCODE,
    ISNULL(NULLIF(BUILDING_REFERENCE_NUMBER, ''), 'NA') AS BUILDING_REFERENCE_NUMBER,
    ISNULL(NULLIF(INSPECTION_DATE, ''), 'NA') AS INSPECTION_DATE,
    ISNULL(NULLIF(LODGEMENT_DATE, ''), 'NA') AS LODGEMENT_DATE,
    ISNULL(NULLIF(CONSTRUCTION_AGE_BAND, ''), 'NA') AS CONSTRUCTION_AGE_BAND
FROM [dbo].[certificates]
WHERE  CAST(INSPECTION_DATE AS DATE) BETWEEN '2013-01-01' AND '2023-12-31'; -- Filter for date range
```

```sql
-- Created View For Descriptions
Create View Vw_Descriptions AS
SELECT
    ISNULL(NULLIF(LMK_KEY, ''), 'NA') AS LMK_KEY,
    ISNULL(NULLIF(POSTCODE, ''), 'NA') AS POSTCODE,
    ISNULL(NULLIF(BUILDING_REFERENCE_NUMBER, ''), 'NA') AS BUILDING_REFERENCE_NUMBER,
    ISNULL(NULLIF(FLOOR_LEVEL, ''), 'NA') AS FLOOR_LEVEL,
    ISNULL(NULLIF(FLOOR_DESCRIPTION, ''), 'NA') AS FLOOR_DESCRIPTION,
    ISNULL(NULLIF(WINDOWS_DESCRIPTION, ''), 'NA') AS WINDOWS_DESCRIPTION,
    ISNULL(NULLIF(WALLS_DESCRIPTION , ''), 'NA') AS WALLS_DESCRIPTION,
    ISNULL(NULLIF(MAIN_HEATING_CONTROLS, ''), 'NA') AS MAIN_HEATING_CONTROLS,
    ISNULL(NULLIF(ROOF_DESCRIPTION, ''), 'NA') AS ROOF_DESCRIPTION,
    ISNULL(NULLIF(MAINHEAT_DESCRIPTION, ''), 'NA') AS MAINHEAT_DESCRIPTION,
    ISNULL(NULLIF(MAINHEATCONT_DESCRIPTION, ''), 'NA') AS MAINHEATCONT_DESCRIPTION,
    ISNULL(NULLIF(LIGHTING_DESCRIPTION, ''), 'NA') AS LIGHTING_DESCRIPTION,
    ISNULL(NULLIF(HEAT_LOSS_CORRIDOR, ''), 'NA') AS HEAT_LOSS_CORRIDOR,
    ISNULL(NULLIF(UNHEATED_CORRIDOR_LENGTH, ''), 'NA') AS UNHEATED_CORRIDOR_LENGTH,
    ISNULL(NULLIF(FLOOR_HEIGHT, ''), 'NA') AS FLOOR_HEIGHT,
    ISNULL(NULLIF(PROPERTY_TYPE, ''), 'NA') AS PROPERTY_TYPE,
    ISNULL(NULLIF(BUILT_FORM, ''), 'NA') AS BUILT_FORM,
    ISNULL(NULLIF(TRANSACTION_TYPE, ''), 'NA') AS TRANSACTION_TYPE,
    ISNULL(NULLIF(TOTAL_FLOOR_AREA, ''), 'NA') AS TOTAL_FLOOR_AREA,
    ISNULL(NULLIF(MAINS_GAS_FLAG, ''), 'NA') AS MAINS_GAS_FLAG,
    ISNULL(NULLIF(FLAT_TOP_STOREY, ''), 'NA') AS FLAT_TOP_STOREY,
    ISNULL(NULLIF(MULTI_GLAZE_PROPORTION, ''), 'NA') AS MULTI_GLAZE_PROPORTION,
    ISNULL(NULLIF(GLAZED_TYPE, ''), 'NA') AS GLAZED_TYPE,
    ISNULL(NULLIF(GLAZED_AREA, ''), 'NA') AS GLAZED_AREA,
    ISNULL(NULLIF(EXTENSION_COUNT, ''), 'NA') AS EXTENSION_COUNT,
    ISNULL(NULLIF(NUMBER_HABITABLE_ROOMS, ''), 'NA') AS NUMBER_HABITABLE_ROOMS,
    ISNULL(NULLIF(NUMBER_HEATED_ROOMS, ''), 'NA') AS NUMBER_HEATED_ROOMS,
    ISNULL(NULLIF(LOW_ENERGY_LIGHTING, ''), 'NA') AS LOW_ENERGY_LIGHTING,
    ISNULL(NULLIF(NUMBER_OPEN_FIREPLACES, ''), 'NA') AS NUMBER_OPEN_FIREPLACES,
    ISNULL(NULLIF(HOTWATER_DESCRIPTION, ''), 'NA') AS HOTWATER_DESCRIPTION,
    ISNULL(NULLIF(MAIN_FUEL, ''), 'NA') AS MAIN_FUEL,
    ISNULL(NULLIF(WIND_TURBINE_COUNT, ''), 'NA') AS WIND_TURBINE_COUNT,
    ISNULL(NULLIF(SOLAR_WATER_HEATING_FLAG, ''), 'NA') AS SOLAR_WATER_HEATING_FLAG,
    ISNULL(NULLIF(MECHANICAL_VENTILATION, ''), 'NA') AS MECHANICAL_VENTILATION,
    ISNULL(NULLIF(TENURE, ''), 'NA') AS TENURE,
    ISNULL(NULLIF(FIXED_LIGHTING_OUTLETS_COUNT, ''), 'NA') AS FIXED_LIGHTING_OUTLETS_COUNT,
    ISNULL(NULLIF(LOW_ENERGY_FIXED_LIGHT_COUNT, ''), 'NA') AS LOW_ENERGY_FIXED_LIGHT_COUNT
```

