The Non-domestic National Energy Efficiency Data-Framework 2022 (England and Wales): Methodology note

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This note details the methodology used in the Non-Domestic National Energy Efficiency Data-Framework (ND-NEED) in England and Wales. This includes detail on how the building stock and sample are constructed, along with changes made this year and the resulting revisions.

Contents

Changes since the 2022 publication

ND-NEED was last published in June 2022. Since then, there have been some changes to the methodology.

The key changes are listed below – the first three are data updates, and the fourth is a change to the method of compiling the raw data:

1. Updated building stock data – now covering the stock as of March 2023 (March 2022 previously). This is used as the basis for creating the ND-NEED sample (where electricity and gas consumption data are matched to the building stock), and therefore impacts on the consumption data presented for all years.

2. Updated electricity and gas meter consumption data for 2021.

3. Updated business characteristics data, as of December 2022 from the Interdepartmental Business Register. Details of the impacts of these changes are presented in the revisions section.

4. Revised historical meter consumption data, notably for gas consumption. The production process for the meter consumption data source has been revised. Further details on this change, and its impacts, are presented in the revisions section.

There has been one change to the charts and data tables that have been published in the 2023 version of ND-NEED, compared to 2022. Table 3 has been expanded to include a breakdown of building age by building use and size.

ND-NEED 2023 revisions

As a result of raw data being updated, the ND-NEED statistics, particularly for time-series, have been revised. This section details the key drivers behind this.

Building stock

The new data from Valuations Office Agency (VOA) updates the ND-NEED spine to 1,763,000 buildings, an increase of 8,000 (0.4%) on that presented in Table 1 of ND-NEED 2022. However, this increase does not account for the 17,000 buildings that existed in the previous edition of the non-domestic ratings (NDR) list but were not captured by ND-NEED since they were not allocated a Unique Property Reference Number (UPRN), see Converting NDR/SMV hereditaments to ND-NEED building stock dataset ("spine") for more information on this process. Therefore, if we remove the 17,000 existing buildings there has been an overall fall in building numbers. In terms of floor area, this represents a 1.2 million m^2 (0.2%) decrease.

Table 1 shows the impact of the building stock update, by building use type. These are figures net of any removals from the stock (as a result of demolition, repurpose or temporary removal). Where there is a net reduction, the impact of removals from the stock has outweighed the impact of additions. The change across sectors is relatively even, with the top percentage increase being seen in Hospitality, followed by Warehouses and Factories. The Emergency Services sector is showing the largest net reduction, with Health, Offices and Shops also showing small decreases. Hospitality has seen a large increase particularly in the number of holiday homes (which may have been repurposed from domestic use), in addition to restaurants and cafes, since the last update.

Table 1 – Update to ND-NEED building stock: number of non-domestic buildings, 2022 and 2023

Building Use	ND-NEED 2022 (as at March 2022)	ND-NEED 2023 (as at March 2023)	Difference (non-rounded)	Difference (non-rounded) (%)
Arts, Community and Leisure	52,000	52,000	-	+0.1%
Education	40,000	40,000	-	+0.1%
Emergency Services	4,000	4,000	-	-1.2%
Factories	239,000	240,000	+2,000	+0.6%
Health	26,000	26,000	-	-0.6%
Hospitality	193,000	199,000	+6,000	+2.9%
Offices	358,000	357,000	-1,000	-0.3%
Shops	497,000	496,000	-1,000	-0.3%
Warehouses	218,000	221,000	+3,000	+1.3%
Other	127,000	127,000	-	+0.1%
Total	1,755,000	1,763,000	+8,000	+0.4%

Table 2 shows the accompanying revisions to floor area, with the most significant decrease in Offices, followed by Shops, Factories, and Health. Whereas Education, Warehouses and Emergency Services have seen increases in floor area.

Table 2 – Update to ND-NEED building stock: floor area of non-domestic buildings, 2022 and 2023

Building Use	ND-NEED 2022 (as at March 2022)	ND-NEED 2023 (as at March 2023)	Difference (non-rounded) (m^2)	Difference (non-rounded) (%)
Arts, Community and Leisure	15,341,000	15,303,000	-38,000	-0.2%
Education	3,841,000	3,852,000	+11,000	+0.3%
Emergency Services	147,000	150,000	+3,000	+1.7%
Factories	151,453,000	150,037,000	-1,416,000	-0.9%
Health	2,360,000	2,341,000	-19,000	-0.8%
Hospitality	13,328,000	13,281,000	-47,000	-0.4%
Offices	76,461,000	73,289,000	-3,172,000	-4.1%
Shops	99,934,000	98,923,000	-1,011,000	-1.0%
Warehouses	209,624,000	214,055,000	+4,431,000	+2.1%
Other	46,399,000	46,465,000	+66,000	+0.1%
Total	618,888,000	617,696,000	-1,192,000	-0.2%

Energy consumption

The electricity and gas consumption figures published in ND-NEED 2023 contain revised figures for 2012-2020, compared with those published in ND-NEED 2022. Tables 3 and 4 summarise these revisions. Broadly, these revisions affect the level of the figures, while the time-series trend remains similar to ND-NEED 2022.

Table 3: ND-NEED electricity consumption 2017 – 2020, from ND-NEED 2022 and ND-NEED 2023

	Electricity consumption 2017 (TWh)	Electricity consumption 2018 (TWh)	Electricity consumption 2019 (TWh)	Electricity consumption 2020 (TWh)
ND-NEED 2022	142	141	138	127
ND NEED 2023	136	135	132	120
Size of revision (non-rounded) (TWh)	-6.0	-6.1	-6.0	-7.8
Size of revision (non-rounded) (%)	-4.3%	-4.3%	-4.4%	-6.1%

Table 4: ND-NEED gas consumption 2017 – 2020, from ND-NEED 2022 and ND-NEED 2023

	Gas consumption 2017 (TWh)	Gas consumption 2018 (TWh)	Gas consumption 2019 (TWh)	Gas consumption 2020(TWh)
ND-NEED 2022	151	152	148	147
ND NEED 2023	152	156	152	152
Size of revision (non-rounded) (TWh)	+1.4	+3.2	+3.2	+4.6
Size of revision (non-rounded) (%)	+1.0%	+2.1%	+2.2%	+3.1%

There are several differences between ND-NEED 2022 and ND-NEED 2023 that have contributed to these revisions.

