



Using Data to Support the Decarbonization of the City of Birmingham, UK



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Introduction

Local governments have an important role to play when it comes to achieving the global climate target and combating the climate emergency. Cities like Birmingham are key players in reducing greenhouse gas (GHG) emissions and can influence the development of policies and programs to strengthen climate action, in collaboration with local stakeholders. There is growing interest in the use of data to enhance climate action by supporting informed decision-making processes while designing policies, projects and strategies for GHG emissions reduction.

This case study showcases how energy and climate-related data is being translated into a strategic project, developed by the UK based organization [Centre of Sustainable Energy \(CSE\)](#), that aims to support Birmingham in achieving its net zero emissions commitment by 2030. It describes the key steps and some of the datasets being used in "Project 3D", which will be used to accelerate both citywide carbon reduction policies and programmes and also community-driven sustainable energy projects. The case study also summarizes key data management issues and emerging lessons around the collection and use of data to support climate action at local level.

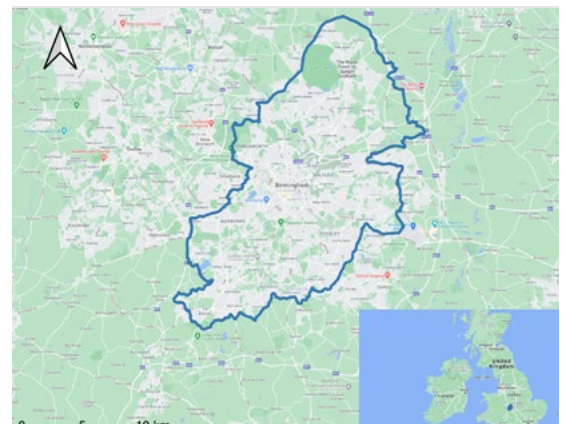


Figure 1- Birmingham, United Kingdom, ICLEI©

Facts & Figures

Population (2020)

1.1 million

Area

598.9 km²

GHG Emissions (2019)

4.46 Mt CO₂e

Average temperatures

3 - 16.5 (°C)

Average precipitation

769 mm (per year)





Figure 2 - Birmingham, United Kingdom, Unsplash©

From climate data to a strategic project for carbon emissions reduction

Birmingham is the second-largest city in the United Kingdom and a metropolitan borough in the West Midlands conurbation, with an area of 598.9 km² (see Figure 1). According to projections by the Office of National Statistics (2014), Birmingham’s population of 1.1 million inhabitants is expected to grow to 1.3 million inhabitants by 2039 [1]. Therefore, important aspects of planning for the city’s future include providing high quality and affordable homes and ensuring access to services and jobs.

[The Birmingham Development Plan 2031 \(BDP\)](#) constitutes the statutory planning framework which guides main decisions and defines the city’s strategy for climate action and sustainable growth in the next 10 years. The sustainability strategies set out in the plan are based on climate change mitigation and adaptation measures, including carbon emissions reduction, promoting energy efficiency, using renewable resources, minimizing the production of waste, promoting a green infrastructure network, managing flood risk and promoting sustainable drainage among others. The city had previously set a target to reduce 60 percent of total CO₂ emissions by 2027, against 1990

levels (6.87 Mt CO₂e) [2]. However, on 11 June 2019 the city of Birmingham formally declared a climate emergency and strengthened its carbon emissions reductions target, committing to become carbon neutral by 2030 in order to support the global effort to address climate change.

The most up to date government data indicates that in 2016 Birmingham’s CO₂ emissions have decreased by 33.7% against the 1990 baseline standing at 4.46 Mt CO₂e.

To contribute to the achievement of Birmingham’s emissions reduction target and help the city decarbonize within a decade, CSE established **“Project 3D”**, an ongoing initiative supported by the [Action Fund](#), which selected different non-profit and academic organizations to carry out data-driven environmental projects in cities. CSE is an independent national charity, working to tackle climate change and create societal change across the UK. CSE’s research team expertise includes buildings and energy



systems data analysis, renewable energy and low carbon technologies, energy demand reduction, and consumer energy behavior analysis [3]. In Project 3D, CSE is working with [Birmingham City Council](#), [The Route to Zero Taskforce](#) (R20 Taskforce), [West Midlands Combined Authority](#) and local community partners to establish an energy data hub. The data hub will enable a range of stakeholders to access information which can be used to support city wide planning and decision making, as well as local community projects which contribute to reducing carbon emissions [4].

