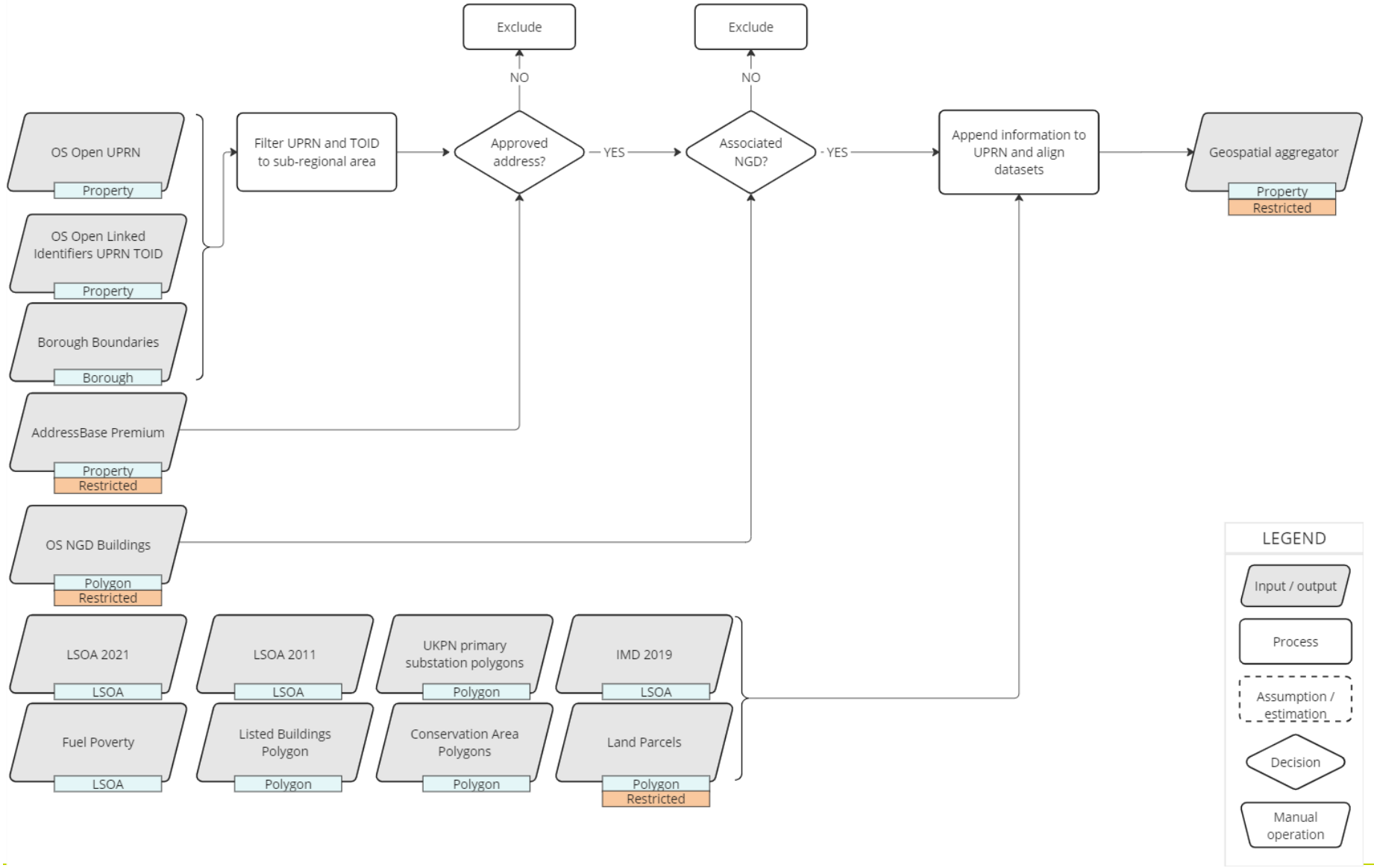
# Appendix A Methodology

# Appendix A – Methodology

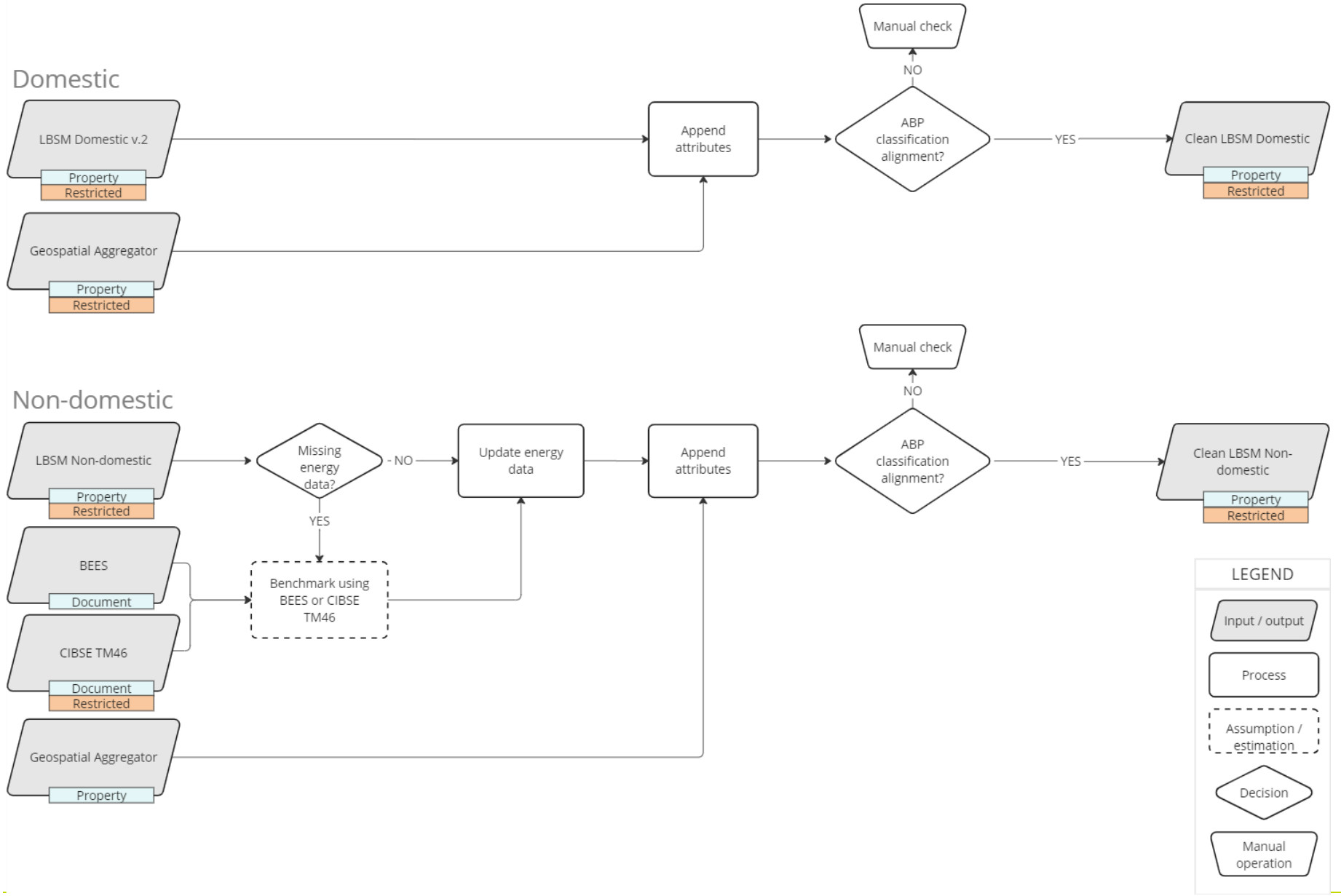
This appendix provides an overview of the methodology used for the subregional LAEPs for both the South and CEIN subregions. This is in the form of flow charts with a record of the key data on the page following each flow chart. Twenty-four different model flows are presented in the following pages, the table below provides their order and a brief description of their theme.

# BUILDING STOCK - GEOSPATIAL AGGREGATION

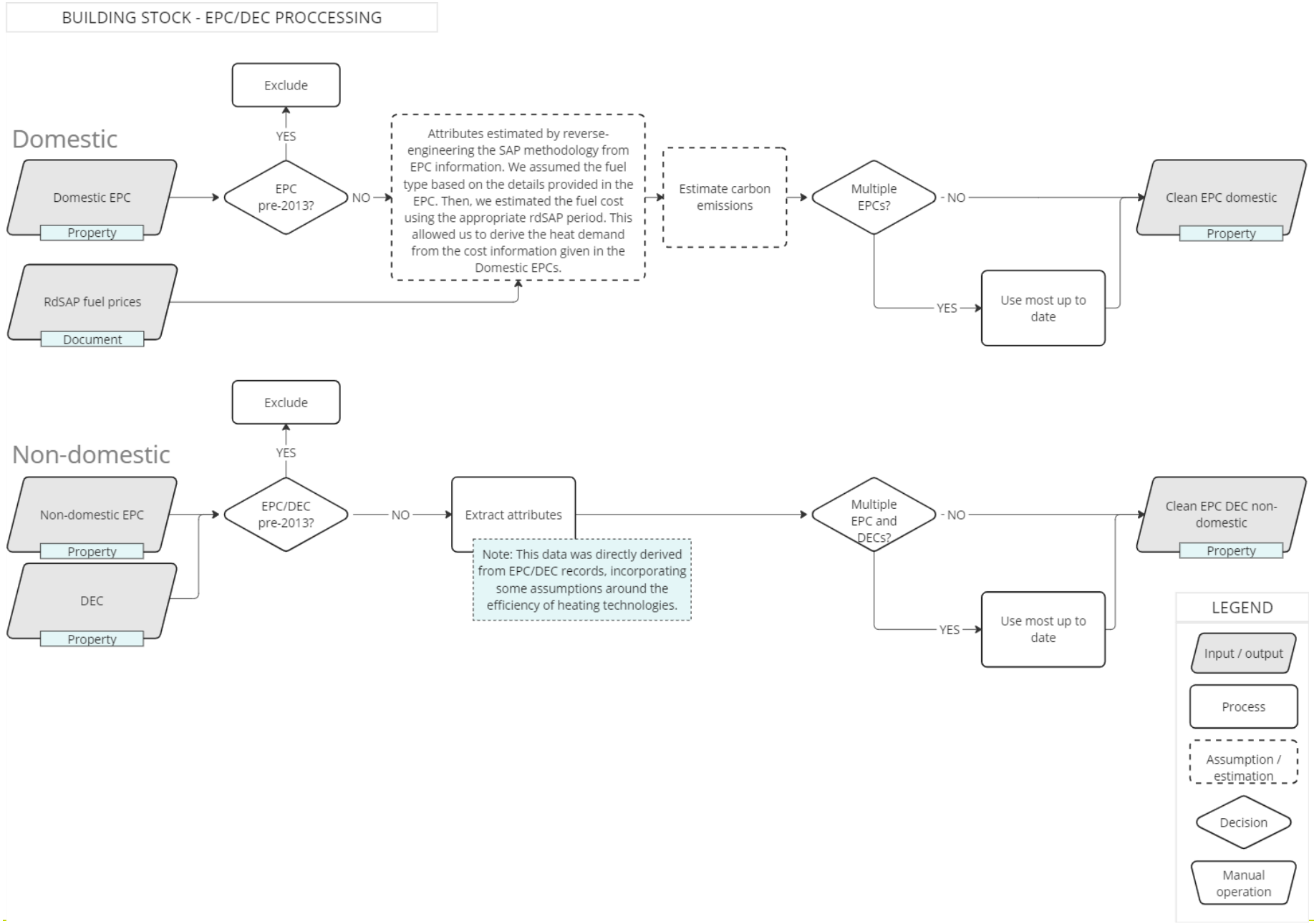


| Data input | Description | Geometry | Format | Source | Date of Harvest | Update frequency | Access |
|---|---|---|---|---|---|---|---|
| OS Open UPRN | Unique Property Reference Number (UPRN) point layer with X Y coordinates clipped to London boundary. | Point | GPKG | https://www.ordnancesurvey.co.uk/products/os-open-uprn | February 2024 | Six weekly | Open |
| OS Open Linked Identifiers UPRN TOID | Linked Identifiers provides authoritative relationship between Unique Property Reference Numbers (UPRNs), and Topographic Identifiers (TOIDs). | | CSV | https://www.ordnancesurvey.co.uk/products/os-open-linked-identifiers | March 2024 | Six weekly | Open |
| Borough Boundaries | Polygon layer of Local Authority Boundaries, clipped to the borough of interest. | Polygon | GPKG | https://www.ordnancesurvey.co.uk/products/boundary-line | February 2024 | 6 months | Open |
| AddressBase Premium | Provides geographical and delivery addresses and postcodes for each Unique Property Reference Number (UPRN) in United Kingdom. | | CSV | https://www.ordnancesurvey.co.uk/products/addressbase-premium#technical | April 2024 | Six weekly | Restricted |
| OS NGD Buildings | Ordnance Survey (OS) National Geographic Database (NGD) Building Polygons. | Polygon | GPKG | https://www.ordnancesurvey.co.uk/products/os-ngd | May 2024 | Daily | Restricted |
| LSOA 2021 | 2021 Lower Super Output Areas (LSOA) and Data Zones (DZ) borders for United Kingdom. | Polygon | GEOJSON | https://geoportal.statistics.gov.uk/datasets/0f80c523f3cd4d0fab5111572f84a2fb_0/explore | March 2024 | Aligns to Census | Open |
| LSOA 2011 | 2011 Lower Super Output Areas and Data Zones borders for all UK. | Polygon | GPKG | 2011 Census Geography boundaries (Lower Layer Super Output Areas and Data Zones) - Features in Shapefile format - UK Data Service CKAN) | March 2024 | Aligns to Census | Open |
| UKPN Primary Substations | Polygons with corresponding details on primary substations including primary substation areas and headroom. | | XLSX | https://ukpowernetworks.opendatasoft.com/explore/dataset/ukpn_primary_postcode_area/information/ | March 2024 | | Open |
| IMD 2019 | The Index of Multiple Deprivation (IMD) datasets are small area measures of relative deprivation across each of the constituent nations of the United Kingdom. | Polygon | GPKG | https://data.cdrc.ac.uk/dataset/index-multiple-deprivation-imd | March 2024 | Varies | Open |
| Fuel Poverty | Fuel poverty 2021 data measured as low income low energy efficiency (LILEE). | | XLSX | https://www.gov.uk/government/statistics/sub-regional-fuel-poverty-data-2023-2021-data | March 2024 | 1-2 years | Open |
| Listed Buildings | Polygons of listed building with properties including grade, building preservation notices and certificates of immunity. | Polygon | GPKG | https://historicengland.org.uk/listing/the-list/data-downloads/ | March 2024 | Daily | Open |
| Conservation Areas | Conservation areas exist to manage and protect the special architectural and historic interest of a place - in other words, the features that make it unique. | Polygon | GPKG | https://historicengland.org.uk/listing/the-list/data-downloads/ | March 2024 | Monthly | Open |
| Land Parcels | Geospatial polygons representing publicly owned land, and all owned land along with relevant ownership information. | Polygon | GPKG | https://use-land-property-data.service.gov.uk/datasets/ccod/tech-spec | March 2024 | Monthly | Restricted |
| **Data output** | **Description** | **Geometry** | **Format** | **Output File Name** | | | |
| Geospatial Aggregator | Collated data for the sub-region | | CSV | N/A | | | |

BUILDING STOCK - PREPROCESSING



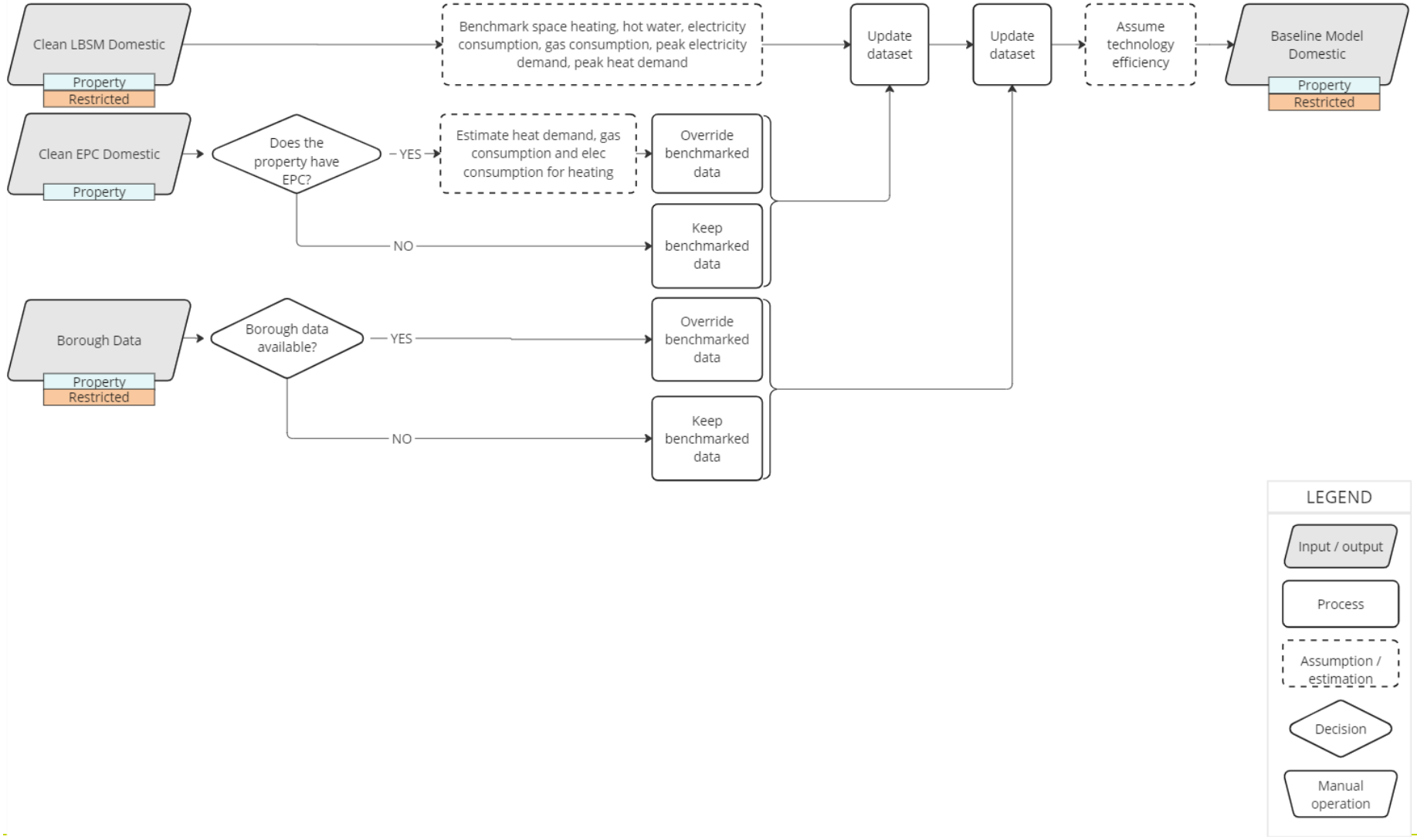
| Data input | Description | Geometry | Format | Source | Date of Harvest | Update frequency | Access |
|---|---|---|---|---|---|---|---|
| LBSM Domestic v.2 | Domestic stock dataset for every building London with with energy and carbon data collected through the Mayor's energy programmes and policies and updated for LAEP and updated by GLA. | | CSV | Greater London Authorities | April 2024 | | Restricted |
| Geospatial Aggregator | Output from previous flow. | | | | | | |
| LBSM Non-domestic | Non-domestic stock dataset for every building London with with energy and carbon data collected through the Mayor's energy programmes and policies and updated for LAEP and updated by UCL. | | CSV | University College London | April 2024 | | Restricted |
| BEES | Building Energy Efficiency Survey (BEES) overarching report is used for benchmarking non-domestic stock. | | PDF | https://assets.publishing.service.gov.uk/media/5a75964540f0b67f59fce0d4/BEES_overarching_report_FINAL.pdf | April 2024 | | Open |
| CIBSE TM46 | Chartered Institution of Building Services Engineers (CIBSE) TM46 Energy benchmarks is used for benchmarking domestic stock. | | PDF | https://www.cibse.org/knowledge-research/knowledge-portal/tm47-operational-ratings-display-energy-certificates | April 2024 | | Restricted |
| **Data output** | **Description** | **Geometry** | **Format** | **Output File Name** | | | |
| Clean LBSM Domestic | Appended data to building stock. | | CSV | N/A | | | |
| Clean LBSM Non-domestic | Appended data to building stock. | | CSV | N/A | | | |


