



Department for  
Energy Security  
& Net Zero



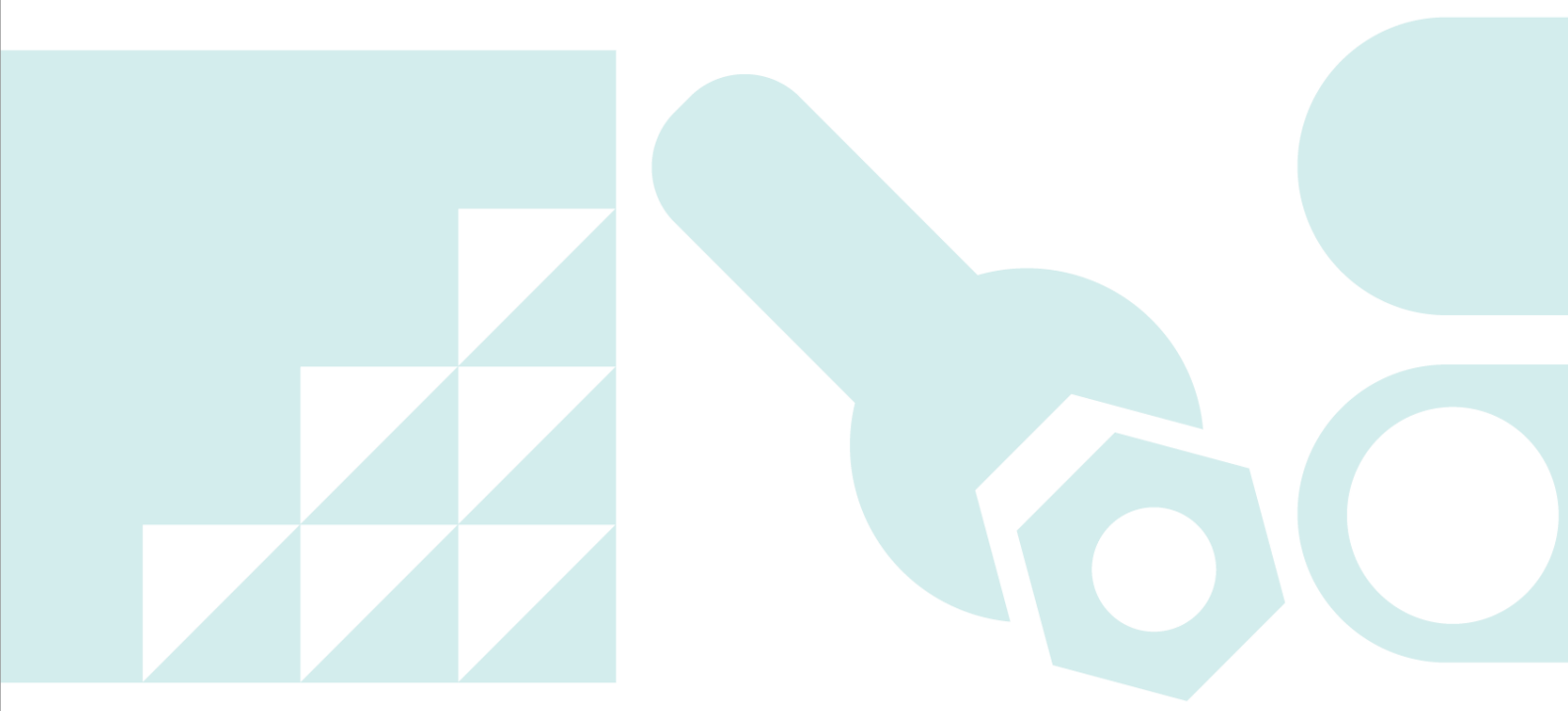
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**CATAPULT**  
Energy Systems

# Developing and delivering your strategy: Combined estimator user guide



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# 1. What is this document for?

This document provides a combined guide on how to use the suite of estimators developed under the Public Sector Decarbonisation Guidance: Business as usual estimator, Intervention estimator and High-level decarbonisation estimator. This guidance is supplemental to information and suggestions that are incorporated within the tools.

This guide is broken into five main sections:

- The first covers how to use the [High-level decarbonisation estimator](#)
- The second section covers how to use the [Business as usual estimator](#)
- The third covers how to use the [Decarbonisation intervention estimator](#)
- The fourth is the [methodology](#) behind the development of the tools
- Finally there is a section on [troubleshooting macros](#)

These estimators have been developed to provide you with flexibility when it comes to the level of detail or accuracy you require. Depending on whether you are at the start of your journey to consider decarbonisation projects for your site/building or you are looking to produce a more detailed roadmap, there is an estimator that will support you.

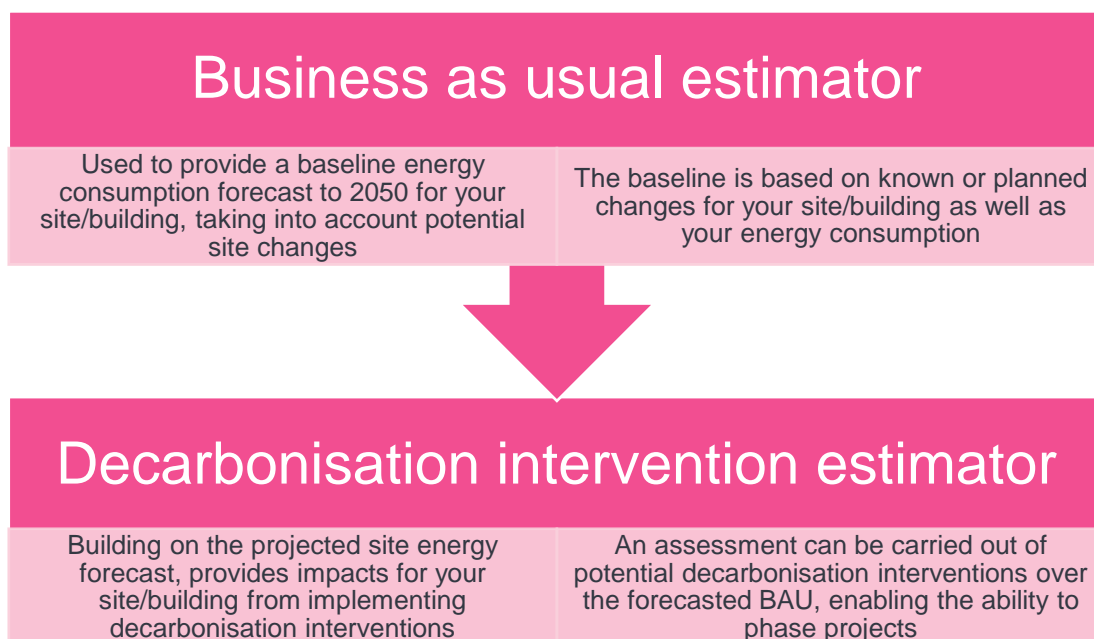
If you need to do a quick assessment of the potentials on your site/building based on a snapshot view of your energy use, then the High-level decarbonisation estimator can be used. This has been designed as a standalone estimator that minimises the amount of input required.

## High-level decarbonisation estimator

Provides a snapshot view of decarbonisation interventions possible on your site/building

For use where a simplistic optioneering view is suitable. Note this does not allow for future changes to the site or emissions and as such is less accurate

If however you are looking for a more in depth assessment of decarbonisation projects with the ability to input proposed changes to site and phasing of projects, you can use the Business as usual estimator and the linked Intervention estimator.



The outputs from these estimators are to be used as guidance and further feasibility work will be required in order to confirm the numbers provided here within.

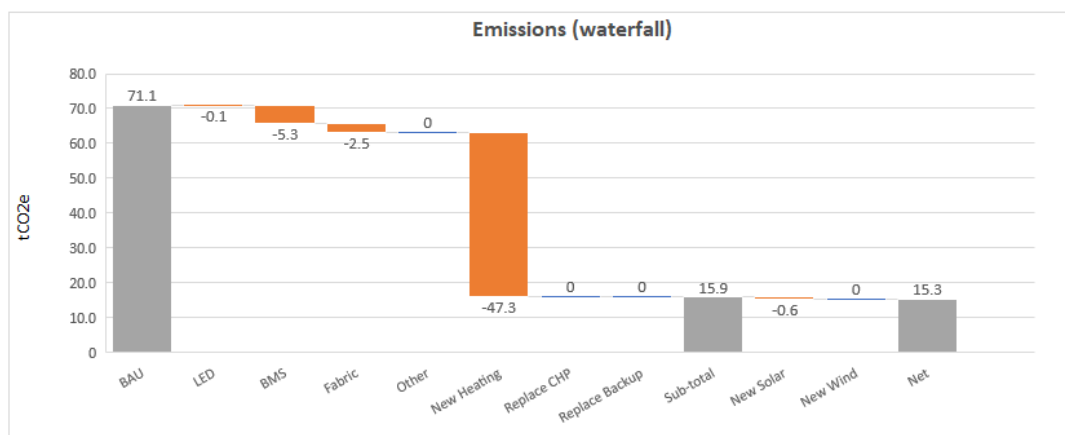
For more information, please email Energy Systems Catapult – [PSDecarbGuidance@es.catapult.org.uk](mailto:PSDecarbGuidance@es.catapult.org.uk).

## 2. What is the purpose of these estimators?

### 2.1 What is the purpose of a High-level decarbonisation interventions estimator?

As explained within the [Theme 1 guide Developing and delivering your strategy](#), the High-level decarbonisation estimator provides a snapshot of the application of a standard set of decarbonisation projects and their potential benefits at a building or site level. This will be based on a reference year of consumption which can be used as a first step in identifying potential solutions and how they could be combined to prepare a decarbonisation pathway given current consumption levels.

An example of the output from the tool is provided below.



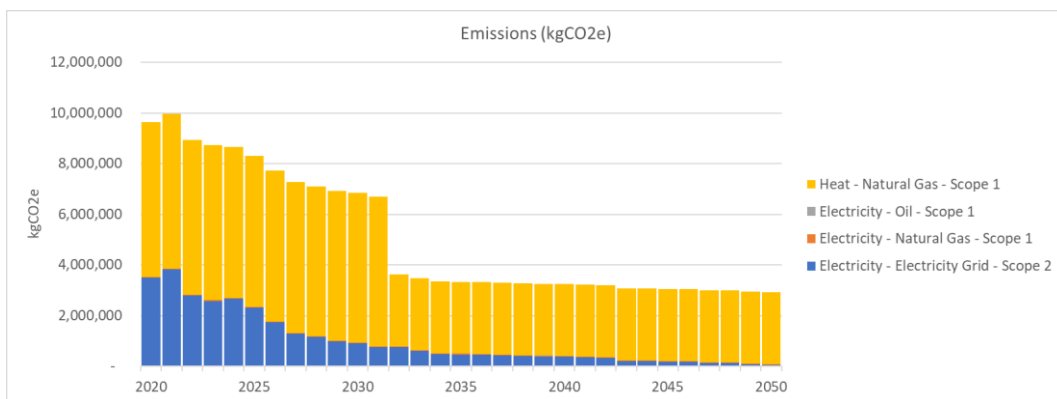
The tool does not provide a future forecast, for which the Decarbonisation intervention estimator should be used in conjunction with the BAU estimator, but as the first step in understanding how potential interventions could be deployed to enable a site to be decarbonised. The tool will however provide estimations on emissions impacts, costs (both up front capital costs and ongoing energy related costs) and consumption of energy resultant from the selection of a range of typical interventions used to decarbonise power and heat across a portfolio of sites.

Further refinement including timing of projects can then be made using the accompanying suite of tools, or taken through to detail design in preparation for implementation.

## 2.2 What is the purpose of a "Business as usual" estimator?

As explained within the [Theme 1 guide Strategic definition, planning and briefing](#), a “business as usual” (BAU) estimator allows input of building, site or portfolio level energy consumption data. It will provide a baseline of energy use over time from which decarbonisation interventions can be assessed. It allows for known future changes to the site to be captured and incorporated into the future assessments. For emissions it is useful to be able to understand what the future will look like as the grid decarbonises and what emissions need to be removed from your portfolio. It also provides a good opportunity to understand and predict energy cost expenditure.

An example of what this could look like is shown below.



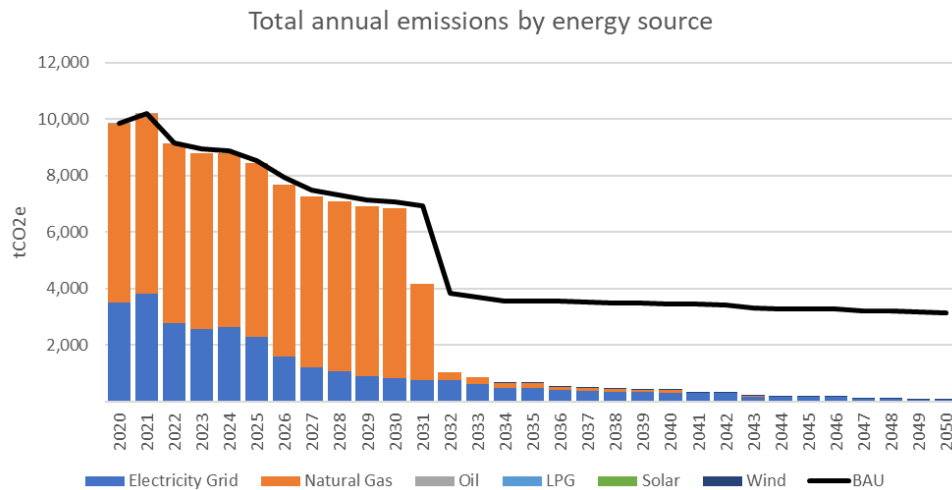
Based on this knowledge, activities which can manage cost and reduce carbon emissions can be planned.