```sql
Create View Vw_Location AS
SELECT
    ISNULL(NULLIF(LMK_KEY, ''), 'NA') AS LMK_KEY,
    ISNULL(NULLIF(POSTCODE, ''), 'NA') AS POSTCODE,
    ISNULL(NULLIF(BUILDING_REFERENCE_NUMBER, ''), 'NA') AS BUILDING_REFERENCE_NUMBER,
    ISNULL(NULLIF(ADDRESS, ''), 'NA') AS ADDRESS,
    ISNULL(NULLIF(CONSTITUENCY_LABEL, ''), 'NA') AS CONSTITUENCY_LABEL,
    ISNULL(NULLIF(POSTTOWN, ''), 'NA') AS POSTTOWN,
    ISNULL(NULLIF(CONSTITUENCY, ''), 'NA') AS CONSTITUENCY,
    ISNULL(NULLIF(COUNTY, ''), 'NA') AS COUNTY,
    ISNULL(NULLIF(LOCAL_AUTHORITY, ''), 'NA') AS LOCAL_AUTHORITY,
    ISNULL(NULLIF(LOCAL_AUTHORITY_LABEL, ''), 'NA') AS LOCAL_AUTHORITY_LABEL,
    ISNULL(NULLIF(CONSTRUCTION_AGE_BAND, ''), 'NA') AS CONSTRUCTION_AGE_BAND
FROM [dbo].[certificates]
WHERE  CAST(INSPECTION_DATE AS DATE) BETWEEN '2013-01-01' AND '2023-12-31'; -- Filter for date range
```

```sql
-- Created View For Cost
Create View Vw_Cost AS
SELECT
    ISNULL(NULLIF(LMK_KEY, ''), 'NA') AS LMK_KEY,
    ISNULL(NULLIF(POSTCODE, ''), 'NA') AS POSTCODE,
    ISNULL(NULLIF(BUILDING_REFERENCE_NUMBER, ''), 'NA') AS BUILDING_REFERENCE_NUMBER,
    ISNULL(NULLIF(ADDRESS, ''), 'NA') AS ADDRESS,
    ISNULL(NULLIF(TENURE, ''), 'NA') AS TENURE,
    ISNULL(NULLIF(LIGHTING_COST_CURRENT, ''), 'NA') AS LIGHTING_COST_CURRENT,
    ISNULL(NULLIF(LIGHTING_COST_POTENTIAL, ''), 'NA') AS LIGHTING_COST_POTENTIAL,
    ISNULL(NULLIF(HEATING_COST_CURRENT, ''), 'NA') AS HEATING_COST_CURRENT,
    ISNULL(NULLIF(HEATING_COST_POTENTIAL, ''), 'NA') AS HEATING_COST_POTENTIAL,
    ISNULL(NULLIF(HOT_WATER_COST_CURRENT, ''), 'NA') AS HOT_WATER_COST_CURRENT,
    ISNULL(NULLIF(HOT_WATER_COST_POTENTIAL, ''), 'NA') AS HOT_WATER_COST_POTENTIAL,
    ISNULL(NULLIF(ENERGY_TARIFF, ''), 'NA') AS ENERGY_TARIFF
FROM [dbo].[certificates]
WHERE  CAST(INSPECTION_DATE AS DATE) BETWEEN '2013-01-01' AND '2023-12-31'; -- Filter for date range
```

The attached images are Screenshots of the queries we created.

Furthermore, we created a Common Table Expression (CTE)