BUILDING STOCK - EPC/DEC PROCCESSING
Domestic
Domestic EPC
Property
RdSAP fuel prices
Document
EPC pre-2013?
YES
Exclude
NO
Attributes estimated by reverse-engineering the SAP methodology from EPC information. We assumed the fuel type based on the details provided in the EPC. Then, we estimated the fuel cost using the appropriate rdSAP period. This allowed us to derive the heat demand from the cost information given in the Domestic EPCs.
Estimate carbon emissions
Multiple EPCs?
NO
YES
Use most up to date
Clean EPC domestic
Property
Non-domestic
Non-domestic EPC
Property
DEC
Property
EPC/DEC pre-2013?
YES
Exclude
NO
Extract attributes
Note: This data was directly derived from EPC/DEC records, incorporating some assumptions around the efficiency of heating technologies.
Multiple EPC and DECs?
NO
YES
Use most up to date
Clean EPC DEC non-domestic
Property
LEGEND
Input / output
Process
Assumption / estimation
Decision
Manual operation

| Data input | Description | Geometry | Format | Source | Date of Harvest | Update frequency | Access |
|---|---|---|---|---|---|---|---|
| Domestic EPC | Energy performance certificate (EPC) for domestic properties. | | CSV | https://epc.opendatacommunities.org/ | March 2024 | Monthly | Open |
| RdSAP Fuel Prices | Fuel prices used to estimate the cost of energy use in domestic energy performance certificates (EPCs). | | XLSX | https://files.bregroup.com/SAP/RdSAP-fuel-prices-from-15th-February-2023.xlsx | March 2024 | | Open |
| DEC | Display energy certificate (DEC) for non-domestic properties. | | CSV | https://epc.opendatacommunities.org/ | March 2024 | Monthly | Open |
| Non-domestic EPC | Energy performance certificate (EPC) for non-domestic properties. | | CSV | https://epc.opendatacommunities.org/ | March 2024 | Monthly | Open |
| **Data output** | **Description** | **Geometry** | **Format** | **Output File Name** | | | |
| Clean EPC Domestic | Pre-processed domestic Energy performance certificate (EPC). | | CSV | N/A. Final EPC values are included in 01_buildings. | | | |
| Clean EPC DEC Non-domestic | Pre-processed non-domestic Energy performance certificate (EPC). | | CSV | N/A. Final EPC values are included in 01_buildings. | | | |

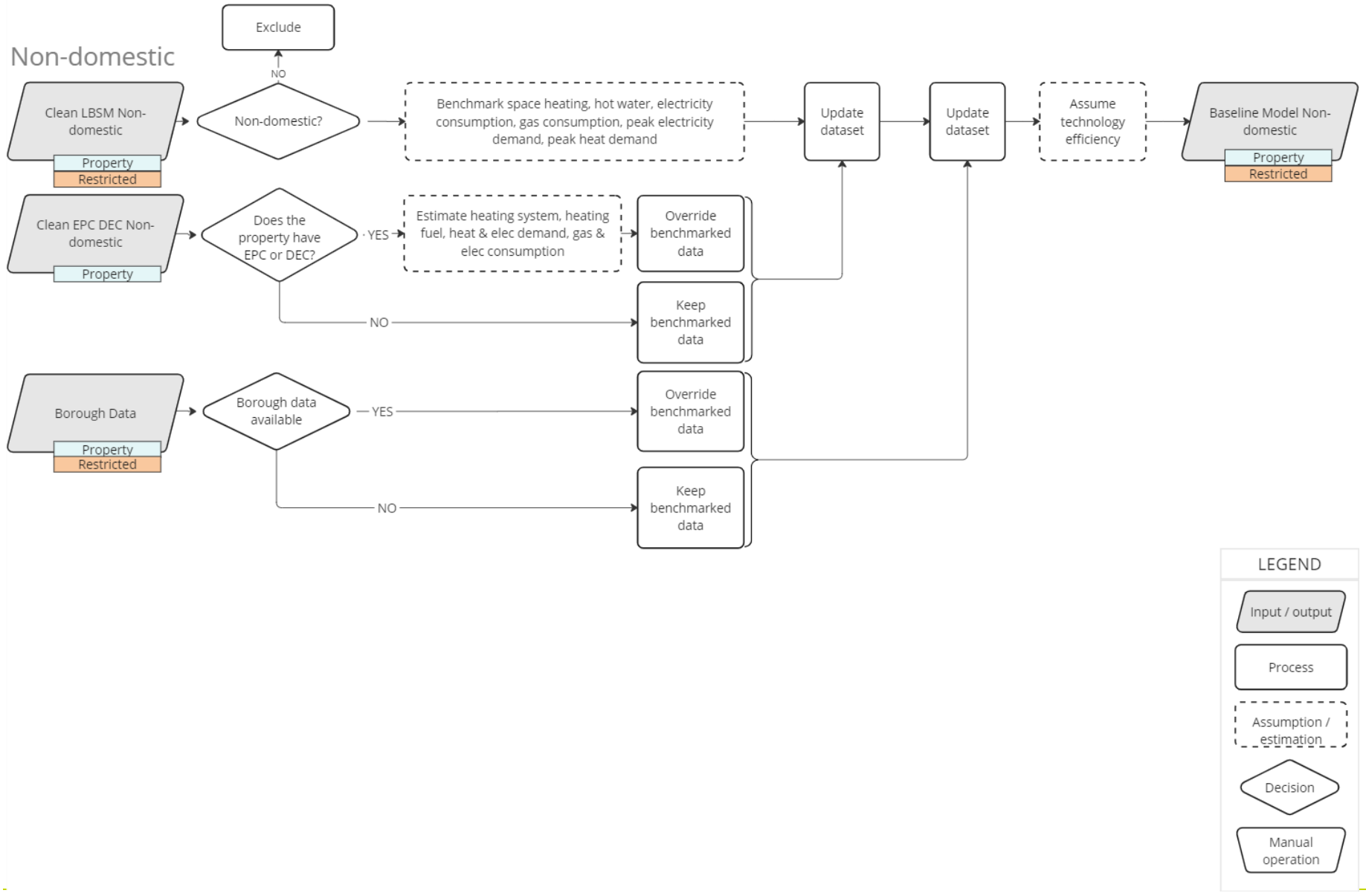
BUILDING STOCK - DOMESTIC BASELINE

## Domestic

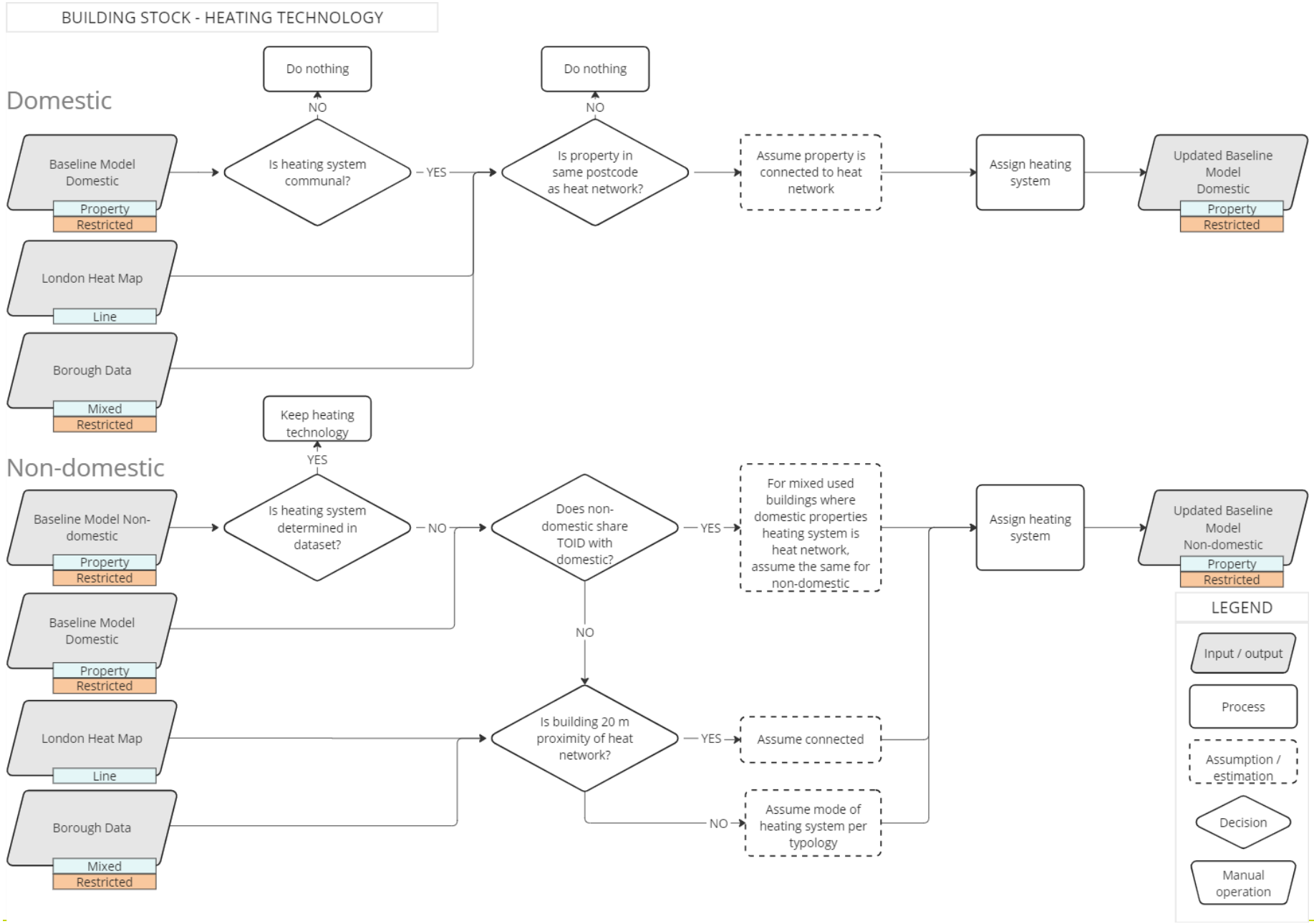


| Data input | Description | Geometry | Format | Source | Date of Harvest | Update frequency | Access |
|---|---|---|---|---|---|---|---|
| Clean LBSM Domestic | Output from previous flow. | | | | | | |
| Clean EPC Domestic | Output from previous flow. | | | | | | |
| Borough Data | Through a request for information process the boroughs provided data, which was integrated in the modelling, where possible. | | CSV | Boroughs | March 2024 | | Restricted |
| **Data output** | **Description** | **Geometry** | **Format** | **Output File Name** | | | |
| Baseline Model Domestic | Pre-processed domestic model with relevant attributes included. | | CSV | N/A. Final values are included in 01_buildings. | | | |

BUILDING STOCK - NON-DOMESTIC BASELINE



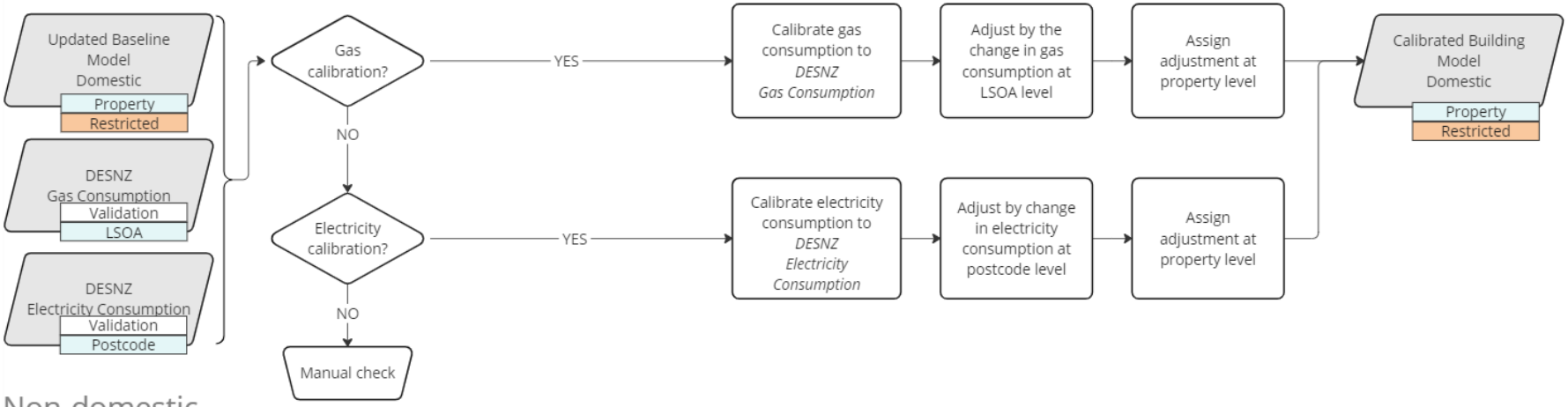
| Data input | Description | Geometry | Format | Source | Date of Harvest | Update frequency | Access |
|---|---|---|---|---|---|---|---|
| Clean LBSM non-domestic | Output from previous flow. | | | | | | |
| Clean EPC non-domestic | Output from previous flow. | | | | | | |
| Borough data | Through a request for information process the boroughs provided data, which was integrated in the modelling, where possible. | | CSV | Boroughs | March 2024 | | Restricted |
| **Data output** | **Description** | **Geometry** | **Format** | **Output File Name** | | | |
| Baseline model non-domestic | Pre-processed domestic model with relevant attributes included. | | CSV | N/A. Final values are included in 01_buildings. | | | |


BUILDING STOCK - HEATING TECHNOLOGY
Domestic
Do nothing
NO
Is heating system communal?
YES
Do nothing
NO
Is property in same postcode as heat network?
Assume property is connected to heat network
Assign heating system
Updated Baseline Model Domestic
Property
Restricted
Baseline Model Domestic
Property
Restricted
London Heat Map
Line
Borough Data
Mixed
Restricted
Non-domestic
Keep heating technology
YES
Is heating system determined in dataset?
NO
Does non-domestic share TOID with domestic?
YES
For mixed used buildings where domestic properties heating system is heat network, assume the same for non-domestic
NO
Is building 20 m proximity of heat network?
YES
Assume connected
NO
Assume mode of heating system per typology
Assign heating system
Updated Baseline Model Non-domestic
Property
Restricted
Baseline Model Non-domestic
Property
Restricted
Baseline Model Domestic
Property
Restricted
London Heat Map
Line
Borough Data
Mixed
Restricted
LEGEND
Input / output
Process
Assumption / estimation
Decision
Manual operation

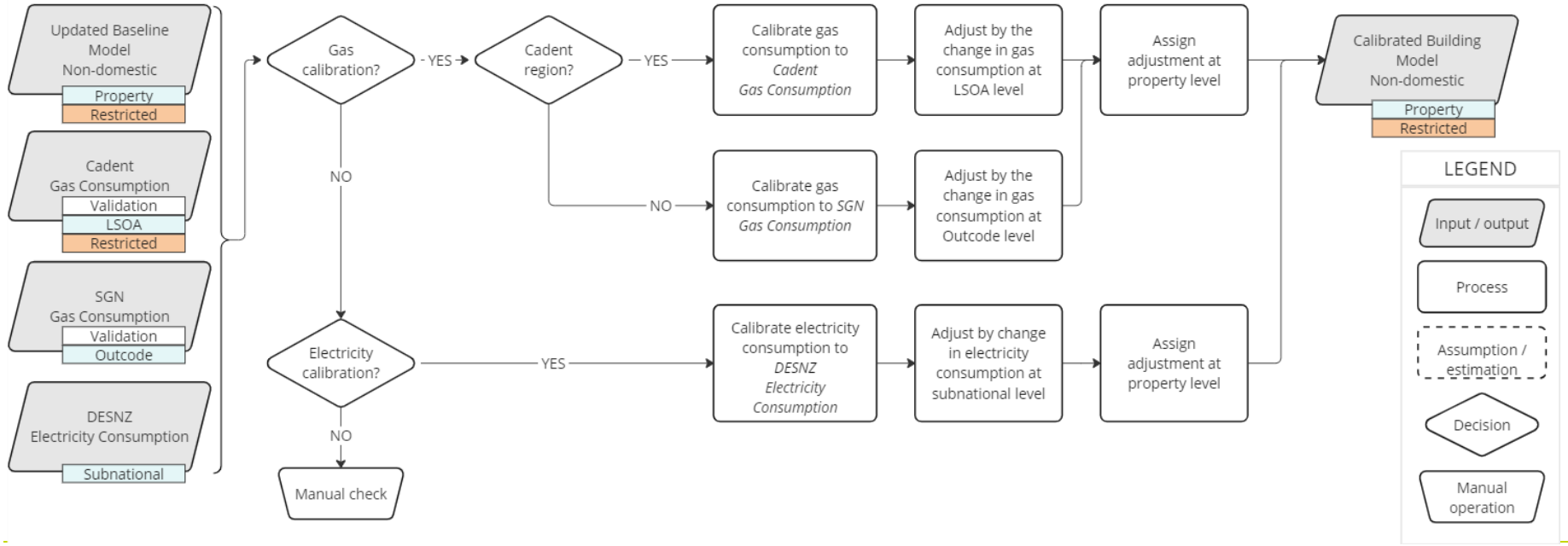
| Data input | Description | Geometry | Format | Source | Date of Harvest | Update frequency | Access |
|---|---|---|---|---|---|---|---|
| Baseline Model Domestic | Output from previous flow. | | | | | | |
| Baseline Model Non-Domestic | Output from previous flow. | | | | | | |
| Borough Data | Through a request for information process the boroughs provided data, which was integrated in the modelling, where possible. | Mixed | Mixed | Boroughs | March 2024 | | Restricted |
| London Heat Map | London Heat Map highlights existing and proposed networks. | Line | GPKG | https://apps.london.gov.uk/heatmap/ | April 2024 | | Open |
| **Data output** | **Description** | **Geometry** | **Format** | **Output File Name** | | | |
| Updated Baseline Model Domestic | Baseline model with heating system assigned. | | CSV | N/A. Final values are included in 01_buildings. | | | |
| Updated Baseline Model Non-domestic | Baseline model with heating system assigned. | | CSV | N/A. Final values are included in 01_buildings. | | | |

BUILDING STOCK - VALIDATION AND CALIBRATION

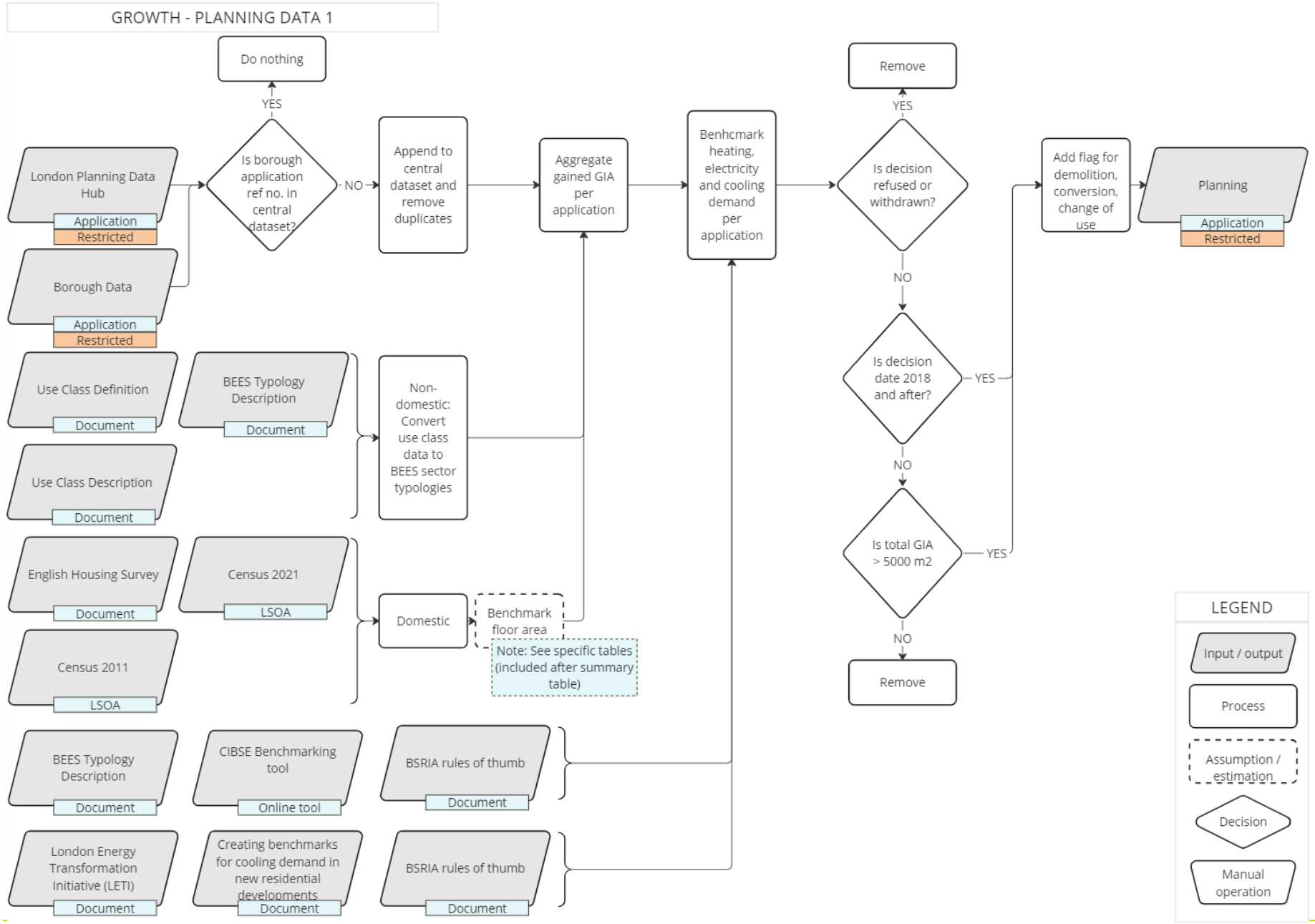
## Domestic




## Non-domestic



| Data input | Description | Geometry | Format | Source | Date of Harvest | Update frequency | Access |
|---|---|---|---|---|---|---|---|
| Updated Baseline Model domestic | Output from previous flow. | | | | | | |
| Updated Baseline Model Non-domestic | Output from previous flow. | | | | | | |
| DESNZ Gas Consumption | Sub-national gas consumption data produced by DESNZ. | | XLSX | https://www.gov.uk/government/collections/sub-national-gas-consumption-data | June 2024 | | Open |
| DESNZ Electricity Consumption | Sub-national electricity consumption data produced by DESNZ. | | XLSX | https://www.gov.uk/government/collections/sub-national-electricity-consumption-data | June 2024 | | Open |
| Cadent Gas Consumption | Cadent provided consumption data which was used to valiate the property level consumption data. | | CSV | Cadent | April 2024 | | Restricted |
| SGN Gas Consumption | Consumption data provided by SGN. | | CSV | https://www.sgn.co.uk/open-data-sharing-portal | April 2024 | | Open |
| **Data output** | **Description** | **Geometry** | **Format** | **Output File Name** | | | |
| Calibrated Building Model Domestic | Baseline model with heating system assigned. | | CSV | N/A. Final values are included in 01_buildings. | | | |
| Calibrated Building Model Non-domestic | Baseline model with heating system assigned. | | CSV | N/A. Final values are included in 01_buildings. | | | |