Weighting process:

1. The ND-NEED weighting process (see Scaling the ND-NEED sample consumption to population: weighting for further information) calculates weights based on consumption in the latest three years and applies these weights to all years in the time series. The updated weighting process therefore results in revisions to the entire time-series, though usually affecting the level, rather than the trend. In ND-NEED 2022 the weights were therefore calculated from 2018 – 2020 consumption data, but in ND-NEED 2023 they are calculated from 2019 – 2021 consumption data.
2. The scaling method contains a manual element where subjective decisions need to be made. This means that if the weights were recreated using the exact same data there could be small differences in the final consumption values.

Electricity:

3. Scaling Factors.
    a. Small changes to the electricity weighting approach to control scaling for high consuming buildings has decreased the scaling factor and therefore weight applied to these buildings. This may have contributed to the reduction in electricity consumption being driven predominantly by Factories, as buildings that are known to be high consumers (see Table 5).
    b. Additionally, there has been a reduction in the building weight scaling factors, for both Factories and buildings in the Other category which is also contributing to the fall in electricity consumption (see Table 5). In comparison to last year, there has been a slight increase in the match rate for Factories with missing or Large (1,000+ m^2) floor area. Buildings of this type are typically among the highest electricity consumers (many do not consume gas in substantial quantities). Therefore, according to the weighting methodology, the improved match rate will decrease the scaling factor applied across all years. These changes to both the building and electric scaling factors are estimated to account for the majority of the revision to electricity consumption in 2020.

Gas:

4. Increased sample size.
    a. This year, the number of buildings matched to at least one year of meter point data has grown, for both gas and electricity. Looking at the 2020 sample, the electricity sample size has increased by 1% (5,000 buildings), whereas the sample size of buildings with gas data has increased by around 9,000 (2%). This is more significant in some sectors that others, for example Hospitality has increased by 20%,

which may have contributed to the increase in gas consumption seen in this sector.

5. DESNZ has implemented a new system and process for processing the raw gas meter point consumption data which has led to the following changes (see the subnational methodology and guidance 2023).
    a. The new system has led to small changes in the approach to data manipulation and processing for ND-NEED.
    b. There has also been a change to the inclusion of non-consuming meters in the raw gas consumption data. Meters that consume less than 1.1 KWh have been deemed 'non-consuming' and removed from the raw gas dataset. This differs from previous years where these values, referred to as 'placeholder' values have been included in the weighting process and consumption figures, but removed from the median consumption and median intensity figures. As this change has been applied to both the population and sample with which the weighting process is based upon, this has not impacted the match rate and resulting scaling of weight and therefore is unlikely to have any significant impact (see more detail on the gas weighting process here).

These reasons highlight the uncertainty that surrounds the scaled ND-NEED consumption figures, and particularly the level, as opposed to the trend, of the time-series. Because of this, small revisions to the ND-NEED consumption data or small changes in ND-NEED consumption over time should be interpreted with caution as they may be a result of the methodological issues described above.

Tables 5 and 6 detail the impacts of these revisions on the consumption in 2020 for individual building use types. Table 5 shows that the decrease in electricity consumption is predominantly being driven by Factories, and buildings that fall into the Other category. For gas, this is more varied across sectors, although over half is also being driven by the Other sector (Table 6).

Table 5 – Revisions to electricity consumption, by building use type, 2020

Building Use	Electricity consumption ND-NEED 2022 (TWh)	Electricity consumption ND-NEED 2023 (TWh)	Revision (non-rounded) (TWh)	Revision (non-rounded) (%)
Arts, Community and Leisure	3	3	+0.01	+0.3%
Education	5	5	-0.04	-1.0%
Emergency Services	1	1	+0.03	+4.6%
Factories	42	38	-4.3	-10%
Health	3	3	+0.2	+6.5%
Hospitality	6	7	+0.2	+1.2%
Offices	19	18	-0.1	-3.9%
Shops	15	15	-0.1	-0.6%
Warehouses	15	14	-0.8	-5.5%
Other	19	17	-2.1	-11%
Total	**127**	**120**	**-7.8**	**-6.1%**

Table 6 – Revisions to gas consumption, by building use type, 2020

Building Use	Gas consumption ND-NEED 2022 (TWh)	Gas consumption ND-NEED 2023 (TWh)	Revision (non-rounded) (TWh)	Revision (non-rounded) (%)
Arts, Community and Leisure	5	5	+0.2	+4.0%
Education	13	14	+0.5	+3.5%
Emergency Services	2	2	+0.1	+5.3%
Factories	56	54	-1.6	-2.9%
Health	10	10	+0.4	+4.3%
Hospitality	9	10	+0.9	+10%
Offices	12	12	+0.1	+0.6%
Shops	9	10	+0.7	+7.6%
Warehouses	8	9	+0.8	+9.8%
Other	24	26	+2.6	+11%
Total	**147**	**152**	**+4.6**	**+3.1%**

Business characteristics

Updating the Inter-Departmental Business Register (IDBR) data for the business characteristics information, as of December 2022, has resulted in some revisions to tables presenting business size information.

Table 7 presents the impact of this on the split of the ND-NEED building stock, and the sample. Looking at the stock, we can see the share of business sizes in this update closely resembles the previous update. Both data sources are on an

enterprise basis and will include many local units that will be allocated the same employment figure as for the company as a whole. The DESNZ Business Population Estimates (BPE, which is also drawn from the IDBR), show a far greater share of smaller businesses (over 90% of registered UK businesses are Micro, and 0.2% are Large or Very Large), but these businesses will be counted only once (whereas ND-NEED may count multiple units of large businesses).

Once matched to the ND-NEED sample, the missing component has fallen (although still slightly higher than last year), possibly reflecting the better quality of addresses in this sub-set.

