Data Article

A compiled dataset of the energy usage indicators and unit energy consumption values available in Ireland

Connor McGookin\textsuperscript{a,b,*}, Brian Ó. Gallachóir\textsuperscript{a,b}, Edmond Byrne\textsuperscript{a,b}

\textsuperscript{a}Energy and Policy Modelling Group, MaREI Centre, Environmental Research Institute, University College Cork, Ireland
\textsuperscript{b}School of Engineering, University College Cork, Ireland

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\textbf{ABSTRACT}

This dataset supports the analysis outlined in (McGookin et al., 2021) "An innovative approach for estimating energy demand and supply to inform local energy transitions" [1]. It consists of four key elements: a range of different energy usage indicators (e.g. the number of employees or cars in a region), national unit energy consumption values, energy supply fuel shares per sector, and an overview of the housing stock. Firstly, the range of socio-economic statistics used as indicators of energy demand are primarily gathered from the Central Statistics Office’s (CSO), along with sector specific sources like the Department of Transport or Fisheries. Secondly, the national energy demand and supply in the five sectors of agriculture and fishing, industry, residential, services and transport comes from the national reporting body Sustainable Energy Authority of Ireland. These two datasets are then used to form the national unit consumption figures for a range of indicators in each sector. A national unit consumption value gives an average energy demand per statistical unit, for example MWh/employee or MWh/km driven. This can be used to estimate subnational energy demand in the absence of recorded energy data below the national level. Finally, the Building Energy Rating database (which is reported quarterly by the CSO) provides details on the Irish
Specifications Table

| Subject | Engineering (General) |
|---------|-----------------------|
| Specific subject area | Developing an estimate of subnational energy demand and supply |
| Type of data | Tables |
| How data were acquired | 
  - Census data gathered from central statistics office (CSO) small area statistics portal - [http://census.cso.ie/sapmap/](http://census.cso.ie/sapmap/)
  - Business and transport surveys taken from the Central Statistics Office data portal - [https://data.cso.ie/](https://data.cso.ie/)
  - National energy balance taken from Sustainable Energy Authority of Ireland reporting - [https://www.seai.ie/data-and-insights/seai-statistics/key-publications/national-energy-balance/](https://www.seai.ie/data-and-insights/seai-statistics/key-publications/national-energy-balance/)
  - The Building Energy Rating database is published quarterly by the central statistics office, with a series of tables available for download as a .csv file
  - Irish Bulletin of Vehicle and Driver Statistics published annually by Department of Transport
  - Irish Sea Fishing Fleet Register published annually by Department of Agriculture, Food and the Marine
| Data format | 
  - Raw input data
  - Filtered input data |
| Parameters for data collection | 
  - Range of socio-economic values that may be used as indicators of energy demand such as employees or distance travelled by cars
  - Energy statistics for Ireland covering the energy demand and supply in the five sectors of agriculture and fishing, industry, residential, services and transport
  - Housing stock data covering the energy demand and size by age
  - Primary heating fuel supply for non-domestic buildings
| Description of data collection | 
  - All data from the CSO is available for download as a .csv file, and was filtered as outlined in Section 2
  - The national energy statistics are taken from annual reports prepared by Sustainable Energy Authority of Ireland
  - Other data taken from government reports from Department of Transport and Department of Agriculture, Food and the Marine |
| Data source location | The data covers national energy and socio-economic statistics for the country of Ireland, as well as two subnational regions within Ireland; County Kerry and the Dingle Peninsula. |
| Data accessibility | Repository name: Mendeley Data |
| Data identification number | [https://doi.org/10.17632/rttsn7ptxk.1](https://doi.org/10.17632/rttsn7ptxk.1) |
| Direct URL to data | [https://data.mendeley.com/datasets/rttsn7ptxk/1](https://data.mendeley.com/datasets/rttsn7ptxk/1) |
| Related research article | C. McGookin, B. Ó Gallachóir & E. Byrne. “An innovative approach for estimating energy demand and supply to inform local energy transitions.” Energy (2021): 120731. [https://doi.org/10.1016/j.energy.2021.120731](https://doi.org/10.1016/j.energy.2021.120731) [1] |

Value of the Data

- Making the data available is important to ensure the research is transparent and accessible.
- Energy planners seeking to understand the current energy demand and supply in their region, city or town will be able to see the energy usage indicators used in this study.
- Comparing this data against other countries would give valuable insights into the representativeness of the various energy usage indicators and varying energy profiles of different countries.
1. Data Description

The range of different socio-economic variables that may be used as indicators of energy demand are listed in Table 1. These range from indicators that are common across sectors (such as employees or gross value added) to sector specific indicators (such as the hectare of farmland or the distance travelled by vehicles).

