Researchers in Schools

"Greenify" your school

Key Stage 4 Programme

Pupil Name

Coursebook Designed by **Dr. Rodriguez**

Timetable and Assignment Submission

Timetable – Tutorials

Tutorial	Date	Time	Location
1	02/12/2019	13:00- 14:00	University of London
2	9/12/2019	15:30-16:30	Desborough College
3	16/12/2019	15:30-16:30	Desborough College
4	06/01/2020	15:30-16:30	Desborough College
5	13/01/2020	15:30-16:30	Desborough College
6 (Feedback)	27/01/2020	15:30-16:30	Desborough College
7 (Feedback)	03/02/2020	15:30-16:30	Desborough College

Timetable – Homework Assignments

Homework Assignment	Description	Due Date
Tutorial 1	Baseline Assignment	9/12/2019
Tutorial 2	TM22 calculation table	16/12/2019
Tutorial 3	Payback period calculations	06/01/2020
Tutorial 4	Energy consumption behaviours	13/01/2020
Tutorial 5	Final assessment (draft/presentation and final essay)	03/02/2020 and 24/02/2020

Assignment Submission – Lateness and Plagiarism

Lateness	
Submission after midnight on 24th February 2020	10 marks deducted
Plagiarism	
Some plagiarism	10 marks deducted
Moderate plagiarism	20 marks deducted
Extreme plagiarism	Automatic fail

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Course Rationale

Tackling climate change is one of the greatest challenges facing the 21th Century. Energy saving constitutes a primary measure for the protection of the environment and for the reduction of the use of polluting fossil fuels. Currently, the global energy use contributed by buildings is about 40%, of which a significant proportion might be wasted due to an inefficient use of these energy.

Energy consumption of existing buildings can often be reduced by introducing energy saving measures. These savings can be achieved with little cost, such as improving energy behavioural consumption, or with high initial investment costs, required for energy technologies implementation in buildings. It is necessary to analyse the potential energy-saving effects of the measures in advance, so that electricity use in buildings and pay back periods can be estimated. Energy audit are useful tools for evaluating the potential for these measures in buildings.

In this course you will learn what an energy audit is and who to implement it. It will covert energy estimations methods and cost-efficiency energy measures, along with renewables and smart technology implementation in buildings. The course will be taught in the style of university tutorials and the final assignment will be similar to the work you would be set at university. You will learn how to prepare an energy audit report and deliver this to the group at a mini presentation, as well as how to write a proposal essay, based on what you have learnt in the course.

The overall aims of the course are:

- To understand what is an energy audit and how it can reduce energy consumption in buildings.
- To evaluate the potential benefits and disadvantages of different energy measure and technologies.
- To develop critical thinking and decision making skills.

Uni Pathways Mark Scheme 2019 – Essay-based assignments

	Skills	1st (70-100)	2:1 (60-69)	2:2 (50-59)	3rd (40-49)	Mark /100
Subject knowledge	Knowledge and understanding	○ All content included and materials used are relevant to the general topic and to the specific question/title ○ Good understanding of all the relevant topics. ○ Technical terms are defined and used accurately throughout ○ Clear justification of how the material and content included is related to the specific issues that are the focus of the assignment	○ Most of the materials used and content included are relevant to the general topic and to the specific question/title ○ Good understanding of most the relevant topics ○ Technical terms are mostly defined and used accurately ○ Adequate justification of how the material used and content included are related to the specific issues that are the focus of the essay	○ Some of the materials used and content included are relevant to the general topic and to the specific question/title ○ Good understanding on some of the relevant topics but occasional confusion on others ○ Technical terms are sometimes used and defined accurately ○ Some justification of how the material used and content included are related to the specific issues that are the focus of the essay	○ The content included and materials used are not applied to the question/title in a relevant manner ○ There is confusion in how understanding of the topics is expressed	
Critical thinking	Research and evidence	○ Includes rich sources of research findings, data, quotations or other sourced material as evidence for the claims/ideas ○ Uses evidence/calculations to support claims/assertions/ideas, consistently clearly and convincingly ○ Evidence of further reading beyond materials provided which were used in an appropriate context ○ Data is effectively analysed and appropriate assumptions/conclusions are reached	○ Includes adequate sources of research findings, data, quotations or other sourced material as evidence for the claims/ideas ○ Uses evidence/calculations to support claims/assertions/ideas, mostly clearly and convincingly ○ Evidence of further reading beyond materials provided ○ Data is analysed and the assumptions/conclusions that are reached are mostly appropriate	○ Includes some sources of research findings, data, quotations or other sourced material as evidence for the claims/ ideas ○ Uses evidence/calculations to support claims/assertions/ideas, at times clearly and convincingly ○ Limited evidence of further reading beyond materials provided ○ There is an attempt to analyse data is and draw assumptions/conclusions	○ Inclusion sources and materials is very limited and mostly not attributed ○ Applicable sources are rarely used to support ideas. ○ Data is not used or few appropriate conclusions are drawn from it.	
	Developing an argument	○ A point of view or position in relation to the title or question is consistently clear. The position is developed effectively and consistently throughout the essay ○ Argument is exceptionally well-developed and well-justified ○ Makes links effectively between subjects that have not previously been associated ○ Uses concepts from the tutorials in an unfamiliar context and does so accurately and confidently.	○ A point of view or position in relation to the title or question is adequately clear. The position is well-developed in most of the essay ○ Argument is clear and well-developed, and position is justified ○ Some evidence of linking subjects that have not previously been associated ○ Uses some concepts from the tutorials in an unfamiliar context, but not always accurately ○ Analyses content to support the	○ A point of view or position in relation to the title or question is somewhat clear. The position is well-developed in parts of the essay ○ Argument is clear but not well-developed ○ Limited evidence of linking subjects that have not previously been associated ○ Limited use of concepts from the tutorials in other contexts ○ Uses some analysis of content to support the argument	○ There is not a clear point of view or position taken and sometimes the argument is not clearly established	

		○ Content is analysed effectively to support the argument	argument			
	Critical evaluation	○ Moves beyond description to an assessment of the value or significance of what is described ○ Evaluative points are consistently explicit/systematic/reasoned/justified ○ Effectively critiques the reliability of sources provided	○ Mostly description but some assessment of the value or significance of what is described ○ Evaluative points are mostly explicit/systematic/reasoned/justified ○ Some evidence of critiques on the reliability of sources provided	○ Describes with minimal assessment of the value or significance of what is described ○ Evaluative points are at times explicit/systematic/reasoned/justified ○ Limited evidence of critiques on the reliability of sources provided	○ The work is descriptive in nature and there is a lack of critical engagement in the value of sources	
Written communication	Structure and presentation	○ Ideas are presented in paragraphs and arranged in a logical structure that is appropriate for the assignment ○ The introduction clearly outlines how the essay/report will deal with the issues ○ The conclusion summarises all the main points clearly and concisely ○ All calculations, formulas and methods are clearly structured, clear to follow and correct ○ Tables and graphs are effectively constructed including appropriate headings, units and scales. ○ All sources are referenced correctly in an agreed format	○ Ideas are presented in paragraphs and arranged in a structure that is mostly appropriate for the assignment ○ The introduction adequately describes how the essay/report will deal with the issues ○ The conclusion summarises most of the main points clearly ○ Calculations, formulas and methods are mostly structured, clear to follow and correct ○ Most tables and graphs are well constructed ○ Most sources are referenced correctly in an agreed format	○ Ideas are presented in paragraphs and arranged in a structure ○ The introduction mentions how the essay/report will deal with the issues ○ The conclusion summarises some of the main points clearly ○ Calculations, formulas and methods are not always structured, clear to follow and correct. ○ Some tables and graphs are well constructed but contains some errors ○ Some sources are referenced correctly in the agreed format with occasional errors	○ Ideas are presented in paragraphs but there is a lack of structure in how the work is presented ○ The work lacks an introduction that establishes the scope of the question ○ The work lacks a conclusion that summarise the main points raised ○ Work is not referenced accurately	
	Language and style	○ No spelling, grammar or punctuation errors ○ Writing style consistently clear, tone appropriate and easy to follow ○ Accurate and consistent use of technical language and vocabulary	○ Minimal spelling, grammar or punctuation errors ○ Writing style mostly clear, tone appropriate and easy to follow ○ Some attempts of using technical language and vocab alary, but not always accurate	○ Some spelling, grammar or punctuation errors ○ Writing style moderately clear, tone appropriate and easy to follow ○ Use of simple language and vocabulary effectively but struggles to use technical language	○ There are a significant number of spelling, grammar and punctuation errors ○ Use of simple language and vocabulary effectively but a lack of technical language	