Birmingham City Council has been a signatory of the [Covenant of Mayors for Climate and Energy in Europe](#) since January 2009. Considering that both residential and non-residential buildings along with transportation are responsible for Birmingham’s highest GHG emissions (see Figure 3), it follows the Route to Zero Action Plan (2019) priority areas that address energy efficiency of homes and buildings, low carbon energy generation, improved energy management, low carbon transport, and awareness campaigns for citizens and businesses [5]. To assist Birmingham in meeting their energy and mitigation targets, CSE’s *Project 3D* will develop an energy data hub bringing

Birmingham is the UK’s most diverse city after London. Carbon neutrality will only be achieved with active involvement of stakeholders and local communities of all types across Birmingham.

together a range of data sets for the city’s housing, non-domestic buildings, existing and planned energy infrastructure [6]. This publicly accessible web-based platform will become a depository of useful datasets for Birmingham and its community, freely available online. It will help to inform and support local climate action, including planning and policy development by making available energy data together with socio-economic and demographic household information. In addition, *Project 3D* plans to evaluate synergies with the publicly available [Google’s Environmental Insights Explorer \(EIE\)](#) data on transportation emissions. The project covers an initial data analysis and modelling decarbonization options for buildings in the city, integrating public datasets, aggregating the data, and in some cases mapping the results. One ongoing element of the project is

GHG Emissions Percentage by Sector

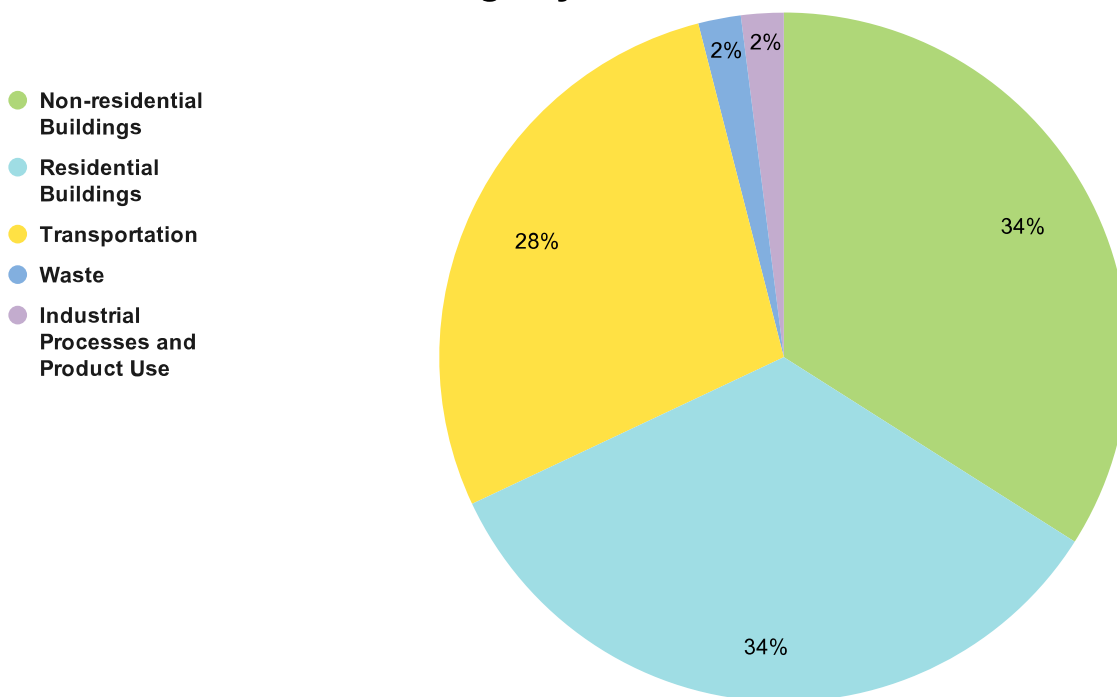


Figure 3 - GHG Emissions by sector in Birmingham, Route to Zero interim report, ICLEI©



a data governance framework which outlines the approaches used for data collection and processing, assessing the usefulness of data sets, meeting licensing conditions, and ensuring that data in the hub is understandable, discoverable, and searchable. The framework is a living document that also describes key stakeholders, processes and technologies used to bring datasets and analysis together as well as how datasets will be made publicly available [7].