In the majority of cases, these variables came from the 2016 Census of Ireland. Thus, the same year was taken for the national energy balance, the breakdown per sector in 2016 is shown in Table 2.

Combining the data from Tables 1 & 2, we can produce a list of unit energy consumption values, as displayed below in Table 3. The unit energy consumption is the amount of energy demand per statistical indicator. The values shown here are based on data from 2016 as that is
Table 3
Unit energy consumption by sector and indicator for Ireland in 2016.

| Sector                  | Indicator                  | Unit       | Unit Energy Consumption |
|-------------------------|----------------------------|------------|-------------------------|
| Agriculture & Fishing   | Population weighted       | MWh / capita | 0.552                  |
| Agriculture & Fishing   | No. of employees          | MWh / employee | 29.494                 |
| Agriculture             | Gross value added         | GWh / emnGVA | 1.103                  |
| Agriculture             | Area of land              | MWh / hectare | 0.482                  |
| Fishing                 | Gross value added         | GWh / emnGVA | 0.594                  |
| Fishing                 | Unladen weight of boats   | MWh / tonne | 3.455                  |
| Industry                | Population weighted       | MWh / capita | 5.971                  |
| Industry                | No. of buildings          | GWh / building | 1.778                  |
| Industry                | No. of employees          | MWh / employee | 135.369                |
| Industry                | Gross value added         | MWh / emnGVA | 300.95                 |
| Residential             | Population weighted       | MWh / person | 6.604                  |
| Residential             | No. of homes              | MWh / house | 18.524                 |
| Residential             | No. of homes adjusted by type | MWh / house | 17.735                 |
| Services                | Population weighted       | MWh / capita | 3.314                  |
| Commercial Services     | No. of buildings          | MWh / building | 36.741                 |
| Commercial Services     | No. of employees          | MWh / employee | 8.091                  |
| Commercial Services     | Gross value added         | MWh / emnGVA | 75.839                 |
| Public Services         | No. of buildings          | MWh / building | 182.061                |
| Public Services         | No. of employees          | MWh / employee | 13.238                 |
| Public Services         | Gross value added         | MWh / emnGVA | 208.493                |
| Transport               | Population weighted       | MWh / capita | 9.086                  |
| Transport               | No. of vehicles           | MWh / vehicle | 36.210                 |
| Transport               | km travelled              | GWh / million km | 1.581                 |
| Transport               | Tonne km                  | GWh / mil tonne km | 1.060                 |
| Transport               | Gross value added         | MWh / emnGVA | 48.245                 |
| Transport               | No. of vehicles           | MWh / vehicle | 12.250                 |
| Transport               | km travelled              | MWh / million km | 680.577                |
| Transport - Public Services | No. of vehicles          | MWh / vehicle | 49.289                 |

Table 4
Energy supply per sector in Ireland in 2016.

| Sector                  | Oil  | Natural Gas | Coal | Peat | Grid Electricity* | Petrol | Diesel | RES-H | RES-E* | RES-T |
|-------------------------|------|-------------|------|------|-------------------|--------|--------|-------|--------|-------|
| Agriculture & Fishing   | 23.2%| 76.8%       |      |      | 100%              |        |        |       |        |       |
| Agriculture incl. forestry |      |            |      |      |                   |        |        |       |        |       |
| Fisheries               | 20%  | 32.9%       | 4.5% | 35.3%| 7.3%              |        |        |       |        |       |
| Residential             | 37.2%| 20.8%       | 7%   | 7%   | 25%               | 1.9%   | 1.2%   |       |        |       |
| Services                | 19.0%| 24.2%       |      |      | 51.5%             | 1.9%   | 3.3%   |       |        |       |
| Commercial Services     | 17.0%| 49.4%       |      |      | 32.3%             | 0.5%   | 0.8%   |       |        |       |
| Public Services         |      |            |      |      |                   |        |        |       |        |       |
| Transport               |      |            |      |      |                   |        |        |       |        |       |
| Road freight            | 0.02%| 0.2%        | 92.5%| 7.2% |                   |        |        |       |        |       |
| Private car             | 0.1% | 49.0%       | 44.6%| 6.3% |                   |        |        |       |        |       |
| Public Services         | 0.05%| 18.3%       | 74.7%| 6.9% |                   |        |        |       |        |       |
| Unspecified             | 0.02%| 28.2%       | 65.1%| 6.7% |                   |        |        |       |        |       |