```sql
--Removing duplicate columns using a CTE
--Checking
WITH CTE AS (
    SELECT *,
           ROW_NUMBER() OVER (PARTITION BY BUILDING_REFERENCE_NUMBER ORDER BY [INSPECTION_DATE]) AS rn
    FROM [dbo].[certificates]
)
SELECT * FROM CTE WHERE rn > 1;

--Deleting
WITH CTE AS (
    SELECT *,
           ROW_NUMBER() OVER (PARTITION BY BUILDING_REFERENCE_NUMBER ORDER BY [INSPECTION_DATE]) AS rn
    FROM [dbo].[certificates]
)
DELETE FROM CTE WHERE rn > 1;
```

We also created Stored Procedures for,

1. To summarize Energy Ratings by Property Type.

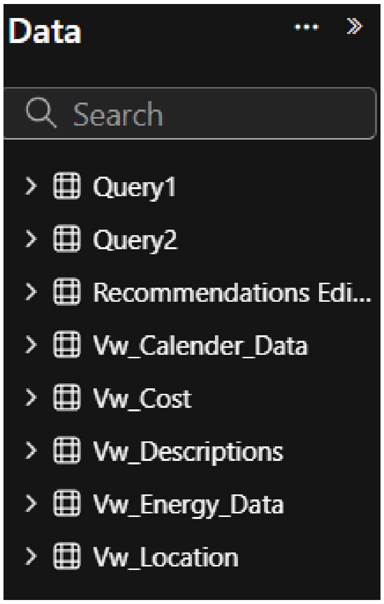
```sql
--Stored Procedures
-- To summarize energy ratings by property type.
CREATE PROCEDURE EnergyRatingsByPropertyType
AS
BEGIN
    SELECT
        [PROPERTY_TYPE],
        AVG(CAST([CURRENT_ENERGY_EFFICIENCY] AS FLOAT)) AS CURRENT_ENERGY_EFFICIENCY,
        AVG(CAST([POTENTIAL_ENERGY_EFFICIENCY] AS FLOAT)) AS POTENTIAL_ENERGY_EFFICIENCY,
        AVG(CAST([CO2_EMISSIONS_CURRENT] AS FLOAT)) AS CO2_EMISSIONS_CURRENT,
        AVG(CAST([CO2_EMISSIONS_POTENTIAL] AS FLOAT)) AS CO2_EMISSIONS_POTENTIAL
    FROM [dbo].[certificates]
    WHERE ISNUMERIC([CURRENT_ENERGY_EFFICIENCY]) = 1
        AND ISNUMERIC([POTENTIAL_ENERGY_EFFICIENCY]) = 1
        AND ISNUMERIC([CO2_EMISSIONS_CURRENT]) = 1
        AND ISNUMERIC([CO2_EMISSIONS_POTENTIAL]) = 1
    GROUP BY [PROPERTY_TYPE]
    ORDER BY [PROPERTY_TYPE]
END;

EXEC EnergyRatingsByPropertyType
```

2. To Calculate Energy Savings

```sql
CREATE PROCEDURE CalculateEnergySavings
AS
BEGIN
    SET NOCOUNT ON;

    -- Create a temporary table to hold the results
    CREATE TABLE #EnergySavings (
        PROPERTY_TYPE VARCHAR(255),
        TOTAL_COST_CURRENT FLOAT,
        TOTAL_COST_POTENTIAL FLOAT,
        ENERGY_SAVINGS FLOAT
    );

    -- Insert calculated values into the temporary table
    INSERT INTO #EnergySavings (PROPERTY_TYPE, TOTAL_COST_CURRENT, TOTAL_COST_POTENTIAL, ENERGY_SAVINGS)
    SELECT
        PROPERTY_TYPE,
        SUM(CAST(LIGHTING_COST_CURRENT AS FLOAT) + CAST(HEATING_COST_CURRENT AS FLOAT) + CAST(HOT_WATER_COST_CURRENT AS FLOAT)) AS TOTAL_COST_CURRENT,
        SUM(CAST(LIGHTING_COST_POTENTIAL AS FLOAT) + CAST(HEATING_COST_POTENTIAL AS FLOAT) + CAST(HOT_WATER_COST_POTENTIAL AS FLOAT)) AS TOTAL_COST_POTENTIAL,
        SUM(
            (CAST(LIGHTING_COST_CURRENT AS FLOAT) + CAST(HEATING_COST_CURRENT AS FLOAT) + CAST(HOT_WATER_COST_CURRENT AS FLOAT)) -
            (CAST(LIGHTING_COST_POTENTIAL AS FLOAT) + CAST(HEATING_COST_POTENTIAL AS FLOAT) + CAST(HOT_WATER_COST_POTENTIAL AS FLOAT))
        ) AS ENERGY_SAVINGS
    FROM
        [dbo].[certificates]
    GROUP BY
        PROPERTY_TYPE;