Baseline Assignment (essay based): Pupil Feedback Report

Name of Pupil	
Name of School	
Name of RIS teacher	
Title of Assignment	

How your assignment is graded:

Grade	Marks	What this means
1st	70+	Performing to an excellent standard at A-level
2:1	60-69	Performing to a good standard at A-level
2:2	50-59	Performing to an excellent standard at GCSE
3rd	40-49	Performing to a good standard at GCSE
Working towards a pass	0-39	Performing below a good standard at GCSE
Did not submit	DNS	No assignment received by The Brilliant Club

Lateness	
Any lateness	10 marks deducted
Plagiarism	
Some plagiarism	10 marks deducted
Moderate plagiarism	20 marks deducted
Extreme plagiarism	Automatic fail

Marks

OVERALL MARK / 100		FINAL MARK / 100 (including any deductions)	
DEDUCTED MARKS		FINAL GRADE	

If marks have been deducted (e.g. late submission, plagiarism) the teacher should give an explanation in this section:

Mark Breakdown and Feedback

Knowledge and Understanding		Research and Evidence	
	mark		*mark*
Developing an Argument		**Critical Evaluation**	
	mark		*mark*
Structure and Presentation		**Language and Style**	
	mark		*mark*

Final Assignment (essay based): Pupil Feedback Report

Name of Pupil	
Name of School	
Name of RIS teacher	
Title of Assignment	

How your assignment is graded:

Grade	Marks	What this means
1st	70+	Performing to an excellent standard at A-level
2:1	60-69	Performing to a good standard at A-level
2:2	50-59	Performing to an excellent standard at GCSE
3rd	40-49	Performing to a good standard at GCSE
Working towards a pass	0-39	Performing below a good standard at GCSE
Did not submit	DNS	No assignment received by The Brilliant Club

Lateness	
Any lateness	10 marks deducted
Plagiarism	
Some plagiarism	10 marks deducted
Moderate plagiarism	20 marks deducted
Extreme plagiarism	Automatic fail

Marks

OVERALL MARK / 100		FINAL MARK / 100 (including any deductions)	
DEDUCTED MARKS		FINAL GRADE	

If marks have been deducted (e.g. late submission, plagiarism) the teacher should give an explanation in this section:

Mark Breakdown and Feedback

Knowledge and Understanding		Research and Evidence	
	mark		*mark*
Developing an Argument		**Critical Evaluation**	
	mark		*mark*
Structure and Presentation		**Language and Style**	
	mark		*mark*

Subject Vocabulary

Word	Definition	In a sentence
Climate change	Occurs when changes in Earth's climate result in new weather patterns that remain in place for a long period of time.	Climate change is already affecting the planet and society and will continue to do so for generations to come.
Energy management	Is a global term which encompass all effects providing reduction in energy cost, direct energy gain and/or extra energy regeneration.	The objectives of energy management strategies are resource conservation, climate protection and cost savings.
Energy efficiency	Is the goal to reduce the amount of energy required to provide products and services.	An easy way to improve your home's energy efficiency is to unplug appliances when not used.
Energy consumption behaviour	Is the way in which energy is being used by consumers.	Energy efficiency can be achieved through energy consumption behaviour changes.
Energy audit	Is an inspection survey and an analysis of energy flows for energy conservation in a building.	A simple energy audit can reduce the energy consumption of your business.
Photovoltaic Panel	Absorb sunlight as a source of energy to generate direct current electricity.	A typical photovoltaic system employs solar panels which generate electrical power.
Wind Turbine	Is a device that converts the wind's kinetic energy into electrical energy.	Wind turbine blades rotate when hit by the wind.
Building Integrated	Is a comprehensive approach to design which considers the whole building design.	The roof tiles have been replaced by building integrate photovoltaic panels.
Payback period	Is the length of time required for an investment to recover its initial outlay in terms of profits or savings	Small businesses tend to focus on projects with short payback periods.
Smart building	Is a term used to describe buildings that include technologies such as automated and energy management systems.	The smart building will require connectivity between all the equipment and systems in a building.

Tutorial 1 – Climate Change

What is the Purpose of Tutorial 1?

At the end of this tutorial I will be able to…….

- define what is mean by climate change
- understand what is causing recent climate change
- identify the main consequences of recent climate change

Climate Change, what it really means?

Climate change has become a trending topic. Images of the disasters caused by this phenomenon constantly appear in newspapers, TV and media. As a result, general public, especially young people, are more and more concern about climate change and its effects. But, do we really know what climate change is?

Starter: *In one sentence, explain what is mean by climate change. Share your definition with the rest of the class and note down other that you have liked.*

Your:

Others:

What is causing climate change?

The concept of climate change is not new, actually, Earth's climate has changed many times throughout history. Just in the last 650,000 years there have been seven cycles of glacial due to natural causes.

Activity 1: *For the four pictures bellow, decide which of them are caused by human action and which by natural causes?*

1.a: *1.b:*

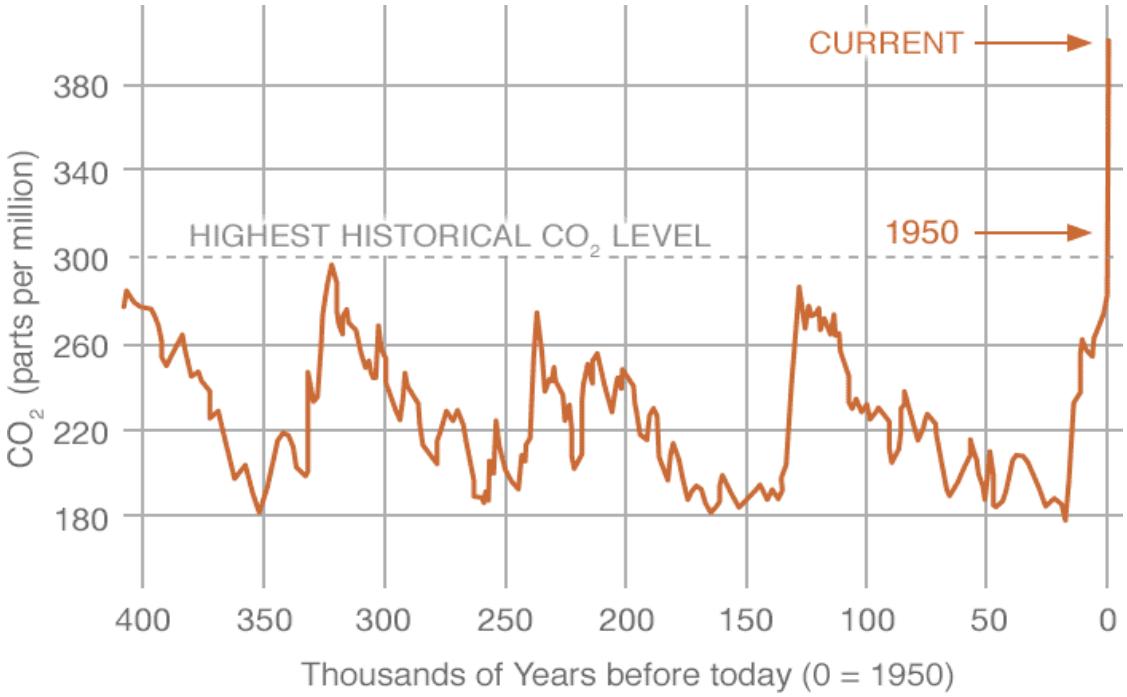
1.c: *1.d:*

Notes:

So, if climate change has always existed, why should we care now?

One of the biggest challenge of activists and researchers is to justify the attribution of climate change to human actions. Recent scientists' research has shown that it is extremely likely that human activity has been the dominant cause of warming since the mid-20th Century.