Table 7 – Impacts of new business data on ND-NEED building stock and sample

Business size	ND-NEED 2022	ND-NEED 2023	Revision (non-rounded) (percentage pt)	ND-NEED 2022	ND-NEED 2023	Revision (non-rounded) (percentage pt)
	Share of ND-NEED building stock (%)			Share of ND-NEED electricity sample (%)		
Micro (less than 10 employees)	17%	17%	-0.2%	25%	25%	-0.2%
Small (10-49 employees)	5.3%	5.3%	+0.01%	7.6%	7.7%	+0.1%
Medium (50-249 employees)	1.9%	1.9%	-0.05%	2.7%	2.6%	-0.05%
Large (250-999 employees)	1.1%	1.1%	+0.01%	1.5%	1.6%	+0.03%
Very Large (1000+ employees)	4.5%	4.3%	-0.2%	6.5%	6.3%	-0.2%
Missing	70%	70%	+0.4%	56%	57%	+0.4%

Data sources

ND-NEED is formed from the linking together of three main data sources: building stock data, meter point electricity and gas consumption data, and business characteristics data. Links and further information on these sources are provided in Table 8.

Table 8 – ND-NEED data sources

Data source	Used for	Owner	Further Information
Non-Domestic ratings list	Building stock	Valuation Office Agency	For further information on the VOA rating list please see this technical guidance.
Summary Market Valuation list			For summary statistics and background information relating to stock of properties in England and Wales please see the VOA website.
Meter point consumption data	Electricity and Gas consumption	DESNZ	For further information please see the sub-national consumption methodology and guidance note.
Inter-departmental Business Register	Business Characteristics	Office for National Statistics	For further information on the IDBR please see the ONS website.

Methodology

ND-NEED building stock

To calculate the building stock figures in ND-NEED, the 2017 version of the Valuation Office Agency (VOA)'s non-domestic ratings list (NDR) and summary valuation data (SMV), as at the end of March 2023, are used.

This data is collected by the VOA as part of their business rate calculations. Almost all properties that are not used for domestic purposes are valued for business rates and so are included in the NDR. The NDR and SMV contain information on the number of non-domestic hereditaments in England and Wales, the size of these and their use. A hereditament can be a building, but there can also be multiple hereditaments within a single building.

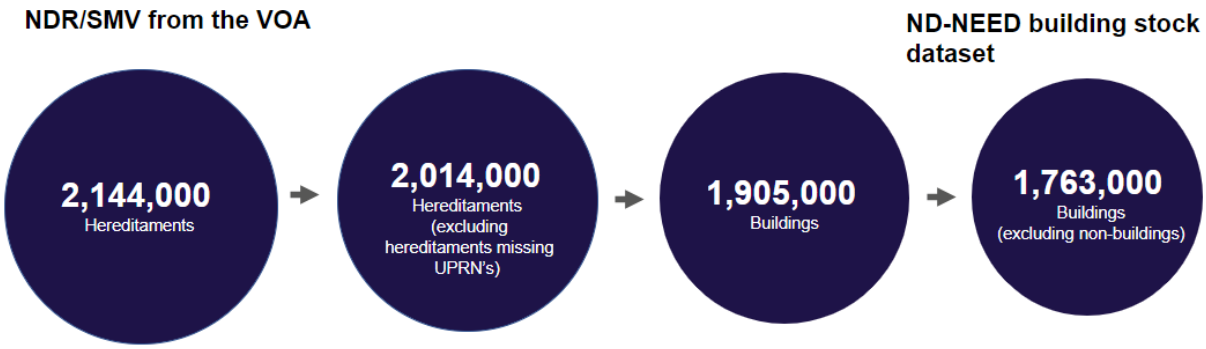
Scope

There are some non-domestic building uses that are exempt from business rates. These buildings are not included in the NDR and building use categories that either fully or largely comprise these buildings are also not covered by ND-NEED. These include: agricultural buildings, prisons, some military buildings and places of worship.

Converting NDR/SMV hereditaments to ND-NEED building stock dataset ("spine")

In order to produce the ND-NEED dataset, hereditament data from the NDR/SMV must first be converted to a building stock. The steps taken to do this are summarised in Figure 1.

Figure 1: The key steps from the NDR/SMV data from the VOA to the ND-NEED building stock population.



Each hereditament in the NDR/SMV is allocated a unique address reference number (UARN). Each hereditament also has a unique property reference number (UPRN), ND-NEED uses the UPRN as its indicator of a building; this may contain one or more UARNs.

Before analysis of the NDR/SMV data can be carried out, any hereditaments which do not have a UPRN are removed – around 130,000 UARNs. This takes the number of hereditaments in the dataset from 2,144,000 to 2,014,000. The 2,014,000 remaining hereditaments must then be aggregated to the building (UPRN) level, which results in 1,905,000 unique UPRNs. For further information on NDR/SMV please see this technical guidance published by the VOA.

The NDR/SMV contain some building uses which are not considered to be non-domestic buildings for the purposes of ND-NEED. These 'non-buildings' are removed before the building stock figures are calculated. The building types that are removed are: Caravan Parks, Advertising Rights and Premises, Car Parks, Beach Huts, Quarries and Telecoms. The removal of the 'non-buildings' takes the number of buildings from 1,905,000 to 1,763,000. Further information on these buildings is provided in Annex B.

Floor area removal

If a hereditament has a floor area of less than 15m^2 this is not included in the building floor area as this floor area data is thought to be unreliable for the purposes of ND-NEED as it results in some extremely high energy intensity values.

The NDR/SMV also contain hereditament floor area information for some building uses for which this floor area information is thought to be unreliable for the purposes of ND-NEED as the floor area does not inform the business rating. The floor area for these building uses is therefore removed. A list of the building uses which have their floor area information removed can be found in Annex D.

Multiple-hereditament buildings

The majority (98%) of UPRNs contain single UARNs. However, of these 1,905,000 UPRNs; 2% contain multiple UARNs, as detailed by Table 9. These must be handled slightly differently since they will have multiple floor areas and may also cover multiple building uses.

Table 9: Single versus multiple hereditaments in ND-NEED non-domestic buildings in England and Wales (end of March 2023)

Number of hereditaments in a building	Number of buildings (UPRNs)
Buildings (UPRN) containing a single hereditament (UARN)	1,857,000
Buildings (UPRN) containing multiple hereditaments (UARN)	47,000

To determine the floor area of buildings containing multiple hereditaments, the floor area of the hereditaments within it are summed. If a building contains hereditaments with multiple building uses, the building use of the hereditament with the largest floor area is taken to be that for the building.

New and removed buildings

By comparing the current ND-NEED building stock list with the previous list, we can present analysis disaggregating the change in the number of buildings, between those newly added to the list and those removed from it. For new additions, this is carried out by comparing the UPRNs that exist now with those in the previous list. For removals, the opposite procedure is carried out.