## 2.3 What is the purpose of a Decarbonisation interventions estimator?

As explained within the [Theme 1 guide Developing and delivering your strategy](#), the decarbonisation intervention estimator provides a range of key decarbonisation options, including heat, renewables and energy efficiency, which can be applied to a building/site/portfolio. This allows for quick assessment of potential benefits of implementing these interventions. This is aimed at organisations that are at the start of their decarbonisation journey and are looking to understand the potential benefits and costs of undertaking projects on their site, building or portfolio.

This estimator uses the base or reference year of consumption calculated from the Business as usual (BAU) estimator.

An example of how total emissions from the indicated energy sources could be reduced following various interventions is shown below (where the BAU is shown in black).

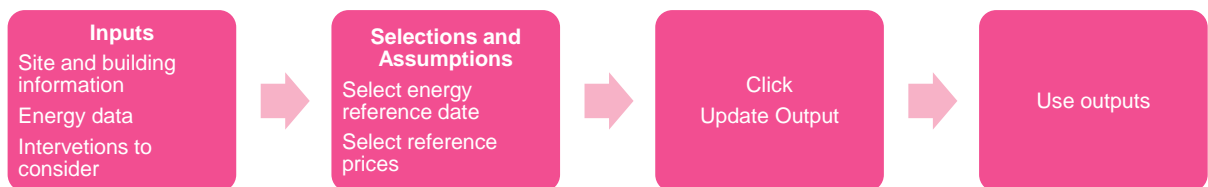




### 3. How to use the High-level decarbonisation intervention estimator

The tool is used in four simple steps as shown below:

- Add in the data to the “Input” tab;
- Choose selections on the “Selections” sheet as required;
- Amend entries in the “Assumptions” tab if relevant;
- Click on the “Update Output” button (note macros will need to be enabled to allow this to work), if you don’t click on this button the outputs will not update; and
- Seek out the results you want on the “Output” sheets.



Before testing this out, read through of all the worksheets to familiarise yourself with the expected content.

#### 3.1 Step 1: Inputs worksheet completion

##### 3.1.1 Inputting site and building information

The tool requires similar information as the BAU estimator, detailing energy use across sites and buildings in a portfolio.

On the input worksheet, add in the sites and buildings that you have in your portfolio. Portfolios can vary so you can add in sites where you have multiple buildings spread over a geographical area or perhaps buildings which are all on one site with separate fiscal meters. It is possible to break up a larger building which has distinct areas with differing characteristics by entering these into separate rows. The tool allows for sites with district heat networks to be input. To this end, it is designed to be flexible and enable you to be able to adapt it to suit your needs.

Note, in situations where there is a single building site, the user should enter the

site name and building name as the same in the relevant fields.

Submetering at a site, often contained within a building management system (BMS), is useful in this tool to allow disaggregation. This can be helpful when considering various interventions at a building level.

When entering a site / building, add in the requested information relating to it. Where multiple buildings are listed for a site, the gross internal area (GIA) for each should be provided separately, adding to the total. This is shown in the example below where Bighill has three buildings shown for one site. This field is required so if not known, please provide an estimate.

Where a building is connected to a heat network, this should also be marked in the relevant column. This will indicate what data is required for the next steps. Please note if a district heat network is in use (where heat is provided from a single boiler or combined heat and power unit (CHP) to multiple buildings), include an energy centre on a separate row and set the Use Category to Energy Centre. This does not need to have a GIA entered as it will not be used in the same way as other categories.

Providing the use category for all other building is also needed to estimate energy demand.

#### Energy Consumption

Site	Building Name	Ref Code (if used / known)	Use Category (select from drop down list)	Gross Internal Area (m <sup>2</sup> )	Part of heat network? (Y / N)
Bighill Health Centre	BigHill Health Centre	BH1	Hospital Clinic	8,300	Y
Bighill Health Centre	Residences	BH2	Hospital Accommodation	600	Y
Bighill Health Centre	Main Energy Centre	BH3	Energy Centre	-	Y
Hunter Valley Health Centre	Hunter Valley Health Centre		Health centres	8,200	N
BigLock Hospital	BigLock Hospital		Hospital Clinic	500	N
Mothers Health Centre	Mothers Health Centre		Health centres	1,400	N
Beach Clinic / Health Centre	Laboratory		Hospital Clinic	300	N

The table below provides an explanation of the terminology and the units used. Required fields are noted in bold.

Measure	Description	Units
Site	Location with one or more connection points to the electricity grid and gas network. Each connection	Text

	point also contains a meter (or meters) to record consumption.	
Building Name	Building located at a site. These are typically supplied from a central connection point / energy centre and may have submeters attached to record individual building energy use.	Text
Ref Code	If a special reference code is used across sites for each building, this can be entered and used when displaying information.	Text
Use Category	This refers to the dominant use category for the site / building indicated above. If there are multiple use cases within a building that are to be assessed individually, this should be entered as separate line items and the areas adjusted / scaled accordingly.	Text (select from drop down list)
Gross Internal Area (GIA)	The total area of the site / building. This can be used to create energy or carbon metrics as well as to estimate costs and energy savings at a later stage.	m <sup>2</sup>
Heat Network	If the site building is part of heat network – please indicate here. Note that a separate line item for an Energy Centre is requested and energy consumption for this will be required.	Y/ N

### 3.1.2 Inputting electricity and heat fuel consumption

After adding the sites and buildings with their GIA and relevant descriptions, enter the energy consumption for each fuel type that is applicable on an annual basis.

This needs to all be against the same time period, typically 12 months, to capture seasonal usage variations. It can be based on a representative year, or an average across multiple years. Targets in the carbon budget are often set against a baseline of 17/18 so that might be a good year, or a later dataset which is more complete. However, given the impact of COVID in usage patterns, 20/21 may not be representative. Typically, a 3-year average gives a good representation if you haven't got one full year of data. More guidance is provided in [Understanding your](#)

[energy data](#), but the most likely sources include supplier data.

The year selected for the datasets can be added into the Selections worksheet as this will set the baseline for forecasting consumption, costs and carbon emissions.

Note, where no consumption is present or the fuel is not applicable, the field should be left blank.

Measure	Source / Fuel	Description	Units
Imports	Electricity consumption	The total annual electricity consumption (metered electricity energy <u>imported</u> to a site / building). Any exports should not be included or netted off from the annual total if possible.	kWh
Renewables	Solar Wind	The total annual electrical renewable energy production used on site from an on-site asset (if possible this should exclude any exported energy).  Note that if roof mounted, this should be applied at the building level. However if the source is separate to a building, this should be entered on a separate line and identified as Energy Centre in the use category.	kWh
Backup generation	Natural gas Oil	The total annual metered fuel consumption for backup generation. This can be calculated using the volume of fuel and appropriate conversion factor. Whilst it is unlikely that back-up is used, it is useful to record as a minimum the average fuel consumption used for testing in a given year.  Electrical output will be calculated taking into account an assumed system efficiency.	kWh
CHP	Natural gas	The total annual fuel consumption for a CHP unit, calculated using the volume of fuel and	kWh

	Oil	appropriate conversion factor.  Electrical and heat output will be calculated taking into account an assumed system efficiency.	
Heating	Heat Network	Used to record building level heat consumption if known / sub-metered for sites which have a heat network present. Cells will be greyed out if Heat Network is not selected and therefore data should not be entered.	kWh
	Natural gas Biomass LPG Oil	The total annual fuel consumption used for heating at a site (metered at a site / building level), calculated using the volume of fuel and appropriate conversion factors if applicable. Cells will be greyed out if Heat Network is selected and therefore data should not be entered unless the Energy Centre use category is selected.  Note that electrical heating does not need to be entered as this will have already been included in the electricity demand for the site and will decarbonise as grid emissions reduce over time.	kWh

The following example shows, for a range of different buildings, the metered energy consumption entered into the model. It outlines examples of how electricity imported from the grid, on site solar production and a breakdown of natural gas and oil consumption for CHP and heat consumption have been entered into the model.

Note that in the instances where a heat network is present on site, the fuel consumption for the heat generation plant is entered on the Energy Centre row under the specific fuel (gas, biomass, LPG or oil), as this is where consumption is likely to be metered. If submetering at a building level is present, this can be entered under the Heat Network column. The cells will be greyed out to help with

identifying where data should be entered.

There may be some minor discrepancy between the input data and the output sheet due to the default efficiencies that are used within the tool. This may be more apparent where heat at the building level on a district heat network is metered as the calculation is based on fuel consumption for the heat generation plant and therefore assumes a network efficiency.

## 3.2 Inputting intervention information

Three types of interventions have been predefined and set up in the tool. These are grouped into the following:

- Energy efficiency interventions
  - LED lighting
  - Building management system (BMS)
  - Building Fabric
  - Retirement of existing CHP system
  - Retirement of existing backup and onsite generation
- Heat interventions
  - New heating system
  - New renewable Generation
  - Installation of solar generation
  - Installation of wind generation

Details on what information to include for the tool follows.

### 3.2.1 Energy efficiency and retiring generation (columns W to AT)

For energy efficiency and retiring generation measures, provide details on how much of the site the efficiency measure is to apply to, which will impact saving and costs. For sites which have not been updated, this should be set to 100%.

Each of the efficiency interventions are treated separately and then combined to provide an overall efficiency gain for an estimated cost.

Field	Description	Units
% of site	Where an intervention is already partially installed on site, % of site allows for the intervention to be scaled and only	%

	to apply to the percentage indicated.  If left blank (or set to 100%, it is assumed the intervention will apply to the whole).	
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### 3.2.2 New Heating (columns AZ)

This intervention will swap out the existing heating systems for a new electric heat system. Select the best system for your site.

For heat networks, a type of system is only required for the energy centre (it is assumed the existing distribution network will be adequate for the new arrangement).

Field	Description	Units
New Heating system	<p>A selection of alternative heating systems is provided in the tool.</p> <p>ASHP – Air source heat pump, typically used to replace a fuel boiler system. ASHP are more suited to smaller loads or where there is not enough space for a GSHP.</p> <p>GSHP – Ground source heat pump, used where suitable space is available for a bore hole (or heat exchange coils) and where loads are larger. GSHP are more costly to install but have higher efficiencies than ASHP.</p> <p>Radiant Heaters (electric) – can be used to replace like for like radiant units, typically in large open spaces such as warehouses. Radiant heater will have a much lower efficiency than heat pumps and thus consume more electricity, but are low cost to install where similar existing systems are in place.</p> <p>Direct electric – replacement of current heating with wall panel heaters. As with radiant, these can be cheap to install but do not benefit from the higher efficiency.</p> <p>Biomass – whilst not electrification, it can be considered decarbonisation with residual emission from the burning of</p>	Drop down list

	fuel on site. They are easier to integrate with existing wet heating systems, particularly where a higher heat is required.	
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### 3.2.3 On site renewable generation (columns BZ and CP)

On site renewable generation can help reduce near term emissions. As the grid decarbonises, this impact will reduce in line with Green Book values.

On site renewables can, however, provide cost benefits in addition to any emissions benefit. These are maximised where self-consumption occurs and exports back to the grid are minimised. If a solar or wind system is indicated, an indicative system size will be calculated and used, based on minimising exports. This is calculated using annual energy and the building use and should only be used as a first estimate.

It is also assumed that only wind turbines would be used at a site, typically connected to the energy centre or largest building.

Intervention	Description	Units
Solar	<p>Installing solar PV can help reduce electricity imports from the grid. This may lead to cost savings and emission reductions (although these will decrease over time as grid supplied electricity is increasingly sourced from non-carbon sources).</p> <p>A selection of systems can be selected based on the suitability:</p> <p>PV – ground</p> <p>PV – roof</p> <p>PV – carport</p> <p>Large ground mounted systems offer the best value for money but are likely to be dependent on the site.</p>	Selection of drop down
Wind	Like solar, installing wind can help reduce electricity imports from the grid.	Selection of drop down



	<p>Larger systems provide better value but are only suitable where sites have higher demand and have substantial space for exclusion zones around a turbine. Wind generation is also better suited to a campus site (where there might be an energy centre) rather than individual building.</p> <p>Wind turbines, however, require far more area and are not suited to urban environments or where there is no available land. Planning consideration are a major factor in where wind generation can be used.</p> <p>Unlike solar however, wind operates at night and typically performs better over winter than summer.</p>	
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### 3.3 Step 3: Update the model forecast

On the “Selections” tab users are able to set the reference date for calculations, and run the macro to update calculations and outputs.

#### 3.3.1 Reference date

A reference date is needed to estimate energy costs and emissions (including that from the national grid in electricity imports). These are taken from the Green Book Output Reference Year are used to provide a guide on cost savings / increases and the expected payback from each intervention.

#### 3.3.2 Energy costs

The tool uses UK Green Book values (version from 17 January 2023<sup>1</sup>) for emissions and the expected cost for various fuels. For Electricity (imported from the grid), Natural Gas and Oil there is a range of potential values to choose from. The costs are provided in a series of ranges, from low to high with the exception of Natural Gas. In this instance, Natural Gas has been provided in a series of four (A, B, C and D) and this is due to the increase in uncertainty regarding fuel price. Therefore there is no central assumption. It is suggested that you should use a range as the midpoint in any analysis, therefore using option B and C.

#### 3.3.3 Update of outputs macro

The next important step on the “Selections” tab is the Update Output button which enables a macro to run and allow updates to be made on the outputs tabs. Note,

macros must be enabled in Excel for these to run. If this macro is not activated then the output data will not be automatically updated.

#### Prepare / update outputs

Update Output

### 3.4 Step 4: Review Outputs

There two output tabs:

- **Output – Summary** – A financial summary, providing an aggregate view of the impact of all interventions across the entire portfolio and key indicators.
- **Output – Intervention** – A table of interventions indicating costs (CapEx, OpEx / energy costs), simple metrics (such as simple payback and abatement cost) and emission savings.

#### 3.4.1 Controls and common definitions

The output page is constructed similar to the BAU output page but allows users to review the impact and timing of interventions.

Interactive summary charts allow easy viewing, with tables for your use. You can copy and paste the information as you like from the tables below the graphs.