    -- Return the results
    SELECT * FROM #EnergySavings;

    -- Clean up temporary table
    DROP TABLE #EnergySavings;
END;

EXEC CalculateEnergySavings
```

2.4 Importing Data to Power Bi

Finally, we imported the Stored Procedures and Views to PowerBI



After importing data into Power BI, we first converted the data types since all the imported data was text.

Next, we created new columns that were needed to develop effective visuals.

2. Cost savings – We reduced the potential cost from actual costs to identify how much cost can be saved if we reach the given potential.

```
Cost Savings = ('Vw_Cost'[HEATING_COST_CURRENT]+'Vw_Cost'[HOT_WATER_COST_CURRENT]+'Vw_Cost'[LIGHTING_COST_CURRENT]) - ('Vw_Cost'[HEATING_COST_POTENTIAL]+'Vw_Cost'[HOT_WATER_COST_POTENTIAL]+'Vw_Cost'[LIGHTING_COST_POTENTIAL])
```

3. Energy Consumption Cost – Total Current Consumption Cost

```
Energy Consumption Cost = 'Vw_Cost'[HEATING_COST_CURRENT]+'Vw_Cost'[HOT_WATER_COST_CURRENT]+'Vw_Cost'[LIGHTING_COST_CURRENT]
```

4. Energy Potential Cost - Total Potential Cost