*Note: In 2016, 27.2% of the grid electricity came from renewable sources. The RES-E shown in this table represents only on-site small-scale generation such as solar PV.

the year of the most recent Census. It provides a useful snapshot of the energy demand in the various sectors. However, as discussed in McGookin et al. [1], could be improved with access to more detailed data that would allow an assessment of the changes over time and also regional variations within the country. Prior to the impact of the COVID-19 pandemic, Ireland’s energy demand had remained fairly stagnant over the period 2016–2019 due to limited progress addressing energy-related CO2 emissions in heating and transport [2], thus the variation over that period to values shown here may be minor.
Table 5
Primary heating fuel in non-domestic buildings Ireland and Co. Kerry in 2016.

|          | Mains Gas | Oil | LPG | Electricity | Solid Fuel |
|----------|-----------|-----|-----|-------------|------------|
| National | 25%       | 12% | 2%  | 62%         | 1%         |
| Kerry    | 0%        | 24% | 6%  | 69%         | 1%         |

Table 6
Primary central heating fuel for households on the Dingle Peninsula in 2016.

| Fuel Type | Solid Fuel | Oil | RES-H |
|-----------|------------|-----|-------|
|           | Peat       | Coal| Renewable | Wood | Electricity |
| No. of houses | 277 | 524 | 3290 | 156 | 66 | 199 | 322 |
|            | 801 | 3446 |        | 265 |     |     | 322 |
| % share    | 5.7% | 10.8% | 68.1% | 3.2% | 1.4% | 4.1% | 6.7% |
|            | 16.6% | 71.3% |        | 5.5% |     |     | 6.7% |

Table 7
Average annual energy demand per metre squared and floor area of Irish households by year of construction

| Period    | kWh/m²/year | Avg. m² |
|-----------|-------------|---------|
| Pre 1919  | 402         | 118     |
| 1919–1945 | 409         | 100     |
| 1946–1960 | 365         | 104     |
| 1961–1970 | 328         | 104     |
| 1971–1980 | 269         | 109     |
| 1981–1990 | 240         | 108     |
| 1991–2000 | 225         | 110     |
| 2001–2010 | 187         | 113     |
| 2011 or later | 78 | 140     |
| Not stated | 266         | 122     |

The breakdown of energy supply per fuel at a national level is displayed in Table 4. In addition, moving to a more granular detail, the primary heating fuel in non-domestic buildings is provided by the BER database for both Ireland and County Kerry in Table 5. The residential heating fuel choice from the 2016 Census is available for the area of interest, the Dingle Peninsula, in Table 6. Finally, Table 7 provides values for the average size of households and annual average energy demand per metre by the year of construction. This is based on the values recorded during building energy rating (BER) assessments carried out from 2009 up to the end of 2016.

2. Experimental Design, Materials and Methods

This section outlines the steps taken to acquire the data contained within this article.

2.1. Data handling process

A flowchart of the primary data gathering process is provided in Fig. 1. There are two central parts. Firstly, the gathering of regional energy usage indicators by aggregating census data for the small areas that make up the case study region (see Section 2.2) or proportioning other key socio-economic variables that we only available at the county or NUTS 3 regional level (see Section 2.3). Secondly, the creation of national unit energy consumption values using national energy usage indicators combined with the energy demand in each sector.
2.2. Census data

The data collected as part of the Census of Ireland is available for download as a comma separated file from the Central Statistics Office (CSO) repository [3], along with a glossary to navigate the dataset. It can also be viewed through an interactive tool called 'SAPMAP', which stands for Small Area Population Map [4]. The survey data is aggregated for a range of spatial levels from the National down to County level of which there are 31 in Ireland and finally the Small Area of which there are 18,641. It contains 45 tables organised according to the themes of the Census survey. The first step of filtering was to identify the relevant Small Areas using the SAPMAP tool. The 24 Small Areas that make up the Dingle Peninsula are listed in Table 8, along with the GEOGID that was used to find them in the comma-separated file downloaded. In addition, the three electoral districts that make up the South West region are also listed.
### Table 8
List of the Small Areas extracted from the CSO database.