GROWTH - PLANNING DATA 1
Do nothing
YES
Is borough application ref no. in central dataset?
NO
Append to central dataset and remove duplicates
Aggregate gained GIA per application
Benhcmark heating, electricity and cooling demand per application
Remove
YES
Is decision refused or withdrawn?
NO
Is decision date 2018 and after?
YES
NO
Is total GIA > 5000 m2
YES
NO
Remove
Add flag for demolition, conversion, change of use
Planning
Application
Restricted
London Planning Data Hub
Application
Restricted
Borough Data
Application
Restricted
Use Class Definition
Document
BEES Typology Description
Document
Use Class Description
Document
Non-domestic: Convert use class data to BEES sector typologies
English Housing Survey
Document
Census 2021
LSOA
Census 2011
LSOA
Domestic
Benchmark floor area
Note: See specific tables (included after summary table)
BEES Typology Description
Document
CIBSE Benchmarking tool
Online tool
BSRIA rules of thumb
Document
London Energy Transformation Initiative (LETI)
Document
Creating benchmarks for cooling demand in new residential developments
Document
BSRIA rules of thumb
Document
LEGEND
Input / output
Process
Assumption / estimation
Decision
Manual operation

| Data input | Description | Geometry | Format | Source | Date of Harvest | Update frequency | Access |
|---|---|---|---|---|---|---|---|
| London Planning Data Hub | Planning growth central dataset which captures development proposals in the planning process, enabling monitoring of how the City is changing. | | XLSX | https://www.planningportal.co.uk/permission/common-projects/change-of-use/use-classes | March 2024 | | Restricted |
| Borough Data | Through a request for information process the boroughs provided planning growth dataset data, which was integrated in the modelling, where possible. | | XLSX | | March 2024 | | Restricted |
| Use Class Definition | The Town and Country Planning (Use Classes) Order 1987 (as amended) puts uses of land and buildings into various categories known as 'Use Classes'. | | | https://www.planningportal.co.uk/permission/common-projects/change-of-use/use-classes | March 2024 | | Open |
| Use Class Description | Planning use class description (appendix D). | | PDF | https://static.geoplace.co.uk/downloads/GeoPlace-Data-Entry-Conventions-Best-Practice-for-Addresses-V-3.4-2016.pdf | April 2024 | 2016 dataset was used | Open |
| BEES Typology Desciption | Building Energy Efficiency Survey (BEES) sector typology description. | | PDF | https://assets.publishing.service.gov.uk/media/5a75964540f0b67f59fce0d4/BEES_overarching_report_FINAL.pdf | April 2024 | Published 2016 not being updated since | Open |
| English housing survey | Average floor area by dwelling type (built form). | | PDF | https://assets.publishing.service.gov.uk/media/5b4750e6e5274a3770774693/Floor_Space_in_English_Homes_main_report.pdf | April 2024 | Yearly (Some EHS is data is updated annually). Floor area benchmark was published at 2018 | Open |
| Census 2011 | The dataset presents the count of households, categorised by dwelling type or built form, at the Local Authority level for 2011. | | CSV | https://www.nomisweb.co.uk/census/2011/ks401uk | April 2024 | Aligns to Census | Open |
| Census 2021 | The dataset presents the count of households, categorised by dwelling type or built form, at the Local Authority level for 2021. | | CSV | https://www.ons.gov.uk/datasets/TS044/editions/2021/versions/1 | April 2024 | Aligns to Census | Open |
| CIBSE Benchmarking tool | Used for non-domestic energy benchmarking in new development. | | XLSX | https://www.cibse.org/knowledge-research/knowledge-resources/knowledge-toolbox/benchmarking-registration | Apr-24 | As needed | Open |
| Creating benchmarks for cooling demand in new residential developments | A set of benchmarks created for typical dwelling types currently being developed in London. | | PDF | https://www.london.gov.uk/sites/default/files/gla_cooling_benchmarking_study_final2.pdf | Apr-24 | | Open |
| BSRIA rules of thumb | Guidelines for building services. Used for estimating the peak heat/electricity demand in new builds. | | PDF | http://ndl.ethernet.edu.et/bitstream/123456789/40265/1/185.pdf | Apr-24 | As needed | Open |
| London Energy Transformation Initiative (LETI) Climate Emergency Retrofit Guide | Used for estimating the future energy demand (heat and electricity) in residential properties. | | PDF | https://www.leti.uk/_files/ugd/252d09_c71428bafc3d42fbac34f9ad0cd6262b.pdf | Apr-24 | | Open |
| **Data output** | **Description** | **Geometry** | **Format** | **Output File Name** | | | |
| Planning | Pre-processed planning data | | CSV | 01_buildings_planning_data | | | |

## Domestic Floor Area Estimates

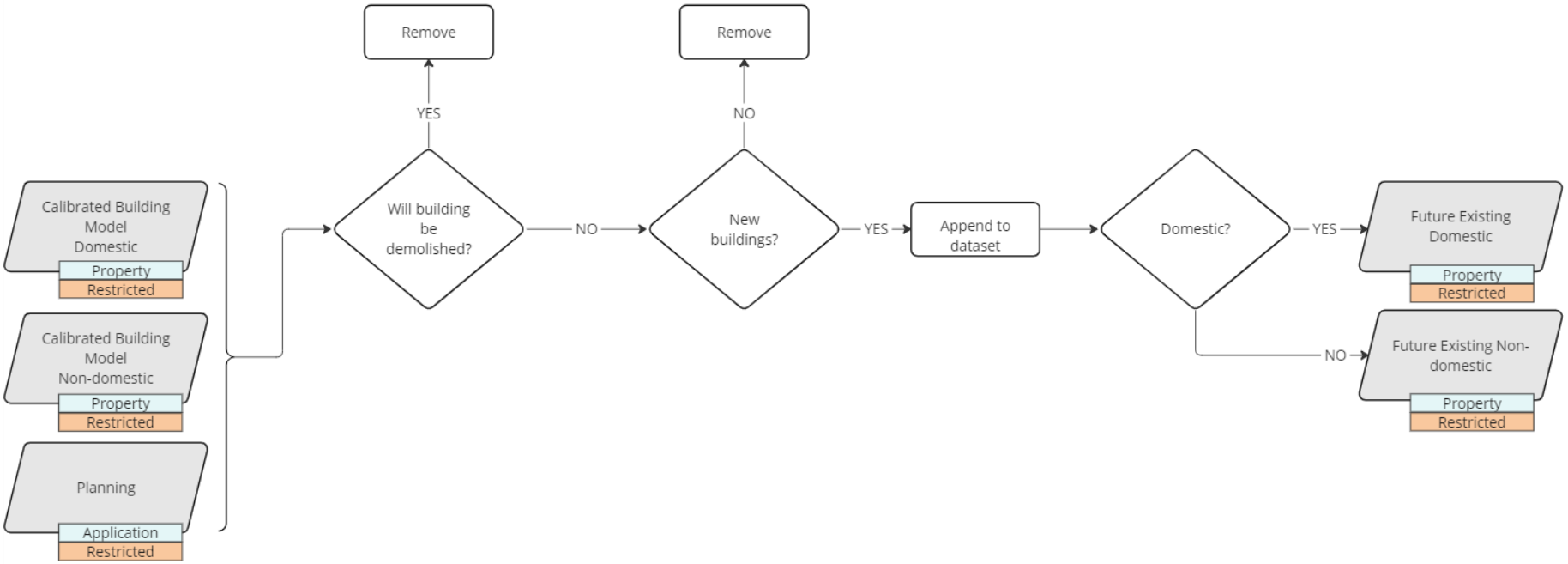
New table

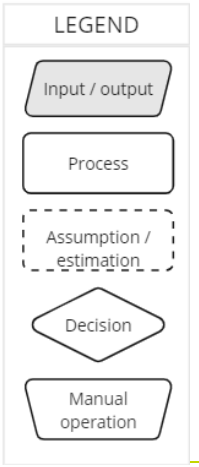
| Northern Boroughs | Floor area per residential unit (m2) |
|---|---|
| Camden | 71.7 |
| City of London | 61.1 |
| Enfield | 85.4 |
| Hackney | 70.5 |
| Haringey | 68.5 |
| Islington | 69.9 |
| Kensington and Chelsea | 65.7 |
| Newham | 63.6 |
| Tower Hamlets | 58.3 |
| Waltham Forest | 65.6 |
| Westminster | 62.9 |

New table

| Southern Boroughs | Floor area per residential unit (m2) |
|---|---|
| Croydon | 66.1 |
| Greenwich | 63.2 |
| Kingston upon Thames | 69.5 |
| Lambeth | 70 |
| Lewisham | 64.2 |
| Merton | 72.9 |
| Southwark | 64.1 |
| Sutton | 67.9 |

GROWTH - PLANNING DATA 2

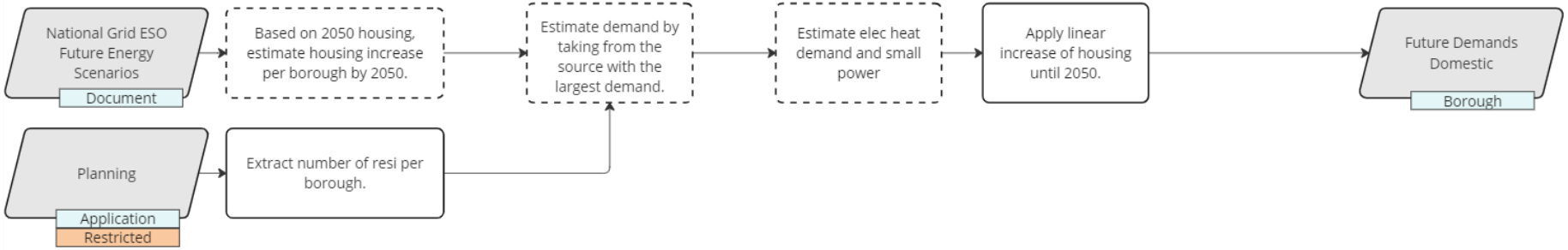


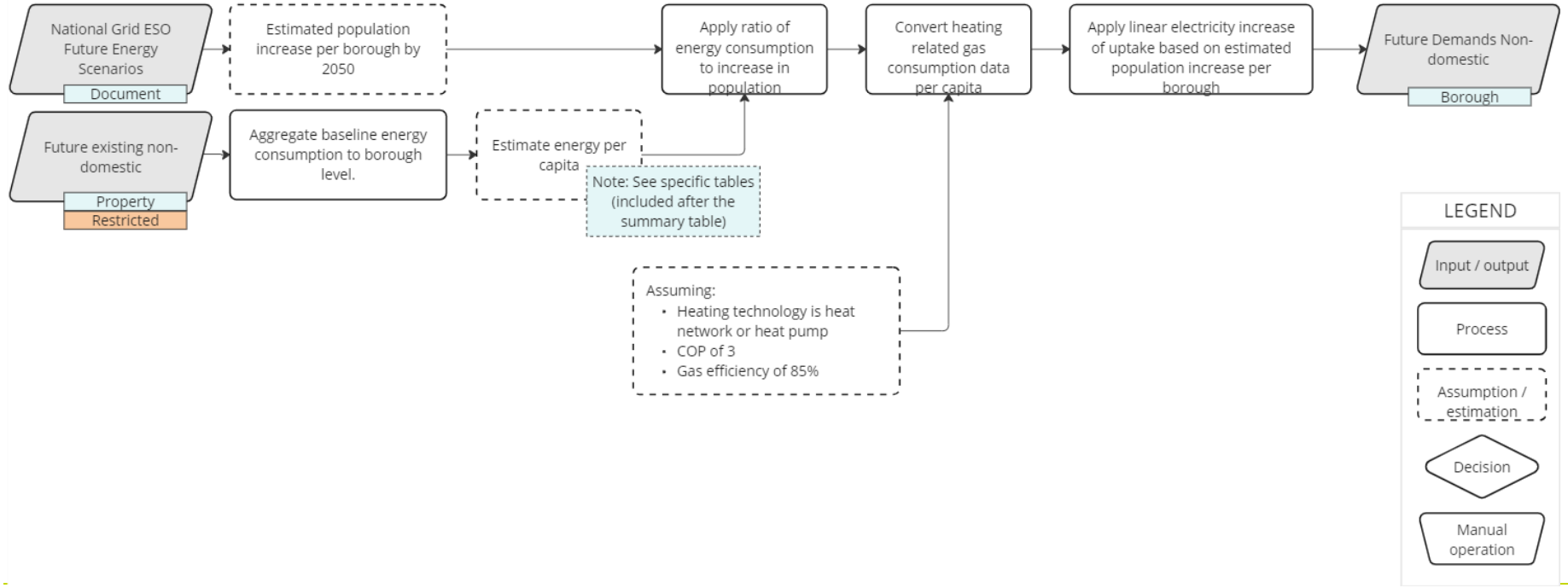
| Data input | Description | Geometry | Format | Source | Date of Harvest | Update frequency | Access |
|---|---|---|---|---|---|---|---|
| Calibrated Building Model Domestic | Output from previous flow. | | | | | | |
| Calibrated Building Model Non-domestic | Output from previous flow. | | | | | | |
| Planning | Output from previous flow. | | | | | | |
| **Data output** | **Description** | **Geometry** | **Format** | **Output File Name** | | | |
| Future Existing Domestic | Domestic building stock, including changes captured in planning data. | | CSV | 01_buildings | | | |
| Future Existing Non-domestic | Non-domestic building stock, including changes captured in planning data. | | CSV | 01_buildings | | | |

GROWTH - FUTURE DEMANDS

## Domestic




## Non-domestic



| Data input | Description | Geometry | Format | Source | Date of Harvest | Update frequency | Access |
|---|---|---|---|---|---|---|---|
| Future Existing Domestic | Output from previous flow. | | | | | | |
| Future Existing Non-domestic | Output from previous flow. | | | | | | |
| National Grid ESO Future Energy Scenarios | ESO Pathways to Net Zero represent different, credible ways to decarbonise energy system towards the 2050 target. | | PDF | https://www.nationalgrideso.com/document/323296/download | July 2024 | Annually | Open |
| **Data output** | **Description** | **Geometry** | **Format** | **Output File Name** | | | |
| Future Demands Domestic | Domestic increase of demand. | | CSV | 01_buildings_future_demands_domestic | | | |
| Future Demands Non-domestic | Domestic increase of demand. | | CSV | 01_buildings_future_demands_non_domestic | | | |

## Non-domestic energy per capita

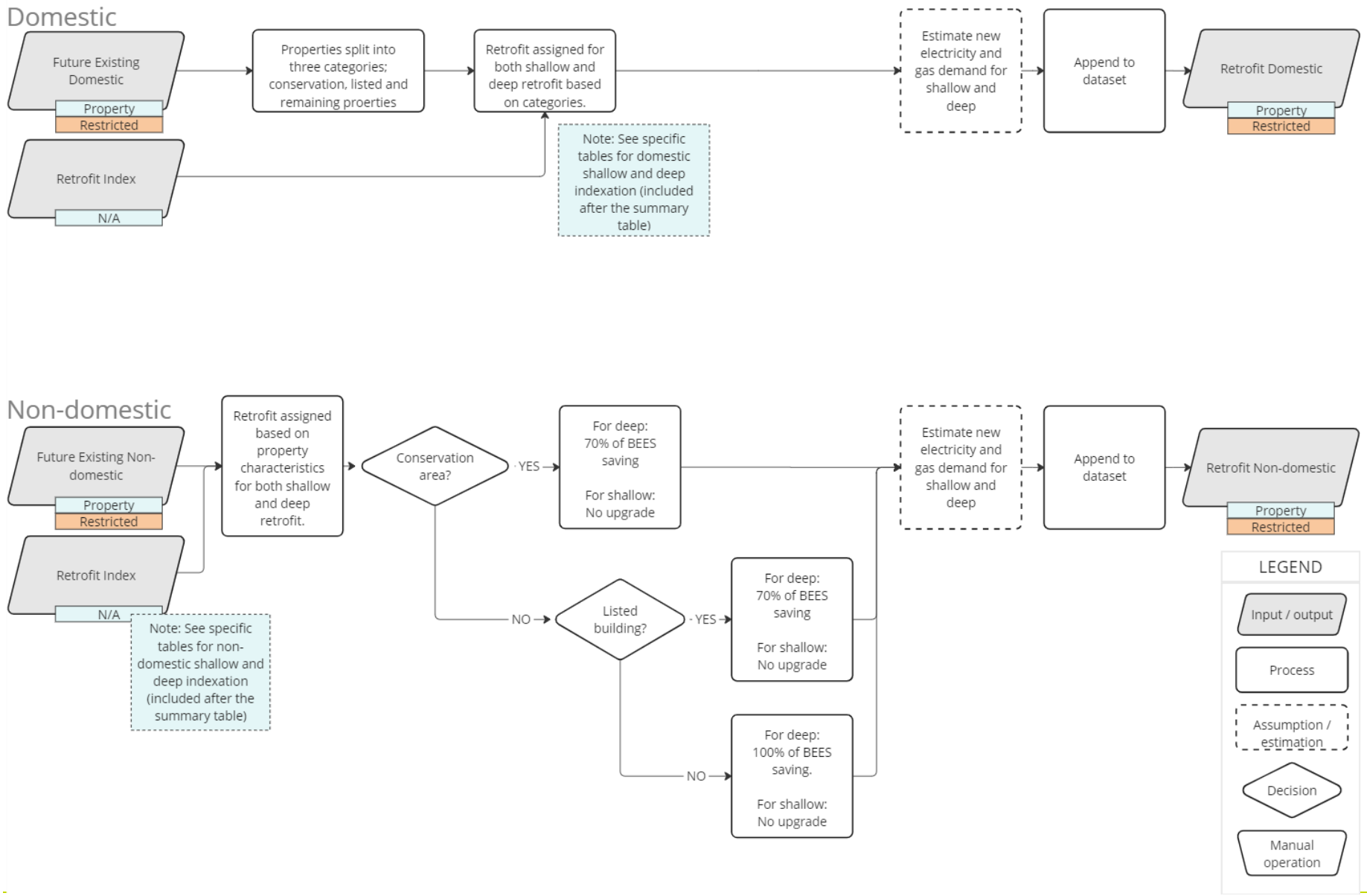
Note: Estimations below are using baseline energy consumption per borough and borough population - and assuming any future consumption would be electrified.

| Northern Boroughs | Estimated annual electricity consumption per capita - future growth (MWh) |
|---|---|
| Camden | 7.5 |
| City of London | 203.9 |
| Enfield | 2 |
| Hackney | 2.4 |
| Haringey | 1.9 |
| Islington | 3.9 |
| Kensington and Chelsea | 7.8 |
| Newham | 3.6 |
| Tower Hamlets | 6.8 |
| Waltham Forest | 1.4 |
| Westminster | 16.6 |

Note: City of London has a high value as a result of high demand and small population.

| Southern Boroughs | Estimated annual electricity consumption per capita - future growth (MWh) |
|---|---|
| Croydon | 1.9 |
| Greenwich | 2.1 |
| Kingston upon Thames | 2.2 |
| Lambeth | 2.6 |
| Lewisham | 1.4 |
| Merton | 2.5 |
| Southwark | 4.1 |
| Sutton | 1.9 |

BUILDING STOCK - RETROFIT



| Data input | Description | Geometry | Format | Source | Date of Harvest | Update frequency | Access |
|---|---|---|---|---|---|---|---|
| Future Existing Domestic | Output from previous flow. | | | | | | |
| Future Existing Non-domestic | Output from previous flow. | | | | | | |
| Retrofit Index | Indexation created to indicate upgrades based on property characteristics. | | CSV | | | | |
| **Data output** | **Description** | **Geometry** | **Format** | **Output File Name** | | | |
| Retrofit Domestic | Domestic building stock, including retrofit output. | | CSV | N/A. Final values are included in 01_buildings. | | | |
| Retrofit Non-domestic | Non-domestic building stock, including retrofit output. | | CSV | N/A. Final values are included in 01_buildings. | | | |

# Domestic Retrofit Indexation

| Domestic | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Shallow retrofit** | **EPC** | **Solid wall insulation** | **Cavity Wall insulation** | **Single Glazing upgrade** | **Secondary glazing upgrade** | **Double/triple glazing** | **Loft insulation** | **Small Power saving** | **Draught proofing** |
| Conservation | A - B | N | N | N | N | N | N | N | N |
| | C | N | Y | N | N | N | Y | N | Y |
| | D | N | Y | Y | Y | N | Y | N | Y |
| | E-G | N | Y | Y | Y | N | Y | N | Y |
| Listed | A - B | N | N | N | N | N | N | N | N |
| | C | N | Y | N | N | N | Y | N | Y |
| | D | N | Y | Y | N | N | Y | N | Y |
| | E-G | N | Y | Y | N | N | Y | N | Y |
| Remaining properties | A - B | N | N | N | N | N | N | N | N |
| | C | N | Y | Y | N | N | Y | N | Y |
| | D | N | Y | Y | Y | N | Y | N | Y |
| | E-G | N | Y | Y | Y | N | Y | N | Y |