Identifying the most appropriate datasets to drive climate action

When deciding on the data requirements for Project 3D, CSE has focused on data that could support a wide range of community-scale carbon reduction initiatives. Potential applications of the data will be explored during the project with a view to building new projects and initiatives in line with Birmingham's existing climate policies and programmes. (Table 1).

Table 1 - Examples of Policies and Actions from the BDP [3]

Policy	Actions
Reducing the city's carbon footprint	<ul style="list-style-type: none"> • Requiring new developments to reduce CO₂ emissions and water consumption. • Promoting and supporting the use of low and zero carbon energy sources and technologies. • Promoting the use of Combined Heat and Power (CHP) schemes and district heating. • Promoting sustainable transport systems including cycling and walking. • Supporting the development of new low carbon technologies. • Supporting the delivery of the principles of sustainable neighborhoods in residential development.
Low and zero carbon energy generation and economy	<ul style="list-style-type: none"> • Inclusion of CHP generation or a network connection to an existing facility. • Use of renewable energy technologies. • Low carbon design and construction, including low carbon renovation of the housing stock and provision of low carbon construction service and trades. • Low carbon vehicle technologies such as electric and hydrogen fuel cell vehicles and hybrid buses, including the installation of refueling and recharging stations.
Sustainable neighborhoods	<ul style="list-style-type: none"> • Environmental sustainability and climate proofing through measures that save energy, water and non-renewable resources, as well as the use of green and blue infrastructure. • Convenient options to travel by foot, bicycle and public transport reduced dependency on cars and options for remote working supported by fast digital access.
A sustainable transport network	<ul style="list-style-type: none"> • The facilitation of modes of transport that reduce carbon emissions and improve air quality. • Building, maintaining, and managing the transport network in a way that reduces CO₂, addresses air quality problems, and minimizes transport's impact on the environment.
Low emission vehicles	<ul style="list-style-type: none"> • Ensuring that new developments include adequate provision for charging infrastructure (e.g. electric vehicle charging points in car parks, measures to encourage LEV use through Travel plans and other such initiatives). • In places appropriate, the city council will facilitate the introduction of charging points in public places.



While [Birmingham District Energy Scheme](#) provides low carbon energy across Birmingham city centre, the solution for decarbonizing heating systems is more complex. Project 3D expects to share building energy data with households, communities, and businesses to help them prioritize and plan building energy upgrade programs. Thus, energy data for the building sector will be collected to inform low-carbon policies for the BDP. Housing energy datasets combined with housing tenure and socio-demographic data could be used to target home energy efficiency programs and inform citizens about local climate initiatives and create public engagement campaigns.

Furthermore, transport accounts for almost a third of Birmingham’s carbon emissions and,

according to the BDP, is the sector in which it has been hardest to cut emissions. Additionally, low-income households have the smallest transport carbon footprint and limited low-carbon travel options. The intention is that transportation data will help with identifying specific neighborhoods for implementing local active and sustainable travel projects and assessing the community’s willingness to switch to sustainable transport modes.

Project 3D aims to use data to strengthen future policies towards a net zero carbon development in buildings, where solar potential data could help the city council, community groups, and businesses to prioritize investments, for example in new PV systems (Figure 4).