| GE0GID     | Name                  | Region                  |
|------------|-----------------------|-------------------------|
| ED3409_19026 | Ballinvoher           |                         |
| ED3409_19028 | Ballynacourty         |                         |
| ED3409_19037 | Inch                  |                         |
| ED3409_19034 | Dún Chaoin            |                         |
| ED3409_19035 | Dún Urlann            |                         |
| ED3409_19038 | Cill Maoilcheadair    |                         |
| ED3409_19039 | Cill Chuain           |                         |
| ED3409_19042 | Márthain              |                         |
| ED3409_19137 | Baurtregaum           |                         |
| ED3409_19138 | Blennerville          |                         |
| ED3409_19152 | Kilgobban             |                         |
| ED3409_19156 | Knockglass            | Dingle Peninsula        |
| ED3409_19030 | Castlegregory         |                         |
| ED3409_19032 | Deelis                |                         |
| ED3409_19044 | An Sráidbhaile        |                         |
| ED3409_19027 | An Baile Dubh         |                         |
| ED3409_19041 | Lack                  |                         |
| ED3409_19139 | Boolteens             |                         |
| ED3409_19151 | Kilgarrylander        |                         |
| ED3409_19029 | Cé Bhréanainn         |                         |
| ED3409_19031 | An Clochán            |                         |
| ED3409_19033 | An Daingean           |                         |
| ED3409_19036 | Na Gleannnt           |                         |
| ED3409_19045 | Ceann Trá             |                         |
| CTY31_CC   | Cork County           |                         |
| CTY31_CK   | Cork City             | South West              |
| CTY31_KY   | Kerry                 |                         |

Having extracted the data for the relevant Small Areas, the second filtering step involved identifying the relevant tables and variables using the glossary of terms, as listed in Table 9.

As this data came from a Census survey, there was some processing required. For age of households, central heating systems and the number of cars, if respondents had chosen “not stated”, an average value was used. In addition, the central heating system data required the following restructuring:

- No central heating was taken to be solid fuel, split between peat and coal
- Natural gas was assumed to be LPG as there is no gas grid in Kerry

### 2.3. Other sources of energy usage indicators

There were a number of additional sources used to get sector specific indicators. These are listed in Table 10 below, along with a brief description of the necessary processing.

### 2.4. National energy demand and energy supply by sector

The national energy balance from 1990–2019 can be downloaded as an Excel file from the Sustainable Energy Authority of Ireland’s (SEAI) [16]. It is given in Ktoe and was converted to GWh, using the conversion 1 Ktoe is 11.63 GWh.
Table 9
List of the Census tables used by theme, data provided, reference name in dataset and short description.