Activity 2: *Concentration of CO_2 on Earth can be measured from ice cores. Based on this scientific technique, the following graph shows the CO_2 concentrations over the last 800,000 years. In groups of two, discuss the shape of the graph and explain why is so high at the end.*



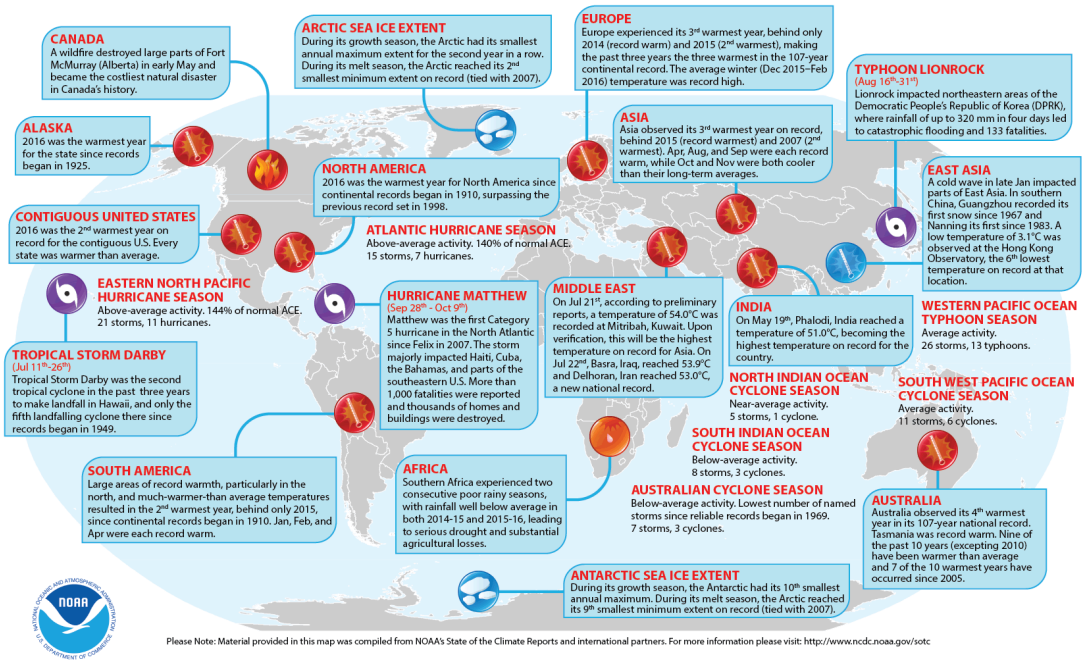
Explanation:

The consequences of climate change across the Earth

But, why does an increase in global average temperature of 1°C or 2°C actually matter? It may seem a small difference but raising the surface temperature of the whole planet: air, land and oceans, by this amount means a vast amount of additional energy in the system that is unevenly distributed.

Activity 3: *The following diagram presents some significant climate anomalies events that have taken place in 2016 across the whole Earth. Take a couple of minutes to read through them, choose one and share your thoughts with the rest of the class (there are space at the end of the activity to write down your notes).*

Selected Significant Climate Anomalies and Events in 2016



Notes:

Baseline Assignment

Imagine you have been elected as the mayor of Maidenhead. Write a short report (approx. 500 words), covering the following key points:

- *Introduction:*
  - ✓ *Why it is so important to tackle climate change nowadays? (approx. 100 words)*
- *Main body:*
  - ✓ *Which strategies/ measures would you implement to tackle climate change? (approx. 150 words)*
  - ✓ *What would be the impact of your strategies and measures and how will you prove to your citizens that they work? (approx. 150 words)*
- *Conclusion:*
  - ✓ *Summarise your key points and main recommendations (50 words)*

You can include diagrams, graphs, pictures, figure and calculations to support your explanations.

Success criteria	Baseline assessment
Knowledge and understanding	Include content that is relevant to the climate change topic and the specific assignment question. Include key words from the glossary and demonstrate that you understand them by explaining what they mean and how they relate to climate change.
Research and evidence	Include research findings from a wide range of sources. As well as using the sources provided and others discovered by yourself. Include relevant data.
Developing an argument	Give reasons and evidence to back up the points that you make. You might find the PEE structure helpful: • Point – make the key point clear • Evidence – explain the evidence for the point • Explanation – explain why your point is relevant and important
Critical evaluation	Include critical evaluation of your propositions.
Structure and presentation	Organise your ideas in paragraphs with a logical structure: Include an introduction that clearly outlines what the assignment will contain, a main body and a conclusion that summarises all the key points clearly. Make sure your calculations, formulas and methods are clear and structured correctly and that you have referenced everything correctly (see appendix 1).
Language and style	Make sure your spelling, grammar and punctuation are accurate and use a formal style of writing.

Tutorial 1 additional Resources

- Nasa website: www.climate.nasa.gov
- WWF website: www.wwf.org.uk/effectsofclimatechange

Tutorial 2 – Why worry about buildings?

What is the Purpose of Tutorial 2?

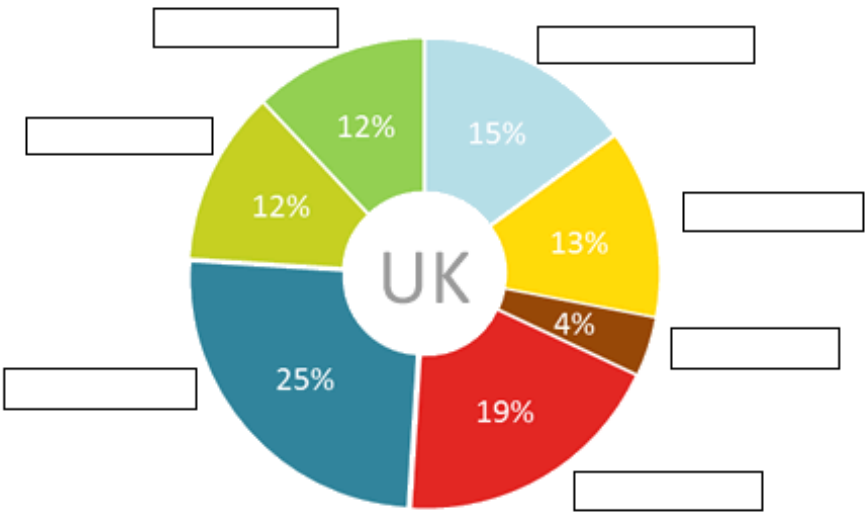
At the end of this tutorial I will be able to…….

- understand the impact of buildings in climate change
- be able to read information from EPCs and DECs
- make energy consumption calculations

The energy consumption in buildings

The global buildings sector is responsible for 40% of final energy consumption and more than 55% of global electricity demand. To generate electricity, most power plants burn coal, crude oil or other fossil fuels. Reduce the use electricity demand at buildings is, therefore, an efficient way of talking climate change. But, in order to reduce, we need to understand how this energy is being used.

Starter: *The following pie chart presents the percentage of energy usage of the different appliances in a typical UK house. In pairs, fulfil the boxes using an item from the following list: Entertainment, Heating, Lighting, Refrigeration, Cooking and Washing.*



What do you need to know about EPCs and DECs

An Energy Performance Certificate (EPC) measures the energy efficiency of a property and the impact that the home, in terms of Carbon Dioxide (CO_2) emissions, has on the environment on a "current" scale rate of A-G. The Certificate also includes recommendations on ways to improve the home's energy efficiency to save you money and help the environment and shows the "potential" new scale rate that can be achieved. Display Energy Certificates (DECs) are the equivalents certificates for commercial buildings and are designed to increase transparency about the energy efficiency of public building.

Activity 1: *Take a couple of minutes to analyse the EPC from 2007 provide in appendix 2. In pairs, answer the following questions.*

2.1.- What is the operational indicator? How are they used for?

2.2.-The building is being operated above or below the average performance for a building of this type? Has it improved since 2005?

2.3.- What is the amount of annual electricity in (kWh/m2/year) currently consumed by the building? Has it improved since 2005?

2.4. What is the main heating fuel source? How much has heating consumption improved since 2005? Why do you think is due to?