```
Energy Potential Cost = 'Vw_Cost'[HEATING_COST_Potential]+'Vw_Cost'[HOT_WATER_COST_Potential]+'Vw_Cost'[LIGHTING_COST_Potential]
```

5. Energy Efficiency Difference – Difference between Potential and Current Efficiency

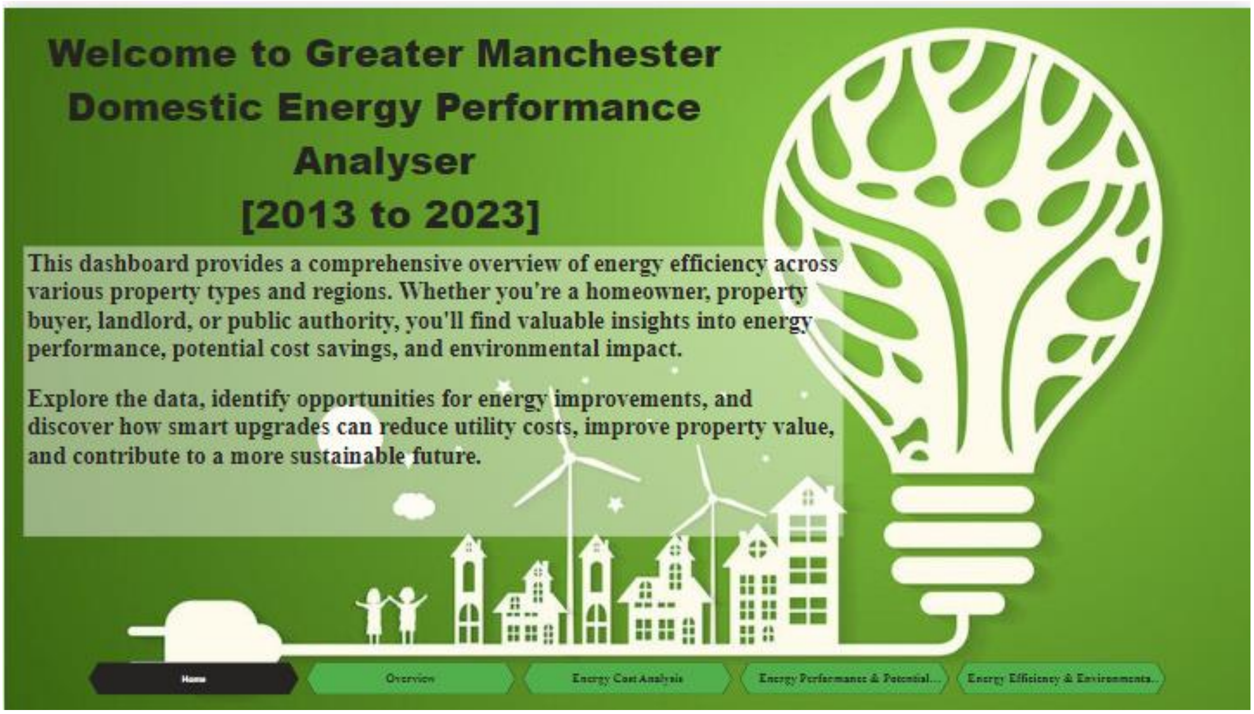
```
Energy Efficiency Difference = 'Vw_Energy_Data'[POTENTIAL_ENERGY_EFFICIENCY] - 'Vw_Energy_Data'[CURRENT_ENERGY_EFFICIENCY]
```

Measures were also used to create Min, Max, Target, Range Values for the Gauge Visual.

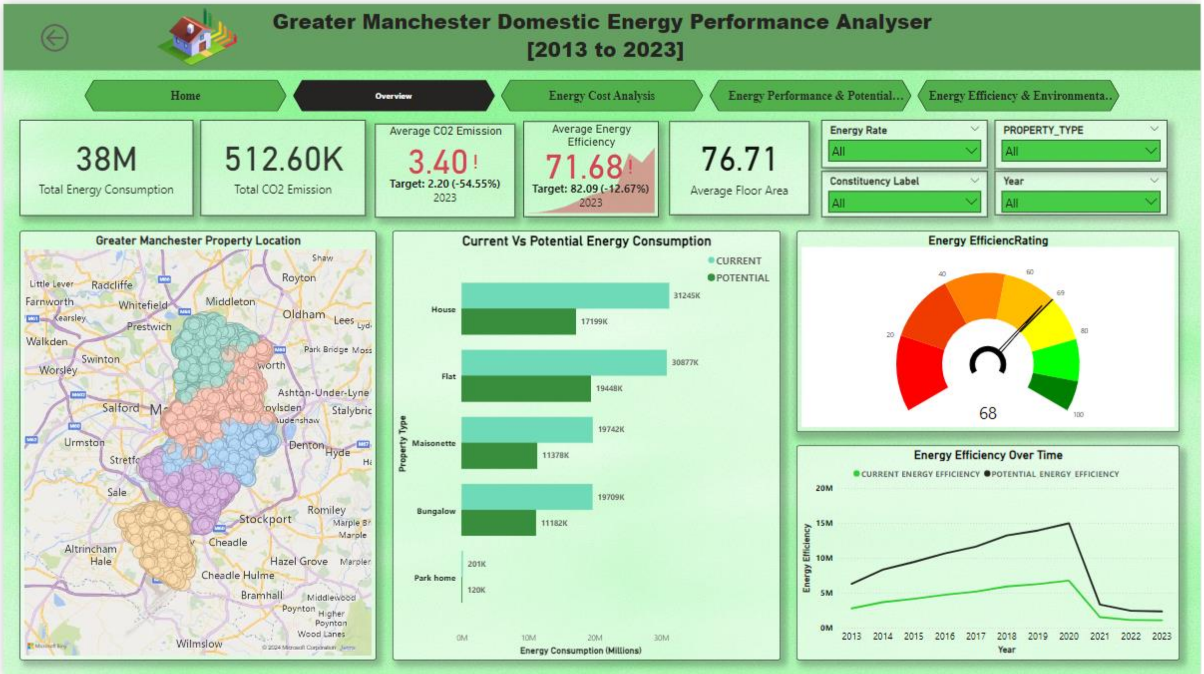
2.5 Illustrating the Power BI Dashboard

The Power BI dashboard was designed to provide actionable insights into energy performance, potential upgrades, cost savings, and environmental impact.

1st Page – Home Page



2nd Page – Overview



1. Key Performance Indicators

- Average CO2 Emission – Displayed with the target which is the Average Potential CO2 Emission. The KPI shows that the current Average CO2 Emission is lagging by 54.55%.
- Average Energy Efficiency – This KPI Indicates the Average Energy efficiency and the trend axis in red indicates that we need to increase are average efficiency by 12.67% to achieve the target or the potential energy efficiency.

2. Card Visuals.

- We have used 3 Card Visuals to indicate Total Energy Consumption, Total CO2 Emissions, and Average Floor Area.

3. Map

- The Map indicates the geographical distribution of properties in Greater Manchester. The different constituencies of Manchester are shown separately. Allows the user to see the significant differences in energy performance across different properties.

4. Clustered Bar Chart

- The purpose of this chart is to compare the current energy consumption with potential energy consumption across different property types. Current consumption is shown in light green, while potential consumption is in dark green. This chart highlights the gap between current and potential energy usage for each property type, suggesting where improvements can be made.