| Theme | Table Name | Column Name | Description |
|-------|------------|-------------|-------------|
| Theme 1: Sex, Age and Marital Status | Table 1 Population aged 0–19 by sex and year of age, persons aged 20 years and over by sex and age group | T1_1AGETT | Total population |
| Theme 6: Housing | Table 2 Permanent private households by year built | T6_2_PRE19H | Pre 1919 (No. of households) |
| | | T6_2_19_45H | 1919–1945 (No. of households) |
| | | T6_2_46_60H | 1946–1960 (No. of households) |
| | | T6_2_61_70H | 1961–1970 (No. of households) |
| | | T6_2_71_80H | 1971–1980 (No. of households) |
| | | T6_2_81_90H | 1981–1990 (No. of households) |
| | | T6_2_91_00H | 1991–2000 (No. of households) |
| | | T6_2_01_10H | 2001–2010 (No. of households) |
| | | T6_2_11LH | 2011 or Later (No. of households) |
| | | T6_2_NSH | Not stated (No. of households) |
| | | T6_2_TH | Total (No. of households) |
| Theme 6: Housing | Table 5 Permanent private households by central heating | T6_5_NCH | No central heating |
| | | T6_5_OCH | Oil |
| | | T6_5_NGCH | Natural gas |
| | | T6_5_ECH | Electricity |
| | | T6_5_CCH | Coal (incl. anthracite) |
| | | T6_5_PCH | Peat (incl. turf) |
| | | T6_5_LPGCH | Liquid petroleum gas (LPG) |
| | | T6_5_WCH | Wood (incl. wood pellets) |
| | | T6_5_OTH | Other |
| | | T6_5_NS | Not stated |
| | | T6_5_T | Total |
| Theme 14: Industries | Table 1 Persons at work by industry and sex | T14_1_AFFT | Agriculture, forestry and fishing - Total |
| | | T14_1_BCT | Building and construction - Total |
| | | T14_1_MIT | Manufacturing industries - Total |
| | | T14_1_CTT | Commerce and trade - Total |
| | | T14_1_TCT | Transport and communications - Total |
| | | T14_1_PAT | Public administration - Total |
| | | T14_1_PST | Professional services - Total |
| | | T14_1_OTHT | Other - Total |
| | | T14_1_TT | Total |
| Theme 15: Motor Car Availability, PC Ownership and Internet Access | Table 1 Number of households with cars | T15_1_NC | No motor car |
| | | T15_1_1C | 1 motor car |
| | | T15_1_2C | 2 motor cars |
| | | T15_1_3C | 3 motor cars |
| | | T15_1_GE4C | 4 or more motor cars |
| | | T15_1_NS | Not stated |
| | | T15_1_TC | Total |
| Sector                | Indicator              | Source                                                                 | Granularity                                                                 | Processing                                                                                                                                                                                                 |
|----------------------|------------------------|------------------------------------------------------------------------|-----------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Agriculture          | Hectares of land       | Census of Agriculture [5]                                               | Available by Small Area                                                      | Aggregate values from relevant Small Areas, as per Table 7 South West GVA in 2016 split between Kerry and Cork based on the share of farming incomes from 2010 Census of Agriculture [5]  |
| Agriculture          | Gross value added      | CSO County Income and Regional GDP 2016 [6]                            | Average farming income reported per County                                  |                                                                                                                                                                                                             |
| Fishing              | Gross value added      | CSO Fish Landings 2007-2018 [7]                                        | Reported by port, i.e. area of interest (Dingle)                             |                                                                                                                                                                                                             |
| Fishing              | Unladen weight of boats| Irish Sea Fishing Fleet Register [8]                                   | County level registration                                                    | Weight of the boats registered to each county reported annually                                                                                                                                         |
| Industry             | Employees              | CSO Business Demography [9]                                            | County level reporting                                                      | South West GVA in 2016 split between Kerry and Cork based on historic share [10]                                                                                                                        |
| Industry             | Gross value added      | CSO County Income and Regional GDP 2016 [6]                            | Regionally reported Ireland South West (Kerry and Cork)                     |                                                                                                                                                                                                             |
| Residential          | Enterprises            | CSO Business Demography [9]                                            | County level reporting                                                      | The share of one-off rural housing in Co. Kerry is 74.1% [12], number of houses in Dingle Peninsula provided by Census data                                                                              |
| Residential          | Energy per house       | The Irish Commission for Energy Regulation (CER) ‘Review of Typical Domestic Consumption Values for Electricity and Gas Customers’ [11] | Average values for heating and electricity per household by type (one-off or terraced) |                                                                                                                                                                                                             |
| Services             | Gross value added      | CSO County Income and Regional GDP 2016 [6]                            | Regionally reported Ireland South West (Kerry and Cork)                     | 'Other' category listed in Table 8 split between public / commercial based on a population-based proportioned of public sector employees from the county level                                                                 |
| Services             | Employees              | CSO Business Demography [9]                                            | County level reporting                                                      |                                                                                                                                                                                                             |
| Transport            | Vehicles               | Irish Bulletin of Vehicle and Driver Statistics 2016 [13]              | County level reporting                                                      | None                                                                                                                                                                                                        |
| Transport - Road freight & Private car | Distance travelled | CSO Transport Omnibus 2016; Road traffic volumes [14]                   | County level reporting                                                      | None                                                                                                                                                                                                        |
| Transport - Road freight | Weight carried     | CSO Transport Omnibus 2016; Road freight transport [15]                 | Regional level reporting                                                    | None                                                                                                                                                                                                        |
2.5. Building energy rating database

The share of heating fuels in non-domestic buildings is taken from the Irish energy performance certificate database known as the Building Energy Rating or BER, it is reported quarterly through the CSO [17]. Similarly, the residential figures are also reported quarterly [18]. This provides figures for the average size (m²) of houses in Ireland by age and the associated energy demand per metre squared (kWh/m²).

Ethics Statement

Not applicable.

CRediT Author Statement

Connor McGookin: Conceptualization, Methodology, Formal analysis, Investigation, Writing original draft, Visualization; Brian O’Gallachoir: Conceptualization, Methodology, Supervision, Writing review & editing; Edmond Byrne: Conceptualization, Methodology, Supervision, Writing review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships which have or could be perceived to have influenced the work reported in this article.

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