The image below shows the interaction options available to focus on different sites, different buildings and different uses to enable you to see the predictions you want to depending on the input cases.

#### Output - Analysis

The screenshot shows the 'Output - Analysis' interface with two filter panels. The 'Site' panel on the left contains buttons for 'Beach Clinic / Health Ce...', 'BigLock Hospital' (selected), 'Hunter Valley Health Ce...', 'Mothers Health Centre', 'University Hospital BigCity', 'University Hospital County', 'University Town Hospital', and '(blank)'. The 'Building' panel on the right contains a grid of buttons including 'BigHill Health Centre', 'BigLock Hospital' (selected), 'Corporate Block', 'Energy Centre', 'Health Centre (new)', 'Health Centre (old)', 'Hunter Valley Health...', 'Kitchen', 'Laboratories', 'Laboratory', 'Main Building', 'Main Centre (New)', 'Main Centre (Old)', 'Main Energy Centre', 'Medium Health Cent...', 'Mothers Health Centre', 'National Treatment ...', 'Nursery', 'Old Clinic', 'Old Hospital', 'Residences', 'Residential Accomod...', 'Residential Accomod...', 'Residential Accomod...', 'Stores', 'Town Health Centre ...', 'Ward 15 & Ward 16', 'Ward 17 & Ward 18', and '(blank)'.

Selections can also be made on fuel type and energy source as per the input cases.

The graphs and tables provide information covering the following:

Measure	Description	Units
Type	Type of energy supplied at a site, such as electricity, natural gas, etc.	
Demand	Demand is the energy need for a site / building. It represents the useful energy provided by a particular fuel and system after energy conversion from a source fuel. The sum of demand from all sources equals the total demand at a site.	kWh
Consumption	Consumption is the amount of a given fuel needed to meet demand. This is equal to the metered energy provided to a site and may differ from demand based on the conversion efficiency of the system.	kWh
Source / fuel	Indicates the source / fuel used.	Text (list)
Emissions	GHG emissions:  Scope 1: emissions produced on site (e.g. on site power and heat generation).  Scope 2: imported from off-site (e.g. the embedded carbon resultant from producing grid supplied electricity).	kgCO <sub>2</sub> e
Costs	Operational fuel costs based on the source / fuel used and consumption levels. Future costs are based on a price curve forecasted in the Green Book.	£k

If you want to update some of the data you can go back and do that at a later date following the previous steps. However, you must remember click on the “Update Output” button on the Selections tab before reviewing the updated outputs.

### 3.4.2 Output summary - example

The output summary page provides an overview of the combined financial impact

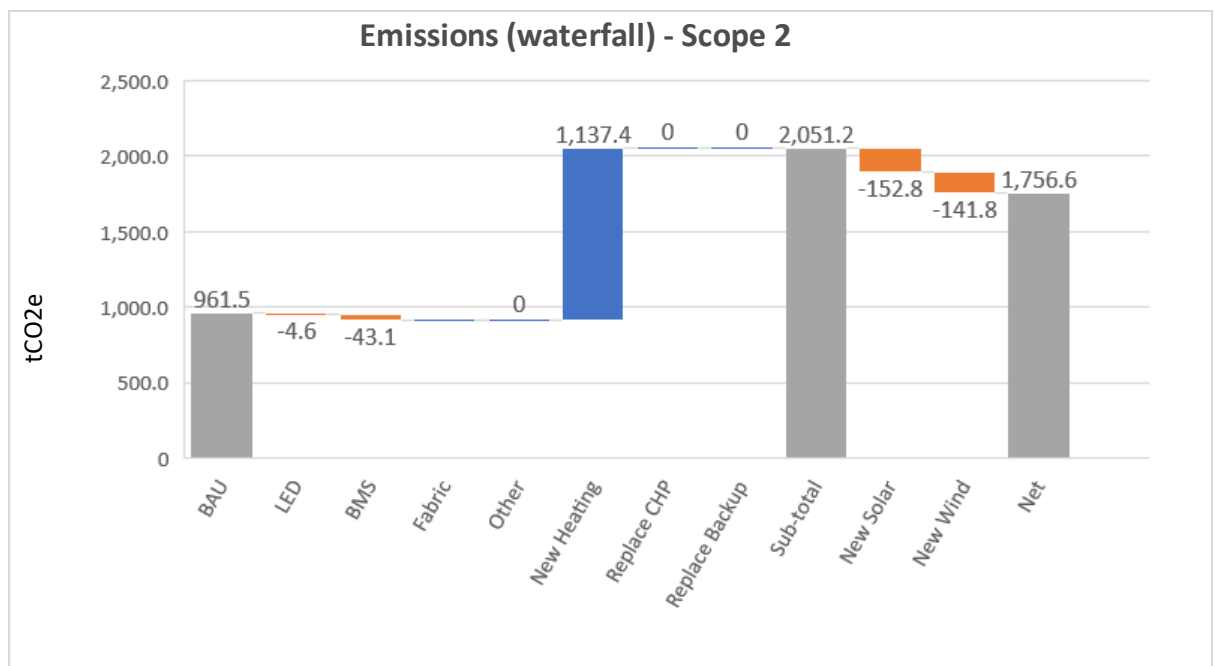
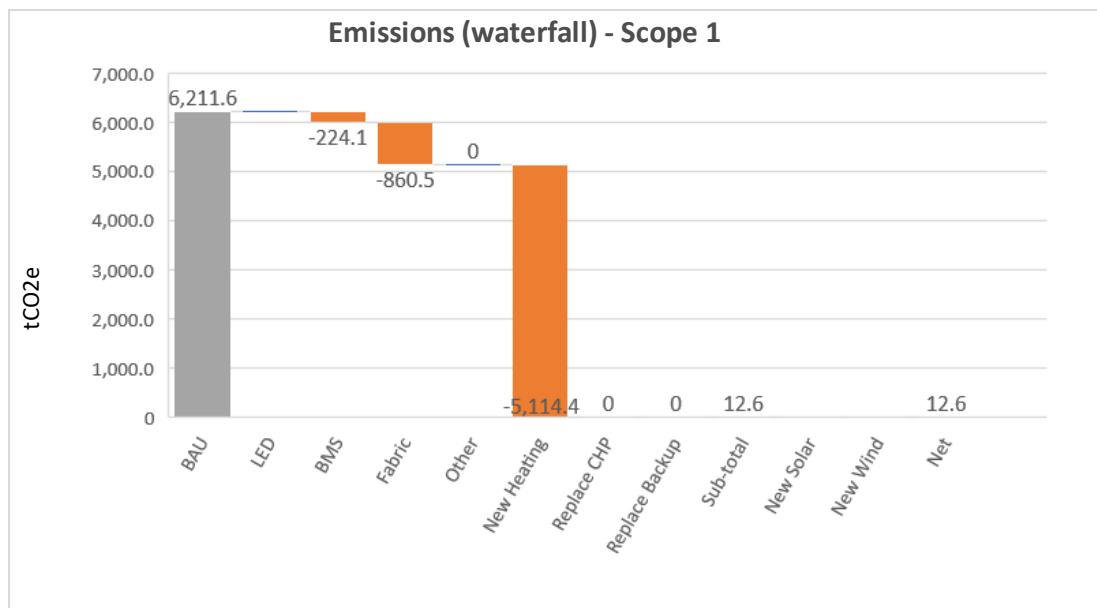
of all of the interventions based on estimated costs. This takes into account CapEx and OpEx requirements based on standard benchmarks, as well as energy cost impacts using expected values based on the Green Book for the year selected.

by Intervention		Emissions (waterfall)	
Measure	Emissions	tCO2e	(select scope)
	<b>BAU</b>	7,173.1	
	LED	-4.6	(0.1%)
	BMS	-267.2	(3.7%)
	Fabric	-860.5	(12.0%)
	Other	-	
	New Heating	-3,977.1	(55.4%)
	Replace CHP	-	
	Replace Backup	-	
	<b>Sub-total</b>	2,063.8	(71.2%)
Imports	New Solar	-152.8	(2.1%)
	New Wind	-141.8	(2.0%)
	<b>Net</b>	<b>1,769.3</b>	<b>(75.3%)</b>

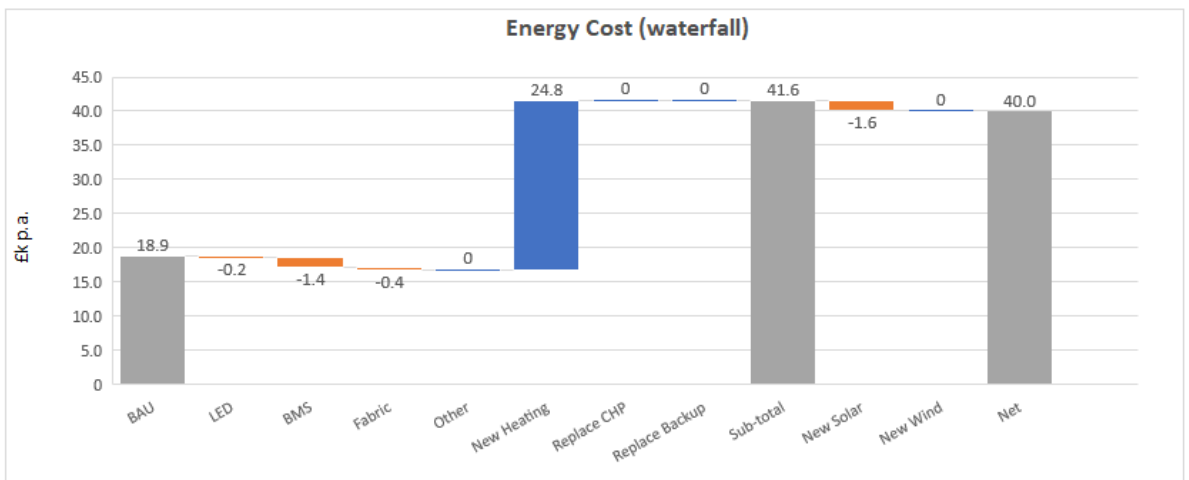
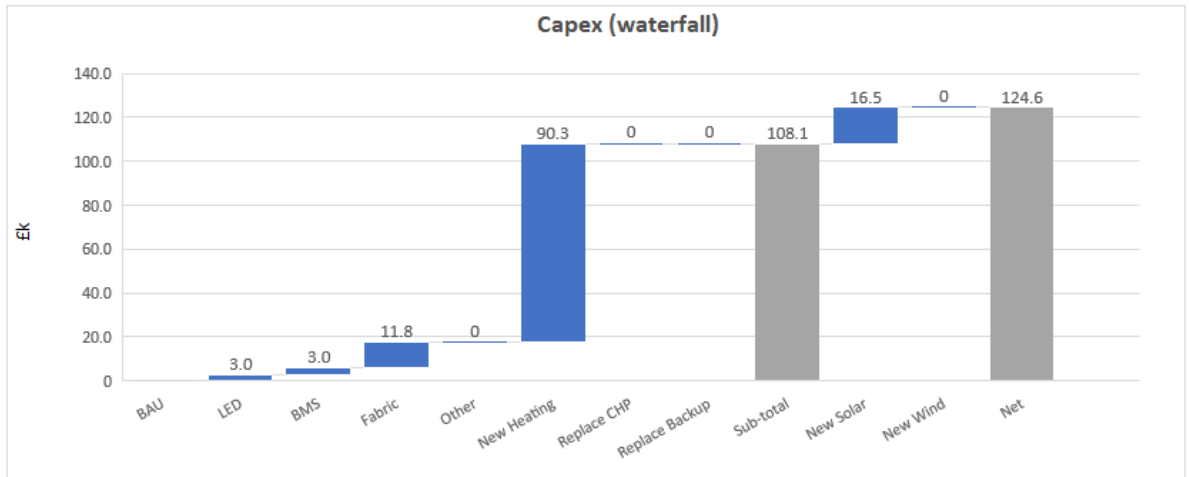
The impact of various interventions are summarised in the table about and corresponding water fall chart. These can be toggled to view Emissions, Energy Cost, Capital Costs (CapEx) and Energy Consumption and demand.

If emissions is selected, it is possible to view scope 1 or scope 2 emissions separately (or both by leaving blank).

- Scope 1 emissions should be reduced to close to zero if heating and any generation is retired
- Scope 2 emissions result from imports related to the national grid. While these can be reduced using solar and wind, they are typically increased when electrical heating solutions are deployed. By 2050, most scope 2 emissions from the grid will be eliminated (based on the latest Green Book figures).



Costs can also be viewed by selecting CapEx and energy costs:



### 3.4.3 Output interventions - example

The output interventions page provides a tabular overview of each intervention, allowing users to filter and compare across sites and types of interventions and site / building.