New additions include both new properties added to the NDR list, as well as properties that were previously present in the NDR, but had not been allocated a UPRN at that point. We can estimate the latter category, by comparing, for these

UPRNs, their UARNs in both NDR editions – in this update, this represents around 17,000 buildings.

Business characteristics data

For the second year, the Interdepartmental Business Register (IDBR) dataset is used as the source for business characteristics in ND-NEED. This replaces Experian data as the source for this information, which was used in ND-NEED 2021. This dataset contains information about the number of employees of the business occupying the building. Data from the Interdepartmental Business Register, as of December 2022, are matched into both the ND-NEED building stock and sample datasets to provide information on businesses occupying non-domestic buildings. The following section outlines the process used for this.

ND-NEED is interested in the business occupying a building – this may be a local branch of an enterprise, or the enterprise unit itself. The combination of these provides a dataset of around 3.2 million records in Great Britain, to which UPRNs are attached in order to match to ND-NEED.

The DESNZ address-matching algorithm is utilised to attach UPRNs to these records, with around 56% of addresses allocated them. Like the building stock data (with UARNs), there is often multiple businesses registered to the same address. This means that the business with the highest scoring match rating is retained as the representative for the building, with the remainder removed. Once this process is complete, around 1.8 million records (for Great Britain) remain, for matching to the ND-NEED sample/spine. Around 30% of buildings in the ND-NEED sample successfully match to the IDBR data. Further information on the address-matching process is set out in Annex A.

ND-NEED is interested in the number of people employed within the enterprise (including proprietors) occupying the building. The business size itself relates to the enterprise unit (for example, a local branch of a supermarket chain will be allocated the number of people employed by the enterprise as a whole).

Energy consumption data

DESNZ collects consumption data for all electricity and gas meter points in Great Britain. All meter points are matched to the corresponding UPRN, using the DESNZ address-matching algorithm. Where more than one meter is allocated to a UPRN, the corresponding electricity or gas consumption for each Meter Point Administration Number (MPAN)/Meter Point Reference Number (MPRN) is aggregated. Further information on the meter point electricity and gas consumption data can be found in the sub-national methodology and guidance note.

Two aspects of the gas consumption data should be noted:

1. ND-NEED received gas consumption meter data that are already temperature corrected, to reflect the impact of weather on gas use. Since electricity

consumptions is less influenced by the weather, the electricity data received are not temperature corrected.

2. Where a meter reading has not been collected for an existing MPRN, a "placeholder" value is often used – this is usually between 0.9 and 1.1 kWh. Whilst this makes little difference to the overall gas consumption figures, it can bias the distributional analysis presented here (including median intensities and consumption). In previous years, these meters were included in the raw data, and removed only from the datasets used for distribution analysis including presenting median intensities and consumption. However, these meters have now been removed from the raw gas source data, meaning that they are excluded from all analysis in ND-NEED 2023.

Creating the ND-NEED sample

Process

The ND-NEED sample is created by matching (via UPRN) the ND-NEED building stock with corresponding meters from the electricity and gas meter point data that DESNZ collects, and subsequently business characteristics data.

This creates a sample of non-domestic buildings with energy consumption and building/business characteristic information. This sample is then weighted to scale the results to the population level (further information on this process in "Scaling the ND-NEED sample consumption to population").

As a pre-requisite for this, both of these additional datasets have to be prepared first, including allocating UPRNs. Address matching of non-domestic buildings can be difficult as non-domestic addresses are often complex (for example, a non-domestic building may occupy a range of building numbers or list the company name in the address). Further detail on this process is set out in Annex A.

Using address matching, 51% of buildings in the ND-NEED stock (903,000 buildings) were successfully matched to at least one year of electricity meter data. Of these 903,000 buildings, 390,000 were also successfully matched to gas consumption meter data. This reduced sample size is because not all non-domestic buildings have a gas connection. Business characteristics data is available for around 30% of the buildings in the stock, although this increases to 42% for the sample.

Non-buildings

Once the electricity and gas weights have been calculated, the buildings that were originally included in the ND-NEED electricity/gas consumption sample, but that are not considered to be non-domestic buildings in ND-NEED ('non-buildings'), are removed. The buildings that are removed are: Caravan Parks, Advertising Right and Premises, Car Parks, Beach Huts, Quarries, and Telecoms. As Figure 2 shows, the

removal of these ‘non-buildings’ reduces the size of the ND-NEED electricity consumption sample from 915,000 buildings to 903,000 buildings, and the size of the gas consumption sample from 392,000 buildings to 390,000 buildings.

Non-buildings are not removed before scaling because some of the electricity and gas consumption in the meter point population data is thought to come from these. Therefore, if non-buildings were removed beforehand, the consumption for non-domestic buildings (excluding non-buildings) would be artificially high as it would be scaled to population figures that includes non-building consumption.

To prevent this, the non-buildings are matched to the energy consumption data and included when the weights are calculated to scale the sample up to the population. After the weights have been calculated the non-buildings are removed.

Figure 2: The removal of non-buildings from the ND-NEED electricity and gas consumption samples

The removal of non-buildings from the sample also removes the energy consumption associated with these non-buildings from the ND-NEED consumption figures (15 TWh for electricity and 15 TWh for gas in 2021).

The removal of non-buildings from the ND-NEED sample is one of the reasons that the ND-NEED energy consumption figures for non-domestic buildings are generally lower than comparable figures from other sources such as the sub-national consumption statistics.

Scaling the ND-NEED sample consumption to population: weighting

As not all non-domestic buildings can be matched to energy use data, weights are used to scale up the ND-NEED sample to population. Weighting is used to ensure the results from ND-NEED are as representative of the 1.9 million non-domestic building population as possible.

As there is not a dataset that contains all non-domestic buildings and all non-domestic building electricity/gas consumption, this weighting takes place in two stages (the building weight and the energy weight).

For the weighted sample figures to be representative of the population, the weighting must account for the key characteristics that could influence energy consumption.

Both building use and floor area are used to inform the weighting, so the ND-NEED consumption figures should be representative for these characteristics. However, where floor area information is missing, the weighting is less effective as buildings missing floor area in the sample will be weighted up to buildings missing floor area in the population, even though the actual floor sizes of buildings in these groups might differ. For this reason, there is more uncertainty around the ND-NEED consumption figures by floor area than by building use (where there is no missing information).