5. Gauge Chart

- This chart indicates the current energy efficiency rating of the properties in Greater Manchester. We have used the color scheme equal to the EPC rating indicating lower values from red and higher values from green. The target is set between 68 and 80, so this visual gives a quick insight into whether the current rating is meeting the target or not.

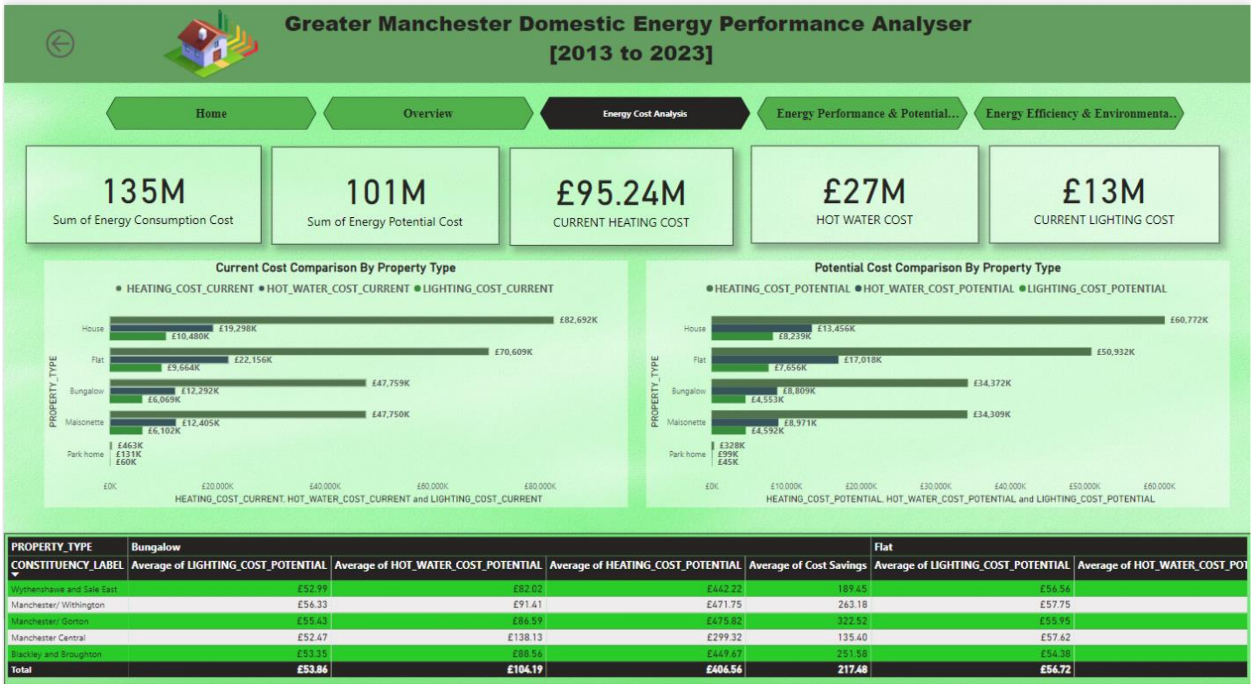
6. Line Chart

- A line chart is used to track the changes between current and potential energy efficiency from 2013 to 2023. The dark green line shows the potential energy efficiency, and the light green line represents the current energy. This chart helps in visualizing the trends.

7. Slicers

- Used slicers to filter data by property type, Constituency Label, Year, Energy Rate.

3rd Page- Energy Cost Analysis



1. Key Performance Indicators

- Sum of Energy Consumption Cost, Sum of Energy Potential Cost, Current Heating Cost, Current Hot Water Cost, and Current Lighting Cost these indicators help in getting a quick idea about this analysis.

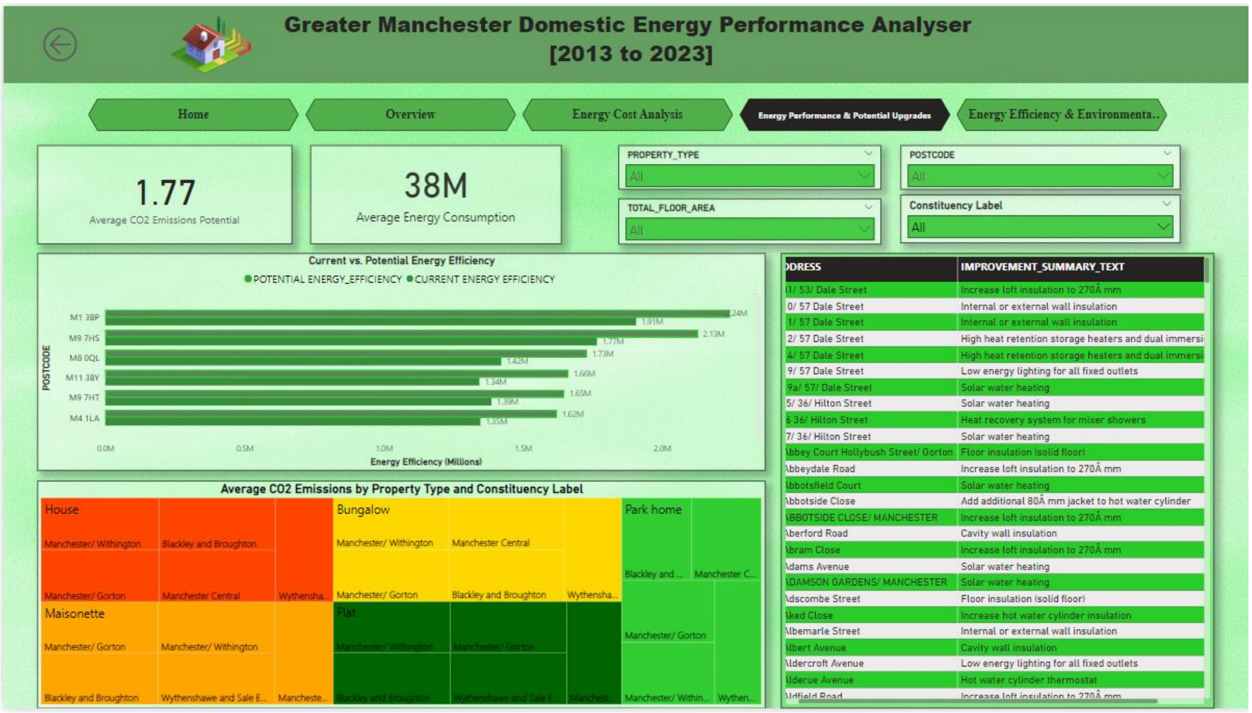
2. Stacked Bar Charts

- Used 2 Stacked Bar Charts to analyze the difference between the current and potential Costs for different property types as well each property type has been divided to sub-categories to analyze the cost for heating, lighting and hot water.
- This helps to compare which property types incur the most costs for each category and where savings could be made.

3. Matrix

- This Breaks down potential costs for lighting, hot water, heating, and total savings per property type. Each row represents a constituency, The table lists the average potential costs for lighting, hot water, heating, and the total cost savings.