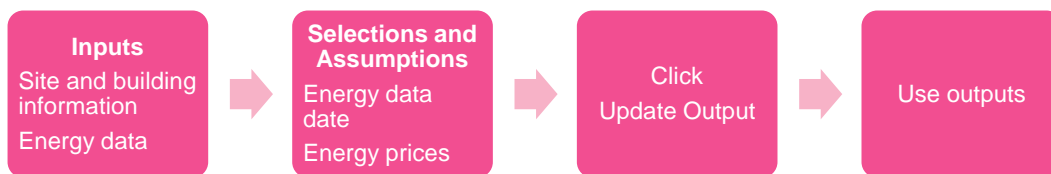
#### Interventions

			Subtotal		416,446	(455,491)	(20,938)	19.9	0.5	(84,196)	(135,055)	-16.5%
Site	Building Name	Intervention	Capex	p.a.	p.a.	Payback	up to 2040	p.a.			in 2040	in 2040
				Energy change (consumption)	Opex (including energy costs)			Emissions	Emissions	Emissions		
	IT		£	kWh p.a.	£ p.a.	Years	£/kgCO <sub>2</sub> e	kgCO <sub>2</sub> e	kgCO <sub>2</sub> e	%		
Mothers Health Centre	Mothers Health Centre	Fabric	65,800	(75,617)	(2,549)	25.8	(0.1)	(13,803)	(13,802)		18.3%	
Mothers Health Centre	Mothers Health Centre	New Wind	41,455	(52,869)	(5,638)	7.4	2.9	(1,343)	(832)		1.1%	
Mothers Health Centre	Mothers Health Centre	New Heating	34,875	(3,154)	4,800	no payback	(0.2)	(27,155)	(54,297)		72.0%	
Mothers Health Centre	Mothers Health Centre	New Solar	31,119	(35,686)	(3,711)	8.4	2.7	(907)	(562)		0.7%	
Mothers Health Centre	Mothers Health Centre	BMS	8,400	(21,681)	(1,229)	6.8	0.4	(2,957)	(5,901)		7.8%	
Mothers Health Centre	Mothers Health Centre	LED	8,400	(4,200)	(632)	13.3	3.3	(64)	(66)		0.1%	
University Hospital BigCity	Residential Accomodation Block B	Fabric	42,300	(48,596)	(1,614)	26.2	(0.0)	(8,871)	(8,873)		14.9%	
University Hospital BigCity	Residential Accomodation Block B	New Heating	39,515	(46,477)	1,077	no payback	(0.2)	(12,426)	(24,711)		41.5%	
University Hospital BigCity	Residential Accomodation Block B	New Wind	27,288	(34,801)	(3,718)	7.3	4.1	(584)	(548)		0.9%	
University Hospital BigCity	Residential Accomodation Block A	Fabric	23,500	(26,998)	(896)	26.2	(0.0)	(4,928)	(4,929)		8.3%	
University Hospital BigCity	Residential Accomodation Block A	New Heating	22,580	(28,378)	641	no payback	(0.1)	(7,573)	(15,090)		25.3%	
University Hospital BigCity	Residential Accomodation Block B	New Solar	20,484	(19,576)	(1,933)	10.6	2.2	(497)	(308)		0.5%	
University Hospital BigCity	Residential Accomodation Block A	New Wind	16,297	(20,784)	(2,218)	7.3	3.8	(382)	(327)		0.5%	
University Hospital BigCity	Residential Accomodation Block A	New Solar	12,234	(11,691)	(1,155)	10.6	2.2	(297)	(184)		0.3%	
University Hospital BigCity	Residential Accomodation Block B	LED	10,800	(5,400)	(811)	13.3	3.2	(99)	(85)		0.1%	
University Hospital BigCity	Residential Accomodation Block B	BMS	5,400	(11,234)	(697)	7.7	0.4	(1,414)	(2,808)		4.7%	
University Hospital BigCity	Residential Accomodation Block A	BMS	3,000	(6,851)	(429)	7.0	0.4	(865)	(1,708)		2.9%	
University Hospital BigCity	Residential Accomodation Block A	LED	3,000	(1,500)	(225)	13.3	3.1	(30)	(24)		0.0%	

## 4. How to use the “Business as usual” estimator

The tool is used in four simple steps as shown below:

1. Add in the data to the “Input” tab;
2. Choose selections on the “Selections” sheet as required;
3. Amend entries in the “Assumptions” tab if relevant
4. Click on the “Update Output” button (note macros will need to be enabled to allow this to work), if you don’t click on this button the outputs will not update;
5. If continuing to use the Decarbonisation intervention estimator, you will need to click on the Export Data button
6. Seek out the results you want on the “Output” sheet.



Before testing this out, read through of all the worksheets to familiarise yourself with the expected content.

### 4.1 Step 1: Inputs worksheet completion

#### 4.1.1 Inputting site and building information

On the input worksheet add in the sites and buildings that you have in your portfolio. We realise that portfolios vary so it has the ability to enable you to add in sites where you have multiple buildings spread over a geographical area or perhaps buildings which are all on one site with separate fiscal meters. It is possible to break up a larger building which has distinct areas with differing characteristics by entering these into separate rows. The tool allows for sites with district heat networks to be input. To this end, it is designed to be flexible and enable you to be able to adapt it to suit your needs.

Note, in situations where there is a single building site, the user should enter the site name and building name as the same in the relevant fields.

Submetering at a site, often contained within a building management system (BMS),

is useful in this tool to allow disaggregation. This can be helpful when considering various interventions at a building level.

When entering a site / building, add in the requested information relating to it. Where multiple buildings are listed for a site, the gross internal area (GIA) for each should be provided separately, adding to the total. This is shown in the example below where Bighill has three buildings shown for one site.

Where a building is connected to a heat network, this should also be marked in the relevant column. This will indicate what data is required for the next steps. Please note if a district heat network is selected where there are multiple buildings connected to an energy centre, this must be entered in a separate row and the Use Category must be chosen as Energy Centre. This does not need to have a GIA entered as it will not be used in the same way as other categories.

#### Energy Consumption

Site	Building Name	Ref Code (if used / known)	Use Category (select from drop down list)	Gross Internal Area (m <sup>2</sup> )	Part of heat network? (Y / N)
Bighill Health Centre	BigHill Health Centre	BH1	Hospital Clinic	8,300	Y
Bighill Health Centre	Residences	BH2	Hospital Accommodation	600	Y
Bighill Health Centre	Main Energy Centre	BH3	Energy Centre	-	Y
Hunter Valley Health Centre	Hunter Valley Health Centre		Health centres	8,200	N
BigLock Hospital	BigLock Hospital		Hospital Clinic	500	N
Mothers Health Centre	Mothers Health Centre		Health centres	1,400	N
Beach Clinic / Health Centre	Laboratory		Hospital Clinic	300	N

The table below provides an explanation of the terminology and the units used.

Measure	Description	Units
Site	Location with one or more connection points to the electricity grid and gas network. Each connection point also contains a meter (or meters) to record consumption.	Text
Building Name	Building located at a site. These are typically supplied from a central connection point / energy centre and may have submeters attached to record individual building energy use.	Text
Ref Code	If a special reference code is used across sites for each building, this can be entered and used when displaying information.	Text



Use Category	This refers to the dominant use category for the site / building indicated above. If there are multiple use cases within a building that are to be assessed individually, this should be entered as separate line items and the areas adjusted / scaled accordingly.	Text (select from drop down list)
Gross Internal Area (GIA)	The total area of the site / building. This can be used to create energy or carbon metrics as well as to estimate costs and energy savings at a later stage.	m <sup>2</sup>
Heat Network	If the site building is part of heat network – please indicate here. Note that a separate line item for an Energy Centre is requested and energy consumption for this will be required.	Y/ N

#### 4.1.2 Inputting electricity and heat fuel consumption

After adding the sites and buildings with their GIA and relevant descriptions, enter the energy consumption for each fuel type that is applicable on an annual basis.

This needs to all be against the same time period, typically 12 months, to capture seasonal usage variations. It can be based on a representative year, or an average across multiple years. Targets in the carbon budget are often set against a baseline of 17/18 so that might be a good year, or a later dataset which is more complete. However, given the impact of COVID in usage patterns, perhaps 20/21 may not be representative. Typically, a 3-year average gives a good representation if you haven't got one full year of data.

Guidance is given in the [Theme 1 guide](#) and [Understanding your energy data](#) on where to seek out this information. But the most likely sources include supplier data. The year selected for the datasets can be added into the Selections worksheet as this will set the baseline for forecasting consumption, costs and carbon emissions.

Note, where no consumption is present or the fuel is not applicable, the field should be left blank.

Measure	Source / Fuel	Description	Units
Imports	Electricity consumption	The total annual electricity consumption (metered electricity energy <u>imported</u> to a site / building). Any exports should not be included or netted off from the annual total if possible.	kWh
Renewables	Solar Wind	The total annual electrical renewable energy production used on site from an on-site asset (if possible, this should exclude any exported energy).  Note that if roof mounted, this should be applied at the building level. However, if the source is separate to a building, this should be entered on a separate line and identified as Energy Centre in the use category.	kWh
Backup generation	Natural gas Oil	The total annual metered fuel consumption for backup generation. This can be calculated using the volume of fuel and appropriate conversion factor. Whilst it is unlikely that back-up is used, it is useful to record as a minimum the average fuel consumption used for testing in a given year.  Electrical output will be calculated taking into account an assumed system efficiency.	kWh
CHP	Natural gas Oil	The total annual fuel consumption for a CHP unit, calculated using the volume of fuel and appropriate conversion factor.  Electrical and heat output will be calculated taking into account an	kWh

		assumed system efficiency.	
Heating	Heat Network	Used to record building level heat consumption if known / sub-metered for sites which have a heat network present. Cell will be greyed out if Heat Network is not selected and therefore data should not be entered	kWh
	Natural gas Biomass LPG Oil	The total annual fuel consumption used for heating at a site (metered at a site / building level), calculated using the volume of fuel and appropriate conversion factors if applicable. Cell will be greyed out if Heat Network is selected and therefore data should not be entered unless the Energy Centre use category is selected.  NOTE: Electrical heating does not need to be entered as this will have already been included in the electricity demand for the site and will decarbonise as grid emissions reduce over time.	kWh

The following example shows, for a range of different buildings, the metered energy consumption entered into the model. It outlines examples of how electricity imported from the grid, on site solar production and a breakdown of natural gas and oil consumption for CHP and heat consumption have been entered into the model.

Note that in the instances where a heat network is present on site, the fuel consumption for the heat generation plant is entered on the Energy Centre row under the specific fuel (gas, biomass, LPG or oil), as this is where consumption is likely to be metered. If submetering at a building level is present, this can be entered under the Heat Network column. The cells will be greyed out to help with identifying where data should be entered.

There may be some minor discrepancy between the input data and the output

sheet due to the default efficiencies that are using within the tool. This may be more apparent where heat at the building level on a district heat network is metered as the calculation is based on fuel consumption for the heat generation plant and therefore assumes a network efficiency

Site	Building Name	Ref Code (if used / known)	Use Category (select closest match from drop down list)	Gross Internal Area (m <sup>2</sup> )	Part of heat network? (Y / N)
Bighill Health Centre	Bighill Health Centre	BH1	Hospital Clinic	8,300	Y
Bighill Health Centre	Residences	BH2	Hospital Accommodation	600	Y
Bighill Health Centre	Main Energy Centre	BH3	Energy Centre	-	Y
Hunter Valley Health Centre	Hunter Valley Health Centre		Health centres	8,200	N
BigLock Hospital	BigLock Hospital		Hospital Clinic	500	N
Mothers Health Centre	Mothers Health Centre		Health centres	1,400	N
Beach Clinic / Health Centre	Laboratory		Hospital Clinic	300	N
Beach Clinic / Health Centre	Stores		Stores	200	N
University Town Hospital	Ward 17 & Ward 18	UT1	Hospital Clinic	2,300	Y
University Town Hospital	Ward 15 & Ward 16	UT2	Hospital Clinic	2,100	Y
University Town Hospital	Nursery	UT3	Nurseries	100	Y
University Town Hospital	Main Building	UT4	Hospital Main Block	74,400	Y
University Town Hospital	Laboratories	UT5	Hospital Clinic	40	Y
University Town Hospital	Kitchen	UT6	Hospital Kitchen	100	Y
University Town Hospital	Corporate Block	UT7	Hospital Admin	900	Y
University Town Hospital	Energy Centre	UT8	Energy Centre	-	Y
University Hospital BigCity	Residential Accommodation Block A		Hospital Accommodation	500	N
University Hospital BigCity	Residential Accommodation Block B		Hospital Accommodation	900	N
University Hospital County	Residential Accommodation Block 1	HC1	Hospital Accommodation	600	N
University Hospital County	Old Clinic	HC2	Health centres	100	N
University Hospital County	Old Hospital	HC3	Health centres	500	N
University Hospital County	National Treatment Centre	HC4	Hospital Main Block	4,200	N
University Hospital County	Town Health Centre (new)	HC5	Health centres	400	N
University Hospital County	Medium Health Centre (new)	HC6	Health centres	400	N
University Hospital County	Main Centre (Old)	HC7	Hospital Main Block	67,600	N
University Hospital County	Main Centre (New)	HC8	Hospital Main Block	110,000	N
University Hospital County	Health Centre (old)	HC9	Health centres	300	N
University Hospital County	Health Centre (new)	HC10	Health centres	400	N

[illegible]

### 4.1.3 Add in changes

Columns I and J give the option to add in flags for the calculations in the cases where significant changes to the portfolio are known. For example, it captures where there is likely to be changes such as:

- Closure or disposal of a building – where a building is scheduled for closure as the lease comes to an end, or disposed / demolished for operational reasons. In column I add in the year where the site / building will be removed from the portfolio.
- New building – where a new building is being constructed or significant refurbishment has been carried out. In this instance in column J add in the year where the site / building will be added to the portfolio.

These actions will result in the model only including energy demand forecasts up to or after (and including) the indicated years. Where an existing building is scheduled to be replaced, it will be necessary to split this across two separate rows with the relevant year's input into the columns.

In the case of a new building being constructed or a significant change of use, the future energy consumption must be estimated and entered in the relevant fields as required.

Examples are shown below, noting the final two examples which showcase the entry in the case of a building being replaced.

Energy Consumption		Site / Building Changes	
Site	Building Name	Retired	New
		End Year	Start Year
Bighill Health Centre	BigHill Health Centre		
Bighill Health Centre	Residences		
Bighill Health Centre	Energy Centre & Workshops		
Hunter Valley Health Centre			
BigLock Hospital		2023	
Mothers Health Centre			
Beach Clinic / Health Centre	Laboratory		
Beach Clinic / Health Centre	Stores		
University Hospital County	Residential Accomodation Block 1		
University Hospital County	Old Clinic	2023	
University Hospital County	Old Hospital	2023	
University Hospital County	National Treatment Centre		2028
University Hospital County	Town Heath Centre (new)		2028
University Hospital County	Medium Heath Centre (new)		2028
University Hospital County	Main Centre (Old)	2031	
University Hospital County	Main Centre (New)		2032
University Hospital County	Heath Centre (old)	2027	
University Hospital County	Heath Centre (new)		2028

## 4.2 Step 2: Making modelling decisions

On the worksheet called Selections there are a number of different variables which can be selected to enable different modelling scenarios to be explored. This section takes you through the Selections worksheet and explains what can be chosen and the implications of those choices.