Note, the weighting used to scale up consumption from the ND-NEED sample to the population does not account for potential differences between the size of businesses in the sample and the size of businesses in the population. This is because of the lower coverage of business size information in the building stock (only 30% of non-domestic buildings have business size information).

This means there is more uncertainty around whether the energy consumption figures by business size are representative of the population, than for the consumption figures by building use or by building size.

Building weighting

The building weights scale up the number of buildings in the ND-NEED sample to the number of buildings in the ND-NEED building population. To account for biases in the ND-NEED sample, the building weights are constructed based on building use and building size. A single building weight is calculated for each building in the ND-NEED sample.

The building population and sample are stratified into 35 building uses and 17 floor area bands to form a matrix. A few of the building types have too few counts in either the population or the sample to be stratified into an area band (a count of below 5 was used as the minimum cut off). In these cases, two or more area bands were merged (in both the population and the sample).

For each cell in the matrix, the population count is divided by the sample count. For example, if there were 1,000 cinemas with a floor area of >500 – 1,000m^2 in the population, and 500 cinemas with a floor area of >500 – 1,000m^2 in the sample these buildings would be assigned a building weight of 2.

Energy weighting

The next stage of the weighting process is to calculate the energy weights. The energy weights scale up the energy meters in the ND-NEED sample to match the number of energy meters in the non-domestic meter population. The weights for electricity meters and gas meters are calculated separately.

The non-domestic meter population contains some building uses that are not covered by ND-NEED. These are agricultural buildings, place of worship and prisons. The meters associated with these building uses are therefore excluded from

non-domestic meter population before the energy weights are calculated. To do this, a profile for each of the excluded building types is created from the meter data. Each of these building types is then grossed up to an estimated population from the UCL Carb model[1]. The resulting population of these building types was then removed from the total population of all consumption meters.

Electricity weight

The population for the electricity weight is all the non-domestic electricity meters in the sub-national electricity consumption statistics (profile classes of 0 and 3 – 8)[2], and any other electricity meters that match to a building in the ND-NEED building stock dataset. The sample is the number of electricity meters in the ND-NEED sample.

To account for biases in the ND-NEED sample, the electricity weights are constructed based on their average electricity consumption in 2019 - 2021 and meter profile class. The population and sample of meters is stratified into 17 consumption bands and into seven profile classes to form a matrix. A few of the cells in the matrix have too few counts in either the population or the sample to be stratified into a consumption band (a count of below 5 was used as the minimum cut-off). In these cases, two or more consumption bands were merged (in both the population and the sample). For each cell in the matrix, the ratio of population count to sample count is calculated. Any meters in the sample with a profile class of 1 or 2 are given a weighting of one, as they will also appear in the population. If a building has multiple meters the total consumption for the building is divided by the number of meters and assigned the resulting consumption band.

For each combination of consumption band/profile, a single electricity weight is calculated, as the population to sample ratio, averaged over the last three years (2019-2021). This is then applied to all years of electricity consumption, for each building in the sample, in the corresponding band.

Gas weight

The population for the gas weight is all the non-domestic gas meters in the sub-national gas consumption statistics (meters than consume more than 73,200 kWh a year), and any other gas meters that match to a building in the ND-NEED building stock dataset. The sample for the gas weight is the gas meters in the ND-NEED sample.

To account for biases in the ND-NEED sample the gas weights are constructed based on their average gas consumption in 2019 - 2021. The population and sample

[1] The UCL Carb model is UCL's non-domestic energy use model which provides estimates of total number of buildings for different building types.

[2] Profile classes 1 and 2 indicate a domestic property. Profile classes 0 and 3 – 8 indicate a non-domestic property.

of meters are stratified into 17 consumption bands. For each cell in the matrix, the ratio of population count to sample count is calculated. Some of the cells in the matrix have too few counts in either the population or the sample to be stratified into a consumption band (a count of below 5 was used as the minimum cut-off). In these cases, two or more consumption bands were merged (in both the population and the sample).

Any gas meters with a consumption of less than 73,200 kWh a year are given a gas weight of one as all meters in the population will also be in the sample. If a building has multiple meters the total consumption for the building is divided by the number of meters and assigned the resulting consumption band.

For each consumption band, a single gas weight is calculated, as the population to sample ratio, averaged over the last three years (2019-2021). This is then applied to all years of gas consumption, for each building in the sample, in the corresponding band.

ND-NEED building stock: matching to business characteristics data

In the same way as business characteristics data is matched to the reduced ND-NEED sample, it can also be matched to the ND-NEED building stock data alone. This follows the same process but gives a larger dataset to analyse the businesses occupying non-domestic buildings.

Annex A: Address matching

The ND-NEED sample is created by matching the ND-NEED building stock with corresponding meters from DESNZ's energy meter data, and then matching to business characteristics data, via the UPRN. The building stock data from VOA has UPRNs allocated already; to match the energy meter and business data, these must also be allocated UPRNs.

Process

The energy meter and business data are each matched separately to the AddressBase dataset, to generate a UPRN for each record with them. This is an Ordnance Survey dataset that contains the addresses of all buildings in Great Britain as well as their UPRN. As both the energy meter data, business data and the AddressBase data contain the buildings address, address matching is used to match these datasets together. The same process is followed for each dataset.

Address-matching algorithm

An algorithm is used to carry out the address-matching. Where buildings in the energy meter dataset successfully match to AddressBase, the UPRN for the building can be identified. As part of the process, the matches are scored to indicate the degree of confidence in the match. Given the complexity of non-domestic addresses, only those matches scoring above a certain threshold are accepted.

Match rates

Table 10 compares the number of buildings in the building stock with those in the electricity sample (all buildings that have electricity consumption data for at least one of 2012-2021). From this, an indication of the match rates (and any bias towards particular building uses) can be obtained.