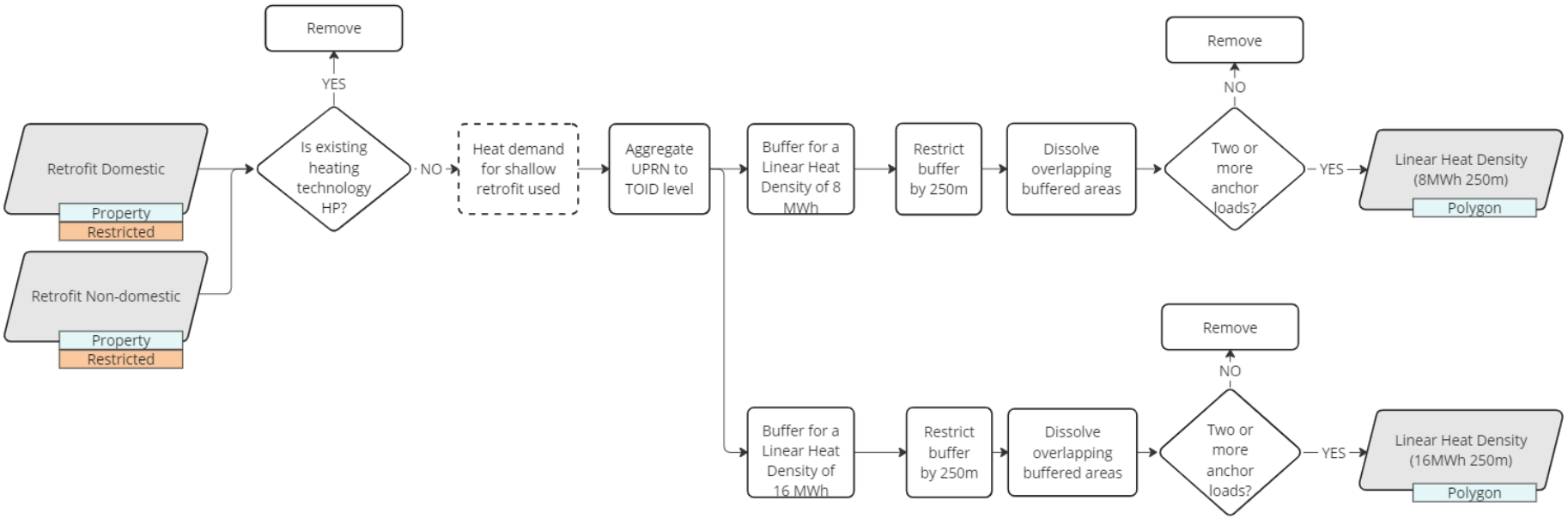
| Domestic | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Deep retrofit** | **EPC** | **Solid wall insulation** | **Cavity Wall insulation** | **Single Glazing upgrade** | **Secondary glazing upgrade** | **Double/triple glazing** | **Loft insulation** | **Small Power saving** | **Draught proofing** |
| Conservation | A - B | N | N | N | N | N | N | N | N |
| | C | N | Y | Y | Y | Y | Y | N | Y |
| | D | Y | Y | Y | Y | Y | Y | N | Y |
| | E-G | Y | Y | Y | Y | Y | Y | N | Y |
| Listed | A - B | N | N | N | N | N | N | N | N |
| | C | N | Y | Y | N | N | Y | N | Y |
| | D | N | Y | Y | N | N | Y | N | Y |
| | E-G | N | Y | Y | N | N | Y | N | Y |
| Remaining properties | A - B | N | N | N | N | N | N | N | N |
| | C | Y | Y | Y | Y | Y | Y | N | Y |
| | D | Y | Y | Y | Y | Y | Y | N | Y |
| | E-G | Y | Y | Y | Y | Y | Y | N | Y |

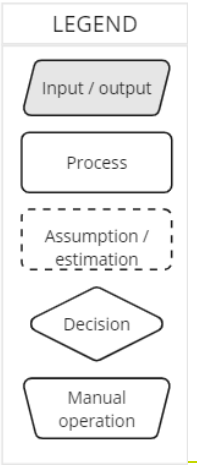
## Non-domestic Retrofit Indexation

| Non domestic (All properties) | | | | |
|---|---|---|---|---|
| **Shallow retrofit** | **A - B** | **C** | **D and below** | **Unknown** |
| Energy Efficiency (fabric) | N | N | N | N |
| Heating | N/A | N/A | N/A | N/A |
| Building energy management (inc. control, distribution, carbon and energy management) | Y | Y | Y | Y |
| Air conditioning and cooling | Y | Y | Y | Y |
| Ventilation | N | N | N | N |
| Electricity saving (small power, lighting and cooled storage) | Y | Y | Y | Y |

| Non domestic (All properties) | | | | |
|---|---|---|---|---|
| **Deep retrofit** | **A - B** | **C** | **D and below** | **Unknown** |
| Energy Efficiency (fabric) | N | Y | Y | Y |
| Heating | N/A | N/A | N/A | N/A |
| Building energy management (inc. control, distribution, carbon and energy management) | Y | Y | Y | Y |
| Air conditioning and cooling | Y | Y | Y | Y |
| Ventilation | Y | Y | Y | Y |
| Electricity saving (small power, lighting and cooled storage) | Y | Y | Y | Y |

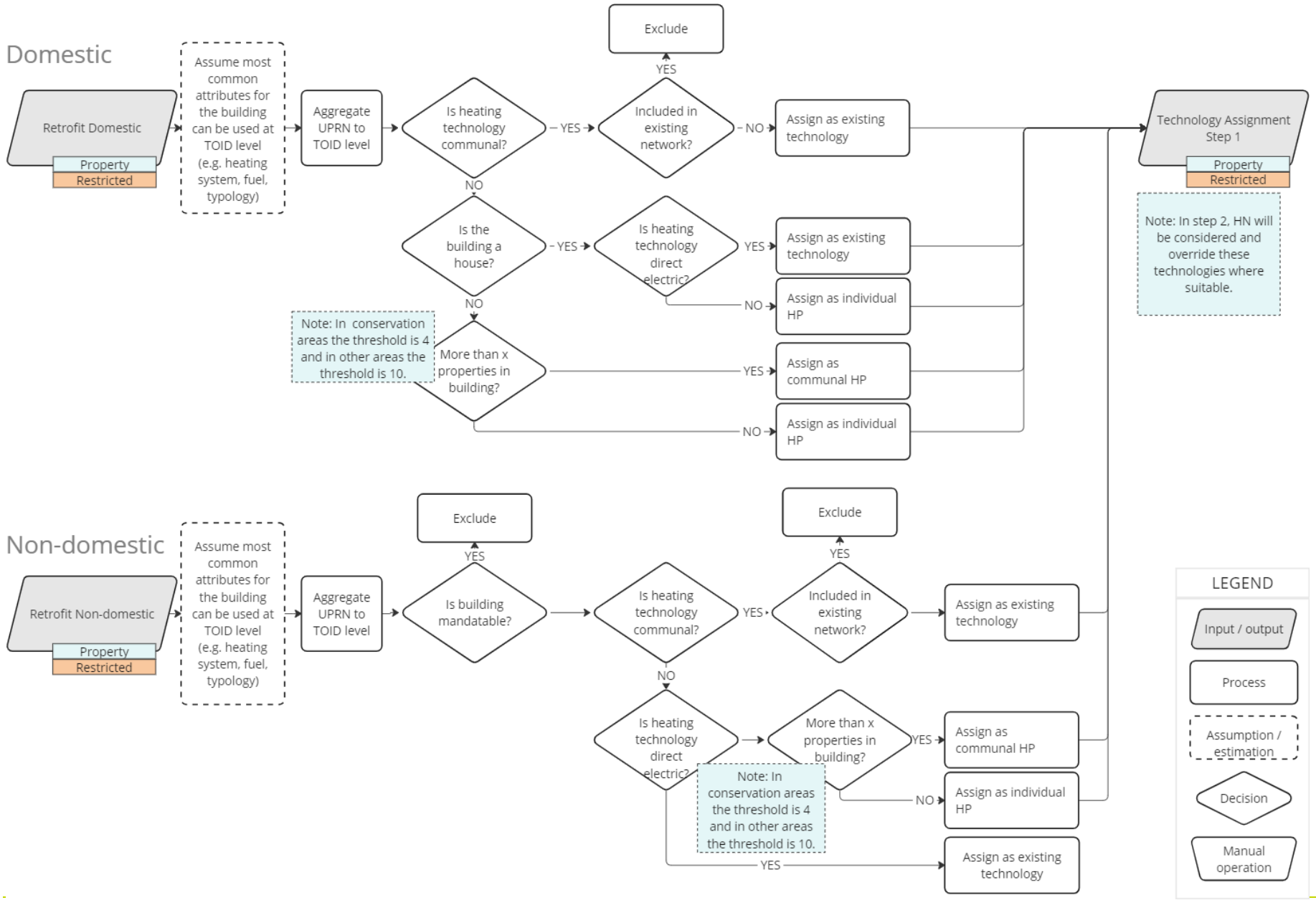
## HEATING TECHNOLOGY - LINEAR HEAT DENSITY



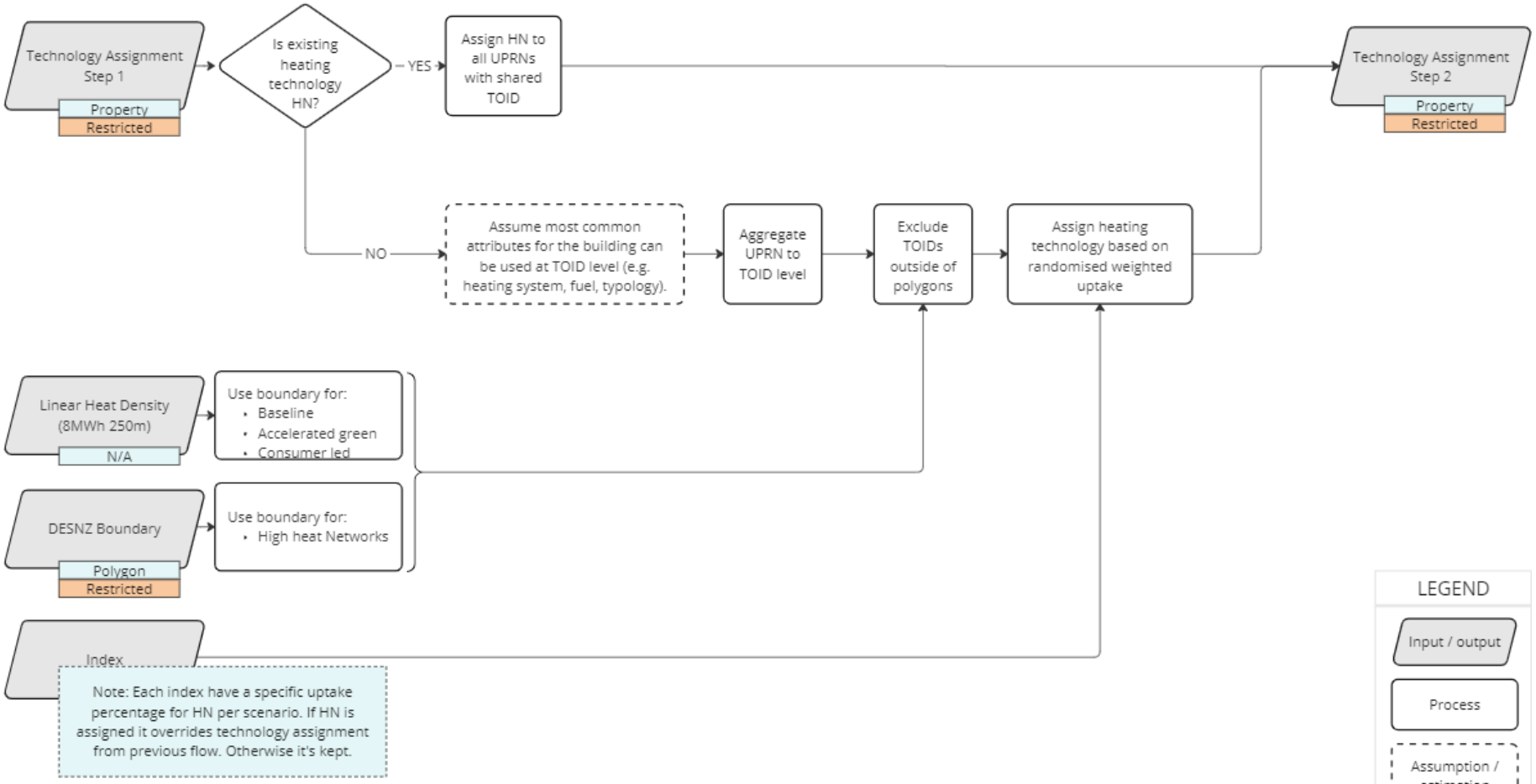
| Data input | Description | Geometry | Format | Source | Date of Harvest | Update frequency | Access |
|---|---|---|---|---|---|---|---|
| Retrofit Domestic | Output from previous flow. | | | | | | |
| Retrofit Non-domestic | Output from previous flow. | | | | | | |
| **Data output** | **Description** | **Geometry** | **Format** | **Output File Name** | | | |
| Linear Heat Density (8MWh 250m) | Linear heat density for the sub-region, comprising of minimum of two anchor loads at 8MWh and restricted to 250m. | Polygon | GEOJSON | 04_heat_networks_South_8mwh_250m, 04_heat_networks_CIEN_8mwh_250m | | | |
| Linear Heat Density (16MWh 250m) | Linear heat density for the sub-region, comprising of minimum of two anchor loads at 16MWh and restricted to 250m. | Polygon | GEOJSON | 04_heat_networks_South_16mwh_250m, 04_heat_networks_CIEN_16mwh_250m | | | |

HEATING TECHNOLOGY - TECHNOLOGY ASSIGNMENT (EXCEPT HEAT NETWORK)

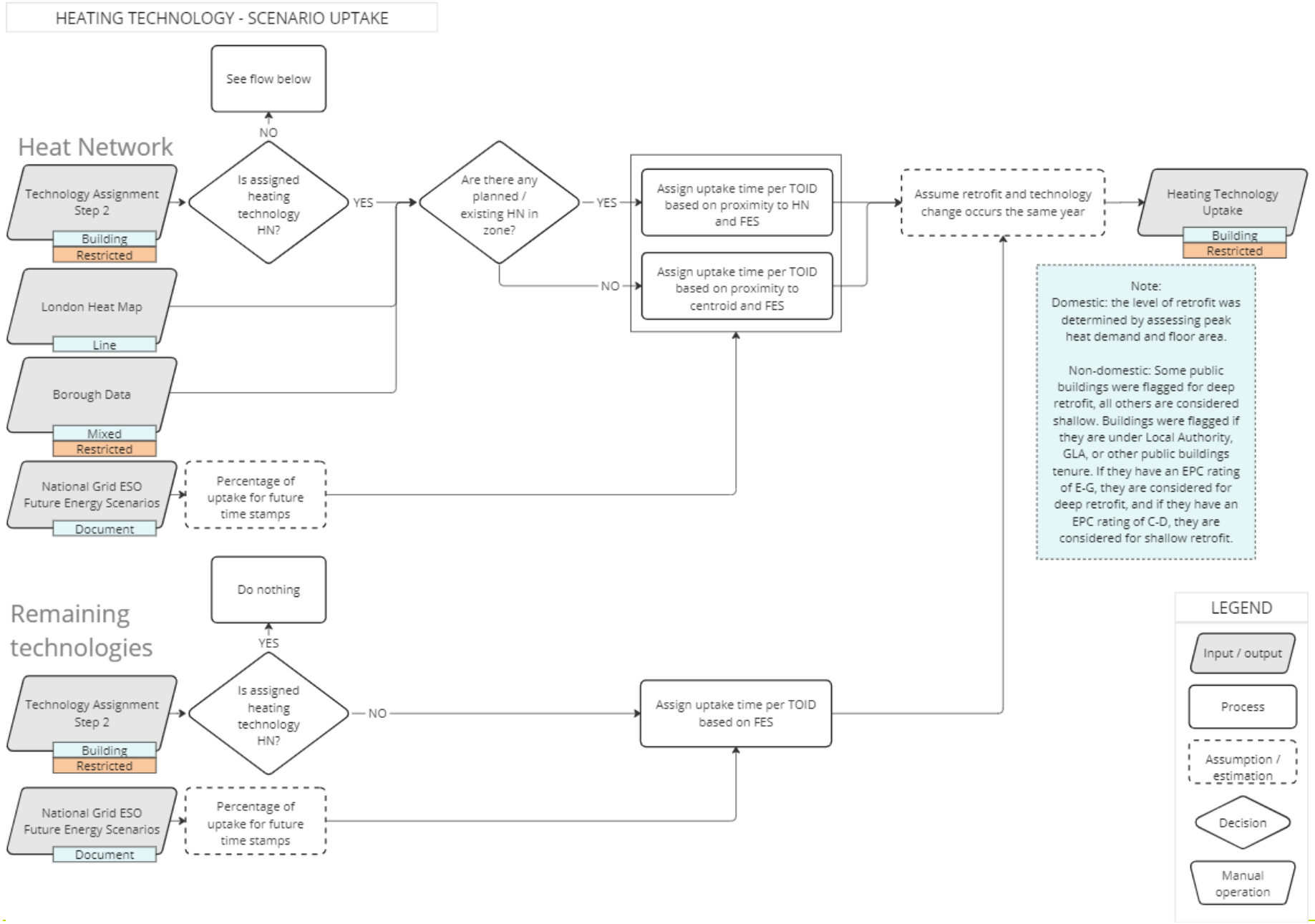


| Data input | Description | Geometry | Format | Source | Date of Harvest | Update frequency | Access |
|---|---|---|---|---|---|---|---|
| Retrofit Domestic | Output from previous flow. | | | | | | |
| Retrofit Non-domestic | Output from previous flow. | | | | | | |
| **Data output** | **Description** | **Geometry** | **Format** | **Output File Name** | | | |
| Technology Assignment Step 1 | Technology assignment for all properties if they were to not connect to heat network. | | CSV | N/A. Final values are included in scenario outputs for buildings: 01_baseline, 02_consumer_transformation, 03_accelerated_green, 04_high_heat_network | | | |

## HEATING TECHNOLOGY - SCENARIO ASSIGNMENT



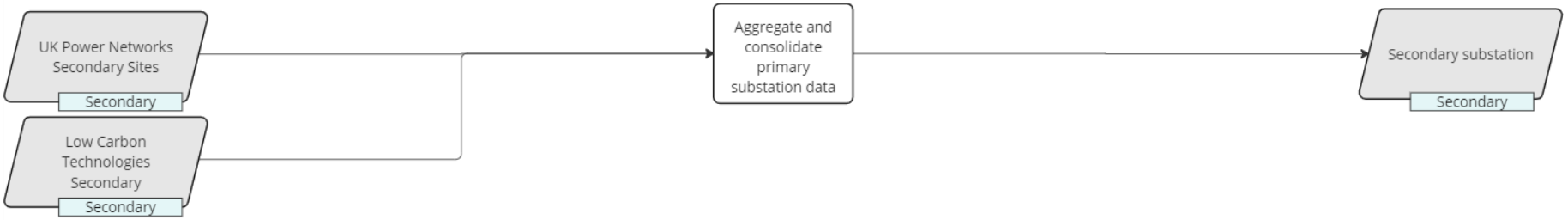
| Data input | Description | Geometry | Format | Source | Date of Harvest | Update frequency | Access |
|---|---|---|---|---|---|---|---|
| Technology Assignment Step 1 | Output from previous flow. | | | | | | |
| Linear Heat Density (8MWh 250m) | Output from previous flow. | | | | | | |
| DESNZ Boundary | Heat network zoning boundary provided by DESNEZ for the subregional area. | Polygon | GPKG | DESNEZ | February 2024 | Likely to go through updates, open version have now been publish. | Restricted |
| Index | Indexation created to establish probability of HN uptake per scenario based on a number of factors. If HN is assigned it overrides technology assignment from previous flow. Otherwise previous assignment is kept. | | CSV | | | | |
| **Data output** | **Description** | **Geometry** | **Format** | **Output File Name** | | | |
| Technology Assignment Step 2 | Technology assignment for all properties. | | CSV | N/A. Final values are included in scenario outputs for buildings: 01_baseline, 02_consumer_transformation, 03_accelerated_green, 04_high_heat_network | | | |


HEATING TECHNOLOGY - SCENARIO UPTAKE
Heat Network
See flow below
NO
Technology Assignment Step 2
Building
Restricted
Is assigned heating technology HN?
YES
Are there any planned / existing HN in zone?
YES
NO
Assign uptake time per TOID based on proximity to HN and FES
Assign uptake time per TOID based on proximity to centroid and FES
Assume retrofit and technology change occurs the same year
Heating Technology Uptake
Building
Restricted
London Heat Map
Line
Borough Data
Mixed
Restricted
National Grid ESO Future Energy Scenarios
Document
Percentage of uptake for future time stamps
Note:
Domestic: the level of retrofit was determined by assessing peak heat demand and floor area.
Non-domestic: Some public buildings were flagged for deep retrofit, all others are considered shallow. Buildings were flagged if they are under Local Authority, GLA, or other public buildings tenure. If they have an EPC rating of E-G, they are considered for deep retrofit, and if they have an EPC rating of C-D, they are considered for shallow retrofit.
Remaining technologies
Do nothing
YES
Technology Assignment Step 2
Building
Restricted
Is assigned heating technology HN?
NO
Assign uptake time per TOID based on FES
National Grid ESO Future Energy Scenarios
Document
Percentage of uptake for future time stamps
LEGEND
Input / output
Process
Assumption / estimation
Decision
Manual operation

| Data input | Description | Geometry | Format | Source | Date of Harvest | Update frequency | Access |
|---|---|---|---|---|---|---|---|
| Technology Assignment Step 2 | Output from previous flow. | | | | | | |
| Borough Data | Heat network specific data provided by boroughs. | Mixed | Mixed | Boroughs | March 2024 | | Restricted |
| London Heat Map | London Heat Map highlights existing and proposed networks. | Line | GPKG | https://apps.london.gov.uk/heatmap/ | April 2024 | | Open |
| National Grid ESO Future Energy Scenarios | ESO Pathways to Net Zero represent different, credible ways to decarbonise energy system towards the 2050 target. | | PDF | https://www.nationalgrideso.com/document/323296/download | | Annually | Open |
| **Data output** | **Description** | **Geometry** | **Format** | **Output File Name** | | | |
| Heating Technology Uptake | Uptake year of technology assigned for each property. | | CSV | scenario outputs for buildings: 01_baseline, 02_consumer_transformation, 03_accelerated_green, 04_high_heat_network | | | |