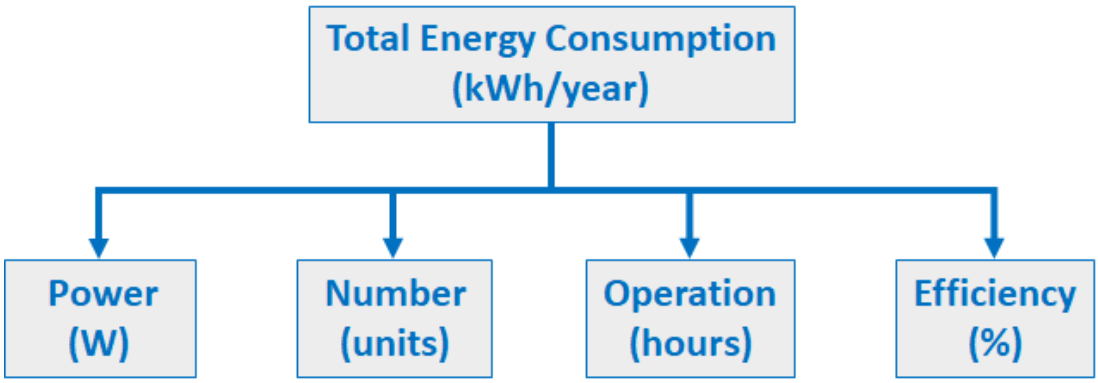
2.5.-What is the amount of electricity in (kWh/m2/year) currently produced by renewables sources? How would you increase this amount and how do you think that would affect the operational rating of the building?

Energy consumption calculator

Energy companies use a unit called kilowatt-hour (kWh) to measure energy consumed. A kilowatt-hour is the amount of energy transferred in one hour by an appliance with a power of 1 kW. There are several ways of estimate the energy consumed by an appliance or system; using energy meters (we will cover this technology in tutorial 5) or through calculation methods.

The TM22 CIBSE calculation method estimates the total energy consumed by each appliance type in one year, based on four input factors:

- *Power (Watt):* is the rate at which work is done, or energy is transmitted by each appliance (watt = joules/second).
- *Number (Units):* the number of installed individual appliances.
- *Operational (hours):* the number of hours per year that the appliance is working.
- *Efficiency (%):* the percentage of useful power delivered by each appliance in relation with its total power consumed.



Activity 2: *The following table* provides the energy input factors for different appliances founded in a typical an office building. *In pairs,* calculate the total annual energy consumed by each of the appliances using the TM22 method. *What is the total annual energy consumption by the office?*

(The first row has been calculated for you and examples of power and efficiency data for each appliance provided in the table).

Light: $60\,W * 100\,Units * 6\,h * \frac{50}{100}\% = 18000\,Wh * \frac{1\,kWh}{1000\,Wh} = 18\,kWh$

Appliance	Power (W)	Number (Units)	Operational (hours)	Efficiency (%)	Total annual energy (KWh)
Light	60	100	6	50	18
Computer	150			25	
Projector	300			30	
Kettle	3000			40	
Microwave	1000			20	
Dishwasher	1300			25	
Fridge	150			60	
Heating	750			40	
Fan	30			50	

Calculations:

Tutorial 2 homework

At your home, using a TM22 calculation table, calculate how much energy is consumed annually.

Appliance	Power (W)	Number (Units)	Operational (hours)	Efficiency (%)	Total annual energy (KWh)

Calculations:

Success criteria	Baseline assessment
Knowledge and understanding	Use of proper notation and terminology.
Research and evidence	Include power and efficiency relevant data for each appliance. Use the sources provided and others discovered by yourself.
Critical evaluation	Include critique response to the problem, based on your calculations.
Structure and presentation	Make sure your calculations, formulas and methods are clear and structured correctly and your work is neatly presented.

Tutorial 2 additional Resources

- A guide to display energy certificates and advisory reports for public buildings: assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/452481/DEC_Guidance__rev_July_2015_.pdf

Tutorial 3 – Building Integrated Renewable Energy

What is the Purpose of Tutorial 3?

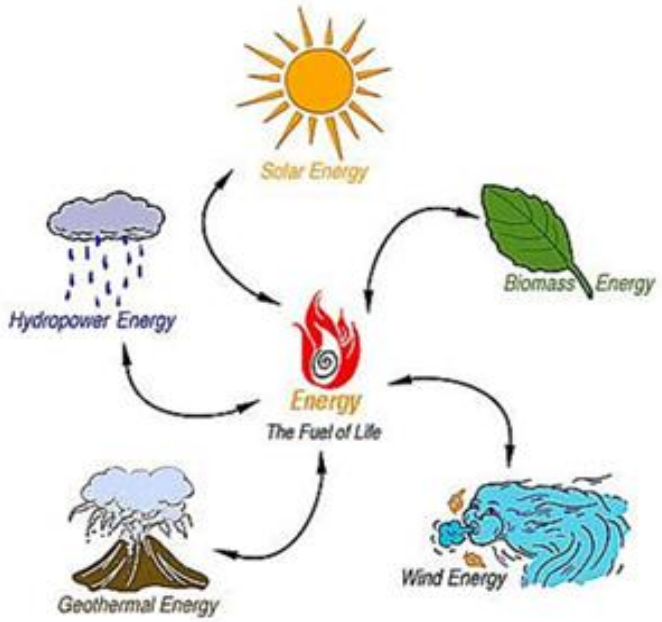
At the end of this tutorial I will be able to…

- decide which renewable energy techniques are more suitable for being implemented in a building.
- describe how different integrated renewable technologies operate.
- conduct payback period calculations.

Renewable sources

There are many types of renewable energy sources that can be implemented using different technologies. However, not all of these technologies are suitable for buildings. The type of renewable technology that can be integrated within a building and their success will depend on their architecture and surroundings.

Starter: *In pairs, discuss which of the following renewable sources are the easiest for being integrated in a building. Share your ideas with the rest of the class.*



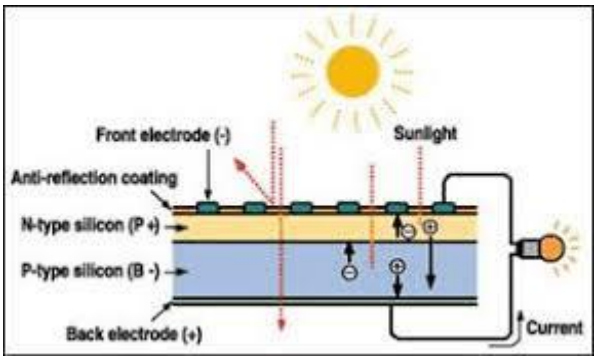
Notes:

Different solar panels

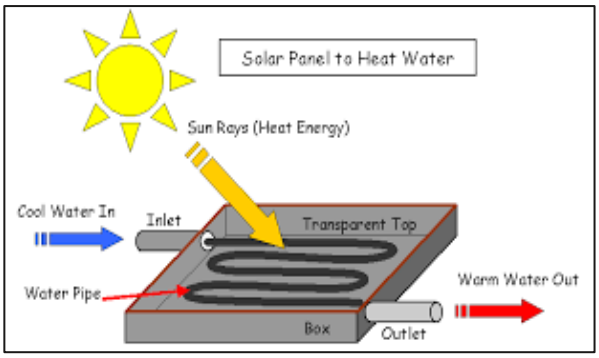
Of the various renewable energy systems that can be installed in the building solar energy systems are currently the most widely used, mostly in the form of solar thermal and photovoltaic systems. The principle behind both types of solar panel – solar photovoltaic

(PV) and solar thermal – is the same. They absorb raw energy from the sun and use it to create usable energy, however, this energy is delivered in different ways.