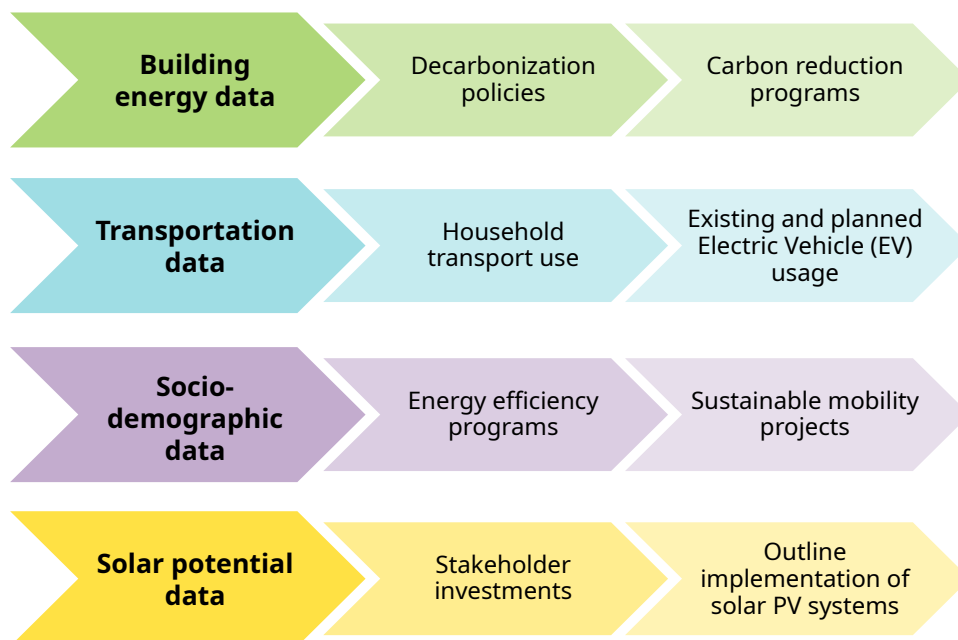


Figure 4 – Information collected from each dataset, CSE Project 3D, ICLEI©



Figure 5 – Birmingham, United Kingdom, Unsplash©



Main data management steps for climate action

For Project 3D key areas of data management include data collection, protection and accessibility, validation, visualization, and monitoring (see Figure 6), making it possible to transform data into meaningful and useful information for stakeholders. A data governance

framework will help to set out processes and responsibilities around data management, including data collection, classification, modelling, architecture, storage, security, integration and interoperability, quality, updates, and access arrangements [7].