POWER - SUBSTATION DATA

## Secondary substation

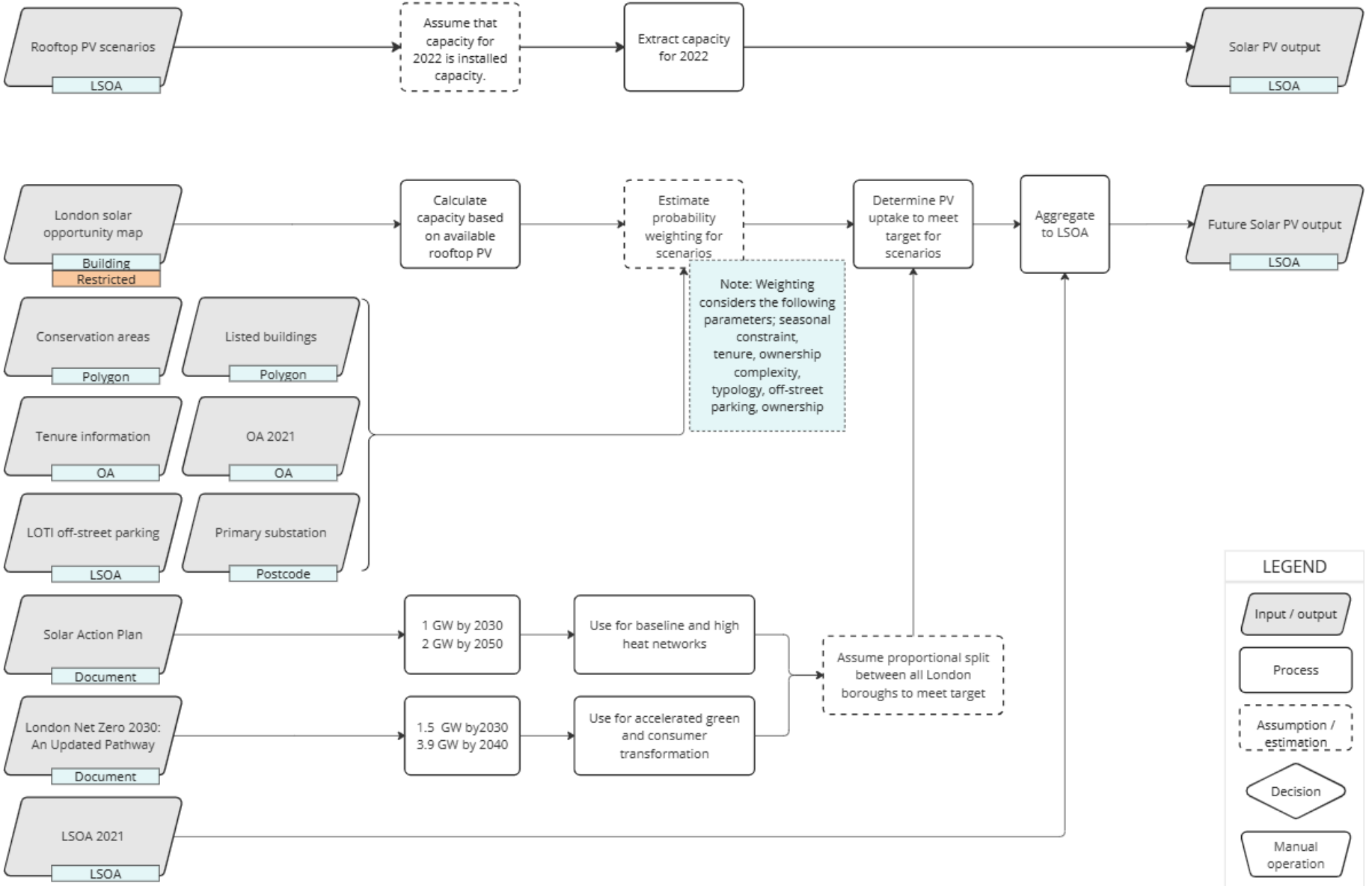



## Primary substation

| Data input | Description | Geometry | Format | Source | Date of Harvest | Update frequency | Access |
|---|---|---|---|---|---|---|---|
| UK Power Networks Secondary Sites | Details on secondary substations including primary substation locations and ratings. | | XLSX | https://ukpowernetworks.opendatasoft.com/explore/dataset/ukpn_primary_postcode_area/information/ | April 2024 | | Open |
| Low Carbon Technologies Secondary | Volume of Low Carbon Technologies (LCT) for both generation and demand (under 1MW) connected to UK Power Networks by Secondary Substation. | | CSV | https://ukpowernetworks.opendatasoft.com/explore/dataset/ukpn-low-carbon-technologies-secondary/information/ | April 2024 | | Open |
| Appendix 3 Competition Data v1.1 | Flexibility procurement historical competition data. | | XLSX | https://dso.ukpowernetworks.co.uk/flexibility/tender-hub?tender_category=previous-tenders | July 2024 | 6 months | Open |
| Code Point Polygon | Ordnance Survey (OS) National Geographic Database (NGD) Building Polygons. | Polygon | GPKG | https://www.ordnancesurvey.co.uk/products/os-ngd | April 2024 | Weekly | Restricted |
| UK Power Networks Primary Substation Distribution Areas | Details on primary substations including primary substation areas and headroom. | | CSV | https://ukpowernetworks.opendatasoft.com/explore/dataset/ukpn_primary_postcode_area/information/ | June 2024 | | Open |
| Long Term Development Statement Table 3b | Details of forecasted loads on the network and envisioned network developments over a 0-5 year period. Shows true substation peak demands with correction added for demand served by generation. | | CSV | https://ukpowernetworks.opendatasoft.com/explore/dataset/ltds-table-3b-load-data-true/information/?disjunctive.season | August 2024 | 6 months | Open |
| Distribution Network Options Assessment | Distribution Network Options Assessment. Details future network constraints, the recommended solution and the current status in the solution progress. | | CSV | https://ukpowernetworks.opendatasoft.com/explore/dataset/ukpn-dnoa/information/?disjunctive.constraint_season | May 2024 | Annually | Open |
| Low Carbon Technologies Primary | Volume of Low Carbon Technologies (LCT) for both generation and demand (under 1MW) connected to UK Power Networks by Primary Substation. | | CSV | https://ukpowernetworks.opendatasoft.com/explore/dataset/low-carbon-technologies/information/?disjunctive.category&disjunctive.type | April 2024 | | Open |

| Data input | Description | Geometry | Format | Output File Name |
|---|---|---|---|---|
| Primary Substation | Consolidates all incoming primary substation data by merging it based on the relevant geographic identifier, with the SiteFunctionalLocation serving as the primary key. | | CSV | 06_power_primary_substation |
| Secondary Substation | Consolidated data set for secondary substation. Includes substations demand, location, capacity of LCTs connected and import, export capacities for LCTs | | CSV | 06_power_secondary_substation |

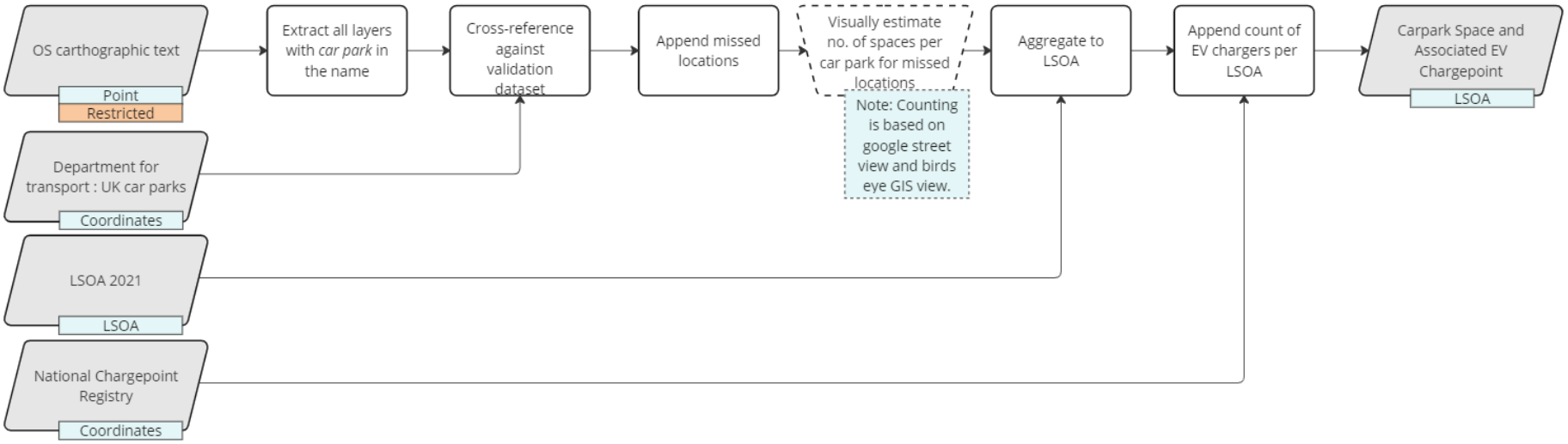
## RENEWABLES - ROOFTOP SOLAR



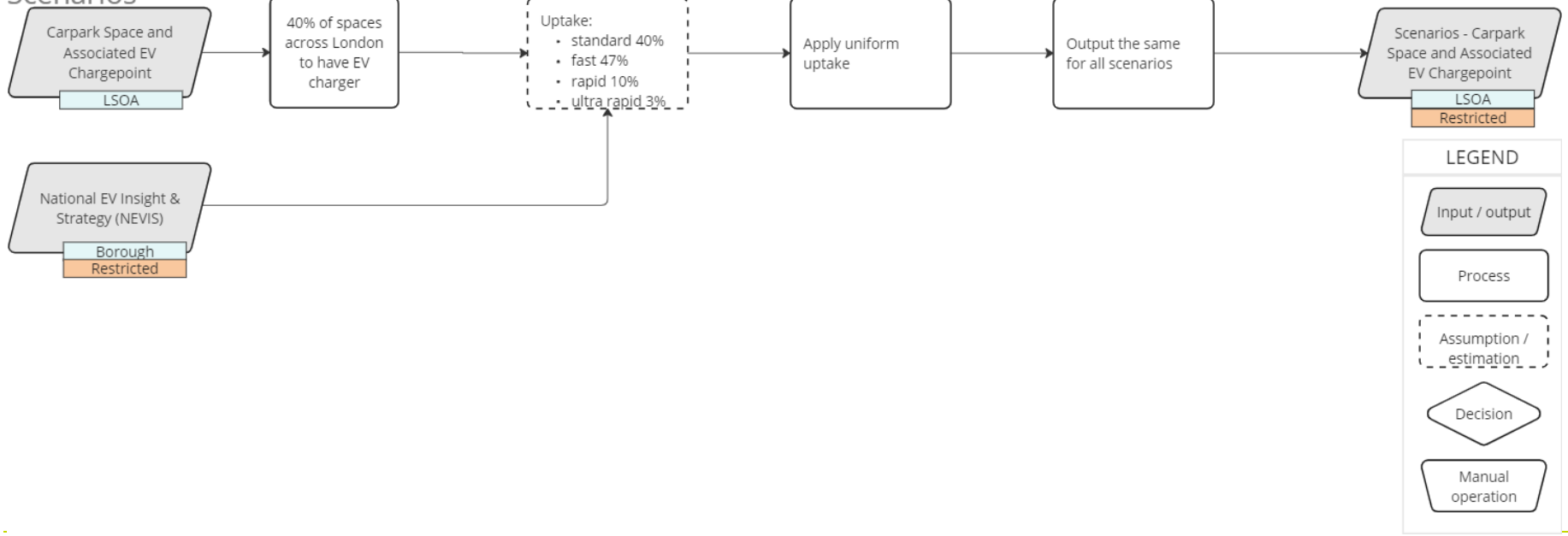
| Data input | Description | Geometry | Format | Source | Date of Harvest | Update frequency | Access |
|---|---|---|---|---|---|---|---|
| Rooftop PV scenarios | Capacity of rooftop PV forecast which is used as part of the Distributed Future Energy Scenarios. | | XLSX | UK Power Networks | April 2024 | | Open |
| London Solar Opportunities Map | Estimates the solar irradiance potential and viable roof area for PV at building level. Uses TOID as identifier. | | CSV | University College London | April 2024 | | Restricted |
| LSOA 2021 | 2021 Lower Super Output Areas and Data Zones borders for United Kingdom. | Polygon | GEOJSON | https://geoportal.statistics.gov.uk/datasets/0f80c523f3cd4d0fab5111572f84a2fb_0/explore | March 2024 | Aligns to Cencus | Open |
| OA 2021 | 2021 Output Areas and Data Zones borders for United Kingdom. | Polygon | GPKG | https://geoportal.statistics.gov.uk/datasets/ons::output-area-2021-to-lsoa-to-msoa-to-lad-december-2021-exact-fit-lookup-in-ew-v3/explore | June 2024 | Aligns to Cencus | Open |
| Tenure Information | Details on property tenure at output area level i.e owned, social rented, private rented. | | CSV | https://www.ons.gov.uk/datasets/TS054/editions/2021/versions/4/filter-outputs/e6ac6489-fb40-4465-b4ee-0df6415458e4?f=get-data#get-data | June 2024 | | Open |
| London Office of Technology and Innovation (LOTI) | % of households with off-street parking per LSOA and % of households with a car. | | CSV | https://loti.london/ | January 2024 | | Restricted |
| Primary Substations | Output from previous flow. | | | | | | |
| Listed Buildings | Polygons of listed building with properties including grade, building preservation notices and certificates of immunity. | Polygon | GPKG | https://historicengland.org.uk/listing/the-list/data-downloads/ | March 2024 | | Open |
| Conservation Area | Conservation areas exist to manage and protect the special architectural and historic interest of a place - in other words, the features that make it unique. | | GPKG | https://historicengland.org.uk/listing/the-list/data-downloads/ | March 2024 | | Open |
| Solar Action Plan for London | Mayor of London's target for Solar PV. | | PDF | https://www.london.gov.uk/sites/default/files/solar_action_plan.pdf | July 2024 | Published June 2018, not been updated since | Open |
| London Net Zero 2030: An Updated Pathway | Accelerated green target for Solar PV. | | PDF | https://www.london.gov.uk/sites/default/files/london_net_zero_2030_-_an_updated_pathway_-_gla_response_1.pdf | July 2024 | Published January 2022, not been updated since | Open |
| **Data output** | **Description** | **Geometry** | **Format** | **Output File Name** | | | |
| Solar PV output | Solar PV output | | CSV | 05_rooftop_solar | | | |
| Future Solar PV output | Solar PV output for future scenarios | | CSV | scenario outputs for rooftop solar pv: 01_baseline, 02_consumer_transformation, 03_accelerated_green, 04_high_heat_network | | | |

TRANSPORT - CAR PARKS AND ASSOCIATED EV CHARGEPOINTS

## Baseline



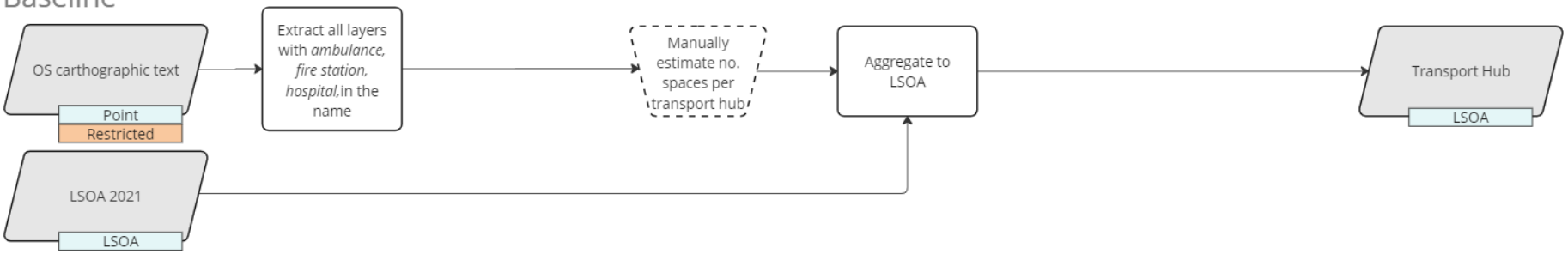

## Scenarios



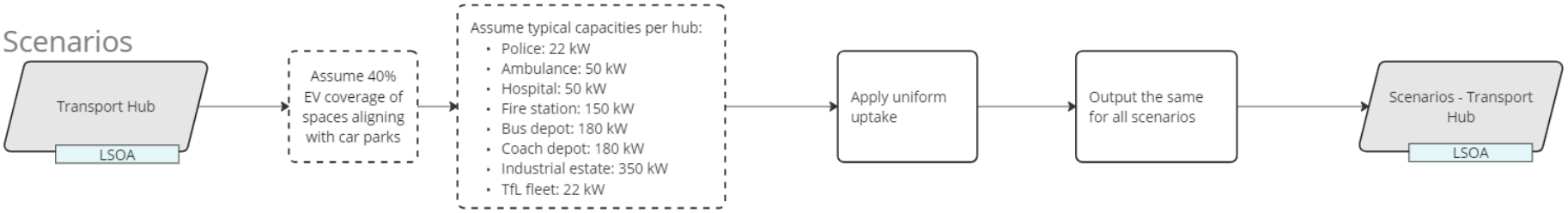
| Data input | Description | Geometry | Format | Source | Date of Harvest | Update frequency | Access |
|---|---|---|---|---|---|---|---|
| OS Carthographic Text | Part of OS MasterMap Topography Layer which links relevant information to point data. | Point | GPKG | https://www.ordnancesurvey.co.uk/products/os-mastermap-topography-layer | Mar-24 | Six weekly | Restricted |
| Department For Transport : UK Car Parks | Dataset for UK Car Parks in great Britain, which was created for the Transport Direct Journey planning website. | | CSV | https://hub.arcgis.com/datasets/bd03477bcb2f46e3a034bcbfc7664a5e/explore | March 2024 | None since Feb 2016 | Open |
| National Chargepoint Registry | Data on the National Chargepoint Registry (NCR) on public electric vehicle chargepoints in the UK. | | CSV | https://www.gov.uk/guidance/find-and-use-data-on-public-electric-vehicle-chargepoints | May 2024 | Monthly | Open |
| LSOA 2021 | 2021 Lower Super Output Areas and Data Zones borders for all UK. | Polygon | GEOJSON | https://geoportal.statistics.gov.uk/datasets/0f80c523f3cd4d0fab5111572f84a2fb_0/explore | March 2024 | Aligns to Census | Open |
| National EV Insight & Strategy (NEVIS) | Deployment of Electric Vehicles (EVs) and Electric Vehicle Infrastructure (EVI). | | CSV | https://nevis.cenex.co.uk/toolkit-data | April 2024 | Quarterly | Restricted |
| **Data output** | **Description** | **Geometry** | **Format** | **Output File Name** | | | |
| Carpark Space and Associated EV | Carpark Space and Associated EV charge point per LSOA | | CSV | 03_transport | | | |
| Scenarios - Carpark Space and Associated EV Charge Point | Future carpark Space and Associated EV charge point per LSOA | | CSV | scenario outputs for transport: 01_baseline, 02_consumer_transformation, 03_accelerated_green, 04_high_heat_network | | | |