Activity 1: *In pairs, discuss the following pictures and identify three differences between photovoltaic and thermal panels.*



Photovoltaic panel



Thermal panel

Difference 1:_____

Difference 2:_____

Difference 3:_____

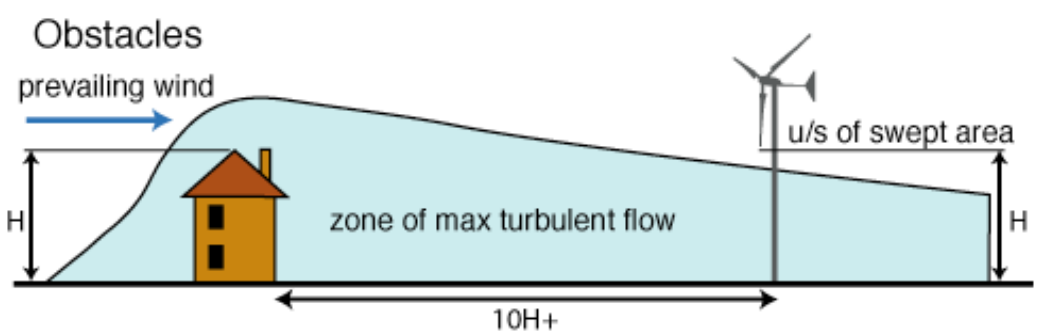
Small wind turbines

A wind turbine is a device that converts the wind's kinetic energy into electrical energy. Small wind turbines (1-6 kW) are manufactured in a wide range of vertical and horizontal axis and may be used for a variety of applications including on- or off-grid residences, telecom towers, rural schools and clinics.

If used appropriately, domestic wind turbines can generate useful electricity, however there is a number of requirements that need to be considered before their installation, particularly in urban areas.

1. To avoid turbulences, wind turbines need a minimum of 10m above the highest point of roof and others closer obstacles, as neighbour buildings.

Activity 2: *Draw three turbines away from the turbulences caused by obstacles*



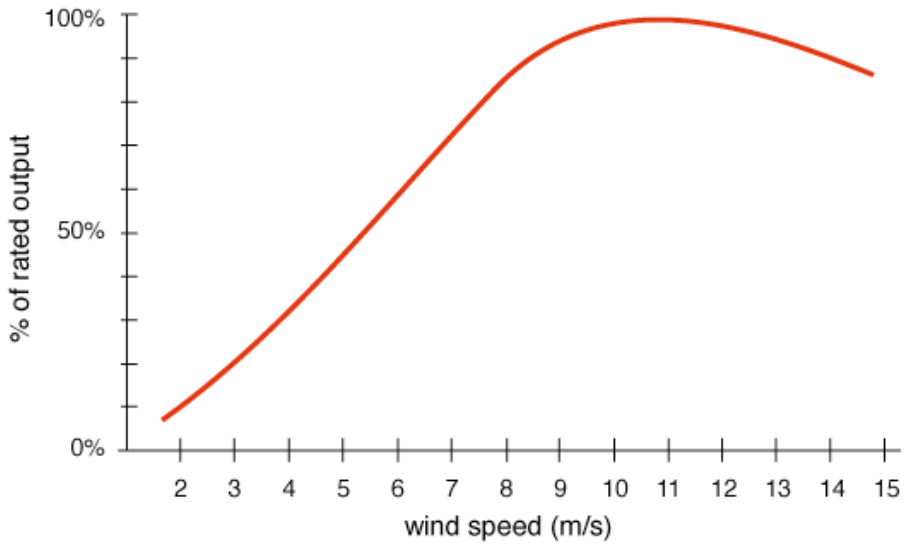
2. (Wind Power) is proportional to (Wind Speed)^3

Activity 3: *Plot a graph with the table data*

height above ground	wind speed
150 m	7.94 m/s
140 m	7.87 m/s
130 m	7.78 m/s
120 m	7.70 m/s
110 m	7.60 m/s
100 m	7.50 m/s
90 m	7.39 m/s
80 m	7.26 m/s
70 m	7.11 m/s
60 m	6.95 m/s
50 m	6.75 m/s
40 m	6.51 m/s
30 m	6.19 m/s
20 m	5.75 m/s
10 m	5.00 m/s

3. The power curve is distinctive for every model of wind turbine and illustrates the power output at a given wind speed.

Activity 4: *From the graph bellow, which is the optimal wind-speed for the performance of the wind turbine?*



4. The power output equation: Output = CPoa x A x PA x G. Where:
   - *CPoa* is the efficiency of the rotor to convert energy (the maximum practical efficiency is 35%)
   - *A* is the swept area of the blade
   - *PA* is the power density of the wind = 0.6125 x S^3, where *S* is the wind speed in m/s
   - *G* is the generator efficiency

Activity 5: *Calculate the power output for a turbine with a 1.75 diameter rotor at a wind speed of 10m/s and 5m/s with a power coefficient of 0.35 and a generator efficiency of 90% (tip: A=2πr)*

Tutorial 3 homework

The payback period tells you how long it will take to save the money that an integrated renewable technology cost and is calculated used the equation bellow:

Payback time (years) = cost of the technology (£) /saving per year (£)

Where: Saving per year (£) = Energy produced in a year (kWh) * Price of electricity (£)

Problem 1: *A standard photovoltaic solar panel has an input rate of around 1000 Watts per square meter, however on the solar panels available at present you will only gain roughly 15-20% efficiency at best. If you want to set up four square meter of photovoltaic panels in your roof, how much power (W) would it likely produce?*

The price of a standard square meter of photovoltaic panels in the UK is 300£. What will be the payback period of your new panels? (consider 14.37p per kWh*)*

Problem 2: *The installed costs of 5kW small-scale turbines is £5,000. If the turbine has 1.75m diameter generating 966 kWh/pa at an average wind speed of 5m/s and given the current cost of electricity at around 12 pence per kWh, calculate its payback period.*

Success criteria	Baseline assessment
Knowledge and understanding	Use of proper notation and terminology.
Research and evidence	Include relevant data for each problem. Use the sources provided and others discovered by yourself.
Critical evaluation	Include critique response to the problem, based on your calculations.
Structure and presentation	Make sure your calculations, formulas and methods are clear and structured correctly and your work is neatly presented.

Tutorial 3 additional Resources

Alternative Energy guide: www.altenergy.orgv

Tutorial 4 – Energy Efficient Measures

What is the Purpose of Tutorial 4?

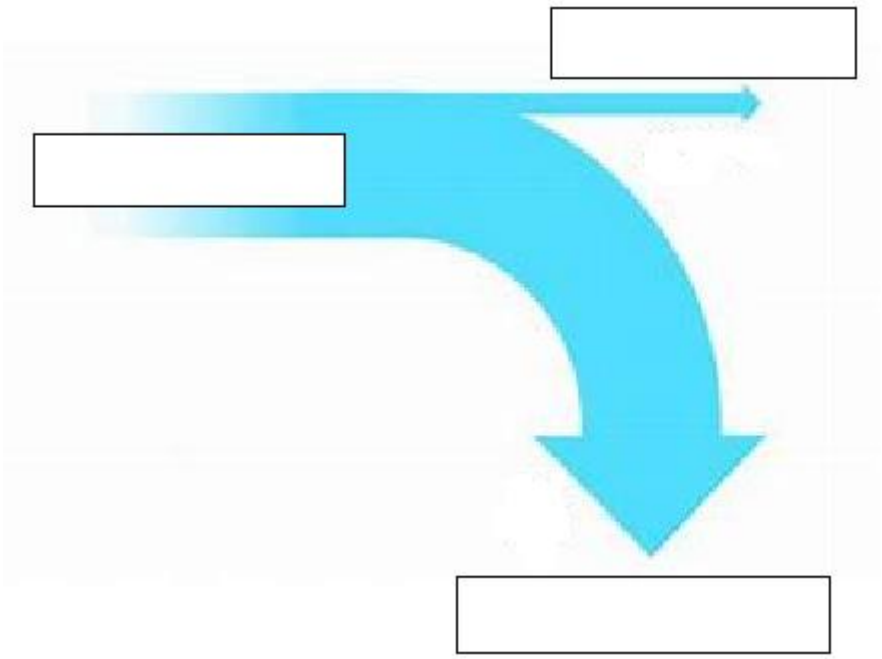
At the end of this tutorial I will be able to…

- define what is mean by energy consumption behaviour and energy efficient measure
- identify and describe some of the main energy efficient measures that can be implemented in buildings
- conduct energy performance calculations

Energy efficiency

Efficient energy use, sometimes simply called energy efficiency, is the goal to reduce the amount of energy required to provide products and services.