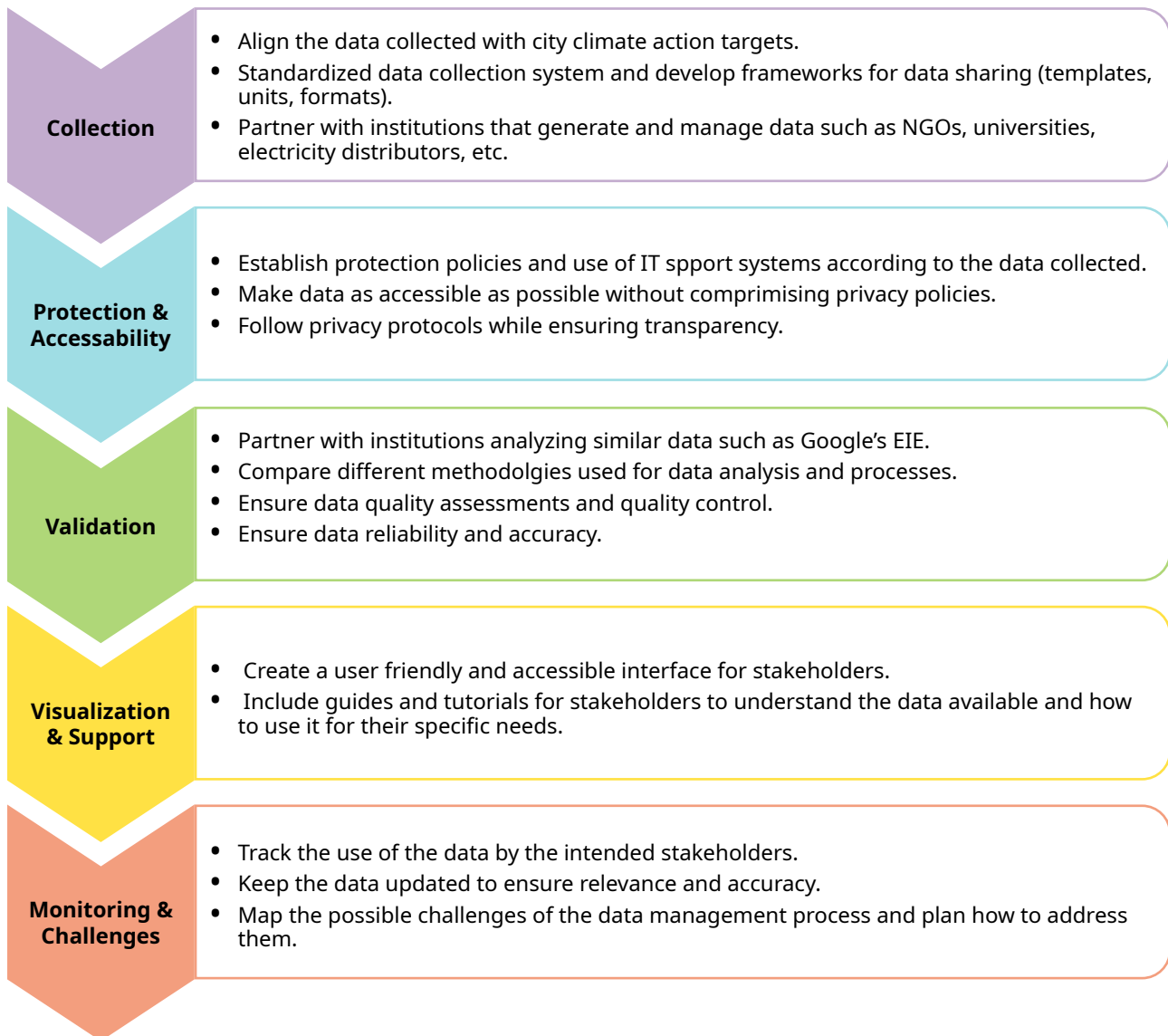


Figure 6 - Main data management steps for Project 3D, ICLEI©

1. Data collection

CSE plans to use publicly available datasets as an input for Project 3D's energy policy model for Birmingham (see Figure 7). Energy data for housing and non-domestic buildings is accessible through CSE's work on [Thermal Energy Resource Modelling and Optimisation](#)

[System \(THERMOS\)](#) [8]. Additionally, CSE will collect Domestic Energy Performance Certificate (EPC) and Non-domestic Display Energy Certificate (DEC) data, electricity network information from [Presumed Open Data \(POD\)](#), a database collected by the electricity distribution