- This provides a detailed look at the cost savings possible per property type and constituency, helping to identify areas that could benefit most from energy-saving interventions.

4th Page – Energy Performance & Potential Upgrades



1. Key Performance Indicators

- Average CO2 Emissions Potential – This shows the potential reduction in CO2 emissions across properties if optimal energy efficiency measures are implemented.
- Average Energy Consumption – This shows the average energy consumption for the properties analyzed in the dataset.

2. Bar Chart

- This chart compares current energy efficiency with potential energy efficiency for various postcodes. This gives a clear view of which properties have the greatest potential for energy efficiency upgrades.

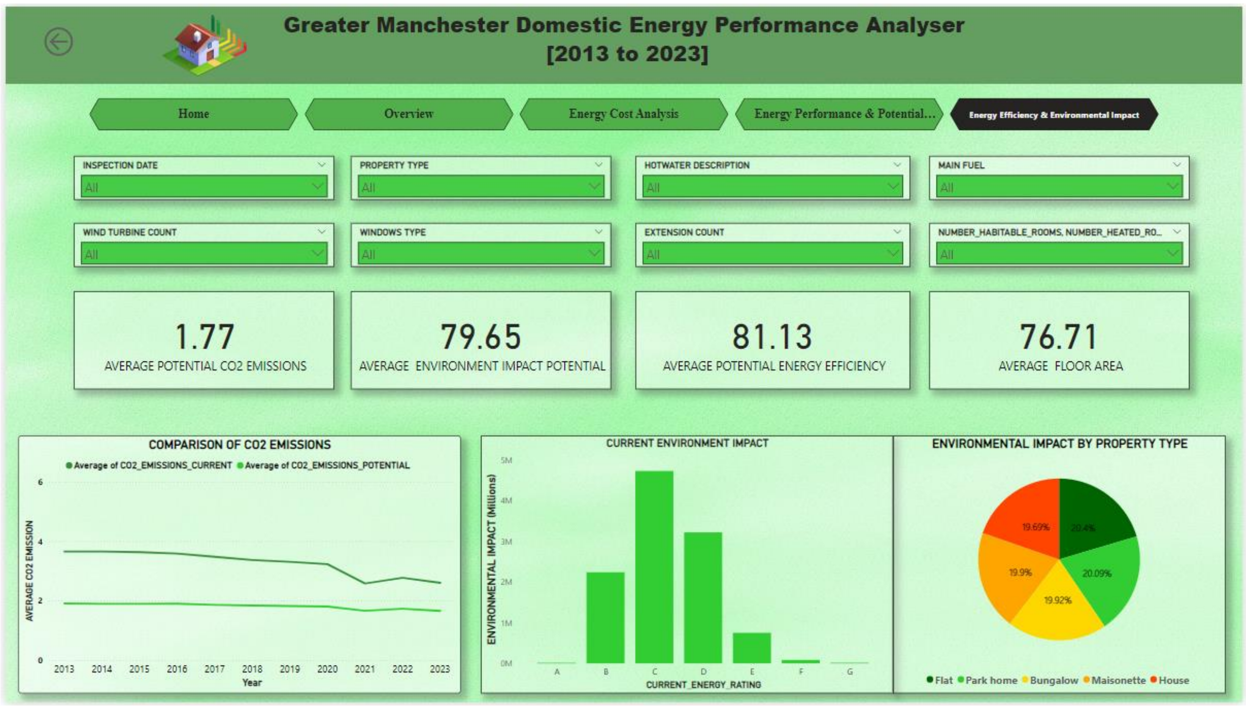
3. Tree Map

- This visual, Visualizes average CO2 emissions across different property types and constituencies. This helps identify which areas and property types contribute the most to CO2 emissions, which will help to keep a significant focus on areas to reduce carbon emissions.

4. Table

- This table is used to indicate potential improvement measures to enhance the energy efficiency of the individual properties. This provides actionable insights for property upgrades, allowing decision makers to assess which energy-saving interventions are required for specific addresses.

5th Page - Energy Efficiency & Environmental Impact



1. Slicers

- Since this page indicates the environmental impact there are many factors effect. We have used several dropdowns such as Inspection Date, Property Type, Hot Water Description, Main Fuel, Wind Turbine Count, Windows Type, Extension Count and a combination of Number of Habitable and Heated Rooms. These filters make it easier to focus on specific characteristics of properties, providing deeper insights into energy performance and environmental impact based on property-specific attributes.