Starter: *Complete the following Sankey diagram. Do you think it represents an efficient system? Why?*



How can your habits affect energy use?

Buildings can be excellently designed by teams of engineers and architects but until they are occupied by users it is very difficult to understand how they will be used. This is predominately because people use buildings in an unpredictable way.

Activity 1: *Watch the video and, in pairs, identify three consumption habit issues and how the heroes of the history overcome them. Discus with the class.*

1-

2-

3-

Switching into efficiency, it is profitable?

Since energy efficient appliances spend the minimum amount of energy to complete their tasks, they are able to enhance the level of energy conservation and therefore, reduce your energy bill. However, they also are more expensive that conventional appliances.

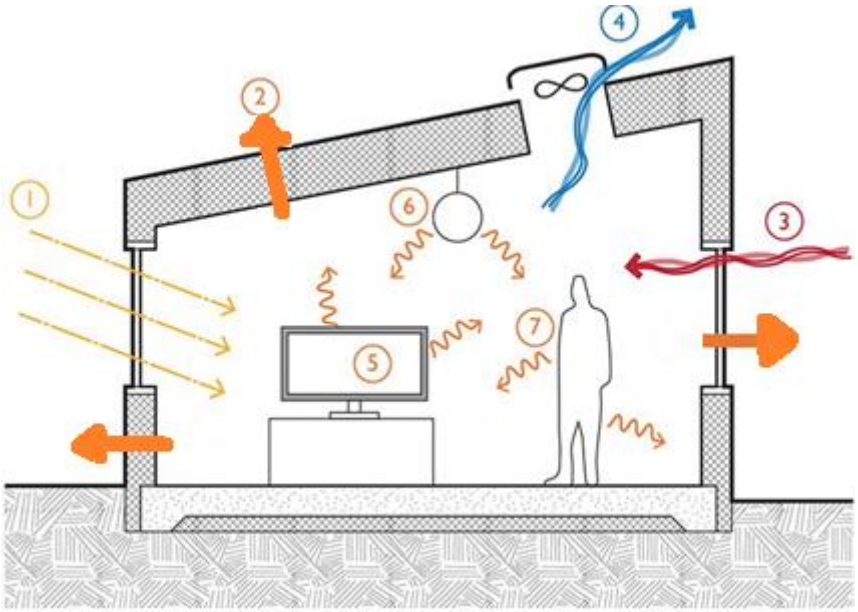
Activity 2: *In pairs, describe the advantages and disadvantages of each of following lamp, including their efficiency and payback periods.*

Energy saving lamp:	Filament lamp:
Power=15W	Power=60W
Cost=£1.50	Cost=£0.30
Lifetime=10 000hours	Lifetime=1 000hours
Produce 20J of light energy for each 100J of electrical energy supplied	Produce 5J of light energy for each 100J of electrical energy supplied

Heat gain and losses

Heat loss is a measure of negative heat transfer through a building's fabric from the inside to the outside. This can be due to either convection, conduction, radiation, or a combination. The colder the outside temperature, the warmer the inside, and the worse the thermal insulation of the building fabric, the greater the heat loss will be. Heat gains can also be produced, due to solar heat coming from the outside, or the heat released by people and appliances from the inside of the building.

Activity 3: *In pairs, identify the source of heat gain and losses in the following diagram*



1

2

3

4

5

6

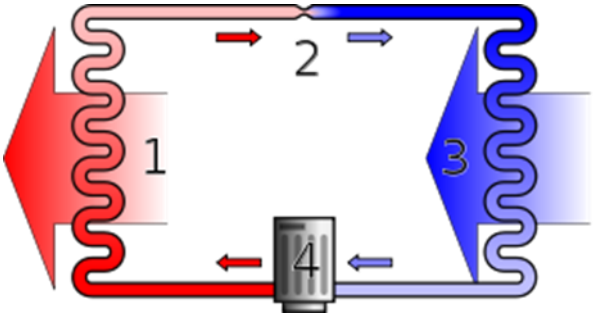
7

Activity 4: *Does the previous heat diagram correspond to an example of a good insulated building? How will you improve it?*

Heat pumps

A heat pump is an extremely efficient device that uses a small amount of energy to pull heat out of the air, ground, rivers and other low grade heat sources - effectively moving heat from one location to the other. When comparing heat pumps with conventional fossil fuelled heating plants, both can result in reduced global CO_2 and local NOx emissions.

Activity 4: *Have look to the following simplified diagram of a heat pump's vapor-compression refrigeration cycle. Discuss them with the class and then explain what is happening for each of the four main process of the cycle.*



1- Condenser:

2- Expansion valve:

3- Evaporator:

4- Compressor:

Activity 5: *For every 1 kWh of electricity, a standard air source heat pump can produce 3kWh of heat. The average annual demand for most homes in the UK is 12,000 kWh, from which around the 25% is used for heating the house. Calculate the annual energy that can be save with a typical heat pump.*

Tutorial 4 homework

Imagine you are the owner of a big company *that want to reduce the energy use of his building. Create as logo and a slogan to encourage your workers to improve their energy consumption behaviours and provide some tips to reduce the energy usage of the building.*

Success criteria	Baseline assessment
Knowledge and understanding	Include content that is relevant to the energy use in building Include key words from the glossary
Research and evidence	Include research findings from a wide range of sources. As well as using the sources provided and others discovered by yourself. Include relevant data.
Developing an argument	Give reasons and evidence to back up the points that you make.
Structure and presentation	Organise your ideas with a logical structure. Make sure your logo design is simple and clear.
Language and style	Make sure your spelling, grammar and punctuation are accurate.

Tutorial 4 additional Resources

Tips for creating a logo: 99designs.co.uk/blog/logo-branding/how-to-design-logo/
Tips for creating a slogan: www.verticalresponse.com/blog/7-tips-to-creating-a-memorable-slogan/

Tutorial 5 – Smart Buildings

What is the Purpose of Tutorial 5?

At the end of this tutorial I will be able to…

- describe what is a ``Smart building''
- explain what is a smart meter
- understand the structure and content of a proposal project

What makes a building smart?

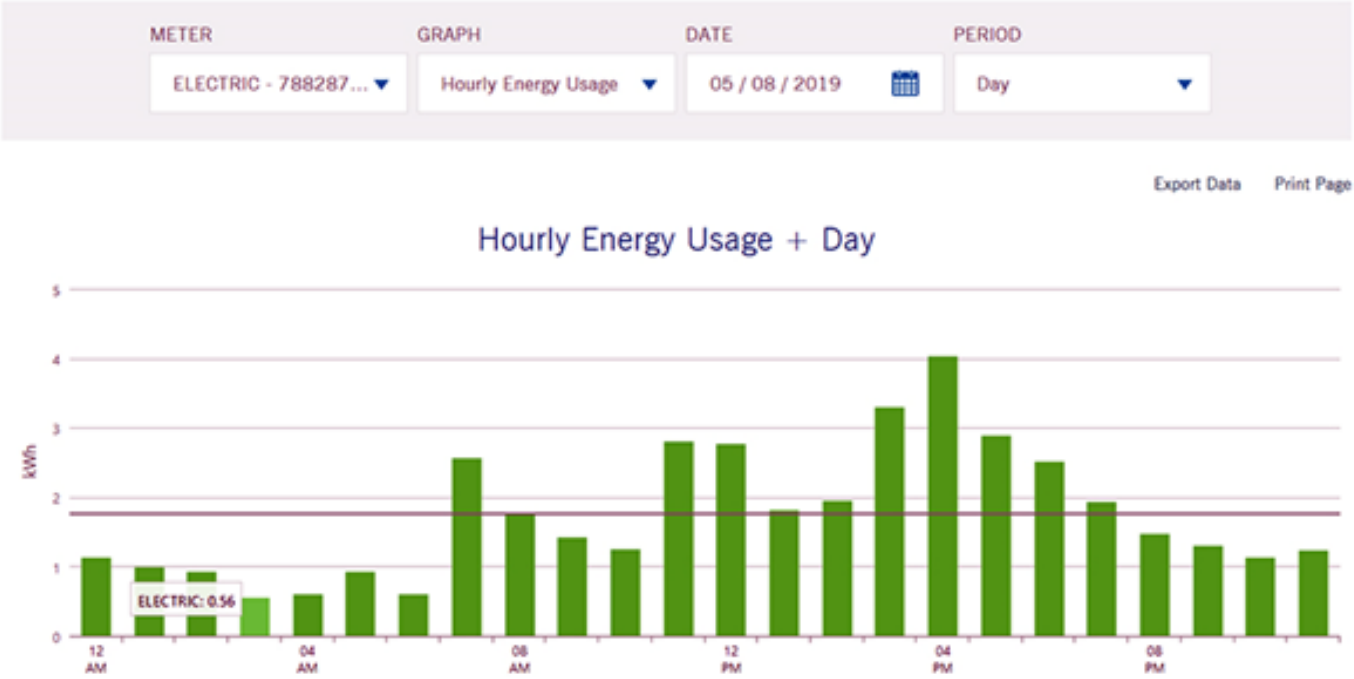
There is no single set of standards that makes up what a smart building is, but what they all have in common is integration. Many new building have "smart" technology, and are connected and responsive to a smart power grid. Smart building strategies can reduce energy costs, increase the productivity of the facility staff, improve building operations, support sustainability efforts and enhance decision-making across the organization.