Table 10 – Electricity sample match rates of ND-NEED building stock, by building use

Building use	ND-NEED building stock 2023	ND-NEED electricity sample	Match rate (%)
Arts, Community and Leisure	52,000	27,000	51%
Education	40,000	28,000	70%
Emergency Services	4,000	3,000	69%
Factories	240,000	102,000	42%
Health	26,000	18,000	70%
Hospitality	199,000	141,000	71%
Offices	357,000	89,000	25%
Shops	496,000	47,000	37%
Warehouses	221,000	370,000	75%
Other	127,000	79,000	36%
Total	**1,763,000**	**903,000**	**51%**

Supplementary meter point data UPRNs

Where meters could not be match to an address using the address matching algorithm described above, a list of Meters-UPRN from a different address matching algorithm was used. The address matching algorithm was developed for DESNZ by a consultancy and used as part of the address matching process in the 2015 edition of ND-NEED. The addition of this historic address matching algorithm improved the match rate between the buildings stock and the energy meter data by around six percentage points.

Annex B: Non-buildings

Further information on the non-buildings that are removed from the ND-NEED sample is provided in Table 11.

Table 11 – Impact of removal of non-buildings

Number of buildings	% of buildings	Floor area (where available) (m^2)	Electricity consumption (TWh, 2021)	Gas consumption (TWh, 2021)
142,000	7.5%	2,086,000	15	15

Annex C: Building use categories

The building use categories that are used in this version of ND-NEED have been chosen to align as far as possible with the categories used in the Energy Consumption in the UK (ECUK)[3] and Business Energy Efficiency Statistics (BEES)[4], [5].

In this publication, ten building use categories are used: Arts, Community and Leisure; Education; Emergency Services; Factories; Health; Hospitality; Offices; Shops; Warehouses and Other. Details of the buildings uses that are included in these ten categories can be found in Table 12. Further information on the description codes can be found in the technical guidance published by VOA.

[3] ECUK, End uses data tables, Table U5
[4] BEES, Overarching report tables
[5] Note – some military premises are not included in the NDR and so are not covered in ND-NEED.

Table 12: The building uses included in the ten building use categories in ND-NEED.

Building use	Broad description	Description codes			
Arts, Community and Leisure	Cinemas, Community centres, Libraries/Museums, Sports centres, Sports grounds	EM EM1 EM1O EM1W EMO LC LC1 LC1O LC1S LC1W LC2	LC2O LC2S LC2W LC3 LC3C LC3O LC3S LCC LCO LCS LCW LI	LI1 LI1O LIO LS LS1 LS2 LS2O LS3 LS3S LS3W LS4	LS5 LS6 LS7 LSO LT LT1 LT1S LT2 LT3 LT3O LT3S LT4
Education	Nurseries, State schools, Private schools, Universities	EL EL1 EL1O EL1S	ELO ELW EN1 EN1O	EN1S EN1W EP EP1	EPO EPS EU EUC EUO
Emergency services	Ambulance/Fire stations, Police stations	MP MP1 MP1O	MP2 MPO MPS	MS1 MS1O MS2	MS2O MS2S MS2W
Factories	Factories	IF IF1 IF1O IF2 IF2O	IF2S IF2W IF3 IF3C IF3O	IF3S IF3W IF4 IF4C IF4O	IF4S IF4W IFO IFS IFW
Health	Healthcare	MH MH1 MH1O	MH1S MH1W MH2	MH2C MH2S MH3	MHC MHO MHS MHW
Hospitality	Restaurants, Hostels, Hotels, Holiday homes/Guesthouses, Pubs	CH CH1 CH1C CH1O CH1S CH1W CH2 CH2C CH2O	CH3 CH3S CHC CHO CHS CHW CL CL1 CL1S	CL2O CL2S CL2W CLO CLS CLW CR CR1 CR1C	CR1W CR2 CRC CRO CRS CRW MR MR1 MR1O

Building use	Broad description	Description codes			
		CH2S	CL1W CL2	CR1O CR1S	MRO MRS
Offices	Offices	CO CO1	CO1O COC COO	COS COW ML	MLC MLO MLW
Shops	Shops	CS CS1 CS10 CS10C CS10O CS10S CS10W CS1O CS1S CS1W	CS2 CS2O CS2S CS3 CS3C CS3O CS3S CS3W CS4 CS4O	CS4S CS4W CS5 CS5S CS6 CS6C CS6S CS6W CS7 CS7C	CS7O CS7S CS7W CS8 CS9 CS9S CSC CSO CSS CSW
Warehouses	Warehouses	CW CW1 CW1C CW1O	CW1S CW1W CW2 CW2O CW2S	CW2W CW3 CW3C CW3O CW3S	CW3W CWC CWO CWS CWW
Other	Bus stations/moorings, Cemeteries, Docks, Electricity hereditaments (including power stations and premises), Garages, Markets, Military premises, Sewage treatments	CG CG1 CG1C CG1O CG1S CG1W CG2 CG2O CG2S CG2W CG3 CG3C CG3O CG3S CG3W CG4 CG4O CG4S CG4W CGC	CM CM1 CMC CMS CX EX FD FE IX LX MC MC1 MCO MX NT NT1 NT1C NT1O NT1S NT1W	NWW NX TD1 TD2 TX CS CS1 CS10 CS10C CS10O CS10S CS10W CS1O CS1S CS1W CS2 CS2O CS2S CS3 CS3C	CS4 CS4O CS4S CS4W CS5 CS5S CS6 CS6C CS6S CS6W CS7 CS7C CS7O CS7S CS7W CS8 CS9 CS9S CSC CSO

Building use	Broad description	Description codes			
		CGO CGS CGW	NT3 NW	CS3O CS3S CS3W	CSS CSW

Annex D: Floor area data

Missing floor area data in ND-NEED sectors

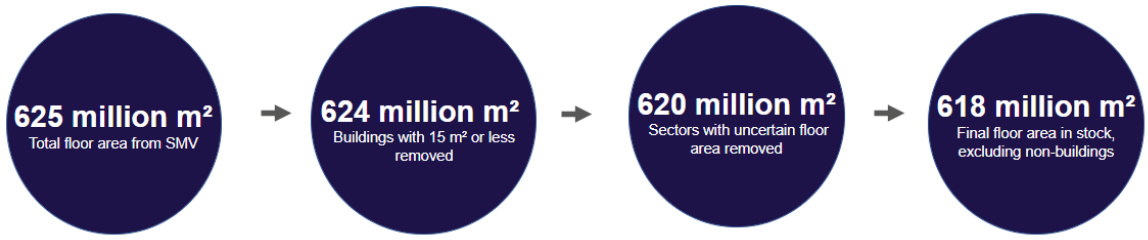
In ND-NEED 2023 dataset, 329,000 (19%) of buildings do not have floor area data. This is because:

1. 10% of the floor area data is already missing from the VOA data that ND-NEED is based on.