2. Key Performance Indicators

- To indicate Average Potential CO2 Emissions, Average Environment Impact Potential, Average Potential Energy Efficiency, Average Floor Area KPI was used.

3. Line Chart

- A line chart was used to analyze the current vs. potential CO_2 emissions over time (2013-2023).The trend indicates a gradual reduction in both current and potential emissions, with the gap between the two lines showing the potential for further improvements. This chart helps totrack the effectiveness of energy efficiency measures over time and highlights the remaining gap to optimal performance.

4. Bar Chart

   - This chart Visualizes the current environmental impact across different energy ratings (A-G). This chart illustrates that Properties with a rating of **C** and **B** have the highest environmental impact, with over 4 million in impact from C-rated properties. This chart highlights which energy ratings have the highest environmental footprint, guiding efforts to target properties with mid-range energy for improvement.

5. Pie Chart

   - This break downs the environmental impact by property type. Indicating that each property type contributes relatively evenly to the environmental impact. This helps in identifying which property types contribute the most to environmental degradation, enabling targeted interventions based on property classification.

2.6 Recommendations

1. Install loft insulations and Fixed Draughts to improve the EPC rating Quickly.

2. Use of Renewable energy solutions. Such as solar panels, Air sources

3. Upgrading the windows

4. Switching to energy-efficient boilers such as system boilers or combi boilers.

5. Installing Cavity wall Insulations

Above mention recommendations can be used to improve the energy efficiency and reduce carbon emission from the environment.

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