Starter: *Watch the video and describe, in your own words, what is a "smart building"*

Smart metering

A smart meter is the next generation of a gas and electricity meter. They're being installed by energy suppliers in every home in England, Scotland and Wales. Smart meters come with an in-home display screen that shows you exactly how much energy you're using in pounds and pence, in near real time and will bring an end to estimated bills. Smart meters measure how much gas and electricity you are using, as well as what it is costing you and display this on a handy in-home display.

Activity 2: *The following graph present the hourly energy usage of a house during one day. In pairs, have a look to the graph and answer the following questions:*



Identify three hours of maximum consumption:

Why do you think these maximums are happening at these times?

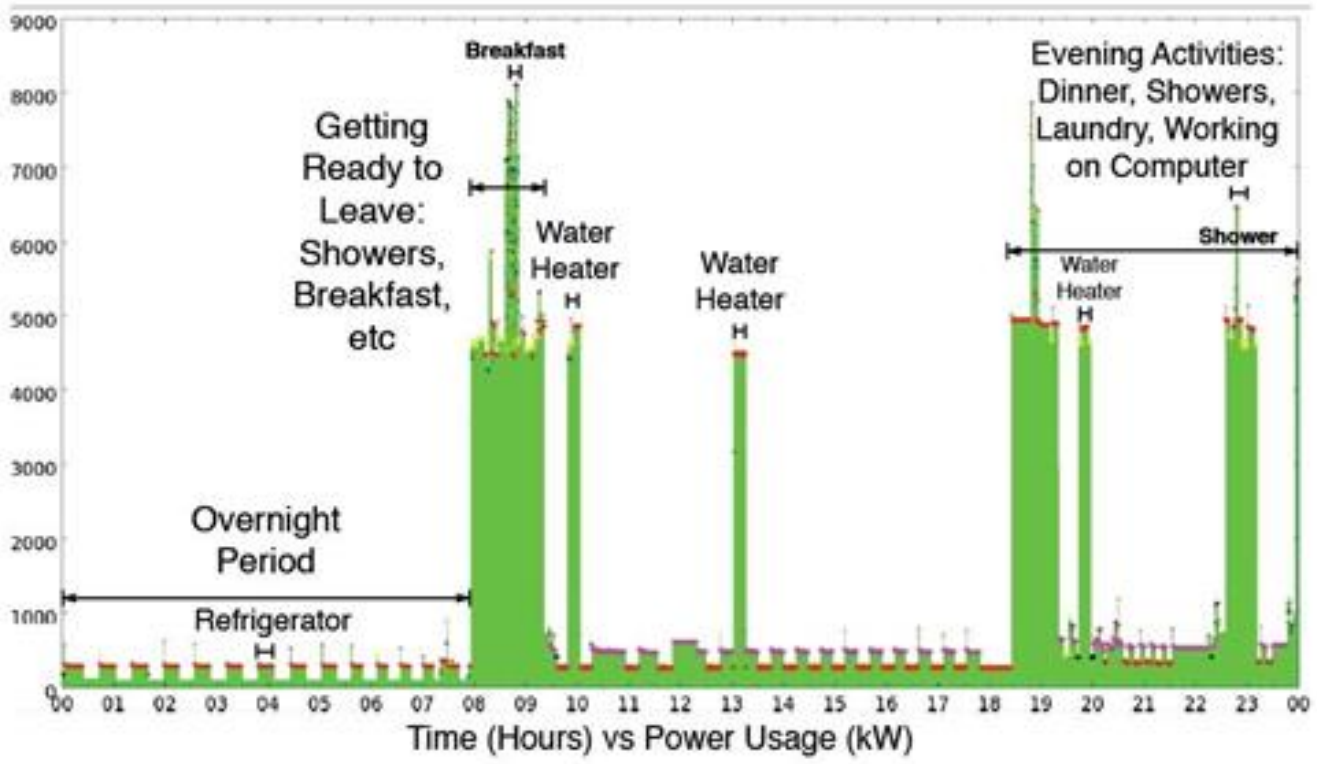
Identify three hours of minimum consumption:

Why do you think these minimums are happening at these times?

The future metering

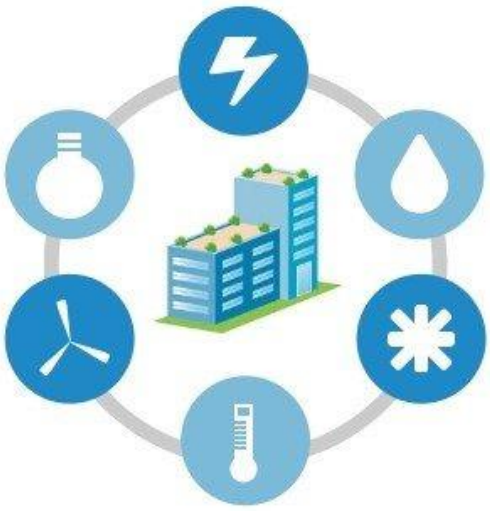
Non-Intrusive Load Monitoring (NIALM) methods are an advanced technique that, using a single meter, monitor the electricity going into a house and, analysing changes in the voltage and current, are able to deduce what appliances are used in the house as well as their individual energy consumption.

Activity 3: *The following graph represents the hourly energy consumption of a house and the appliances recognized using smart metering. In pairs discuss the information provided by the graph and explain in which ways you think NIALM can be better that normal meters.*



Energy audit proposal

An energy audit is the first step in identifying opportunities to reduce energy expense and carbon footprint. They are used to identify the efficiency of energy use and a basis on which to make any decision for enhancing energy management in smart buildings.



Activity 4: In group, *have a look to the energy audit reports (provided during the tutorial) and identify their main headings and key content.* Give examples.

Introduction:

Main body:

Conclusion:

Final assignment

- Write an energy audit proposal to the mayor of Maidenhead (a person very concern about the environment) on how to "greenefy" your school. There is a large budget available for green projects, but there are a lot of energy auditors trying to win the project.

  The proposal (2000 words) should contain:

  - An introduction (approx. 500 words).
    - ✓ presenting the specific school building characteristic
    - ✓ and explaining why it should be "greenify"

  - A main body, explaining your green propositions and justifying them (approx. 1000 words).
    - ✓ Energy consumption estimations (based on the TM22 method)
    - ✓ Energy saving proposal, including renewable technology and/or efficient measures
    - ✓ Estimate energy savings and compare them to actual energy consumptions
    - ✓ Calculation of payback period.

  - A conclusion, summing up your work and supporting it (approx. 500 words)

The Display Energy Certificates (DECs) of the school and monthly energy consumption readings of the building will be provided during the tutorial.