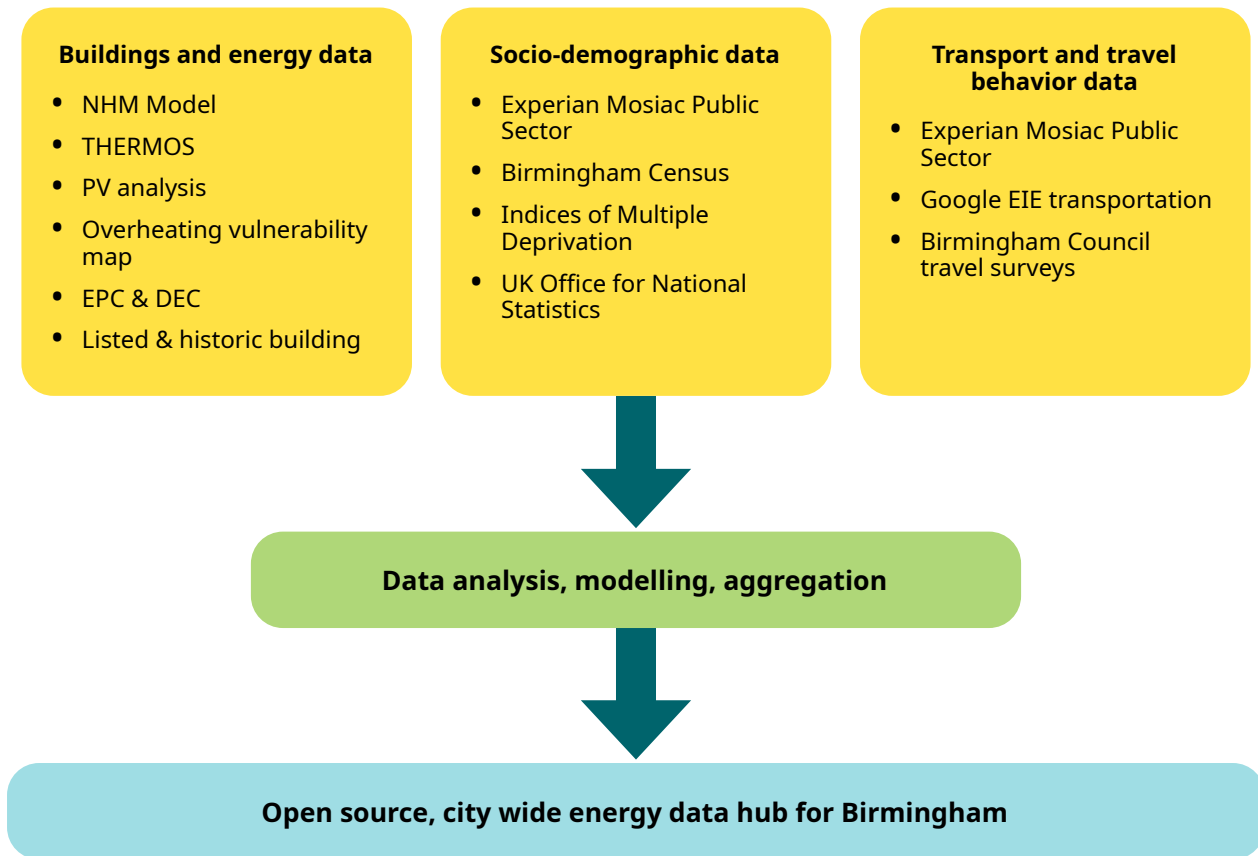


Figure 7 - Data process, CSE Project 3D©

network operator for the Midlands ([WPD](#)), and housing energy efficiency data from CSE's [National Household Model \(NHM\)](#) [9]. CSE will also gather licensed household socio-economic data from [Mosaic Public Sector](#), a database operated by [Experian UK](#) [10]. Moreover, the model envisages the inclusion of national datasets containing other socio-demographic, health, and economic data, which overall will be used to map Birmingham's solar potential and forecast feed-in tariffs for solar PV installations from the [Office of Gas and Electricity Markets \(Ofgem\)](#) [11]. For transportation, CSE will use Birmingham's electric vehicle charging point data and will expect to also evaluate Google's EIE transportation greenhouse gas (GHG) emissions and trip information.

2. Data protection and accessibility

All data sets (except Google's EIE data) are expected to be collected and modelled on a secure server benefiting from CSE's organizational-wide data protection policies and IT support systems. After analyzing the datasets, data will be published in the data

hub and made publicly available. However, in some cases data restrictions (for example because of licensing conditions or data sharing agreements) may mean that raw data cannot be published, in which case wherever possible amalgamated data and outputs of data analysis will be shared instead.

The classification process of each dataset will include a sensitivity check, which will affect whether or not the data can be published as open data. The majority of data is expected to be categorized as 'Open and Public' so that stakeholders can use these datasets to develop and pilot interventions. CSE works with [The EU General Data Protection Regulation \(GDPR\)](#) compliant data protection systems and procedures. The data hub is expected to have a GDPR-compliant user registration and verification function that would allow CSE to track usage and inform users when new data is posted. Furthermore, electronic backups will support the protection of the collected data.



3. Data validation

Data validation is essential to ensure collected data is accurate for further analysis and use. For this matter, it is important to clearly define the structure of data, along with the types and formats in which this would be managed and modelled to obtain the best results. *Project 3D* plans to maintain a directory and have a proper classification of each dataset. At the same time data in the hub needs to be relevant to Birmingham's net zero emissions pathway. Therefore, datasets will be categorized to align with the key priority areas identified in the Route to Zero action plan) and will be reviewed during training workshops and discussions to improve understanding of the data and potential applications.