Below is an example of the Selections page. There are several key areas for user input.

### Selections

Purpose	
This page allows users to select a range of parameters for the tool to use with regard to reference dates and future fuel pricing. It also contains buttons to update the forecast (which must be used to update outputs if changed) and generate a output for export.	
Dates should be chosen to aid in reporting (against historic reference points) and where representative data is available. Consideration of the impact of one off events that are unlikely to continue should also be taken into consideration (i.e. Covid / New Building works). The reference year is used to estimate underlying demand, now and into the future.	
For Fuel Pricing, the UK Green Book published by HM Treasury provides a range of indicative prices for use in forecasting and reporting. This tool uses the Commercial/Public sector rate and allows a user to select the most representative value for electricity (low, mid, high), natural gas (A, B, C, D) and oil (low, mid, high). In exceptional cases, users can define their own "local" prices, which must be entered on the Assumptions tab.	

<b>Date Range</b>		<b>NOTE:</b>
Consumption Reference Year	2022	The consumption year is the reference year when readings have been taken.
Forecast Start year	2020	The forecast year indicates the start year for data (i.e. set to 2020 for carbon savings relative to this year).

<b>Cost Range</b>		<b>NOTE:</b>
		The forecast use UK Green Book values (version from 17 January 2023) for the expected unit cost of various fuels. For Electricity (imported from the grid), Natural Gas and Oil there is a range of potential values to choose from. Select the range that best matches your supplier, or if these do not match you can select local and provide values on the "Assumptions" tab.

	Cost Base	2020	2021	2022	2023	2024	2025	2026	2027	Units
Electricity Grid	Mid	13.34	13.34	14.38	30.09	28.98	23.03	13.80	13.21	p/kWh
Natural Gas	B	2.80	2.53	3.26	8.85	8.92	6.40	3.31	3.02	p/kWh
Oil	Mid	5.92	5.42	8.27	7.73	6.85	6.64	6.64	6.36	p/kWh
Biomass	Mid	6.16	6.34	6.34	6.34	6.34	6.34	6.34	6.34	p/kWh
LPG	Mid	2.18	2.21	2.30	2.44	2.57	2.71	2.76	2.76	p/kWh

**Prepare / update outputs**

Update Output	Updates all values using EAU forecast information and selected cost curves and prepares pivots
Export Data	Prepares a database output sheet for use in the interventions model

### 4.2.1. Add in date range

This is related to the dates for the consumption data that has been entered in the Input page. Select the year relevant to the starting of the datasets, recognising that often data is collected on calendar or fiscal year, e.g. if data starts in April 2022, state 2022 as the starting year.

#### Date Range

Consumption Reference Year	2022
Forecast Start year	2020

By means of background the tool is designed to provide a 31-year forecast from the start date. By default, this range is from 2020 through to 2050. The date for consumption information is required to align with expected efficiencies and

emissions. This can be altered by the user if a different period is required using the second year list.

### 4.2.2 Select cost ranges

This allows you to choose the predicted costs that you might experience for your fuel. These are based on the HM Treasury Green Book projections. Selections can be made by choosing the appropriate cost base.

#### Cost Range

	Cost Base	2020	2021	2022	2023	2024	2025	Units
Electricity Grid	Mid	13.34	14.38	30.09	28.98	23.03	13.80	p/kWh
Natural Gas	B	2.53	3.26	8.85	8.92	6.40	3.31	p/kWh

You may wish to have a think which of the sets is most relevant to your portfolio. It is also a useful way to test out different scenarios by changing the datasets and seeing what the impact may be.

Alternatively, if you would like to add in your own specific cost projections, you can select Local from the drop-down menu. If this is the case, you must swap to the Assumptions tab and input the desired cost projections for the relevant fuels in the allocated cells (salmon shaded cells in rows 26-30).

By means of background the [UK Green Book](#) provides a number of price forecasts for electricity, natural gas and oil. These cover both historical prices (average) and a range for current and future prices. Users should select the best values that match their rates (note that the tool will default to mid-range values unless changed).

### 4.2.3 Update of outputs macro

The other important thing on the Selections page is the button which enables a macro to run and allows updates to be made on the outputs page. Note, macros must be enabled in Excel for these to run.

#### Prepare / update outputs

Update Output

Export Data

If this step is not followed then the Output data will not be automatically updated.



Secondly it gives you a way to export the data from the file and use it in the Decarbonisation interventions estimator (more on this in the next section).

## 4.3 Step 3: Outputs

The Output page provides a summary of the findings from the tool. It uses the input data and the selections you have made, against a series of background data and assumptions to produce interactive summary charts and tables for your use. You can copy and paste the information as you like. The image below shows the interaction options available to drill down on different sites, different buildings and different uses to enable you to see the predictions you want to depending on the input cases.

**Output (BAU)**

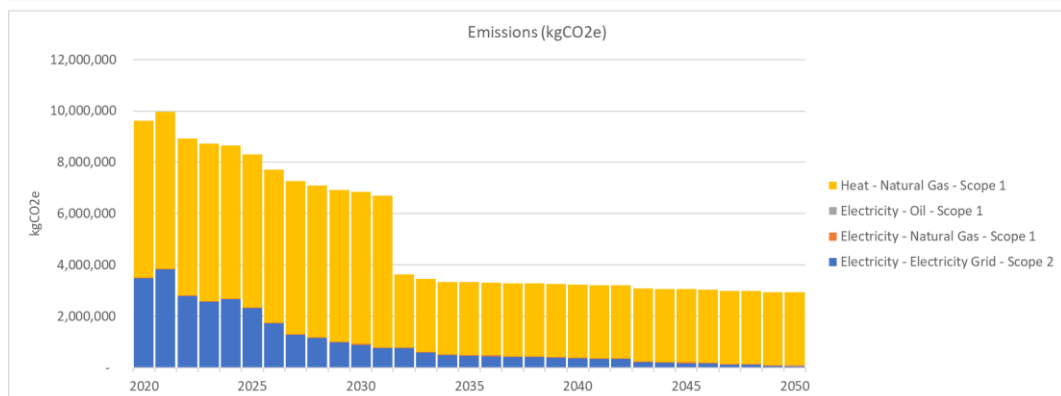
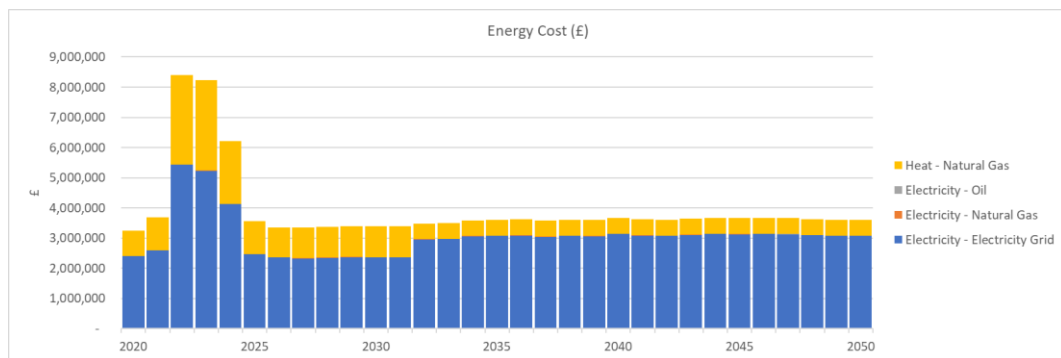
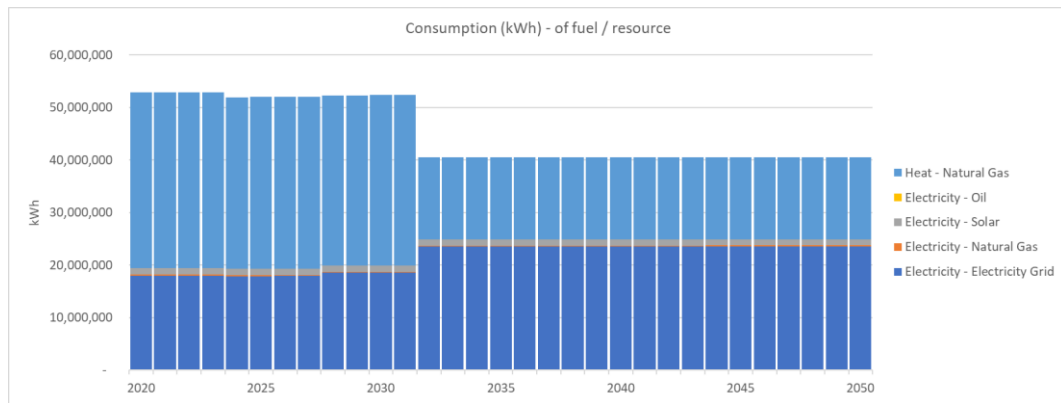
Site	Building
Beach Clinic / Health Cen...	BigHill Health Centre
BigHill Health Centre	BigLock Hospital
BigLock Hospital	Corporate Block
Hunter Valley Health Centre	Energy Centre
Mothers Health Centre	Energy Centre & Worksho...
University Hospital BigCity	Health Centre (new)
University Hospital County	Health Centre (old)
University Town Hospital	Hunter Valley Health Centre
(blank)	Kitchen
	Laboratories
	Laboratory
	Main Building
	Main Centre (New)
	Main Centre (Old)
	Medium Health Centre (n...
	Mothers Health Centre
	National Treatment Centre
	Nursery
	Old Clinic
	Old Hospital
	Residences
	Residential Accomodatio...
	Residential Accomodatio...
	Residential Accomodatio...
	Stores
	Town Health Centre (new)
	Ward 15 & Ward 16
	Ward 17 & Ward 18
	(blank)

Selections can also be made on fuel type and energy source as per the input cases.

Use	Type	Energy S...
Electricity	Backup Generation	Electricity Grid
Heat	CHP	Natural Gas
(blank)	Heating	Oil
	Imports	Solar
	Renewable Gener...	(blank)
	(blank)	

The forecast predictions can be tailored by using the above interactive areas on the Output sheet. If you want to update some of the data you can go back and do that at a later date following the previous steps. However, you MUST remember click on the “Update Outputs” button on the Selections worksheet to enable the outputs to update.

Example predictions are shown in graphs and tables below:



The tables further down the tab are able to provide you with data by year, site and for each source present.

Sum of Value	Beach Clinic / Health Centre		Bighill Health Centre			BigLock Hospital		Hunter Valley Health Centre			Mothers Health Centre	
	Electricity Grid	Natural Gas	Electricity Grid	Natural Gas	Heat	Electricity Grid	Natural Gas	Electricity Grid	Natural Gas	Solar	Electricity Grid	Natural Gas
2020	59,966	67,316	1,120,423	13,700	1,006,312	54,311	313,001	984,933	580,328	11,558	165,215	351,1
2021	59,966	67,316	1,120,423	13,700	1,006,312	54,311	313,001	984,961	580,328	11,529	165,215	351,1
2022	59,966	67,316	1,120,423	13,700	1,006,312	54,311	313,001	984,990	580,328	11,500	165,215	351,1
2023	59,966	67,316	1,120,423	13,700	1,006,312	54,311	313,001	985,019	580,328	11,471	165,215	351,1
2024	59,966	67,316	1,120,423	13,700	1,006,312	-	-	985,048	580,328	11,443	165,215	351,1
2025	59,966	67,316	1,120,423	13,700	1,006,312	-	-	985,076	580,328	11,414	165,215	351,1
2026	59,966	67,316	1,120,423	13,700	1,006,312	-	-	985,105	580,328	11,385	165,215	351,1
2027	59,966	67,316	1,120,423	13,700	1,006,312	-	-	985,134	580,328	11,356	165,215	351,1
2028	59,966	67,316	1,120,423	13,700	1,006,312	-	-	985,163	580,328	11,328	165,215	351,1
2029	59,966	67,316	1,120,423	13,700	1,006,312	-	-	985,191	580,328	11,299	165,215	351,1
2030	59,966	67,316	1,120,423	13,700	1,006,312	-	-	985,220	580,328	11,270	165,215	351,1
2031	59,966	67,316	1,120,423	13,700	1,006,312	-	-	985,249	580,328	11,241	165,215	351,1
2032	59,966	67,316	1,120,423	13,700	1,006,312	-	-	985,278	580,328	11,213	165,215	351,1
2033	59,966	67,316	1,120,423	13,700	1,006,312	-	-	985,306	580,328	11,184	165,215	351,1
2034	59,966	67,316	1,120,423	13,700	1,006,312	-	-	985,335	580,328	11,155	165,215	351,1
2035	59,966	67,316	1,120,423	13,700	1,006,312	-	-	985,364	580,328	11,126	165,215	351,1
2036	59,966	67,316	1,120,423	13,700	1,006,312	-	-	985,393	580,328	11,098	165,215	351,1
2037	59,966	67,316	1,120,423	13,700	1,006,312	-	-	985,421	580,328	11,069	165,215	351,1
2038	59,966	67,316	1,120,423	13,700	1,006,312	-	-	985,450	580,328	11,040	165,215	351,1
2039	59,966	67,316	1,120,423	13,700	1,006,312	-	-	985,479	580,328	11,011	165,215	351,1
2040	59,966	67,316	1,120,423	13,700	1,006,312	-	-	985,508	580,328	10,983	165,215	351,1
2041	59,966	67,316	1,120,423	13,700	1,006,312	-	-	985,536	580,328	10,954	165,215	351,1
2042	59,966	67,316	1,120,423	13,700	1,006,312	-	-	985,565	580,328	10,925	165,215	351,1
2043	59,966	67,316	1,120,423	13,700	1,006,312	-	-	985,594	580,328	10,896	165,215	351,1
2044	59,966	67,316	1,120,423	13,700	1,006,312	-	-	985,623	580,328	10,868	165,215	351,1
2045	59,966	67,316	1,120,423	13,700	1,006,312	-	-	985,651	580,328	10,839	165,215	351,1
2046	59,966	67,316	1,120,423	13,700	1,006,312	-	-	985,680	580,328	10,810	165,215	351,1
2047	59,966	67,316	1,120,423	13,700	1,006,312	-	-	985,709	580,328	10,781	165,215	351,1
2048	59,966	67,316	1,120,423	13,700	1,006,312	-	-	985,738	580,328	10,753	165,215	351,1
2049	59,966	67,316	1,120,423	13,700	1,006,312	-	-	985,766	580,328	10,724	165,215	351,1
2050	59,966	67,316	1,120,423	13,700	1,006,312	-	-	985,795	580,328	10,695	165,215	351,1

The graphs and tables provide information covering the following:

Measure	Description	Units
Type	Type of energy supplied at a site	
Demand	Demand is the energy need for a site / building. It represents the useful energy provided by a particular fuel and system after energy conversion from a source fuel. The sum of demand from all sources equals the total demand at a site.	kWh
Consumption	Consumption is the amount of a given fuel needed to meet demand. This is equal to the metered energy provided to a site and may differ from demand based on the conversion efficiency of the system.	kWh
Source / fuel	Indicates the source / fuel used	Text (list)
Emissions	GHG emissions  Scope 1: emissions produced on site (e.g. on site power and heat generation)  Scope 2: imported from off-site (e.g. the embedded carbon resultant from producing grid	kgCO <sub>2</sub> e

	supplied electricity)	
Costs	Operational fuel costs based on the source / fuel used and consumption levels. Future costs are based on a price curve forecasted in the Green Book.	£k

Note that if you select the Energy Centre building in isolation you may see that there is no data at this level. This is due to the methodology employed which effectively re-distributes any central heating and power generation across the rest of the buildings on site. The sum total for the site will however not be impacted.