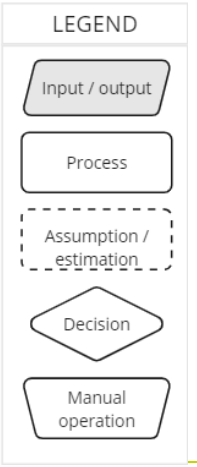
TRANSPORT - TRANSPORT HUBS

## Baseline




## Scenarios

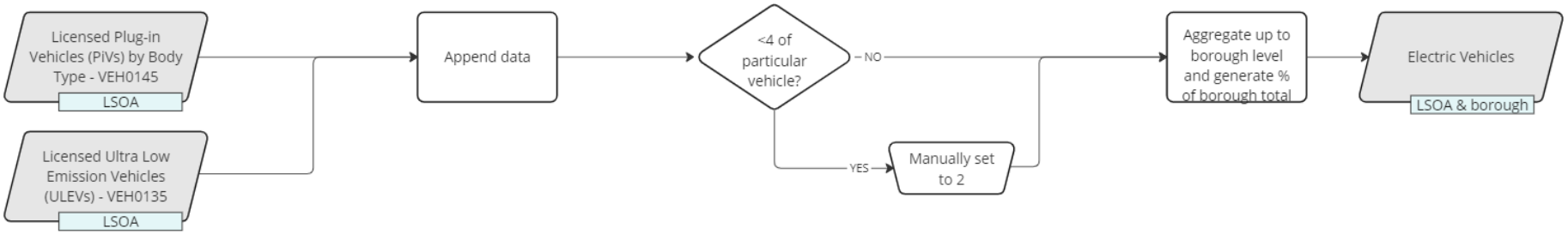


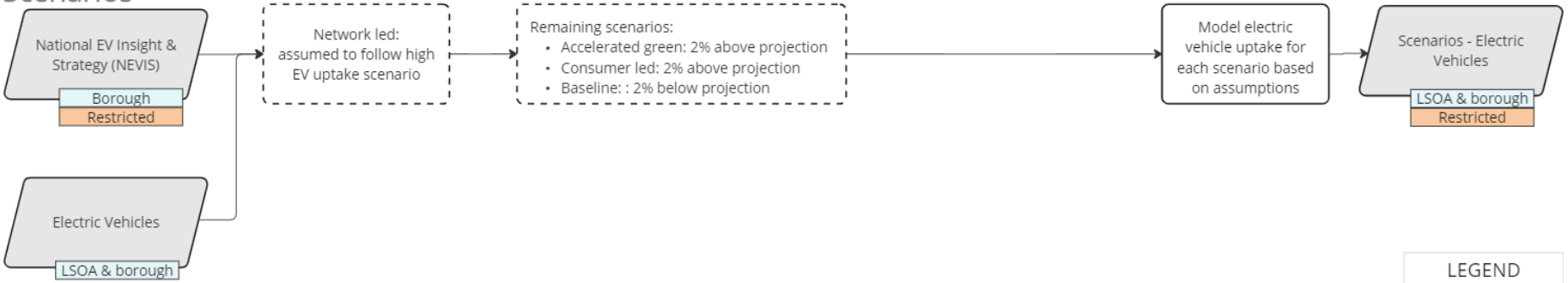
| Data input | Description | Geometry | Format | Source | Date of Harvest | Update frequency | Access |
|---|---|---|---|---|---|---|---|
| OS Carthographic Text | Part of OS MasterMap Topography Layer which links relevant information to point data. | Point | GPKG | https://www.ordnancesurvey.co.uk/products/os-mastermap-topography-layer | March 2024 | Six weekly | Restricted |
| LSOA 2021 | 2021 Lower Super Output Areas and Data Zones borders for all UK. | Polygon | GEOJSON | https://geoportal.statistics.gov.uk/datasets/0f80c523f3cd4d0fab5111572f84a2fb_0/explore | March 2024 | Aligns to Census | Open |
| **Data output** | **Description** | **Geometry** | **Format** | **Output File Name** | | | |
| Transport Hub | Baseline for transport hub per LSOA. | | CSV | 03_transport | | | |
| Scenarios - Transport Hub | Scenarios output for transport hub per LSOA. | | CSV | scenario outputs for transport: 01_baseline, 02_consumer_transformation, 03_accelerated_green, 04_high_heat_network | | | |

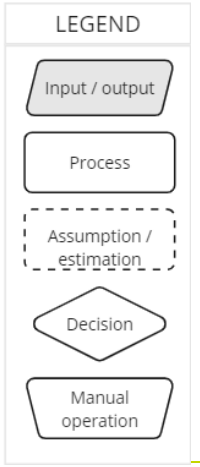
TRANSPORT - ELECTRIC VEHICLES

## Baseline

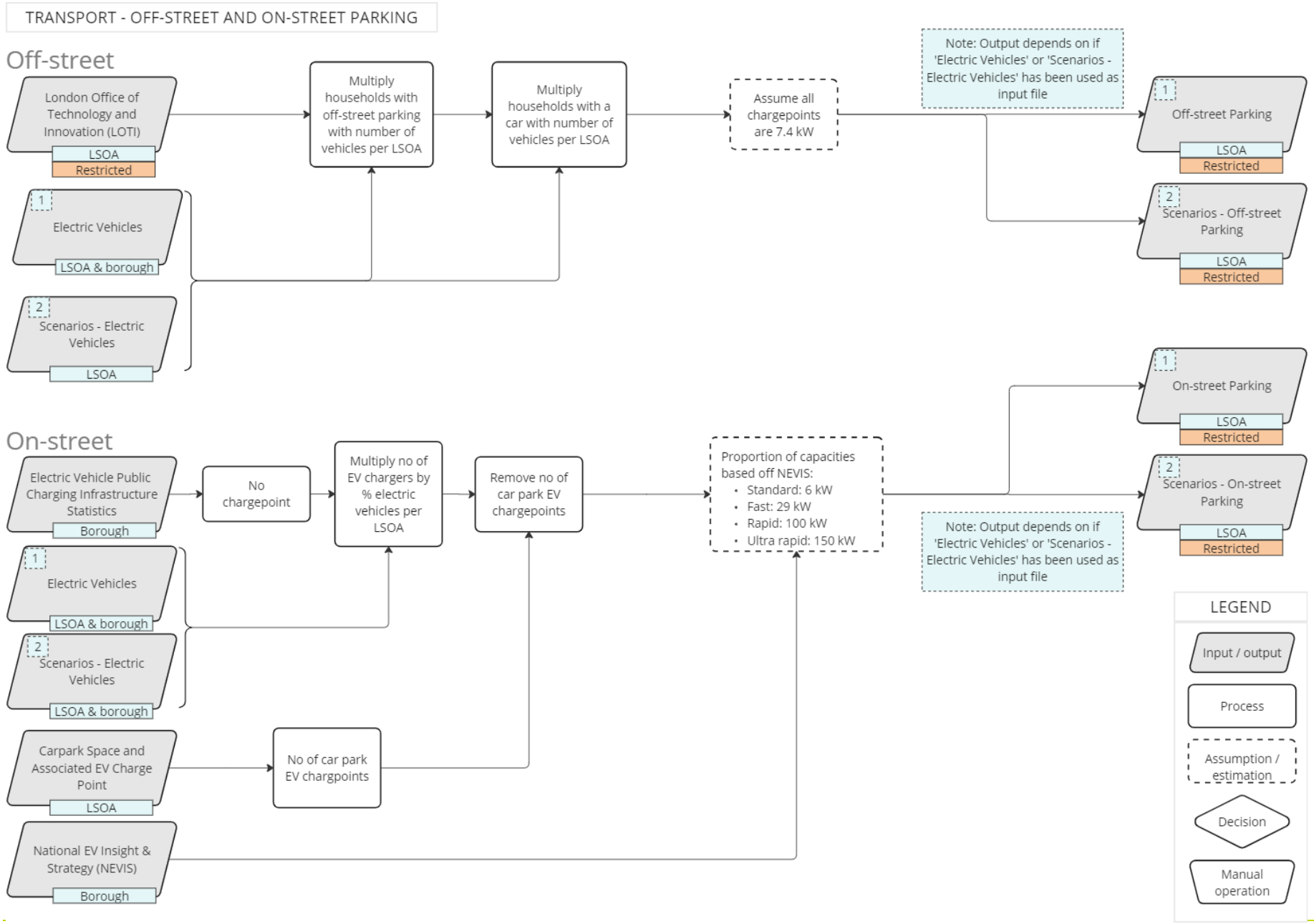



## Scenarios



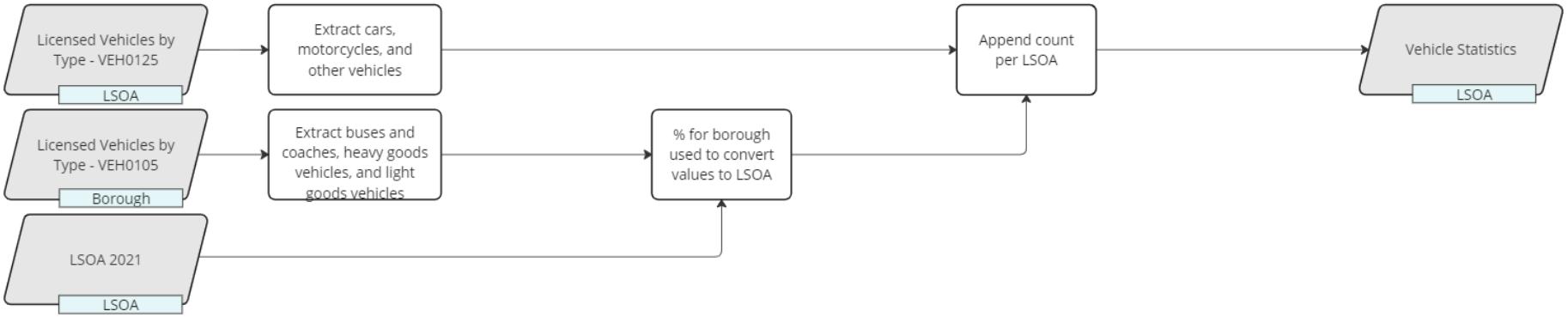
| Data input | Description | Geometry | Format | Source | Date of Harvest | Update frequency | Access |
|---|---|---|---|---|---|---|---|
| Licensed Plug-in Vehicles (PiVs) by Body Type - VEH0145 | Licensed plug-in vehicles (PiVs) at the end of the quarter by fuel type, keepership and LSOA: United Kingdom | | CSV | Vehicle licensing statistics data files - GOV.UK (www.gov.uk) | March2024 | Quarterly | Open |
| Licensed Ultra Low Emission Vehicles (ULEVs) - VEH0135 | Licensed ultra low emission vehicles (ULEVs) at the end of the quarter by fuel type, keepership and LSOA: United Kingdom | | CSV | Vehicle licensing statistics data files - GOV.UK (www.gov.uk) | March 2024 | Quarterly | Open |
| National EV Insight & Strategy (NEVIS) | Deployment of Electric Vehicles (EVs) and Electric Vehicle Infrastructure (EVI). | | CSV | https://nevis.cenex.co.uk/toolkit-data | April 2024 | Quarterly | Restricted |
| **Data output** | **Description** | **Geometry** | **Format** | **Output File Name** | | | |
| Electric Vehicles | Baseline electric vehicles per LSOA along with associated borough %. | | CSV | 03_transport | | | |
| Scenarios - Electric Vehicles | Scenarios electric vehicles per LSOA along with associated borough %. | | CSV | scenario outputs for transport: 01_baseline, 02_consumer_transformation, 03_accelerated_green, 04_high_heat_network | | | |


TRANSPORT - OFF-STREET AND ON-STREET PARKING
Off-street
London Office of Technology and Innovation (LOTI)
LSOA
Restricted
1
Electric Vehicles
LSOA & borough
2
Scenarios - Electric Vehicles
LSOA
Multiply households with off-street parking with number of vehicles per LSOA
Multiply households with a car with number of vehicles per LSOA
Assume all chargepoints are 7.4 kW
Note: Output depends on if 'Electric Vehicles' or 'Scenarios - Electric Vehicles' has been used as input file
1
Off-street Parking
LSOA
Restricted
2
Scenarios - Off-street Parking
LSOA
Restricted
On-street
Electric Vehicle Public Charging Infrastructure Statistics
Borough
No chargepoint
Multiply no of EV chargers by % electric vehicles per LSOA
Remove no of car park EV chargepoints
Proportion of capacities based off NEVIS:
Standard: 6 kW
Fast: 29 kW
Rapid: 100 kW
Ultra rapid: 150 kW
1
Electric Vehicles
LSOA & borough
2
Scenarios - Electric Vehicles
LSOA & borough
Carpark Space and Associated EV Charge Point
LSOA
No of car park EV chargpoints
National EV Insight & Strategy (NEVIS)
Borough
1
On-street Parking
LSOA
Restricted
2
Scenarios - On-street Parking
LSOA
Restricted
Note: Output depends on if 'Electric Vehicles' or 'Scenarios - Electric Vehicles' has been used as input file
LEGEND
Input / output
Process
Assumption / estimation
Decision
Manual operation

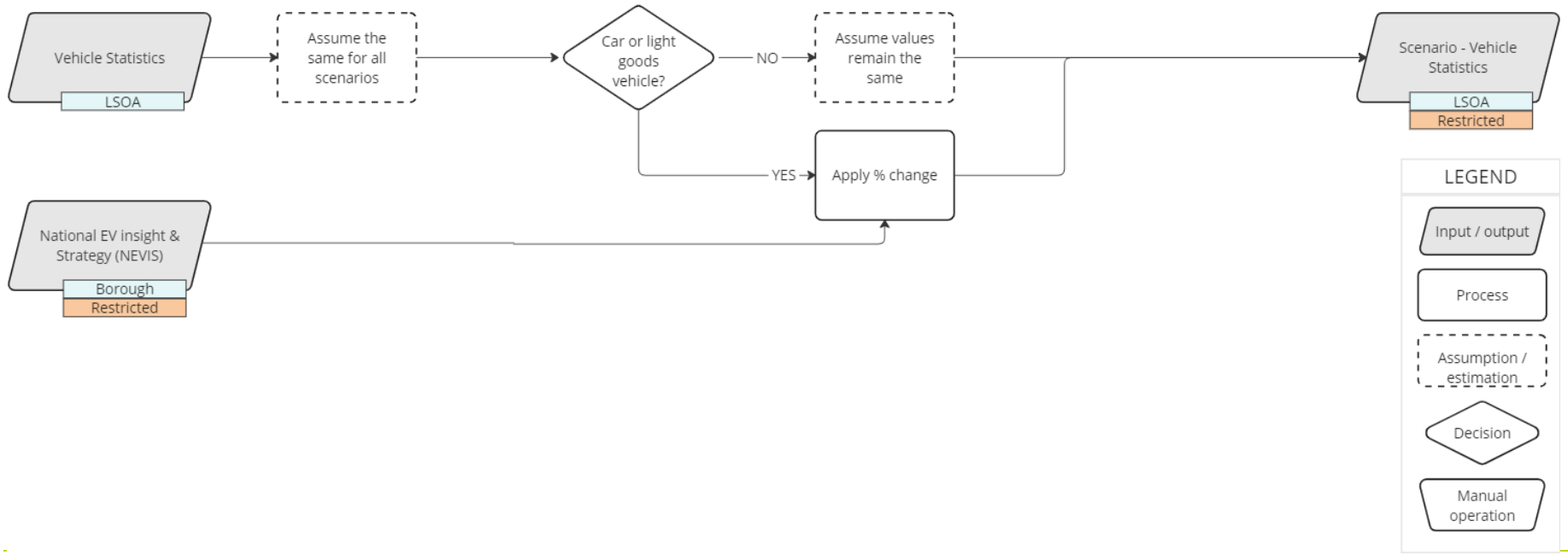
| Data input | Description | Geometry | Format | Source | Date of Harvest | Update frequency | Access |
|---|---|---|---|---|---|---|---|
| London Office of Technology and Innovation (LOTI) | % of households with off-street parking per LSOA and % of households with a car. | | CSV | GLA | January 2024 | Census Dates | Restricted |
| Electric Vehicles | Output from previous flow. | | | | | | |
| Scenarios - Electric Vehicles | Output from previous flow. | | | | | | |
| Electric Vehicle Public Charging Infrastructure Statistics | The number of publicly available electric vehicle charging devices in the UK. | | XLSX | https://www.gov.uk/government/statistics/electric-vehicle-charging-device-statistics-january-2024 | March 2024 | Quarterly | Open |
| Carpark Space and Associated EV Charge Point | Output from previous flow. | | | | | | |
| **Data output** | **Description** | **Geometry** | **Format** | **Output File Name** | | | |
| Off-street Parking | Baseline number off-street parking by LSOA. | | CSV | 03_transport | | | |
| On-street Parking | Baseline number on-street parking by LSOA. | | CSV | 03_transport | | | |
| Scenarios - off-street Parking | Scenarios number off-street parking by LSOA. | | CSV | scenario outputs for transport: 01_baseline, 02_consumer_transformation, 03_accelerated_green, 04_high_heat_network | | | |
| Scenarios - on-street Parking | Scenarios number on-street parking by LSOA. | | CSV | scenario outputs for transport: 01_baseline, 02_consumer_transformation, 03_accelerated_green, 04_high_heat_network | | | |

TRANSPORT - VEHICLE STATISTICS

## Baseline



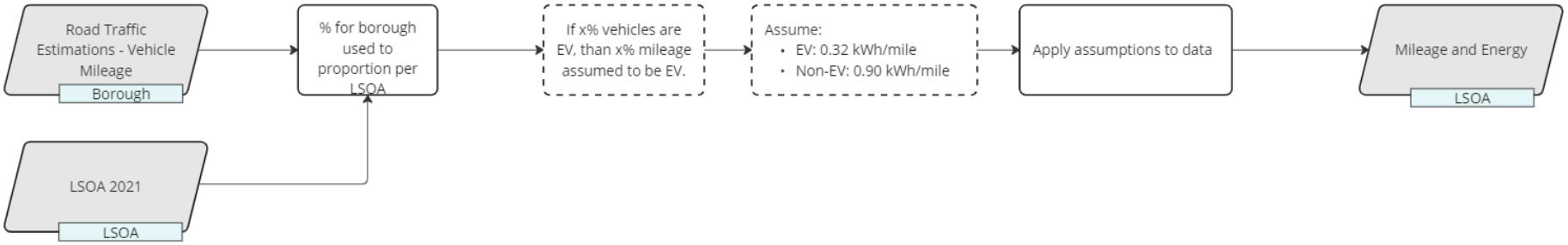

## Scenarios



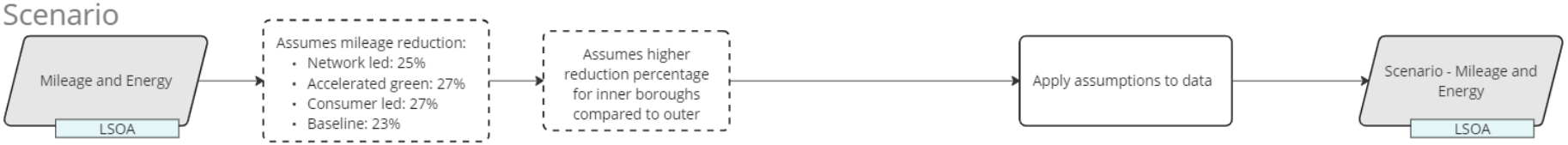
| Data input | Description | Geometry | Format | Source | Date of Harvest | Update frequency | Licence |
|---|---|---|---|---|---|---|---|
| Licensed Vehicles by Type - VEH0105 | Licensed vehicles by body type, fuel type, keepership and upper and lower tier local authority. | | CSV | https://www.gov.uk/government/statistical-data-sets/vehicle-licensing-statistics-data-tables | March 2024 | Quarterly | Open |
| Licensed Vehicles by Type - VEH0125 | Vehicles at the end of the quarter by licence status, body type, keepership and lower super output area (LSOA). | | CSV | Vehicle licensing statistics data files - GOV.UK (www.gov.uk) | March 2024 | Quarterly | Open |
| LSOA 2021 | 2021 Lower Super Output Areas and Data Zones borders for all UK. | Polygon | GEOJSON | https://geoportal.statistics.gov.uk/datasets/0f80c523f3cd4d0fab5111572f84a2fb_0/explore | February 2024 | Aligns to Census | Open |
| **Data output** | **Description** | **Geometry** | **Format** | **Output File Name** | | | |
| Vehicle Statistics | Breakdown of vehicles per LSOA. | | CSV | 03_transport | | | |
| Scenario - Vehicle Statistics | Breakdown of predicted vehicles per LSOA. | | CSV | scenario outputs for transport: 01_baseline, 02_consumer_transformation, 03_accelerated_green, 04_high_heat_network | | | |

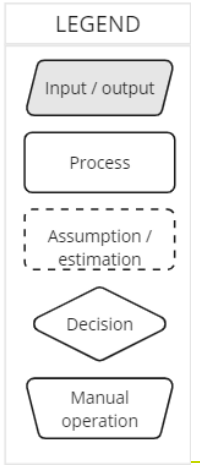
TRANSPORT - MILEAGE AND ENERGY

## Baseline



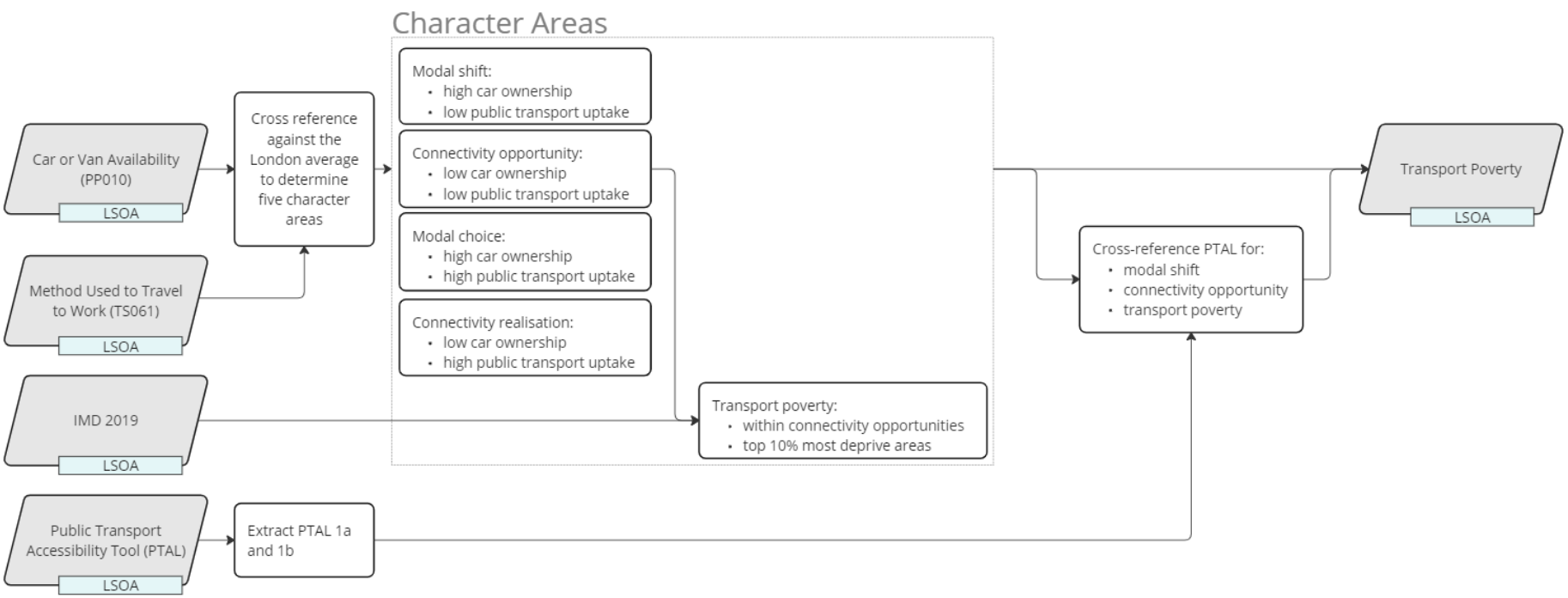

## Scenario

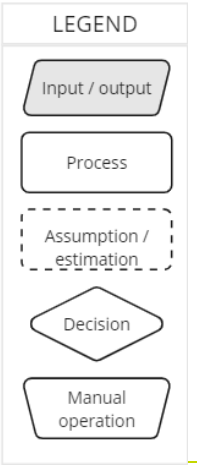


| Data input | Description | Geometry | Format | Source | Date of Harvest | Update frequency | Licence |
|---|---|---|---|---|---|---|---|
| Road Traffic Estimations - Vehicle Mileage | Road traffic estimates for Great Britain broken down by vehicle type and road type for 2022. | | XLSX | https://www.gov.uk/government/statistics/road-traffic-estimates-in-great-britain-2022 | April 2024 | Yearly | Open |
| LSOA 2021 | 2021 Lower Super Output Areas for United Kingdom. | Polygon | GEOJSON | https://geoportal.statistics.gov.uk/datasets/0f80c523f3cd4d0fab5111572f84a2fb_0/explore | February 2024 | Census Dates | Open |
| **Data output** | **Description** | **Geometry** | **Format** | **Output File Name** | | | |
| Mileage and Energy | Mileage and energy per LSOA. | | CSV | 03_transport | | | |
| Scenario - Mileage and Energy | Future mileage and energy per LSOA. | | CSV | scenario outputs for transport: 01_baseline, 02_consumer_transformation, 03_accelerated_green, 04_high_heat_network | | | |

