Methodology for establishing emissions performance trajectories

ABSTRACT: The methodology for establishing the top 15% most energy-efficient buildings in a city

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1. Introduction

For a non-residential building, the energy efficiency performance requirement is an emissions targets derived from an "emissions performance trajectory" that starts with the emissions performance of the top 15% most energy-efficient buildings (of its type e.g. offices) in its city and declines to zero carbon emissions in 2050.

For a residential building, the energy efficiency performance requirement is a CBI-approved proxy, derived either through benchmarking against the local market emissions performance (i.e. emissions performance trajectory) or through analysis of a particular rating/label as a proportion of total ratings/labels awarded under a scheme.

As an emissions performance trajectory is simply a linear pathway from the emissions performance of the top 15% most energy efficient buildings in a local market to zero carbon emissions in 2050, this document focuses on explaining the methodology for establishing the emissions performance of the top 15%.

2. Methodology to establish the top 15% most energy-efficient buildings

For non-residential buildings, the local market is defined as the city.

For residential buildings, the local market may be extended to a wider area such as country, as long as there is consistency in climate and grid energy intensity within that wider area.

Step 1: Checking the data

The data used to establish the emissions performance of the top 15% most energy-efficient buildings must satisfy the following requirements:

- It originates from a reliable source.
- There must be a sufficient sample of buildings that is representative of the market.
- Building emissions performance must reflect emissions for the full fuel cycle (scope 1, 2, and 3).
- Building emissions performance must relate to operational performance not modeled performance.
- Building emissions performance is expressed on an annual basis in $kgCO_2$ terms.

Data could relate to statistical results from a local market survey (where the top 15% has been determined) or a raw data set of individual building emissions performance. The next few steps are only relevant to the latter where the top 15% still has to be derived.

Step 2: Prepare raw data fields

The key data fields required for the analysis are:

A. **Year:** This is the reporting year. Emissions performance of all buildings in the data set should be based on the same reporting year, for the latest year available.
B. **Geographic range:** This relates to the range of postcodes covered by the data set.
C. **Boundary for emissions performance measurement:** This specifies the boundary for the measurement of emissions performance of each building (e.g. whole building or base building). The boundary for the data set must EITHER be aligned with CBI's boundary* OR adjustments may be made in the case of whole building performance being reported, on the condition that reliable assumptions can be made, and at the end of the process (i.e. Step 5).
D. **Emissions performance:** Must fulfill the requirements specified in Step 1 (i.e. reflect emissions for the full fuel cycle, relate to operational performance, expressed on an annual basis in $kgCO_2$ terms).
E. **Emissions intensity factor:** This is the factor used to convert emissions performance into a level of emissions intensity. This is more relevant for non-residential buildings than for residential buildings. For non-residential buildings, the factor to calculate emissions intensity is either floor area (in square metres) or number of rooms, whichever is relevant for the particular building type (e.g. offices, hotels).* For residential buildings, the lower variation within one building type (e.g. 3-bedroom dwellings) means that emissions performance can expressed for the whole building, removing the need to calculate emissions intensity.

* For each building type, Appendix 1 provides information on:
- CBI's boundary for emissions performance measurement (e.g. whole building or base building)
- The factor to calculate emissions intensity (e.g. floor area or number of rooms)
- The measurement basis for the emissions intensity factor (e.g. net lettable area as the measurement of floor area for commercial offices)

Step 3: Calculate the emissions intensity of each building in the data set

The emissions intensity of each building in the data set is calculated based on (D ÷ E).

Using the example of commercial offices, the emissions intensity of each office is calculated as:
= Annual emissions performance of that office (in $kgCO_2$) ÷ Floor area of that office (net lettable area in m^2)
= X $kgCO_2/m^2$

Step 4: Eliminate extreme outliers

This step involves identifying and eliminating extreme outliers from the data set that may skew the calculation of the emissions performance of the top 15% most energy-efficient buildings.

The emissions performance of the median ("MD"), first quartile ("Q1") and third quartile ("Q3") of the data set are calculated based on results from step 3.

To establish the performance range for "mild outliers", a calculation is made to derive the "mild deviation" ("MDV"):
(Q3 – Q1) × 1.5

The performance range for "mild outliers" is then (Q1 – MDV) to (Q3 + MDV).

To establish the performance range for "extreme outliers", a calculation is made to derive the "extreme deviation" ("EDV"):
(Q3 – Q1) × 3

The performance range for "extreme outliers" is then (Q1 – EDV) to (Q3 + EDV).

"Extreme outliers" are omitted from the data set for the next step in the process.

Step 5: Calculation of emissions performance of the top 15% most energy-efficient buildings

Buildings in the data set, excluding "extreme outliers", are arranged from lowest to highest emissions intensity and the emissions intensity of the top 15% of the data set is taken.

Appendix 1

Building Type	Boundary for emissions performance measurement	Factor for emissions intensity calculation	Measurement basis for emissions intensity factor
Commercial Buildings (Non-Residential)			
- Offices	Base building[1]	Floor area (square metres)	Net lettable area[2] May be estimated from gross floor area*
- Hotels	Whole building	Number of rooms	N.A.
- Shopping centres	Base building	Floor area (square metres)	Net lettable area May be estimated from gross floor area*
- Warehouses	Base building	Floor area (square metres)	???
…			
…			
Public buildings (Non-Residential)			
- Hospitals			
- Schools			
- Libraries			
…			
Residential Buildings			
…			

* On the condition that reliable assumptions can be made. An adjustment is made at the end of the process (i.e. Step 5).

[1] The base building (i.e. landlord component) of energy consumption typically comprise the energy consumed by landlord-owned plant and equipment that are required to service the building and are not controlled by the building's tenants. It includes energy end uses related to: heating, ventilation and air conditioning; lifts and escalators; car park lights and ventilation; common area light and power; exterior lighting and signage. It excludes energy end uses that are controlled by the building's tenants: lighting within tenant areas; tenant power; tenant supplementary cooling; tenant data facilities.

[2] This is the normal measure of floor space within a commercial building. It is normally the total occupiable floor space of a building taken from the inside surfaces of the exterior walls and/or the mid-line of any shared walls and excludes areas such as common stair wells, toilets, lift lobbies and vertical service ducts.