CSE and Birmingham City Council plan to work with existing detailed datasets on carbon emissions and rooftop solar energy potential. This data will be used as a baseline to validate other public and privately owned data sources and tools and create a consumption-based carbon footprint. Some address level data will be amalgamated to larger geographical areas (for example ward level).

Project 3D may also explore the possibility of integrating Google's EIE data for Birmingham (see Figure 8) or using this as an input or comparative dataset to support data validation and inform the development of the project outputs. For this, CSE, together with ICLEI,

intends to review the EIE data methodology and incorporate more detailed and localized data to enhance the value of this data source. In particular, the embedded Google EIE transportation data could support city-wide decarbonization campaigns, and community engagement projects to encourage switching to non-motorized transport modes and increase walking and cycling, besides supporting policy updates associated with active transport in the BDP. Likewise, comparing methodologies and assumptions of the existing modelled datasets with the Google EIE building emissions and rooftop solar data could provide more detailed information, related to the potential for localized solar and/or other energy efficiency improvements.

Project 3D is in partnership with Birmingham City Council, Route to Zero Task Force, Route to Zero Task Board, West Midlands Combined Authority and Local community organizations. The Project 3D platform will be designed in consultation with Local Governments for Sustainability – ICLEI, Google, and Local stakeholders.

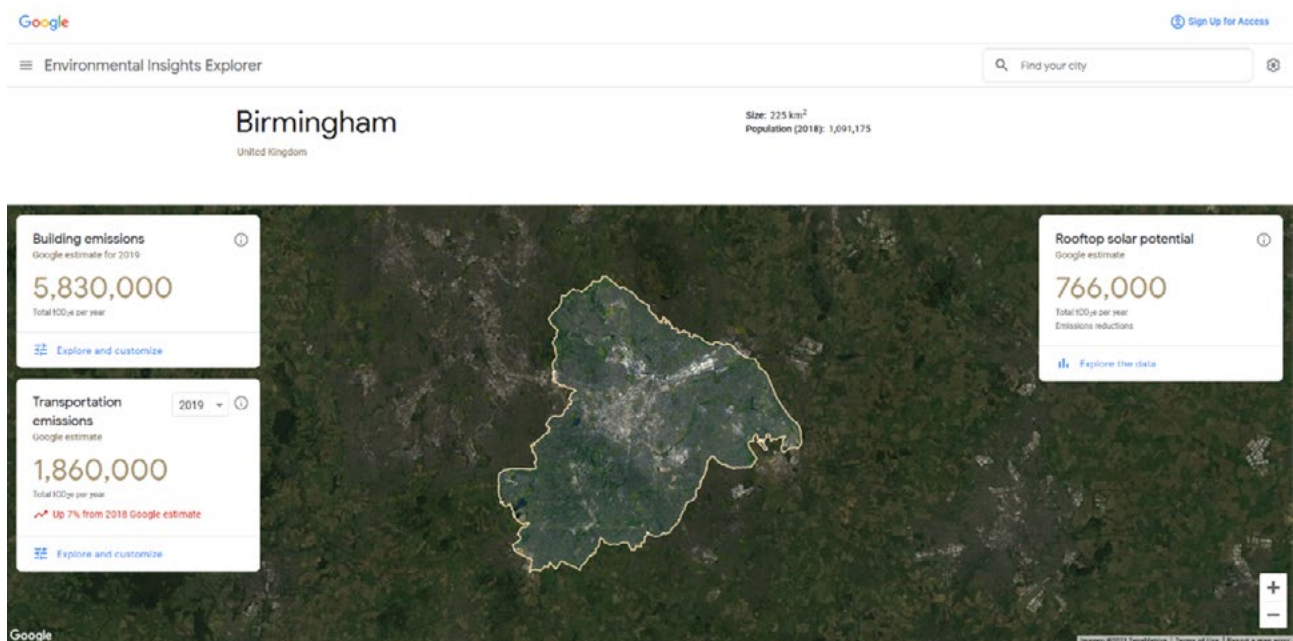


Figure 8 – Birmingham, UK, Google EIE©



4. Data-driven support and visualization tools

The data collected, analyzed, and released through *Project 3D* will be made available to stakeholders through the online data hub, accessed from a dedicated website, www.3dhub.org.uk. This will not only provide a platform for downloading data, but it will also introduce the project’s objectives and provide accessible visualization tools to support stakeholders needs and purposes. Ultimately the *Project 3D* platform will be designed to be user-friendly and intuitive with geographic information systems (GIS) based maps, charts, and other data visualization tools appropriate to the respective datasets. It will also include simple user guidance in written and potentially video format to help stakeholders better understand the available datasets, how to filter and overlay data, and how to download data at different geographic levels. CSE also expects to provide training sessions for Birmingham City Council officers and the Route to Zero Task force to help key stakeholders get the most from the data and the *Project 3D* platform.

5. Measuring and monitoring project and city targets

To measure and monitor how *Project 3D* assists Birmingham in decarbonizing in a decade, CSE will take two courses of action. First, the citywide use of the data hub to inform the BDP

will drive new planning and transport policies and decisions aiming to reduce the city’s carbon footprint. CSE will track the process of emissions reduction while comparing emissions reduced before the use of the data hub and after its implementation. Second, CSE will be running an open grant scheme for community organizations within Birmingham to carry out carbon reduction activities. As part of the application process, applicant groups will be expected to estimate GHG emissions reductions using available datasets from *Project 3D*. For example, an application that aimed to encourage a shift from private car journeys to alternative transportation modes would be