TRANSPORT - TRANSPORT POVERTY



| Data input | Description | Geometry | Format | Source | Date of Harvest | Update frequency | Licence |
|---|---|---|---|---|---|---|---|
| Car or Van Availability (PP010) | Census 2021 estimates that classify households in parishes England and Wales by car or van availability. | | CSV | https://www.nomisweb.co.uk/datasets/c2021pp010 | July 2024 | | Open |
| Method Used to Travel to Work (TS061) | Census 2021 estimates that classify usual residents in England and Wales by their method used to travel to work. | | CSV | https://www.nomisweb.co.uk/datasets/c2021ts061#:~:text=Method%20of%20travel%20to%20workplace%20 | July 2024 | | Open |
| Public Transport Accessibility Tool (PTAL) | PTALS are a detailed and accurate measure of the accessibility of a point to the public transport network, taking into account walk access time and service availability. | | CSV | https://tfl.gov.uk/info-for/urban-planning-and-construction/planning-with-webcat/webcat | July 2024 | | Open |
| IMD 2019 | The Index of Multiple Deprivation (IMD) datasets are small area measures of relative deprivation across each of the constituent nations of the United Kingdom. | Polygon | GPKG | https://data.cdrc.ac.uk/dataset/index-multiple-deprivation-imd | March 2024 | 3-4 years | Open |
| **Data output** | **Description** | **Geometry** | **Format** | **Output File Name** | | | |
| Transport Poverty | Five character areas to identify transport poverty and opportunities. | | CSV | 03_transport_character_areas | | | |

Borough readiness - Phase 2 LAEP

Readiness to deliver a borough-led Local Area Energy Plan and/or Net Zero Projects has been mapped under six indicators. Officers have provided their insight on their borough's progress under key decarbonisation themes in terms of projects, data and resource and existing activities and policies to drive decarbonisation without progressing to a full borough-led LAEP. The completed assessment included officer insights added to the Miro board and our policy, data and projects assessment as presented during the 1-2-1 borough engagement workshops.

| Readiness indicators | | RED - Limited action to support the commissioning and successful implementation of a Phase 2 LAEP | AMBER - Some action to support the commissioning and successful implementation of a Phase 2 LAEP | GREEN - Significant action to support the commissioning and successful implementation of a Phase 2 LAEP |
|---|---|---|---|---|
| Net Zero Pipeline Projects | Projects and opportunities that have been identified in your borough (including cross-borough projects) | Limited | Some | Significant |
| | Implementation of projects that have been identified e.g., resource and partner organisations | Limited | Some | Significant |
| | Data to identify more projects | Limited | Some | Significant |
| Borough-led LAEP (Phase 2) | Identifying a team to commission Phase 2 | Limited | Some | Significant |
| | Buy-in from stakeholders in the council | Limited | Some | Significant |
| | Existing studies and policies to support or reduce the need for a formal LAEP | Limited | Some | Significant |

Borough readiness - LAEP delivery (borough-led LAEP completed)

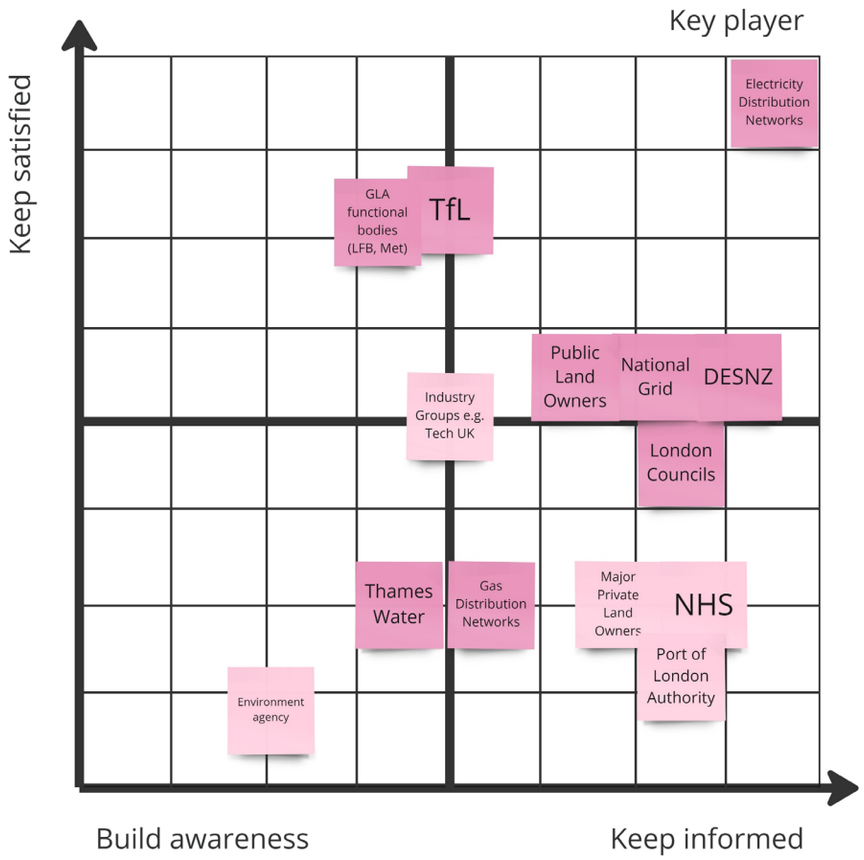
Readiness to deliver the outcomes of a borough-led Local Area Energy Plan and/or Net Zero Projects has been mapped under six indicators. Officers have provided their insight on their borough's progress under key decarbonisation themes in terms of projects, data and resource and existing activities and policies to drive decarbonisation. The completed assessment included officer insights added to the Miro board and our policy, data and projects assessment as presented during the 1-2-1 borough engagement workshops.

| Success indicators | | RED - Limited action to support the successful implementation of a Phase 2 LAEP | AMBER - Some action to support the successful implementation of a Phase 2 LAEP | GREEN - Significant action to support the successful implementation of a Phase 2 LAEP |
|---|---|---|---|---|
| Net Zero Pipeline Projects - priority intervention areas | Enabling actions |   | | |
| | Projects identified under key priority areas |   | | |
| | Data to identify more projects |   | | |
| | Stakeholder engagement / partnerships to deliver the proposed actions |   | | |

# Appendix B Stakeholder engagement and mapping

# Subregional LAEP Phase 1 – Stakeholder mapping

Stakeholder engagement is a core component in the development of the LAEP at different levels for subregional and borough-level LAEPs. For the subregional LAEP scale the focus is on larger stakeholders, such as central government, individual boroughs and utilities (such as network operators). A key aspect of the subregional engagement included the mapping of Phase 1 stakeholders. The map below was presented and discussed during borough 1-2-1 engagement to map subregional stakeholders for engagement during the Phase 1 work.




## Key

**Primary Stakeholder**

**Primary stakeholders are key players that have influence over the LAEP development and delivery**

**Secondary Stakeholder**

**Secondary stakeholders are those that will be kept informed about the LAEP outcomes**

## Acronyms

**DESNZ - Department for Energy Security and Net Zero**

**TfL - Transport for London**

**LFB - London Fire Brigade**

**Met - Metropolitan Police**

# Appendix C Smart DCC report

# Enabling better use of smart meter data to enhance Local Area Energy Planning

## Overview

This report forms a deliverable as part of the wider Subregional LAEP study being delivered for the GLA by Buro Happold.

The report summarises the key aspects of smart meter system data use, for the first time, in the LAEP planning process. Smart meter system data refers to the transactions taking place across the smart meter network (rather than message contents - such as consumption profiles). In high level summary, system data has been used to establish insights in relation to:

- Borough 'readiness' - the rate of smart meter installs and projected trajectory on a borough-by-borough basis which enables greater understanding of areas that are more or less able to benefit as the energy system transition continues and time of use tariffs and flexibility services continue to increase in availability.

- Fuel poverty indicators – analysing an anonymised sub-set of system data transactions from pre-payment meters to establish output areas in which there are increased indicators of financial difficulty, self-disconnections for example.

Whilst the benefits of use of the data set are growing, limitations are acknowledged in relation to data coverage (~27% of installed pre-payment meters) and granularity in particular.

Suggested next steps to further capitalise on the availability of smart meter data and the insights that can be drawn include:

- A detailed workshop to resolve key consideration around data access, data legislation and regulatory change needed to enable enduring data use
- A benefits mapping exercise to establish key metrics for successful data integration and use
- Formation of a working group of built environment practitioners to establish a standardised approach to the incorporation of smart metering data sets into the LAEP process

## Context

In response to the climate crisis, most local authorities are targeting net zero before 2050 and the need for consistent, repeatable and robust planning processes is widely recognised.

Local Area Energy Planning (LAEP) has evolved to meet this need, ensuring that strategic investment is deployed in the right local areas to unlock net zero in an accelerated, cost effective and efficient way. As LAEP methodologies mature, it's recognised that digital and data led approaches will play a critical role in ensuring that 'place-based planning' approaches are accurate, dynamic and scalable. Utilising accurate and timely smart metering data will be key

to this, helping overcome multiple data quality, information asymmetry and access challenges that exist today.

For example, current benchmarking on building efficiency and heat system performance based on EPC data is flawed. Significant errors in determining technology / asset sizing at both building level and across the networks are compounded through lack of visibility of consumer behaviour including potential 'rebound' effects (i.e. Consumers go on to use more energy than anticipated through financial savings made through energy efficiency).

The planning process does not reflect the capabilities and selection of the right mix of low carbon technologies, nor their value from a consumer and network perspective. This misalignment holds the potential to be compounded further as system flexibility potential (and participation) is not factored into the planning.

In parallel, the digitalisation of the energy sector is happening at pace creating an abundancy of data at a vast scale. Smart metering data forms a key part of this transition. Over 30m households and small businesses have a smart meter installed and this volume of devices, combined with the functionality of the system is generating over 2.2bn data transactions across the smart meter system every month.

More broadly, much government policy (within the energy sector and beyond) is seeking to enable better use of data to deliver a multitude of public benefits. [ref what]

Overlaying the challenges and issued identified in current LAEP processes with the emerging availability of smart meter data presents a substantial and timely opportunity to deliver improved plans, more accurate and lower cost investment, and better consumer outcomes.

## The Opportunity

### Smart meter data and routes to access

Smart metering is commonly considered in context with accurate recording of energy usage, enablement of automated meter readings and improved accuracy of energy bills. In practice the capabilities of the smart metering system and the data generated are far more expansive.

Today the network supports over 150 distinct types of messages (Service Request Variants - SRVs) of which more than 2 billion are sent across the DCC's network each month. As figure 1 highlights, an important distinction must be made between two distinct categories of smart metering data that flows through the DCC's system:

- 'Message Contents' (for example energy consumption data) is fully encrypted and only accessible to organisations who have 'onboarded' to the DCC

- 'System Data' (information about the messages) is retained centrally within the DCC's system and is used primarily to maintain and manage the performance of the network. System data has huge potential to offer insights for a variety of use cases and applications – including, for example, fuel poverty identification.

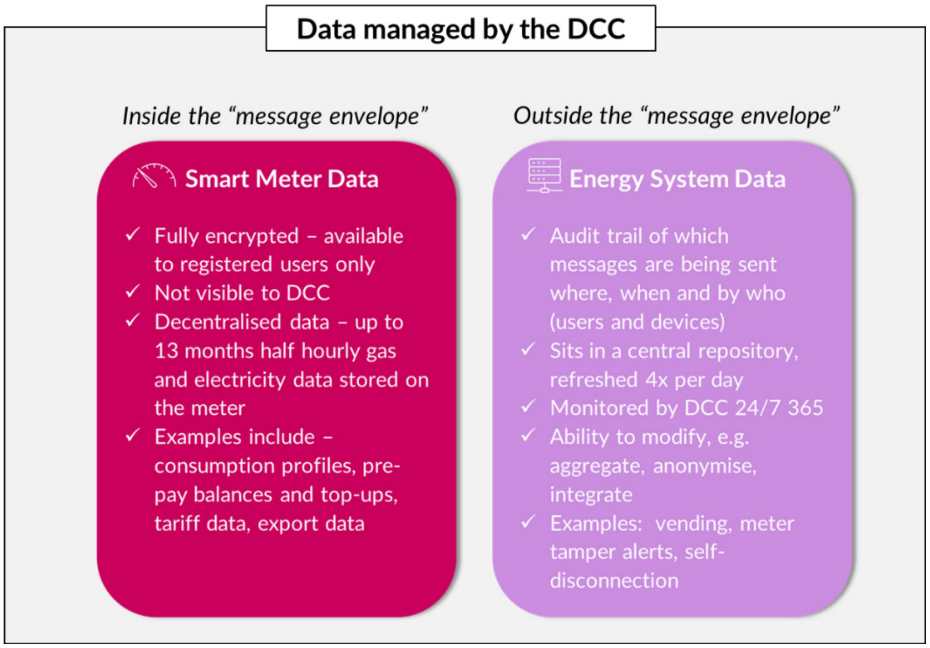



*Figure 1: Inside and outside the 'message envelope' data categories managed by the DCC.*

The route to accessing smart meter data depends on which data category it falls into:

Access to 'Message Content' data

At present, message content data (such as smart meter consumption data) can be accessed at a household level, with the explicit consent of the consumer, in two ways:

1. through integration with the smart metering system directly via the DCC ('onboarding')
2. via a third party 'Managed Service Provider' (MSP).

The functionality of the system allows users to interact with specific meters and devices and retrieve data, including half-hourly consumption profiles. Organisations that have integrated in this way include energy suppliers, distribution networks (DNO) and a growing segment of 'Other Users' – a term used to describe any other organisation who has onboarded to the DCC but is not an energy supplier or DNO. Alternatively, data can be retrieved via a 'Consumer Access Device (CAD)', a supplementary read-only device which is connected to the home area network. Connecting a CAD can only be undertaken by a registered user of DCC's systems.

Access to 'System data'

System data is derived from a combination of registration data, device inventory data and the audit trail of message transactions. The data sits centrally in DCC systems and is refreshed around 4 times a day. The data includes a temporal range from 2020 onwards (the point by which a relative mass of meters was installed).

To date, there is no defined access mechanism for smart meter 'system data'. In the case of this project, special agreement has been provided by Ofgem to allow the DCC to share this data, shared in raw form to GLA and through analytics and insights to Buro Happold.

Accessing data for this project

As integration and on-boarding to the smart metering system is a considerable undertaking (minimum 6-month duration) it was not possible for message contents (consumption data) to be incorporated into the project. Instead, focus was placed on smart meter 'system data' which was used, in an anonymised form to ensure compliance with regulatory approvals and

wider data legislation. The key categories of data utilised and the granularity at which they were analysed is provided below:

| Data category | Granularity | Data format |
|---|---|---|
| Smart meter penetration rates | Borough level | % of premises that have a smart meter installed |
| Smart meter penetration rate projections | Borough level | % of premises that have a smart meter installed – projected to 2028 |
| Smart meters operating in pre-pay or credit mode | Borough level | % split of meters operating in pre-pay / credit (at a single reporting point) |
| Smart meters operating in export | Borough level | % of premises that have a smart meter that have operated in export mode |
| Fuel poverty system data - insights (as approved under the Ofgem Permitted Purpose) | LSOA / Output Area (subject to anonymisation approach on an area-by-area basis) | - Proportion of households and frequency of 'credit exhausted' alerts<br>- Proportion of households and frequency reaching low credit thresholds<br>- Average number of pre-payment transactions |
| Fuel poverty system data – **raw anonymised data, accessible to GLA only** (as approved under the Ofgem Permitted Purpose[1])<br><br>See figure 2 below for full list of data categories | LSOA / Output Area (subject to anonymisation approach on an area-by-area basis) | - See below for full list of data categories |

| Message Type | Service Reference Variant / Alert Code | Description |
|---|---|---|
| N/A | | 2011 Census Output Area Classification |
| Service Reference Varient | 1.5 | Update Meter Balance |
| Service Reference Varient | 1.6 | Update Payment Mode |
| Service Reference Varient | 2.1 | Update Prepay Configuration |
| Service Reference Varient | 2.2 | Top Up Device |
| Service Reference Varient | 2.3 | Update Debt |
| Service Reference Varient | 2.5 | Activate Emergency Credit |
| Service Reference Varient | 4.13 | Read Prepayment Configuration |
| Service Reference Varient | 4.14 | Read Prepayment Daily Read Log |
| Service Reference Varient | 4.18 | Read Meter Balance |
| Service Reference Varient | 4.3 | Read Instantaneous Prepay Values |
| Service Reference Varient | 4.4.2 | Retrieve Change Of Mode / Tariff Triggered Billing Data Log |
| Service Reference Varient | 4.4.3 | Retrieve Billing Calendar Triggered Billing Data Log |
| Service Reference Varient | 4.4.4 | Retrieve Billing Data Log (Payment Based Debt Payments) |
| Service Reference Varient | 4.4.5 | Retrieve Billing Data Log (Prepayment Credits) |
| Service Reference Varient | 6.2.9 | Read Device Configuration (Payment Mode) |
| Alert | 0x810D | Combined Credit Below Low Credit Threshold (prepayment mode) |
| Alert | 0x810E | Credit Added Locally - Not Smets1 |
| Alert | 0x8119 | Emergency Credit Has Become Available (prepayment mode) |
| Alert | 0x8168 | Supply Disabled then Armed - Activate Emergency Credit triggered |
| Alert | 0x81AA | Emergency Credit Exhausted |
| Alert | 0x81AB | Emergency Credit Activated |
| Alert | 0x8F0F | Credit Below Disablement Threshold (prepayment mode) |
| Alert | 0x8F83 | Disablement of Supply due to insufficient credit has been suspended |
| Service Reference Varient | 3.2 | Restrict Access For Change Of Tenancy |
| Service Reference Varient | 8.1.1 | Commission Device |
| Service Reference Varient | 8.3 | Decommission Device |
| Service Reference Varient | 8.5 | Service Opt Out - Not Smets1 |
| Service Reference Varient | 8.6 | Service Opt In - Not Smets1 |
| Service Reference Varient | 8.7.1 | Join Service (Critical) |
| Service Reference Varient | 8.7.2 | Join Service (Non- Critical) |
| Service Reference Varient | 8.8.1 | Unjoin Service (Critical) |
| Service Reference Varient | 8.8.2 | Unjoin Service (Non-Critical) |

*Figure 2: Full list of data categories available under this scope.*

[1] Consent granted to DCC under Conditions 9 and 10 of the Smart Meter Communication Licence, and Section M4.3 of the Smart Energy Code - August 2023 | Ofgem

### Future smart meter data categories

Whilst unavailable today, in addition to smart metering consumption and system data, further smart metering data sets are currently being explored via DCC's innovation projects and services. Each offer future potential to enhance the LAEP approach further. Subject to timelines and regulatory feasibility, these avenues will explored in all future phases of LAEP delivery, including subsequent phases of current sub regional LAEP activities (ie phases 5-7).

These include:

- backhaul of additional data such as temperature and humidity through the system as part of the Smart Meter System Based Internet of Things programme
- data from the DCC Centralised Switching Service – Retail Energy Location data which provides a 'gold standard' address data
- Potential creation of a Centralised Asset Register of low carbon technologies through the Automatic Asset Registration project.

## Initial smart metering findings / applications to support the LAEP approach

Data insights and analytics provided into the project were grouped into two key areas 1) 'borough readiness' indicators and 2) fuel poverty data indicators.

The following section provides a short summary of how smart metering data has been applied across these categories and in turn how these insights can underpin practical applications and interventions, derived from the wider LAEP approach.

### Borough Readiness Indicators – insights from smart meter installations

In accepting a smart meter, households can benefit immediately from accurate billing, remote meter readings, easy supplier switching and direct financial reward for changing energy usage behaviours through participation in the Demand Flexibility Service.

As the energy system transition continues, industry is moving quickly toward Half-Hourly Settlement, Time of Use Tariffs are becoming more prevalent and increasingly sophisticated demand-side response services are materialising. The ability to participate in these services will become increasingly important for households to ensure the best deal from the energy system and a reduced cost of living.