#### **4.3.1 Export Output for use in Decarbonisation intervention estimator**

The output data from this estimator can be used as the baseline for the separate [Decarbonisation intervention estimator](#). This is a resource which will enable a user to test a range of decarbonisation solutions on their portfolio. The estimator follows a similar structure to the BAU estimator and therefore is designed to be integrated if applicable.

## 5. How to use the Decarbonisation intervention estimator

The tool requires a reference BAU forecast to estimate the impact of various interventions on energy use, fuel costs and emissions. This can be prepared in the BAU estimator tool as described in the previous section.

1. Import a BAU forecast using the BAU estimator tool and copy into the Decarbonisation interventions tool.
2. Add data into the “Input tab” for each site, based on a predefined short list of typical interventions.
3. Go to the “Selections” sheet.
  - Select energy and fuel costs to use.
  - Click on the “Update Output” button to run a macro to update calculations and refresh charts
4. Review results on the output pages



Before testing this out, read through of all the worksheets to familiarise yourself with the expected content.

### 5.1 Step 1: Import BAU forecast

Once you have prepared a BAU forecast using the available tool and as per the guidance in this guide, you will be supplied with an export file containing the pertinent forecasts for this tool. This is achieved by selecting the export data button on the Selections tab which will prepare the export file. Once generated:

- Copy and paste the data from the export sheet of the BAU estimator into the “BAU – Import” tab in the intervention estimator.
- Ensure any old data is deleted from this tab.

The data imported should look like the snapshot below.

Reference	Site	Building	Use	Measure	Type	Energy Source	Unit	Emissions Scope	Forecast	Year	Value
37	Beach Clinic / Health Centre	Laboratory	Electricity	Consumption	Imports	Electricity Grid	kWh		BAU	2020	32659.46334
819	Beach Clinic / Health Centre	Laboratory	Electricity	Consumption	Imports	Electricity Grid	kWh		BAU	2021	32659.46334
1603	Beach Clinic / Health Centre	Laboratory	Electricity	Consumption	Imports	Electricity Grid	kWh		BAU	2022	32659.46334
2387	Beach Clinic / Health Centre	Laboratory	Electricity	Consumption	Imports	Electricity Grid	kWh		BAU	2023	32659.46334
3171	Beach Clinic / Health Centre	Laboratory	Electricity	Consumption	Imports	Electricity Grid	kWh		BAU	2024	32659.46334
3955	Beach Clinic / Health Centre	Laboratory	Electricity	Consumption	Imports	Electricity Grid	kWh		BAU	2025	32659.46334
4739	Beach Clinic / Health Centre	Laboratory	Electricity	Consumption	Imports	Electricity Grid	kWh		BAU	2026	32659.46334
5523	Beach Clinic / Health Centre	Laboratory	Electricity	Consumption	Imports	Electricity Grid	kWh		BAU	2027	32659.46334
6307	Beach Clinic / Health Centre	Laboratory	Electricity	Consumption	Imports	Electricity Grid	kWh		BAU	2028	32659.46334
7091	Beach Clinic / Health Centre	Laboratory	Electricity	Consumption	Imports	Electricity Grid	kWh		BAU	2029	32659.46334
7875	Beach Clinic / Health Centre	Laboratory	Electricity	Consumption	Imports	Electricity Grid	kWh		BAU	2030	32659.46334
8659	Beach Clinic / Health Centre	Laboratory	Electricity	Consumption	Imports	Electricity Grid	kWh		BAU	2031	32659.46334
9443	Beach Clinic / Health Centre	Laboratory	Electricity	Consumption	Imports	Electricity Grid	kWh		BAU	2032	32659.46334
10227	Beach Clinic / Health Centre	Laboratory	Electricity	Consumption	Imports	Electricity Grid	kWh		BAU	2033	32659.46334
11011	Beach Clinic / Health Centre	Laboratory	Electricity	Consumption	Imports	Electricity Grid	kWh		BAU	2034	32659.46334
11795	Beach Clinic / Health Centre	Laboratory	Electricity	Consumption	Imports	Electricity Grid	kWh		BAU	2035	32659.46334
12579	Beach Clinic / Health Centre	Laboratory	Electricity	Consumption	Imports	Electricity Grid	kWh		BAU	2036	32659.46334
13363	Beach Clinic / Health Centre	Laboratory	Electricity	Consumption	Imports	Electricity Grid	kWh		BAU	2037	32659.46334
14147	Beach Clinic / Health Centre	Laboratory	Electricity	Consumption	Imports	Electricity Grid	kWh		BAU	2038	32659.46334

The [BAU estimator](#) also holds key site and building data which should be replicated in this estimator. To do so, copy and paste the site and building data that you have in the “Input” tab. These can be copy-pasted into the first cell of the “Input” tab of the estimator and include site, building name, ref code, use category, GIA and heat network indicator (columns B-F).

Note that the Reference Year should match the year that has been used for the BAU estimator, and entered in cell C4.

## 5.2 Step 2: Input worksheet completion

### 5.2.1 Inputting intervention information

Three types of interventions have been predefined and set up in the tool. These are grouped into the following:

1. Energy efficiency interventions
  - LED lighting
  - Building management system (BMS)
  - Building Fabric
2. Heat interventions
  - New heating system
3. Generation interventions
  - Retirement of existing CHP system
  - Retirement of existing backup and onsite generation
  - Installation of solar generation
  - Installation of wind generation

Details on what information to include for the tool follows, with a short description of the methodology in estimating energy, cost and emissions impacts in section 6.

### 5.2.2 Common fields for all interventions

Field	Description	Units
Project Start Year	<p>This sets the start year for an intervention.</p> <p>It corresponds to the year that capital payments are required to be made for the intervention, with benefits from the intervention automatically calculated in any subsequent years. At this stage it is assumed that interventions will be completed within the year and not split over multiple years.</p> <p>Energy consumption, cost and emissions are then calculated from this point, based on standardised metrics.</p>	Year
% of site	<p>Where an intervention is already partially installed on site, % of site allows for the intervention to be scaled and only to apply to the percentage indicated.</p> <p>If left blank (or set to 100%, it is assumed the intervention will apply to the whole).</p>	%

### 5.2.3 Specific fields

Energy Efficiency interventions (columns I-AI).

Each of these interventions reduce the amount of energy (power and / or heat) required. Savings will be automatically estimated based on size of building, its use and selection noted below.

Intervention	Description	Units
LED	<p>The LED intervention is based on upgrading existing lighting to high efficiency LED lighting. This results in a reduction of electricity consumed on site.</p>	<p>List:</p> <p>Low, Med,</p>

	<p>The lighting requirement selection allows users to indicate the level of lighting required (low, med, high):</p> <p>Low for normal lighting (such as for accommodation)</p> <p>Med for office-based situations requiring brighter lighting</p> <p>High for location needing high luminosity lighting such as hospital wards</p>	High
BMS	<p>The BMS intervention is based on installing a new building management system or upgrading an existing system. This will be typically for monitoring and controlling heating, lighting and ventilation. A reduction in both heat and electricity can be expected.</p> <p>The BMS requirement selection allows users to indicate the level of upgrade (low, med, high):</p> <p>Low for limited upgrades, where an existing system is already in place but extended.</p> <p>Med a system where significant upgrades and extension is required.</p> <p>High where there is no system or the existing system is to be fully replaced.</p>	<p>List:</p> <p>Low, Med, High</p>
Building Fabric	<p>The building fabric intervention involves upgrading the walls, windows, floor, and roof insulation. A reduction in heat demand can be expected from this intervention.</p> <p>The building fabric improvement selection allows users to indicate the level of upgrade (low, med, high):</p>	Text



	Low - Walls only.	
	Med - Walls, roof and floor (no windows).	
	High - Roof, floor, walls and double glazing windows.	

A generic “other” intervention is also provided which allows for location specific interventions to be entered manually. In this case the impact on energy (electrical and heat) as well as costs (CapEx and OpEx) is required. The impact on emissions and fuel costs will then be estimated and included in the overall assessment based on these inputs.

#### **Heating interventions (columns AM-AO).**

These interventions will swap out the existing heating systems for a new system (typically an electric heat pump or other electrical heating system) and calculate the impact on fuel consumption and emissions. In this case the assumption is that energy demand remains constant (as the heating need has not changed), but the energy consumption will decrease where the selected system has greater efficiency.

Emissions and costs for the new system are dependent on the source energy – which if electricity, is expected to reduce over time. Emissions and future cost for electricity are based on the Green Book.

Field	Description	Units
New Heating system	<p>A selection of alternative heating systems is provided in the tool.</p> <p>ASHP – Air source heat pump, typically used to replace a fuel boiler system. ASHP are more suited to smaller loads or where there is not enough space for a GSHP.</p> <p>GSHP – Ground source heat pump, used where suitable space is available for a bore hole (or heat exchange coils) and where loads are larger. GSHP are more costly to install but have higher efficiencies than ASHP.</p>	Drop down list

	<p>Radiant Heaters (electric) – can be used to replace like for like radiant units, typically in large open spaces such as warehouses. Radiant heater will have a much lower efficiency than heat pumps and thus consume more electricity, but have low cost to install where similar existing systems are in place.</p> <p>Direct electric – replacement of current heating with wall panel heaters. As with radiant, these can be cheap to install but do not benefit from the higher efficiency.</p> <p>Biomass – whilst not electrification, it can be considered decarbonisation with residual emission from the burning of fuel on site. They are easier to integrate with existing wet heating systems, particularly where a higher heat is required.</p>	
Cost and performance	<p>The cost and performance of the heating solution may vary based on the building needs and existing systems for heat distribution.</p> <p>A selection allows users to indicate the level of intervention.</p> <p>Low where low temperature networks are suitable (such as underfloor heating).</p> <p>Med for most cases where higher efficiencies can help reduce operational costs.</p> <p>High where the site is complex or where higher temperature distribution heat networks are required, or large areas are to be heated.</p>	Drop down list

#### **On site generation interventions (columns BR-DJ).**

These consist of two broad categories:

- Local renewable generation (solar or wind) which reduce the need for electricity imports from the grid and can provide savings in energy costs.
- Retirement of fossil fuel generation systems, either combined heat and power (CHP) or for backup generation. Note the model only indicates the emission and fuel cost impact of retiring these systems, and doesn't address any requirements for backup generation in the case of mains failure.

For solar photovoltaic (PV) installations:

Field	Description	Units
Type of installation	<p>Installing solar PV can help reduce electricity imports from the grid. This may lead to cost savings and emission reductions (although these will decrease over time as grid supplied electricity is increasingly sourced from non-carbon sources).</p> <p>A selection of systems can be selected based on the suitability:</p> <p>PV – ground</p> <p>PV – roof</p> <p>PV – carport</p> <p>Large ground mounted systems offer the best value for money but are likely to be dependent on the site.</p>	Selection of drop down
Max area available	<p>Providing the available area allows the sizing of the system to be set, based on typical area required for a standard panel.</p> <p>Where a large area is available, the size of the system will be made to limit exports of electricity to the grid.</p>	m <sup>2</sup>
Resources	<p>Users can select low, med and high resource based on:</p> <p>Low – where the area indicated will require flat</p>	Selection of drop down

	<p>panels or where there is periodic shading.</p> <p>Med – where the area allows for partially south facing pitched orientation of panels and where there is limited shading.</p> <p>High – where the site has non-shaded location allowing for optimally pitched south facing arrays.</p> <p>For location at higher latitudes (such as Scotland), "Low" resources should be selected</p>	
Costs	<p>Cost for the site should also be indicated, based on the complexity of support structure, electrical connections and access:</p> <p>Low – where access is not restricted, additional support structures already in place and complexity is low.</p> <p>Med – where the build is likely to require some upgrades or access restrictions.</p> <p>High – for complex sites with restricted access or significant infrastructure build requirements.</p>	Selection of drop down

For wind installations:

Field	Description	Units
Type of installation	<p>As for solar, installing wind can help reduce electricity imports from the grid.</p> <p>Larger systems provide better value but are only suitable where sites have higher demand and have substantial space for exclusion zones around a turbine. Wind generation is also better suited to a campus site (where there might be an energy centre) rather than individual building.</p>	Selection of drop down

Suitability / available area	<p>Wind turbines however require far more area and are not suited to urban environments or where there is no available land. Planning consideration are a major factor in where wind generation can be used.</p> <p>Unlike solar however, wind operates at night and typically is better over winter than summer.</p>	m <sup>2</sup>
Resources	<p>Users can select low, med and high resources:</p> <p>Low – lower average wind speed or some obstructions (below 6 m/s)</p> <p>Med – good average wind speed (between 6-10 m/s).</p> <p>High – excellent average wind speed (above 10 m/s)</p> <p>This information can be obtained from average wind speed maps of the UK and can be taken as average for the year.</p>	Selection of drop down
Costs	<p>Cost for the site should also be indicated, based on the complexity of support structure, electrical connections and access:</p> <p>Low – where access is not restricted, additional support structures already in place and complexity low.</p> <p>Med – where the build is likely to require some upgrades or access restrictions.</p> <p>High – for complex sites with restricted access or significant infrastructure build requirements.</p>	Selection of drop down

Retirement of fossil fuel generation systems (CHP and backup generation) require data on the date at which they are to be retired/disconnected. The retirement date

for CHP could be aligned with the expected economic lifetime of the units involved and arrival of new heating systems. The retirement of backup systems additionally requires consideration of any security of supply requirements, however this is outside of the scope of the current tool.