2. A further 14% of buildings are removed that have a floor area of 15m^2 or less. This information is removed from the ND-NEED dataset because the data is believed to be unreliable, and accounts for around 1,500,000 m^2 of floor area (less than 1% of the total ND-NEED floor area).

    a. Buildings in subsectors not used to inform VOA's building rating are also removed (9%). This removes just under 4,000,000 m^2 of floor area. The exact amount of floor area missing from ND-NEED is not known and therefore cannot be accounted for.

Figure 3: The Removal of floor area from the ND-NEED building stock.



All floor area data presented is therefore believed to be an underestimate. Table 13 shows that the proportion of buildings missing floor area information in ND-NEED varies substantially between sectors. Due to variations, floor area comparisons between sectors must be done with caution.

Table 13: Percentage of non-domestic buildings missing floor area data.

Building use	Proportion of buildings missing floor area
Arts, Community and Leisure	21%
Education	65%
Emergency Services	96%
Factories	2%
Health	40%
Hospitality	69%
Offices	14%
Shops	3%
Warehouses	6%
Other	44%
Total	**19%**

Excluded floor area data

The NDR/SMV received from the VOA contains information on floor area. This floor area information is at hereditament level. For some hereditaments, this floor area information is missing in the VOA's data. As ND-NEED presents information at the building level, when there are multiple hereditaments in a single building the floor area of the constituent hereditaments are added together. Before hereditament floor areas are aggregated to the building level all hereditaments with a floor area of <15m^2 have their floor area value are removed. This is because, for the purposes of ND-NEED, these floor area values are thought to be inaccurate.

The floor area of building uses for which floor area is not used to inform VOA's building rating are also removed, as detailed in Table 14.

Table 14: Building uses where floor area has been removed

Building Uses		
Abattoirs and Slaughterhouses, Agricultural Showgrounds, Airports, Air Strips, Aluminium Smelting Works, Amusement Parks, Aquaria, Archives, Arenas, Army Hereditaments, Artificial Fibre Works, Asphalt Plants, Beet Sugar Factories, Bingo Halls, Bird Sanctuaries, Bowling Centres, Brickworks, Bulk Cement Storage Depots, Bus Garages, Bus Stations, Caravan Parks, Caravan Sites and Pitches, Cattle Breeding Centres, Cement Tiles Works, Cement Works, Cemeteries, Chalet Parks, Chemical Works, Cinemas, Civic and Public Buildings, Civic Amenity Sites, Civil Airports, Coaching Inns, Coastguard Stations, Courts, Coking and Carbonising Plants, Colleges of Further Educations, Communication Stations, Concert Halls, Concrete Batching Plants, Concrete Block Works, Concrete Product Works, Conference and Exhibition Centres, Conference Centres in Country Houses, Country House Hotels,	Leisure Miscellaneous, Libraries, Lifeboat Stations, Liquid Bulk Storage, Livestock Markets, Local Authority Schools, Lodges, Marinas, Markets, Mineral Depots and Premises, Minerals Miscellaneous, Mineral Producing Hereditament – Blockstone, Mineral Producing Hereditament – Brine, Mineral Producing Hereditament – Chalk, Mineral Producing Hereditament – China Clay, Mineral Producing Hereditament – Clay, Mineral Producing Hereditament – Coal, Mineral Producing Hereditament – Fluorspar, Mineral Producing Hereditament – Gas, Miniature Railways, Model Villages, Mineral Producing Hereditament – Inert, Mineral Producing Hereditament – Oil, Mineral Producing Hereditament – Other Mineral Categories, Mineral Producing Hereditament – Putrescible, Mineral Producing	Public Houses/Pub Pumping Mines Railways and Tramways, Religious Retreats/Study Centres (Residential), Restaurants (inc. Lodge), Roller Skating Rinks, Rugby League Grounds, Sea Dredged Aggregate Processing Plants and Depots, Sewage Works, Ship Building Yards, Ship Repair Yards, Ski Centres, Showhouses, Speedway Racetracks, Spoil Heap Workings, Sporting Rights, Sports and Leisure Centres (Wet and Dry), Sports and Leisure Centres Within/Part of Specialist Property, Sports Stadia, Stately Homes and Historic Houses, Statutory Docks and Harbours (Formula), Statutory Docks and Harbours (Non-Formula Prescribed), Statutory Docks and Harbours (Other), Surgeries Clinics Health Centres (Contractors Valuation), Swimming Pools (Local Authority),

Building Uses

Courts,
Crematoria,
Cricket Centres,
Cricket Grounds,
Crown Miscellaneous,
District Heating Undertakings and Networks,
Docks and Harbours,
Domestic Fuel Installations, Effluent Minewater Treatment Plants and Premises,
Electricity Undertakings,
Field Study Activity and Adventure Centres,
Fire Stations,
Fish Farms,
Flour Mills,
Football Stadia,
Formula Assessed Miscellaneous,
Game Farms,
Gas Processing Plants,
Go Kart Rinks,
Golf Driving Ranges,
Grain Silos,
Greyhound Racetracks,
Hatcheries/Poultry Farms,
Health Farms,
Heliports,
Hereditaments used for Primary Treatment/Processing of Minerals,
Heritage Railways,
Holiday Centres,
Horse Racecourses,
Hospitals and Clinics NHS,
Hospitals and Clinics Private, Hotels (3 star and under), Operated,
Ice Rinks,
Information/Visitor Centres,
Iron and/or Steel Works,
Lakes with Water Sport Facilities,
Land used for Car Boot Sales,
Landfill Gas Generator Sites, Land used for Waste Composting,
Hereditament – Sand, Gravel, and, Slates,
Mortuaries,
Motor Racetracks,
Motor Vehicle Works, Motorway and Major Road Service Areas,
Museums and Art Galleries (Contractors),
Museums and Art Galleries (Non-Contractors),
Nuclear Establishments,
Nursing Homes,
Observatories,
Oil Refineries,
Oxbridge Colleges,
Peat Fields,
Petrol Filling Stations, Pipelines,
Pitch and Putting Greens
Pleasure Piers,
Point to Point and Eventing Courses,
Police Stations,
Police Training Colleges,
Power Generators,
Prison Service Hereditaments,
Property used for Secondary Aggregate Processing,
Provender Mills,
Public Conveniences,
Public Halls,
Public Houses/Pub Restaurants,
Swimming Pools (Private),
Telecommunications Cable Networks,
Telecommunications Switching Centres,
Telescope Sites,
Tennis Centres,
Theatres,
Theme Parks,
Timeshare Complexes,
Tolls,
Totalisators on Horse racecourses,
Tourist Attractions/Dark Rides,
Training Centres (Residential),
University – Ancillary Land or Buildings,
Universities (excluding Oxbridge),
War Game Courses/Misc. Agriculture Use,
Universities (excluding Oxbridge),
University Occupation Within Hospitals,
Waste Incinerator Plants, Waste Transfer Stations,
Water Undertakings (Non-Statutory),
Windmills,
Zoos and Safari Parks.