able to provide an estimate of avoided emissions based on average vehicle emissions data from the [UK Department for Transport](#). In addition to measuring GHG emissions reductions, CSE will also ask applicants to outline potential measurable social impacts that will be delivered by their projects, such as alternative transportation shifts, fuel poverty improvements, air quality improvements, and provide estimates of the impacts that they might achieve. Moreover, CSE will also render a meta-emissions-reduction dataset for the local community initiatives that will be funded. As part of project evaluation activities, CSE aims to collect feedback from the funded community organizations and stakeholders and produce a report which will highlight achievements and lessons learned.



Figure 9 – Birmingham, United Kingdom, Unsplash©



Project 3D data related challenges

- The main challenge of the project is to make potential stakeholders and community partners recognize the value/benefits of using the data hub. CSE plans to address this through early engagement to understand their priorities and interests.
- Multiple partners and multiple data applications require careful prioritization and selection of resources to achieve maximum time efficiency, impact and value.
- Some applications of the data might be unpredictable or inaccurate in the project platform. This may cause the data to not be presented in a way that best suits all applications.
- Building energy datasets are most useful at address-level but for privacy and data protection purposes, datasets will need to be aggregated to small-area levels when publicly released.

Lessons Learned

Project 3D plans to provide a data hub that could support key stakeholders with informed-decision making processes and assist Birmingham in its goal to decarbonize by 2030. Whilst still in the early stages of project development, some findings around designing the data hub can already be shared in order to benefit other organizations, cities and local governments planning future climate action projects.

The main lessons learned to date from this case study are:

- Data-driven projects developed by civil society organizations could have more impact if aligned to city or local government’s current climate indicators and targets, so the plan will be a part of ongoing climate action efforts.
- Selecting data based on the city’s latest climate action policies is an important process for developing a data-driven climate action project. This process ensures that the data collected is aligned with the stakeholders’ targets.
- Using datasets from previous projects and from data platforms such as Google’s EIE is important for validating new data and monitoring the impact of the city’s climate actions.
- Planning a publicly available web-based platform in alignment with data protection policies and providing guidelines and visualization tools is a good practice to engage stakeholders and enhance data accessibility for decision-making allowing community-driven projects development.
- Setting up stakeholder surveys at an early stage of project development and building user testing and feedback mechanisms into the design process results in a more accessible and user-friendly platform.



Figure 11 – Birmingham Council House and Victoria Square. Photos.com/Jupiterimages©



About the Action Fund

The Action Fund is an initiative led by ICLEI with support from Google.org, to boost environmental projects in selected cities in Europe, Mexico and South America. The grant aims at empowering civil society organisations, academic institutions and non-profit research institutes, leading data-driven climate action efforts to reduce citywide emissions.

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