## 5.3 Step 3: Update the model forecast

On the “Selections” tab users are able to set the date for financial discount calculations, and run the macro to update calculations and outputs.

### 5.3.1 Date ranges

There are two dates that impact calculations:

- Financial Reference Year – used in discounted cash flow and NPV for each site. This is displayed on the “Output – Summary” tab.
- Output Reference Year – used to display the expected payback and emissions savings from each intervention. This is displayed on the “Output – Interventions” tab.

The tool is designed to provide a 31-year forecast from 2020 through to 2050 as standard. This must be aligned with the Business as Usual forecast for the tool to work.

### 5.3.2 Update of outputs macro

The next important step on the “Selections” tab is the Update Output button which enables a macro to run and allow updates to be made on the outputs tabs. Note, macros must be enabled in Excel for these to run. If this macro is not activated then the output data will not be automatically updated.

#### Prepare / update outputs



The second macro gives you a way to export the data from the file and use for further analysis. This generates a further Excel spreadsheet with the data in tabular form which can be used as required.

## 5.4 Step 4: Review Outputs

There are four output tabs:

- Output – Summary - A financial summary, providing an aggregate view of the impact of all interventions across the entire portfolio and key indicators.
- Output – Analysis – An interactive user interface allowing analysis of the impact of different interventions. These can be layered onto the BAU to review the impact on energy, costs, and emissions at a site or building level.
- Output – Intervention – A table of interventions indicating costs (CapEx, OpEx / energy costs), simple metrics (such as simple payback and abatement cost) and emission savings.

### 5.4.1 Controls and common definitions

The output page is constructed similar to the BAU output page but allows users to review the impact and timing of interventions.

Interactive summary charts allow easy viewing, with tables for your use. You can copy and paste the information as you like from the tables below the graphs.

The image below shows the interaction options available to drill down on different sites, different buildings and different uses to enable you to see the predictions you want to depending on the input cases.

#### Output - Analysis

The screenshot displays the 'Output - Analysis' interface. It features a 'Filters' section on the left with two main categories: 'Site' and 'Building'. The 'Site' filter is expanded, showing a list of sites including 'Beach Clinic / Health Ce...', 'BigLock Hospital' (which is selected), 'Hunter Valley Health Ce...', 'Mothers Health Centre', 'University Hospital BigCity', 'University Hospital County', 'University Town Hospital', and '(blank)'. The 'Building' filter is also expanded, showing a grid of building types including 'BigLock Hospital' (selected), 'Corporate Block', 'Energy Centre', 'Health Centre (new)', 'Health Centre (old)', 'Hunter Valley Health...', 'Kitchen', 'Laboratories', 'Laboratory', 'Main Building', 'Main Centre (New)', 'Main Centre (Old)', 'Main Energy Centre', 'Medium Health Cent...', 'Mothers Health Centre', 'National Treatment ...', 'Nursery', 'Old Clinic', 'Old Hospital', 'Residences', 'Residential Accomod...', 'Residential Accomod...', 'Residential Accomod...', 'Stores', 'Town Health Centre ...', 'Ward 15 & Ward 16', 'Ward 17 & Ward 18', and '(blank)'.

Selections can also be made on fuel type and energy source as per the input cases.

Forecast / Intervention		Use	Energy Source
BAU	LED	Electricity	Solar
BMS	Fabric	Heat	Wind
Other	New Heating	(blank)	
New Solar	New Wind		Biomass
Replace Backup	Replace CHP		Electricity
(blank)			Electricity Grid
			HVO
			Natural Gas
			Oil

The graphs and tables provide information covering the following:

Measure	Description	Units
Type	Type of energy supplied at a site.	
Demand	Demand is the energy need for a site / building. It represents the useful energy provided by a particular fuel and system after energy conversion from a source fuel. The sum of demand from all sources equals the total demand at a site.	kWh
Consumption	Consumption is the amount of a given fuel needed to meet demand. This is equal to the metered energy provided to a site and may differ from demand based on the conversion efficiency of the system.	kWh
Source / fuel	Indicates the source / fuel used.	Text (list)
Emissions	GHG emissions:  Scope 1: emissions produced on site (e.g. on site power and heat generation).  Scope 2: imported from off-site (e.g. the embedded carbon resultant from producing grid supplied electricity).	kgCO <sub>2</sub> e
Costs	Operational fuel costs based on the source / fuel used and consumption levels. Future costs are	£k



	based on a price curve forecasted in the Green Book.	
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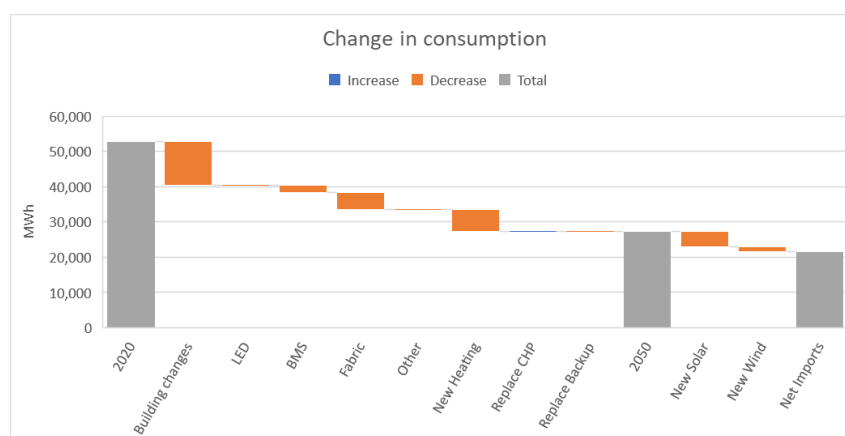
If you want to update some of the data you can go back and do that at a later date following the previous steps. However, you must remember click on the “Update Output” button on the Selections tab before reviewing the updated outputs.

### 5.4.2 Output summary - example

The output summary page provides an overview of the combined financial impact of all of the interventions based on estimated costs. This takes into account CapEx and OpEx requirements based on standard benchmarks, as well as energy cost impacts using expected values based on the Green Book, allowing for a payback and net present value (NPV) calculation.

Emission savings are also presented, allowing for calculation of % savings relative to the BAU and an abatement cost (£/tCO<sub>2</sub>e). Positive abatement costs indicate no-regrets actions that provide a saving once implemented, while negative abatement costs indicate the relative gap to having a payback.

Options Appraisal (nominal)										
	Energy consumption Capex (£k)	Carbon Reduction to 2050 pa (kWh)	Carbon Reduction to 2050 pa (tCO <sub>2</sub> e)	Cost Saving to 2050 pa (£k)	Scope 1 Reductions 2050 (%)	Scope 2 Reductions 2050 (%)	Abatement Cost (£/tCO <sub>2</sub> e)	NPV (£k)	IRR (%)	Simple Payback (Yrs)
All interventions	14,264	(25,497)	(58,480)	14,316	100%	0%	(4.10)	(3,181)	None	1

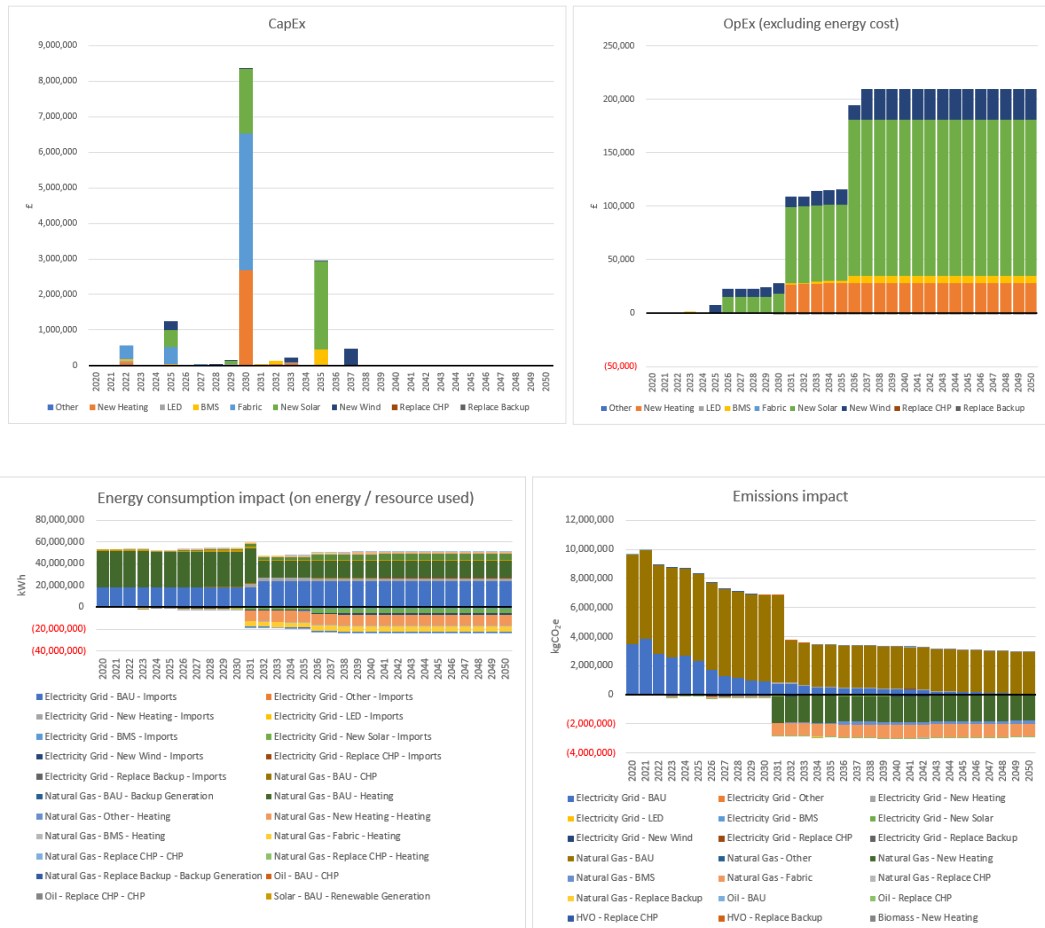


### 5.4.3 Output analysis - example

The output analysis allows review of each intervention, which can be viewed individually or layered to gain insights into their combined impact. Graphs and

table are provided across the date rage 2020 to 2050, with each intervention commencing based on the project start date provide din the inputs tab.

Example predictions are shown below.



#### 5.4.4 Output interventions - example

The output interventions page provides a tabular overview of each intervention, allowing users to filter and compare across sites and types of interventions and site / building.

## Interventions

Subtotal			416,446	(455,491)	(20,938)	19.9	0.5	(84,196)	(135,055)	-16.5%
Site	Building Name	Intervention	p.a.			up to 2040		p.a.		
			Capex	Energy change (consumption)	Opex (including energy costs)	Payback	Abatement Cost	Emissions	Emissions	Emissions
			£	kWh p.a.	£ p.a.	Years	£/kgCO <sub>2</sub> e	kgCO <sub>2</sub> e	kgCO <sub>2</sub> e	%
Mothers Health Centre	Mothers Health Centre	Fabric	65,800	(75,617)	(2,549)	25.8	(0.1)	(13,803)	(13,803)	18.3%
Mothers Health Centre	Mothers Health Centre	New Wind	41,455	(52,869)	(5,638)	7.4	2.9	(1,943)	(832)	1.1%
Mothers Health Centre	Mothers Health Centre	New Heating	34,875	(3,154)	4,800	no payback	(0.2)	(27,155)	(54,297)	72.0%
Mothers Health Centre	Mothers Health Centre	New Solar	31,119	(35,886)	(3,711)	8.4	2.7	(907)	(562)	0.7%
Mothers Health Centre	Mothers Health Centre	BMS	8,400	(21,681)	(1,229)	6.8	0.4	(2,957)	(5,901)	7.8%
Mothers Health Centre	Mothers Health Centre	LED	8,400	(4,200)	(632)	13.3	3.3	(64)	(66)	0.1%
University Hospital BigCity	Residential Accomodation Block B	Fabric	42,300	(48,596)	(1,614)	26.2	(0.0)	(8,871)	(8,873)	14.9%
University Hospital BigCity	Residential Accomodation Block B	New Heating	39,515	(46,477)	1,077	no payback	(0.2)	(12,426)	(24,711)	41.5%
University Hospital BigCity	Residential Accomodation Block B	New Wind	27,288	(34,901)	(3,718)	7.3	4.1	(584)	(548)	0.9%
University Hospital BigCity	Residential Accomodation Block A	Fabric	29,500	(26,998)	(896)	26.2	(0.0)	(4,928)	(4,929)	8.3%
University Hospital BigCity	Residential Accomodation Block A	New Heating	22,580	(28,378)	641	no payback	(0.1)	(7,573)	(15,090)	25.3%
University Hospital BigCity	Residential Accomodation Block B	New Solar	20,484	(19,576)	(1,933)	10.6	2.2	(497)	(308)	0.5%
University Hospital BigCity	Residential Accomodation Block A	New Wind	16,297	(20,784)	(2,218)	7.3	3.8	(382)	(327)	0.5%
University Hospital BigCity	Residential Accomodation Block A	New Solar	12,234	(11,691)	(1,155)	10.6	2.2	(297)	(184)	0.3%
University Hospital BigCity	Residential Accomodation Block B	LED	10,800	(5,400)	(811)	13.3	3.2	(89)	(85)	0.1%
University Hospital BigCity	Residential Accomodation Block B	BMS	5,400	(11,234)	(697)	7.7	0.4	(1,414)	(2,808)	4.7%
University Hospital BigCity	Residential Accomodation Block A	BMS	3,000	(6,851)	(429)	7.0	0.4	(865)	(1,708)	2.9%
University Hospital BigCity	Residential Accomodation Block A	LED	3,000	(1,500)	(225)	13.3	3.1	(30)	(24)	0.0%

## 6. Methodology

### 6.1 Defining business as usual (BAU)

Business-as-usual provides a future forecast of greenhouse gas (GHG) emissions, based on current energy use and associated emissions. It is also possible to incorporate known / planned changes to site or operations that might take place in the future. As a minimum the BAU must establish the following:

Future energy demand;

- Fuel consumption per annum to meet future energy demand;
- Carbon emissions per annum (measured in tCO<sub>2</sub>e), and;
- Energy costs per annum.