Tutorial 5 additional Resources

Tips for writing an energy report: smallbusiness.chron.com/write-energy-audit-report-12313.html

Tips for writing a report: www.openpolytechnic.ac.nz/current-students/study-tips-and-techniques/assignments/how-to-write-a-report/

Success Criteria		Final assignment
Knowledge and understanding		Include content that is relevant to the topic and the specific assignment title. Include key words from the glossary and demonstrate that you understand them by explaining what they mean and how they relate to the topic.
Research and evidence		Include research findings from a wide range of sources. As well as using the sources provided, you should be discovering some sources yourself from the independent work that you do outside tutorials and include relevant data.
Developing an argument		Give reasons and evidence to back up the points that you make. You might find the PEE structure helpful: • Point – make the key point clear • Evidence – explain the evidence for the point • Explanation – explain why your point is relevant and important Make links to topics you have covered during tutorials as well as some topics that you have not discussed during tutorials.
Critical evaluation		Include critical support for your suggestions/ propositions, including numerical evaluation when appropriate.
Structure and presentation		Organise your ideas in paragraphs with a logical structure: Include an introduction that clearly outlines what the assignment will contain, a main body and a conclusion that summarises all the key points clearly. Make sure your calculations, formulas and methods are clear and structured correctly and that you have referenced everything correctly (see appendix 1).
Language and style		Make sure your spelling, grammar and punctuation are accurate. Use a formal style of writing that is appropriate for an industrial proposal.

Tutorial 6 – Feedback tutorial

What is the Purpose of Tutorial 6?

- To receive feedback on your final assignment
- To respond to the feedback from your Uni Pathways teacher
- To write targets for improvement on your final assignment

Final assignment feedback from your Uni Pathways Teacher

(Remember to look at the mark scheme to help you understand what you have done well so far, and how you can do even better in your final assignment)

Here are three things that my Uni Pathways Teacher thought I did well in my draft assignment
•   •   •

Here are three things that my Uni Pathways Teacher thinks that I could do to get a higher mark in my final assignment
•   •   •

Tasks from my Uni Pathways Teacher to do during the feedback tutorial to help me improve
•   •   •
My response:

Actions I will take to improve my final assignment after this tutorial…
•   •   •

Hand in date for my final assignment:	

Tutorial 7 – Final tutorial

What is the Purpose of Tutorial 7?

- To receive feedback and a grade on your final assignment.
- To reflect on the programme including what you enjoyed and what was challenging.
- To ask any questions you may have about university.

Final assignment feedback from my Uni Pathways Teacher

Final mark:	University style grade:
Feedback: Here are three things that my Uni Pathways teacher thought I did well in my final assignment • • •	

Here are three things that my Uni Pathways teacher thinks I should remember for when I am doing this kind of study in the future
• • •

University

What questions do you still have about University after taking part in Uni Pathways?
•   •   •

Reflecting on Uni Pathways

What did you most enjoy about Uni Pathways?
•   •   •

What did you find challenging about the programme?	How did you overcome these challenges?
• • •	• • •

Appendix 1 – Referencing correctly

When you get to university, you will need to include references in the assignments that you write, so we would like you to start getting into the habit of referencing in your Brilliant Club assignment. This is really important, because it will help you to avoid plagiarism. Plagiarism is when you take someone else's work or ideas and pass them off as your own. Whether plagiarism is deliberate or accidental, the consequences can be severe. In order to avoid losing marks in your final assignment, or even failing, you must be careful to reference your sources correctly.

What is a reference?

A reference is just a note in your assignment which says if you have referred to or been influenced by another source such as book, website or article. For example, if you use the internet to research a particular subject, and you want to include a specific piece of information from this website, you will need to reference it.

Why should I reference?

Referencing is important in your work for the following reasons:

- It gives credit to the authors of any sources you have referred to or been influenced by.
- It supports the arguments you make in your assignments.
- It demonstrates the variety of sources you have used.
- It helps to prevent you losing marks, or failing, due to plagiarism.

When should I use a reference?

You should use a reference when you:

- Quote directly from another source.
- Summarise or rephrase another piece of work.
- Include a specific statistic or fact from a source.

How do I reference?

There are a number of different ways of referencing, and these often vary depending on what subject you are studying. The most important to thing is to be consistent. This means that you need to stick to the same system throughout your whole assignment. Here is a basic system of referencing that you can use, which consists of the following two parts:

1- **A marker in your assignment**: After you have used a reference in your assignment (you have read something and included it in your work as a quote, or re-written it your own words) you should mark this is in your text with a number, e.g. [1]. The next time you use a reference you should use the next number, e.g. [2].

2- **Bibliography**: This is just a list of the references you have used in your assignment. In the bibliography, you list your references by the numbers you have used, and include as much information as you have about the reference. The list below gives what should be included for different sources.

   a- Websites – Author (if possible), title of the web page, website address, [date you accessed it, in square brackets].
   E.g. Dan Snow, 'How did so many soldiers survive the trenches?', http://www.bbc.co.uk/guides/z3kgjxs#zg2dtfr [11 July 2014].
   b- Books – Author, date published, title of book (in italics), pages where the information came from.
   E.g. S. Dubner and S. Levitt, (2006) *Freakonomics*, 7-9.
   c- Articles – Author, 'title of the article' (with quotation marks), *where the article comes from* (newspaper, journal etc.), date of the article.
   E.g. Maev Kennedy, 'The lights to go out across the UK to mark First World War's centenary', Guardian, 10 July 2014.

Appendix 2 – Display Energy Certificate

Display Energy Certificate

How efficiently is this building being used?

HM Government

A Government Dept
12th & 13th Floor
Jubilee House
High Street
Anytown
A1 2CD

Certificate Reference Number:
1234-1234-1234-1234

This certificate indicates how much energy is being used to operate this building. The Operational Rating is based on meter readings of all the energy actually used in the building. It is compared to a benchmark that represents performance indicative of all buildings of this type. There is more advice on how to interpret this information on the Government's website www.communities.gov.uk/epbd.

Energy Performance Operational Rating

This tells you how efficiently energy has been used in the building. The numbers do not represent actual units of energy consumed; they represent comparative energy efficiency. 100 would be typical for this kind of building.

More energy efficient

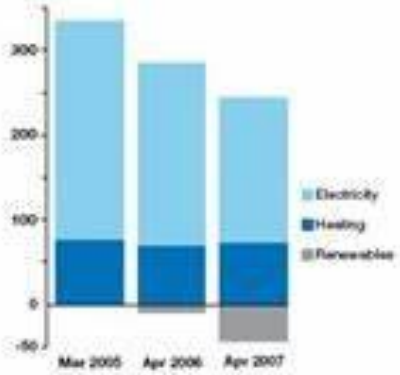
- A 0-25
- B 26-50
- C 51-75
- D 76-100
- E 101-125 ◀ 108
- F 126-150
- G Over 150

100 would be typical

Less energy efficient

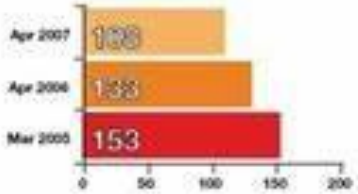
Total CO_2 Emissions

This tells you how much carbon dioxide the building emits. It shows tonnes per year of CO_2.



Previous Operational Ratings

This tells you how efficiently energy has been used in this building over the last three accounting periods



Technical information

This tells you technical information about how energy is used in this building. Consumption data based on actual readings.

Main heating fuel:	Gas
Building Environment:	Air Conditioned
Total useful floor area (m²):	2327
Asset Rating:	92

	Heating	Electrical
Annual Energy Use (kWh/m²/year)	126	129
Typical Energy Use (kWh/m²/year)	120	95
Energy from renewables	0%	20%

Administrative information

This is a Display Energy Certificate as defined in SI2007:991 as amended.

Assessment Software:	OR v1
Property Reference:	891123776612
Assessor Name:	John Smith
Assessor Number:	ABC12345
Accreditation Scheme:	ABC Accreditation Ltd
Employer/Trading Name:	EnergyWatch Ltd
Employer/Trading Address:	Alpha House, New Way, Birmingham, B2 1AA
Issue Date:	12 May 2007
Nominated Date:	01 Apr 2007
Valid Until:	31 Mar 2008
Related Party Disclosure:	EnergyWatch are contracted as energy managers

Recommendations for improving the energy efficiency of the building are contained in Report Reference Number 1234-1234-1234-1234

Notes

Notes

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researchersinschools.org