Ensuring equity in take up of new services is crucial to a just transition and better data use will provide greater confidence in the expected cost-savings as low carbon technologies, heat pumps in particular and avoid technology and system specification that could potentially increase energy bills.

The degree to which boroughs and their residents are 'ready' to participate in these services will be determined by the willingness and ability to take a smart meter, factors limiting take may be driven by attitudes, demographics, geography and technology limitations. Further understanding of the limitations (and motivations) to smart meter installs can help boroughs to design pro-active campaigns and schemes to increase adoption.

## Current.install.rates

Across Great Britain, the average rate of smart meter installations has reached around 60%. Taking this average as a baseline, relatively straightforward analysis of smart meter installs enables an assessment of particularly local authorities that are behind this curve.

Plotting the anticipated trajectory of installs through to 2028 identifies where anomalies may be exacerbated (or potentially resolved over time). Further insights can be derived from:

- meter operation including density of meters that have operated in export mode indicating generation technology installed
- propensity of meters operating in credit vs pre-payment mode.

The current overall level of smart meter connected homes to all homes in London is 50%. However, this does vary by local authority with Sutton and Bexley having the highest levels with 59% and Westminster and Kensington & Chelsea having only 31% and 32% respectively. Of the smart meters, 11% are currently operating in prepayment mode.

The levels of smart meter penetration by local authority are shown on the following two maps:

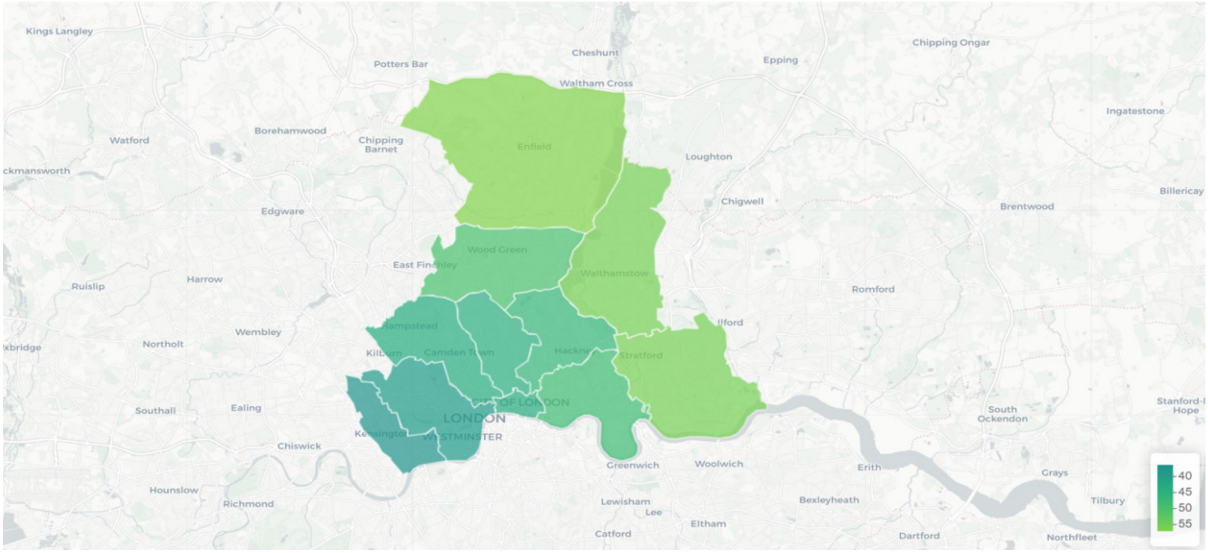



*Figure 3: Smart meter penetration by local authority, percentage of electric meters that are smart in the CIEN subregion.*

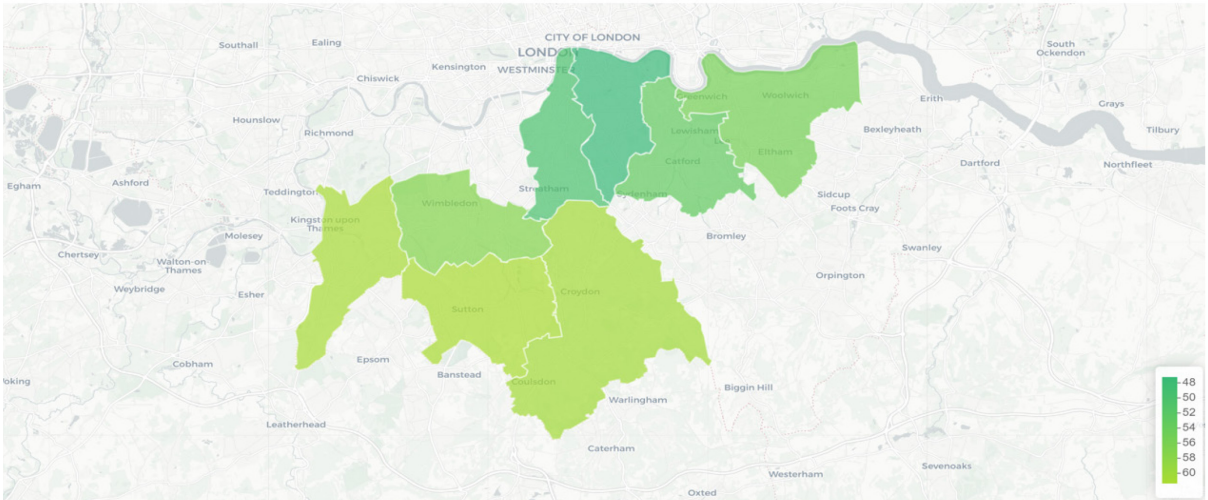



*Figure 4: Smart meter penetration by local authority, percentage of electric meters that are smart in the South subregion.*

Over the next two years, the number of connected homes are forecast to continue to increase with Haringey, Camden and Enfield having the highest rates while Hillingdon, Bromley and Redbridge are expected to have the lowest. However, even the slowest rates are expected to see the amount of homes connected tripled from the levels of January 2022, with the fastest growth areas reaching four times those January 2022 levels. The proportion of prepayment to credit meters are not expected to significantly change whilst economic uncertainty and energy prices remain high.

## Fuel poverty indicators – insights from smart meter system data

The potential of the smart meter system data to combine with existing Greater London datasets and reveal fuel poverty indicators was explored. This work needed to balance the requirements to gain the most information from the data whilst maintaining the anonymity of the personal data and so aggregated all data to census output area. This allowed data from many sources to be linked together as shown in Figure 3 below.

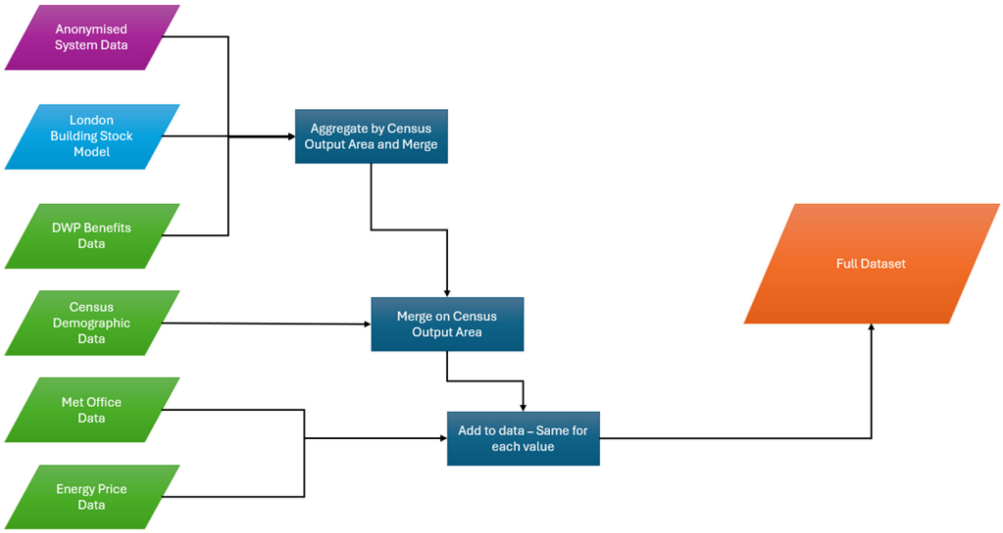



*Figure 5: Datasets used to inform fuel poverty modelling and analysis.*

Within the smart meter system data set, certain alerts were found to indicate issues with fuel affordability for consumers, for example the alert sent by a smart meter when the emergency credit is exhausted. The combined data was found to dovetail with these indicators so that, with machine learning, models could be created that predicted the occurrence of these alerts for a given month. This has applications in forecasting which locations will be impacted in the future as well as how changes to the environment, energy price, temperature and building energy performance, could impact consumers.

### Limitations.to.the.data.

It is important to note that use of smart meter data in LAEP remains nascent with insights being received from continued exploration and linkage of the data with existing models. Whilst the overall smart meter statistics are based upon the entire smart meter estate, only 27% of consumers could be included in the fuel poverty indicator modelling. Work is continuing with the energy suppliers to gain greater participation in this.

It is also important to note that the fuel poverty indicators used in this model are different from the official definition of fuel poverty. As these reflect real usage patterns however, these can be

more powerful in showcasing behaviour and could potentially be updated frequently to allow for help to be delivered to areas promptly and before the issues become overwhelming. However, solutions that use this data must allow for the fact that the dataset only covers smart meters, so visibility of issues will be reduced in areas with lower levels of metering.

## Future potential

The broadest impact from smart meter data for local area energy planning can be achieved through delivery of dynamic data at the lowest possible granularity into the planning process on a frequent basis. Figure 4 sets out how both existing and future smart meter data will be able to deliver LAEP insight and impact to local and regional authorities across all phases.

In parallel, opportunities exist to drive collaboration around data access usage across a broader set of actors who are aligned around the same priorities – not least community energy groups (as a priority group identified by the incoming Labour government) and social housing providers.

Figure 4 (activities within the red dotted box indicates what's possible to achieve today):

Multiple opportunities exist for smart meter consumption data, system data and other network capabilities to support Local and Regional authorities in their Net Zero planning, delivery and monitoring journey

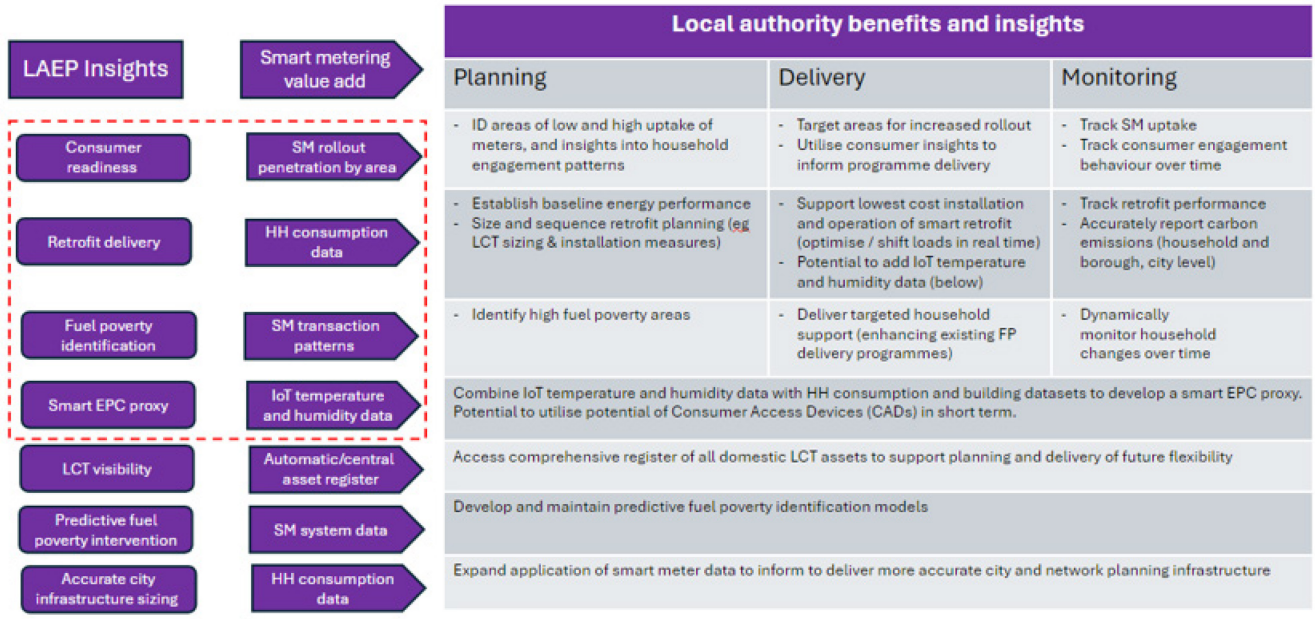



*Figure 6: Existing and future smart meter data future potential for local authorities.*

While this represents a worthwhile goal to work towards, fully realising this vision will require resolution of a range of mid-long term regulatory, legal and technical considerations (set out in section 6).

In the meantime, significant near-term opportunities exist to build on the findings of this phase of work and ensure a continued (and continually improved) flow of smart meter 'system data' into the LAEP planning process. Key questions to explore with relevant stakeholders include:

- How can outputs from this project phase be used as a foundation to support the next stages of LAEP delivery in London (i.e. stages 5-7 of the LAEP methodology – led by boroughs themselves)?
- What are the roles and responsibilities of the DCC, GLA, London's boroughs and the wider delivery chain in delivering this over the mid-long term (i.e. fully unlocking the value of smart meter data for fuel poverty identification and support in London)?

With today's current data flows, access and governance arrangements (see figure 5 below) in mind, further dialogue is needed with the GLA and London boroughs to resolve the following questions:

- What does an enduring data ecosystem (and associated data sharing framework) look like?
    - Clarify what datasets will need to go to who? Is a single point of contact (via SharePoint) the best way to share relevant dataset / model / report in a set format each period, to be incorporated into local applications? How will the GLA and London boroughs work collaboratively on this?
- Have the benefits been sufficiently crystallised (i.e. why this is worth doing, how the information can enhance existing processes)? If not, what further evidence is needed?
    - For example, to capitalise on the real time value of this data, would DCC need to provide the data at a set schedule (weekly?) so that local authorities pro-actively investigate hot spots in a preventative manner?
- How would the fuel poverty identification model be refined and kept up to date?
    - Retrain with each new dataset?
    - What are the implications from an IPR, model code / service perspective?

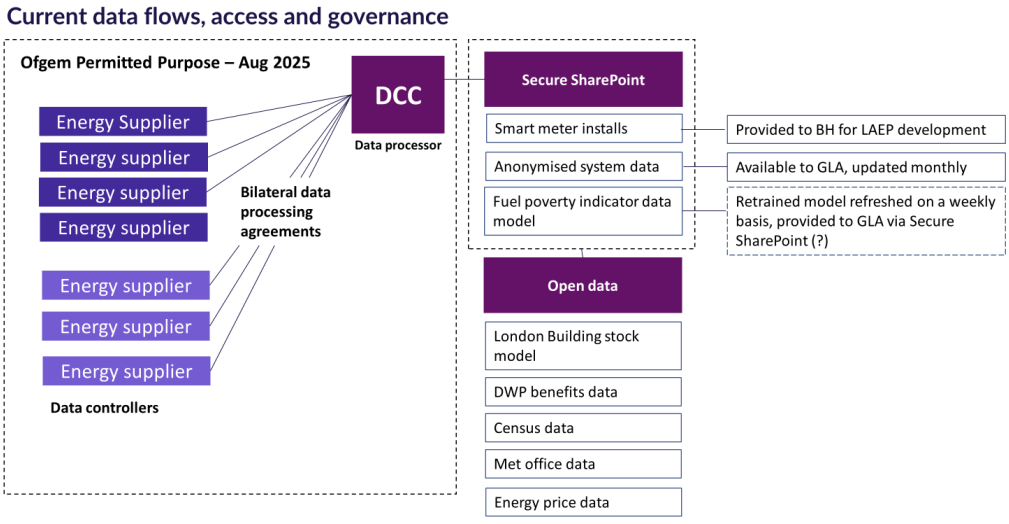



*Figure 7: Current data flows, access and governance*

# Unlocking data for future use

With implications beyond the scope of this project, multiple considerations will need to be addressed to unlock the wider opportunity that the smart metering network presents. These are set out below, consolidated across four key areas:

Regulatory considerations – access to smart meter system data is not explicitly permissible under DCC's current regulatory framework. The current access regime is underpinned through a Permitted Purpose consent from Ofgem, which is timebound and due to expire in August 2025. There are several routes through which regulatory compliance could continue beyond this date:

- an extended / expanded Permitted Purpose – Ofgem have already shown willing to explore this route
- development of a Smart Energy Code modification – this would coalesce industry around the changes needed for DCC to provide access to smart meter system data for specific use cases
- expansion of Ofgem's Energy Data Best Practice Guidance – through this mechanism, DCC as a licenced entity may be mandated to treat energy system data as 'presumed open'
- enabled through the renewed DCC licence. The current DCC licence is due to expire in 2025 (with an expected 1-2 year extension). Ofgem is exploring as part of the future licence period, through to 2040) to what degree provision of access to smart meter system data should be treated as mandatory business for the licence holder.

Data legislation - irrespective of the regulatory mechanism through which data access is made viable, data legalisation will remain a key consideration.

The current approach, which places energy suppliers as Data Controllers and DCC as a Data processer has been resource intensive to set up and scaling or establishing new use cases, underpinned by different data categories is not scalable or sustainable. In parallel, a desire to increasingly lower the granularity of data to maximise utility creates further considerations from a data privacy perspective.

Areas of consideration in context with enduring data access include:

- Potential use of a Trust Framework approach to increase efficacy in data governance
- Implications of Ofgem's plans for a centralised consumer consent management solution
- Increasing sophistication of privacy enhancing technologies to maximise utility whilst retaining data privacy
- Enduring models of data governance, developed in tandem with new data access regimes – as described below.

Technical considerations – the current access regime relies on access to data via CSV files, hosted within a secure SharePoint site. Over time, there will be a need to automate and enhance the sophistication of data access, particularly where data flows are underpinning dynamic data models.

Key considerations include:

- The potential for development of API data access to smart meter system data for self-service, controlled, data access. DCC is exploring the development of this functionality

for its core customer base (energy suppliers and DNOs) and access could be extended to broader users, alongside an appropriately robust access regime.
- New access regimes such as the creation of a Smart Meter Energy Data Repository – this is a government funded innovation project which is testing the technical and financially viability of such an approach.

Standardisation and commercial considerations – it is important that smart meter data is used create robust insights that are interpreted and acted on consistently.

Lack of standardisation and uniformity risks creating further misalignment and fragmentation across a multitude of planning approaches, which could in turn exacerbate rather than resolve current issues with LAEP. Further work is needed to validate data insights, establish consistent definitions and best practice methodologies for future applications.

This should be explored in context with commercial considerations i.e. it should not inhibit the opportunity for built environment practitioners to access data and provide commercial services for LAEP. Rather future services should be developed from a base-line industry acceptance of the data integrity and uniform agreement on the insights that can (or can't) be derived from it.

## Recommendations

This initial suite of activity has sought to demonstrate the potential value of including smart meter system data into the LAEP process. As identified above, several key considerations need to be addressed in order to create a repeatable and scalable process that ensures a dynamic flow of the right data categories to the right organisations.

Suggested activities to achieve this include:

- A workshop with project participants to ensure shared learning of the insights being derived and prioritising the use cases that can be supported. A proposed (in person workshop) with Buro Happold and the GLA Energy and Infrastructure teams would enable the GLA to identify and capture synergies across all GLA smart metering related initiatives (if not already), and determine a unified smart meter data ingestion, analysis and exploitation strategy.
- Through alignment with the regulatory pathway mapping exercise (bullet below), this would deliver a comprehensive smart metering exploitation plan for London. Questions to address (building on those outlined in section 5 above) include:
    a. How will GLA ingest smart metering datasets (eg data hub?) and what are the data flows within GLA for both smart meter system and consumption data (NB initially these will require different access routes). Eg how will the London building stock model and other energy planning applications interface with data hub? Includes what security protocols need exist to support safe, secure data sharingHow will London boroughs and other interested stakeholders access smart metering data from the GLA, and what are the technical, regulatory and legal implications of this (ie what granularity of data [or insights] can be shared with whom, for what purposes, and what data sharing mechanisms will be required)
    b. What analytics will be needed, and who will have responsibility to do so (incl DCC analytics required to share data in useable format, GLA analytics needed for internal purposes, and third-party analytics needed to derive additional value from the datasets

c. What data classification strategy will the GLA adopt for different data categories, and how will this be communicated / disseminated to the public (eg via London data store?)
d. What additional policies and initiatives will be needed alongside the above in order to extract necessary value from SM data (eg consumer awareness / engagement campaign, additional funding avenues etc)
e. What does a fit for purpose governance framework look like, that satisfies the smart energy industry requirements (eg SEC) but also works for the GLA and London boroughs
f. What does a pan London consent management approach look like (necessary for accessing consumption data today)

- Establishing a benefits mapping exercise to demonstrate how the value of smart meter data can be quantified against the current approach. This would help to underpin future regulatory change and secure buy-in from necessary partners (e.g. energy suppliers).

- Setting out a clear pathway for access to smart meter data in the short, medium and long term. The current regulatory derogation from Ofgem will enable GLA access to anonymised smart meter system data through to August 2025. Wider planning including timelines for on-boarding to the DCC for access to consumption data can ensure a co-ordinated approach to data access, considering related policy developments such as Ofgem's plans for a central consent management solution.

- Convening a working group / forum of built environment practitioners. As discussed above some degree of standard interpretation of the insights derived from smart meter is needed to minimise misalignment between organisations involved in the planning process. Collaboration in this area can help industry to coalesce around standard practice enabling better outcomes and minimising duplication - with the formation of a working group a potential first step to achieve this.