In developing the BAU output it is often hard to get information on the strategic direction of a site. In most cases a reasonable assumption is persistence, which assumes today's underlying "energy demand" will remain into the future.

Underlying energy demand, defined as the energy needed to provide power and heating across a site, regardless of the fuels and systems used to provide it, and any waste that occurs in its conversion. Persistence does however have limitations, where significant changes have been planned. This could include:

- Construction of new buildings
- Demolition of existing buildings
- Energy asset disposals (boilers / generators)
- Energy network changes
- Change of use
- Increase in footfall and /or occupancy

It is important to appreciate what impact a change in one of these might have and capture any significant change appropriately in the forecast.

### 6.2 Energy consumption versus energy demand

Energy demand at a site differs from the energy consumed at a site, with energy consumption a measure of the fuel used and efficiency of the systems employed to

extract useful energy to meet the energy demand of the site. In this instance, energy demand is classified by its use – as either Electrical or Heat.

Energy consumption is what is most familiar as it corresponds to the fuel that is used to meet our demand. This also relates to the energy that is metered, reported and charged for on energy bills. Given this, it forms the basis for the data input.

**Example:**

- Gas boilers typically have an efficiency of around 85%, indicating a consumption of 100kWh of natural gas would satisfy an underlying heating demand of 85kWh.
- A typical ASHP, with an efficiency of around 250% (expressed as a coefficient of performance (COP) of 2.5), would meet the same underlying heating demand of 85kWh, but from a consumption of 34kWh of electricity (85kWh heat / 2.5 COP).

For the purpose of establishing a BAU, both the energy demand of a site, and the consumption of various fuels / systems to meet this demand are required. Once these have been established, the emissions, and fuel cost can be calculated.

## **6.3 Interventions**

A series of interventions are needed to reach net zero for a site or building.

The Decarbonisation intervention estimator provides a future forecast of greenhouse gas (GHG) emissions, based on current and forecasted energy use and associated emissions, to indicate the size and scope of interventions needed. This is achieved by using benchmarks calibrated across various projects and sites reviewed during the Modern Energy Partners (MEP) programme.

Interventions are grouped into three categories:

- Energy efficiency – these interventions lower overall energy demand at the site / building and apply to either electricity or heat (or both). Where these interventions provide a net savings (capital costs and lower than future energy cost savings), these are deemed “No regrets” actions.
- Heating – this is likely to be the most significant intervention where fossil fuel is

used for heating. Replacing an existing system for an electrified solution is the most likely outcome, where a new system providing the same output heat is installed (adjusted for any anticipated energy efficiency savings). Consumption of fossil fuel is reduced in this case, with consumption of electricity increased. These solutions may or may not provide net savings, dependent on the cost of fuel and electricity.

- Renewable generation – Solar and wind (if available space permits) are additional interventions that can help in reducing net emissions, but mainly provide cost savings. The earlier these are installed, the greater the emissions savings as imported electricity is expected to be largely emissions free by 2050. Cost savings are dependent on the price of imported power versus the upfront costs for installing solar and wind. The tool provides an estimate of their impact but does not review load matching throughout the year so should only be used as a guide.

## 6.4 Methodology and model structure

The Business-as-usual estimator is based on current energy usage, systems efficiency assumptions, emission factors and future energy costs across a range of sites and buildings. For each site / building the following will be required:

- Site information – is required describing each site / building. Where building submetering is available (or energy usage can be estimated) a building level BAU can be calculated. Site / building information must include the GIA (gross internal area) in square meters as this is used in the tool. It is also possible to indicate whether a building is part of a centralised heat network. However, note that if this is the case an energy centre from which it is fed will need to be added.
- Site / Building changes allows the user to select a start year or end year if any changes to the operations are expected (such as a new building under construction or being demolished in the future).
- Current Energy usage – must be provided by the user and is typically obtained from metered electricity consumption, renewable generation and fuel consumption data available from your supplier or provided in your bills. This data is to be provided as annual total in kWh – with a breakdown of fuel used between heating and power generation (such as backup generators and CHP plant). Cells are to be left blank where no consumption is relevant for particular fuels.

In addition to location information, the model uses a number of benchmarks to calculate overall emissions and energy / fuel consumption levels to the required underlying energy demand of the site / building.

These assumptions include:

- System efficiencies – are based on metrics and benchmarks developed by the Energy Systems Catapult from experience across multiple sites.
- Emission factors provided by HM Treasury in the Green Book and GHG reporting documentation.
- Future energy costs for electricity, natural gas and other fuels, likewise based on the HM Treasury Green Book.

Future forecasts are based on projecting underlying demand for electricity and heat into the future for each site / building. This demand is then met using the current mix of fuels and grid imports, adjusted for any efficiencies changes that may be required. The expected emissions and future energy costs are then calculated taking into account any expected changes (such as those from electricity imported from the National Grid) and future price changes.

The Decarbonisation interventions estimator uses a number of additional assumptions to calculate both overall energy impact and subsequent emissions and fuel consumption savings.

Measure	Description	Key driver / benchmark
LED	Energy demand reduced by factor based on size of the building and cost of lighting.	£/m <sup>2</sup>
BMS	Energy savings resultant and better monitoring and control systems	% kW / £
Building Fabric	Typical savings from building fabric upgrades (wall, windows, roof, and floor)	£ / m <sup>2</sup>
Heating	Estimation of heating systems size (by building use)	kW / m <sup>2</sup>
	Estimations of heating system costs	£ / kW
	Estimations of heating system efficiency	SCOP
Solar and Wind	Estimation of system size	kW / m <sup>2</sup>
	Estimation of system cost	£ / kW
	Estimation of system performance	Load factor

Other factors such as system efficiencies, emissions factors and future energy costs are as for the ones in use in the BAU estimator for consistency.

## 6.5 Background assumptions

There are a number of assumptions also used in the model. These relate to the efficiency of the current heating system, to the emissions related to fuel use, and costs over the period to be modelled. Where possible we have used the latest Green Book values, or established benchmarks from our work across multiple sites.

Measure	Description	Units
Unit cost (fuel)	<p>Unit cost estimations for each fuel and electricity imports from the grid are used to calculate to operational fuel costs. These values are based on the Green Book provided by HMT (last updated 17 January 2023).</p> <p>The user is able to import / create their specific price projections in the salmon cells for a number of fuels if required (note that will need to select “Local” from the Selections tab to use). It is important to provide a full projection up to 2050 as the costs will not be calculated for blank cells.</p>	£/kWh
Emission factors	<p>GHG emissions factors are used to calculate the emissions of a given quantity of energy.</p> <p>For most fuels / sources these values will remain constant over time. For grid supplied electricity however, the emission factor is dependent on the composition of the fuel used to generate electricity across the national grid which is decreasing as more renewables are integrated into the national grid.</p> <p>The model uses emission factors provided by HM Treasury Green Book (last updated 17 January 2023.)</p>	kgCO <sub>2</sub> e/kWh
Efficiency factors	Efficiency factors are used to calculate the percentage of energy supplied (to a building to meet demand) vs	%

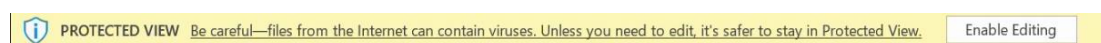


	<p>energy consumption (contained in the fuel).</p> <p>ESC has benchmarked a number of common systems and prepopulated the tool with these values.</p>	
Conversion factors	<p>Conversion factors can be used to calculate the energy associated with a fuel (in kWh) based on volume (litres or cubic meters). Conversion factors consider the calorific energy in each fuel based on its chemical composition which will not change over time.</p>	<p>kWh / l</p> <p>kWh / m<sup>3</sup></p>

## 7. Macro troubleshooting

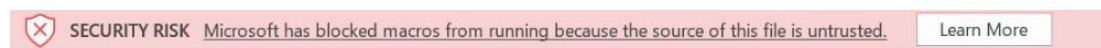
Please note that these estimators use macro-enabled MS Excel files. If you encounter anything unexpected, we've put together some guidance to address the most common messages. This advice is relevant for the latest version of MS Excel on Windows.

More likely: **File opens in Protect View**



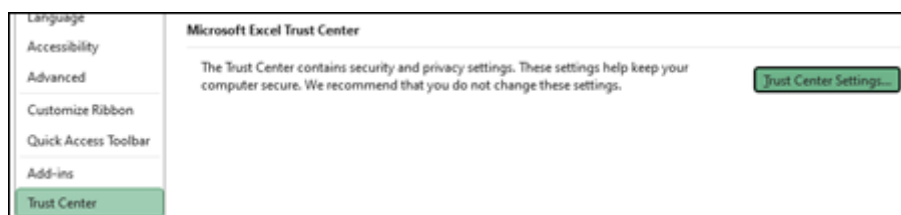
This is a common warning for files downloaded from the internet. Please simply click **Enable Editing** to be able to use the tool.

Less likely: **File opens with Security Risk message**

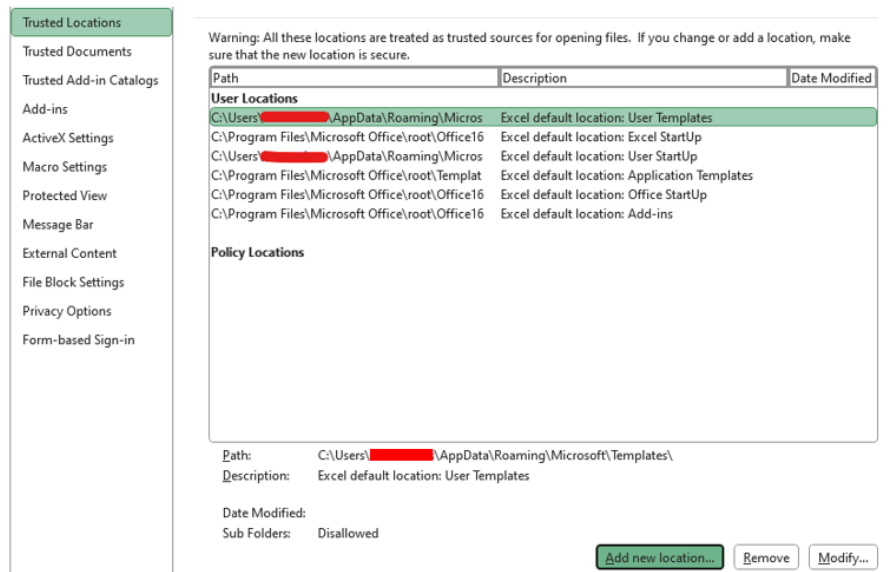


This warning is more common on later versions of Excel, as Microsoft has begun by default to restrict additional functionality that is required for the necessary usage of the tool.

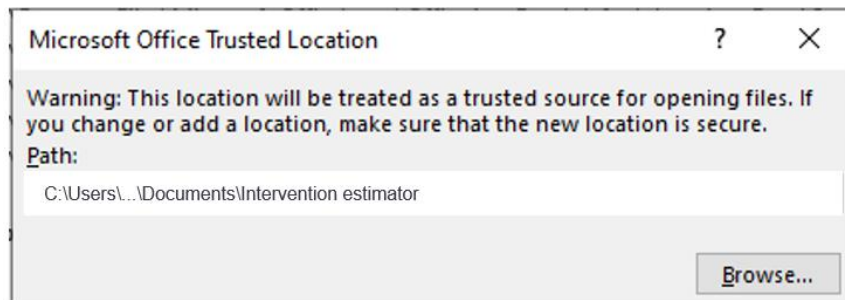
1. Save the downloaded tool in a new dedicated folder, e.g. create a folder in your **Documents** called **Intervention estimators** or other name of your choosing.
2. Open Excel and click **File** followed by **Options**.
3. Click **Trust Center**, followed by **Trust Center Settings**.



4. Go to Trusted Locations and click Add new location.



5. Click Browse and choose your new folder containing the tool.



**Note:** The dedicated folder method is recommended rather than choosing your default Downloads folder as trusted. This is because any other downloaded file would then be able to execute macros.

6. Click OK on all boxes to return to Excel. If the tool is open please close it and reopen it – the warning should now not appear.



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