Main limitations of ND-NEED

There are several aspects of ND-NEED's methodology which currently limit the insights that ND-NEED can provide. Work is continually being undertaken to try to address these.

Address matching (see also Annex A: Address matching)

- Incorrect matches between the non-domestic buildings data and the energy consumption data).
    - Due to difficulties with the address matching process used to match the energy consumption data to AddressBase, some matches will not be correct. It is estimated that around 5% of address matches are incorrect.
    - If an energy meter data has been matched with the wrong address in AddressBase it will then match to the wrong address in the ND-NEED building stock. The consumption of that building with therefore be assigned to the wrong building and business characteristics information, and weighted accordingly, causing distortions in the data.

- Around 51% match rate between the non-domestic buildings data and the energy consumption data.
    - Only 51% of non-domestic buildings in the ND-NEED building stock are matched to electricity consumption data.
    - Only 20% are matched to gas consumption data (including non-buildings) – however, this is expected to be lower than for electricity since not all buildings use gas.
    - The address matching algorithm uses addresses from January 2022. This means that any old addresses that no longer exist in AddressBase (because the building no longer exists or because the buildings address has changed e.g., if a new business is occupying the building) will not be matched.

Weighting (see also Scaling the ND-NEED sample consumption to population: weighting)

- Because we cannot match all non-domestic buildings data with their energy consumption data, weighting is needed to ensure the ND-NEED consumption figures are representative of the population. There are several issues with this:
    - Firstly, there is currently no information in ND-NEED about business size at the population level. Business size is therefore not accounted for in the weighting process.

    - Secondly, although floor area is a factor in the weighting process, the relatively high rates of missing floor area information in ND-NEED reduces the efficacy of the floor area weighting.

- Applying energy weights to energy intensity figures:
    - Energy intensity is influenced by both the energy consumption and the floor area of a building, whereas the energy weight currently applied to energy intensity figures is just influenced by a building's energy consumption. This means that differences in floor area between the buildings in the sample and the population are not accounted for.

- Manual elements of the weighting process:
    - The current ND-NEED weighting processes requires subjective decisions to be made about when to merge adjacent cells when there are a low number of buildings/meters in a particular cell and which cell to merge these 'low value' cells with. This means that two people running the weighing process would calculate slightly different weights, and consequently slightly different consumption values. This adds to the uncertainty surrounding all ND-NEED consumption estimates.

Consumption: time-series

There are several reasons why consumption in the earlier years in the time series maybe being underestimated in ND-NEED:

- The building stock figures used in ND-NEED, based on position of the 2017 NDR at March 2023, do not include sites that have closed (or no longer attract business rates, for example, if converted to domestic use). Because of this, any buildings that do not exist in March 2023 will not be included in the ND-NEED stock and so cannot be matched to energy consumption data.

- The energy consumption data used in this version of ND-NEED only includes meters which are active in 2021. Because of this, any energy consumption from meters that have now been deenergised e.g. because the building has been destroyed, is not captured.

- The weighting process:
    - The weighting process in ND-NEED is currently unable to account sufficiently for the underestimation of consumption in earlier years. This makes it difficult to create a robust time series from the ND-NEED. Energy consumption in earlier years is likely to be underestimated, as energy consumed by buildings/meters that no longer exist would not be captured.

    - The manual element of the weighting process (see above) introduces uncertainty into the consumption figures which can also have a small impact on the time series trend presented. This means that it is not

possible to determine whether small changes in the time series trend are real changes in consumption or caused by noise in the data.

Missing data

- Many buildings in ND-NEED are missing information on business/building size.
    - The main consequences of the high level of missing data in ND-NEED is that the consumption value associated with a particular business or building size will likely be an underestimate, as some consumption from buildings that are missing business/building size information will likely fall into that category.

Mixed building use

- The data received from the VOA (NDR/SMV) is at the hereditament level and must be aggregated to the building level for use in ND-NEED. Where a building contains multiple hereditaments of different building uses the building use of the hereditament with the largest floor area is assigned to the building. However, it is possible that the building use of the hereditament with the largest floor area does not best represent the building use of the building as a whole. Improving the building use classification for building uses with multiple hereditaments would improve the accuracy of ND-NEED's energy consumption and energy intensity figures by building use.

Business size

- The business size information in ND-NEED is the size of the business that occupies the building, not the number of employees that work in the building. Because of this a small branch of a national store will be a large business in ND-NEED, even if there are only a few employees occupying the building.

- Additionally, similar to mixed building use, there are often multiple businesses occupying – or registered to – a building, or even a premises. The method takes the business with the best match rating to represent that building, which may not best represent the building as a whole.

Scope

- The definition of a non-domestic building in ND-NEED is an area to review, particularly with regards to excluded buildings, such as prisons; and included buildings, such as those within the "Other" category – particularly electricity hereditaments (which include some generating stations that may consume electricity for non-building purposes).

Revisions policy

The DESNZ statistical revisions policy sets out the revisions policy for these statistics, which has been developed in accordance with the UK Statistics Authority Code of Practice for Statistics.

User engagement

Users are encouraged to provide comments and feedback on how these statistics are used and how well they meet user needs. Comments on any issues relating to this statistical release are welcomed and should be sent to the Energy Efficiency Statistics mailbox.

The DESNZ statement on statistical public engagement and data standards sets out the department's commitments on public engagement and data standards as outlined by the Code of Practice for Statistics.

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