north east & yorkshire
NET ZERO HUB

WHAT DOES GOOD ENERGY DATA LOOK LIKE?

North East & Yorkshire Net Zero Hub

Public Sector Estate Decarbonisation Programme

Locogen

Turner & Townsend

OUR PARTNERS

Hull & East Yorkshire LEP, North East LEP, South Yorkshire Mayoral Combined Authority, Tees Valley Combined Authority, West Yorkshire Combined Authority, and York & North Yorkshire LEP

Contents

1 Introduction

1.1 Purpose

This guide sets out to help offer a better understanding of what good energy data looks like. This guide has been developed as part of the North-East and Yorkshire Net Zero Hub's Public Sector Estate Decarbonisation programme.

Turner & Townsend are working with the Hub to deliver a suite of training programmes and guides to build capacity and upskill the public sector to deliver decarbonisation projects in their buildings.

1.2 What is energy data?

Energy data is data related to the production, consumption, and storage of energy i.e. gas, electricity, thermal energy are the common types. Energy data is used to inform decisions about the conservation of energy including measuring the impacts of energy efficiency and renewable technologies. Energy data can also be used to inform decisions about energy use in a building, including implementing controls and changing schedules to better suit the needs of the building occupiers.

Data is the key to achieving a decarbonised and digitalised energy future. It is the means by which we will close the gap between where we are and where we must be in order to reach UK Net Zero carbon reduction targets by 2050.

1.3 Why Energy data is important

Emissions from the public sector were 7.9 $MtCO_2$ in 2021, a 6.3% (0.5 Mt) increase from 2020, and accounted for 2.3% of all territorial carbon dioxide emissions.[1] The Net Zero Strategy and the Heat in Building Strategy set up the public sector to lead by example in the government's ambitions to reach net zero by 2050.[2] [3] The government committed in these strategies to halving greenhouse gas emissions in the public sector by 2032, and 75% by 2037, on the path to net zero by 2050.

Energy data plays a key role in enabling us to understand consumption, areas of waste/ and over consumptions. And one of the ways of understanding usage is through metering.

1.4 How energy data is collected

The methodologies employed in obtaining energy data can be grouped into four main categories:

[1] UK Greenhouse gas emissions 2021 report: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1064923/2021-provisional-emissions-statistics-report.pdf

[2] UK path to net zero set out in landmark strategy: https://www.gov.uk/government/news/uks-path-to-net-zero-set-out-in-landmark-strategy

[3] Heat and buildings strategy : https://www.gov.uk/government/publications/heat-and-buildings-strategy

administrative sources, estimated, measuring/metering, and modelling. However, with regards to this programme our focus is on measuring/metering:

- **Fuel bills:** will include the unit consumption (typically in kWh) for the period covered.
- **Meters:** buildings will typically have an incoming meter that measures the total amount of energy used by the building/site.

Types of meters are covered in more detail in section 0.

1.5 Cost and carbon

By collecting the unit consumption of energy (kWh), you can use this to compare previous consumption periods determine how energy use changes over time. Other variables you may wish to understand are how the cost and carbon emissions also change over time and or with change occupancy patterns. These can be simply calculated using conversion factors or modelling using heating degree day calculations (HDD) and regression analysis.

1.5.1 Cost

The building energy supply contract will contain the unit tariff (p/kWh) and any other charges associated with energy consumption such as standing charges. This same information will be available on the most recent utility bills.

1.5.1.1 Standing charge

A standing charge is a fixed amount of money pay to energy provider each month, regardless of how much energy is used. This charge is intended to cover the cost of maintaining a supply and the infrastructure required to deliver it.

1.5.1.2 *Consumption charge*

A consumption charge is the fee pay for each unit of energy use. This charge is based on the amount of energy used and will vary from month to month depending on usage.

1.5.1.3 *Carbon intensity level (CIL)*

CILs are used to measure the environmental performance of energy suppliers in terms of the amount of carbon dioxide emitted per unit of energy produced. Suppliers must adhere to the CILs in order to remain compliant with environmental regulations.

1.5.2 Greenhouse gases

Greenhouse gas emissions or carbon equivalent (CO_2e) is calculated using conversion factors. Conversion factors are updated and published by the government on an annual basis[4], to account for changes in carbon intensity of electricity.

Carbon conversion factors for some common fuels are provided in the table below.

[4] Government conversion factors for company reporting of greenhouse gas emissions: https://www.gov.uk/government/collections/government-conversion-factors-for-company-reporting

Fuel	Emissions factor ($kgCO_2e/kWh$)
Electricity[5]	0.21107
Gas	0.18254
Fuel oil	0.26816
LPG	0.21449

Figure 1: Carbon conversion factors (2022)

To calculate the carbon emissions of 500,000 kWh of gas for example, you would:

1. 500,000kWh × 0.18254 = 91,270kgCO2e

To calculate this in tonnes of carbon, you can divide kilograms by 1,000:

2. 91,270kgCO2e/1,000 = 91.27tCO2e

2 Metering

2.1 Types of Energy metering systems

There is a wide range of energy meters and data collection techniques for utilities:

2.1.1 Utility meters

Utility metering is considered 100% accurate when determining the consumption of a site as the data measures the exact consumption of a fuel.[6]

These are meters with an analogue or digital displays that do not have the capability to communicate with the utility provider and rely on the building occupier to take and submit manual readings, or a representative from the utility company to physically check the meter and take a reading.

Many of the utility meters covered below now exist in 'smart' format which enables remote measurement of energy consumption in a half hourly format.

2.1.1.1 Electricity meters

An electricity meter is a device that measures the amount of electric energy consumed by a site, building or an electrically powered device. Electric meter or energy meter measures the total power consumed over a time interval. Electricity meters vary in types with some examples shown below.

Figure 2: Traditional analogue meter

5 Including transmission and distribution losses, which is the additional consumption of electricity associated with transporting electricity from a power station, via the National Grid a consumer.

6 International Performance Measurement and Verification Protocol

Figure 3: Dual rate meter

Figure 4: Digital meter

A dual rate meter measures consumption of energy at different times of day when different tariffs are charged. For example, a different day and night rate.

2.1.1.2 Gas meters

A gas meter is a specialised flow meter, used to measure the volume of fuel gases such as natural gas and liquefied petroleum gas, and can measured fuel consumption in m^3 or kWh.

Figure 5: Mains gas income and meter

Figure 6: Close up of incoming gas meter

2.1.1.3 Heat meters

Heat meters is a device which measures thermal energy (kWth) provided by a source or delivered to a sink (e.g. a building), by measuring the flow rate of the heat transfer fluid and the change in its temperature between the outflow and return legs of the system.

Heat meters are typically applied in district heating set ups where a building receives heat and hot water from a centralised source. There are many different types of heat meters including:

Multijet, Electromagnetic, Vortex, Fluidic Oscillator and Ultrasonic meter -which is the most popular.

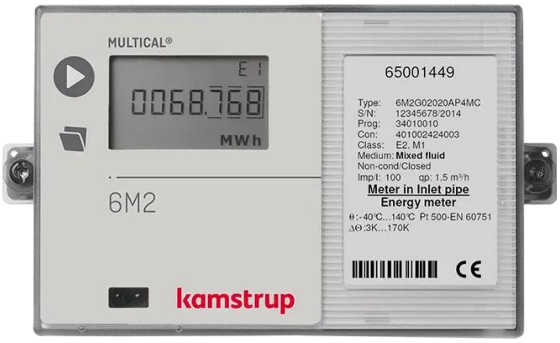

Figure 7: Example heat meter

2.1.2 Smart meters

A smart meter is an electronic meter measures real time energy consumption and can be set to capture multiple utilities (such as electricity and gas). Smart meters transmit data to suppliers for system monitoring and customer billing as well as to consumers for better understanding of use patterns. It displays energy usage in both kWh, pounds & pence, and in some instance carbon. This makes it easier to keep track of actual consumption, when peak loads are reached and the cost of fuel. Smart meters often report periodically at brief intervals throughout the day, often half hourly, and record energy in close to real-time.

Figure 8a: Example of a Smart meter

Figure 9b: Smart meter display monitor

Smart metering is suitable for sites that have either:

- Non-half-hourly electricity meters
- Manually read gas meters

2.1.3 Sub-meters

Sub meters are used to measure the energy consumption of a specific appliance or area in a property. This allows for tailored energy efficiency measures to be put in place to reduce the overall energy consumption of the property.

They measure energy use in one of two ways:

- Singular buildings on an estate
- Individual circuits
- Individual items of equipment

This may be useful if you have installed a particular equipment that can be optimised regularly, or for buildings with multiple areas of different usage and greater visibility is desired.

Figure 10: Example of sub metering on an incoming electrical line

Figure 11: Close up of sub meters on an incoming electrical line

2.1.4 Building energy management systems (BEMS)

The primary function of a BEMS system is to provide overarching control to building services equipment such as lighting, heating and ventilation. BEMS can however include sub-metering for the circuits or equipment it controls, enabling users to fine-tune requirements for the site specific conditions. Some BEMS software also includes the capability to interrogate data to identify efficiency savings and provide reactive services based on real-time usage of a building.

Figure 11: Example of BEMS

2.1.5 'Clamp on' meters

Electrical test equipment called 'clamp on' metres is used to measure current without connecting to a circuit in series. They are simple to operate, low cost, and can be used to measure live conductors without resulting in damage or power loss. In a nutshell, they are tools for convenient and secure current measurement. A 'Clamp on' meter is similar to a sub-meter but cheaper and can be moved to monitor specific things for short periods of time.

Figure 12: Example of a clamp-on meter

3 What is good energy data?

Collecting data has become a fundamental strategic element of organisations seeking to improve their decision making about energy use, site/building metering strategy, fuel bills and greenhouse gas emissions.

3.1 Aspects of good energy data

3.1.1 Accuracy

Accurate data is data that reflects reality. Data accuracy is important because inaccurate data can mislead decision making about courses of action to reduce energy consumption.

There are several ways to ensure accuracy in energy data:

- Use a calibrated meter.
- Use an online energy monitoring system.
- Compare your energy data to previous months.
- Use sub meters and compare to building incoming meters to check for signs of drift.
- Use your fuel bills to validate meter data, and vice versa.

3.1.2 Completeness

Data is considered complete when all the data required for a particular use is present and available to be used. It's not about ensuring 100% of data is present, it's about determining what data is critical and what is optional. For example, missing data makes it hard for benchmarks to be completed as well as understanding the patterns of energy use for that building. In ensuring data completeness the following must be put into consideration:

- Establishing clear and consistent data requirement
- Working with a trusted and experienced data provider
- Using data quality control and validation processes
- Monitoring data over time to look for any patterns or trends

3.1.3 Relevance

Data needs to be relevant to the period to gage an understanding and predict future. For example, data collected during the COVID lockdowns might not be a good comparator because buildings were not in use in comparison to the year before the pandemic.

Likewise, comparing the cost of your fuel bill from previous years to the cost now might not give you helpful results as the cost of fuel is volatile. Comparing unit consumption (kWh) will provide a more relevant insight, the cost of fuel can always be added later by finding the unit rate (pence per kWh) from a recent fuel bill.

3.1.4 Timeliness

Timeliness indicates whether the data is available when expected and needed. Where half-hourly metering is mandatory for all electricity customers with a maximum power demand (peak load) greater than 100 kW, half hourly data is timely dependent and always desired to show in depth and provide a thorough analysis of energy use which can help with providing internal training/ changes to reduce energy use.

4 Half hourly data

Tasked with hitting net zero targets, energy managers are turning to more granular energy data to find clues on how to cut emissions, and bills. However, the demand for data comes with its own risk: the hidden energy costs of data collection and administration.

Making the most of your energy insights begins with an often-overlooked initial step: understanding how your data is obtained. The development of smart meters is in line with the expanding number of consumers who are interested in connecting their energy data to their sustainability goals. Although different meters provide varying degrees of insight, half-hourly electricity supply is the industry gold standard where your meter remotely collects and reports information on your energy use every half-hour.

Half hourly data is data collected over a period of time at an interval of 30 minutes. It typically covers energy usage data, such as electricity and gas, that is collected from a variety of sources, such as residential, commercial, and industrial sites. The data covers a range of detail, from energy consumption to cost. Half hourly data is used to identify trends and seasonal fluctuations in energy usage to enable proper energy management and inform decision.

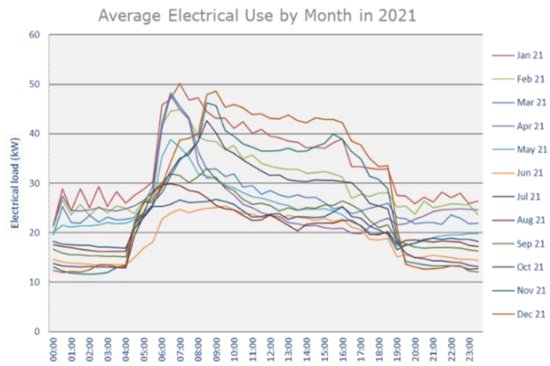

Figure 13: Example of half hourly data

The figure above analyses the average energy consumption of a business during the day (weekdays only) on a monthly basis. According to the graph, daily increase in electricity consumption occurs around the same time (04:00 – 07:00). Total electricity consumption during the hours 06:30 – 18:30 (Monday to Friday) only accounts for 24% of the total energy consumption. This means that 76% of the site's energy consumption takes place outside of operational hours (overnight and at weekends).

The analysis shows that all systems normally shut down about 18:30. As the building is typically not inhabited until 06:30 at the earliest, the half hourly data help in highlighting the need for extending operational hour to later time hence reduce energy use and making the facility more energy efficient.

The following approach are methods for using half hourly data to identify potential savings:

- The first step is to calculate your energy use over time. This can be done by hand, or by using software designed for tracking energy use.
- Once you have your energy use tracked, you can start to identify patterns. Are there certain times of day when you use more energy than others? Are there certain activities that are particularly energy-intensive?
- Once you have identified patterns in your energy use, you can start to look for ways to reduce your consumption. This might involve changing your habits or making changes to the way you use energy-consuming appliances.

5 Stakeholders of good energy data

Consumers: Consumers are the end-users of energy data. They may use the data to make decisions about when and how to utilise energy and conserve resources

Utility Companies: Utility companies use energy data to provide better services to their consumers and to identify areas where demand is high or low.

Governments: Governments use energy data for policymaking and to identify areas where renewable energy would be most beneficial or cost effective.

Data Storage Companies: Data storage companies are responsible for storing energy data securely and making it accessible to those who need it.

Data Analysts/Engineers: Data analysts and engineers are responsible for interrogating and processing good energy data. They use the data to create reports, models and insights which can help inform decisions.

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