Researchers in Schools

How can we keep the lights on?

Key Stage 4 Programme

Pupil Name

Coursebook Designed by **Dr H Wyman-Pain**

Timetable and Assignment Submission

Timetable – Tutorials

Tutorial	Date	Time	Location
1	9th December	12:00	University of Sheffield
2	14th January	15:00	B13
3	21st January	15:00	B13
4	28th January	15:00	B13
5	4th February	15:00	B13
6 (Feedback)	25th February	15:15	B13
7 (Feedback)	10th March	15:15	B13

Timetable – Homework Assignments

Homework Assignment	Description	Due Date
Tutorial 1	Describe three ways we use electricity every day	13th December
Tutorial 2	Changing demand patterns in the future	20th January
Tutorial 3	Which is better?	27th January
Tutorial 4	Energy storage in our lives	3rd January
Tutorial 5	Draft Final Assignment	14th February
Final Assignment	Spoken part	25th February
Final Assignment	Written part	6th March

Assignment Submission – Lateness and Plagiarism

Lateness	
Submission after midnight on 6th March	10 marks deducted
Plagiarism	
Some plagiarism	10 marks deducted
Moderate plagiarism	20 marks deducted
Extreme plagiarism	Automatic fail

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Course Rationale

We all use electricity every day; from lighting our rooms to charging our mobile phones, but how do we keep the lights on? You can see wind farms appearing around our country but what impact do they have on our electricity supply? What happens when it isn't windy?

How much electricity we use must be balanced with how much electricity we make. Think of the system as a tug of war, if we pull too much electricity towards us (demand) but don't have enough supply pulling back (generation), we all fall over and the lights in our rooms will go out. This means we have to change how much electricity is generated in response to how much electricity we want all the time.

In these tutorials we will look at our electricity system and the challenges in managing it, particularly in balancing it at short notice. We will also look at how our generation sources are changing and the impact this has on the balancing challenge. Different technology, which can save us money and reduce our carbon footprint, will be analysed and you will be able to understand why electricity overnight is cheaper.

Our final assignment will be to compare three options (energy storage, flexible generation and demand side response) to ensure the electricity supply and demand is balanced, choosing which one you think is the best. We will make short presentations to the group and write a report on why we need to balance our electricity supply and the three mechanisms explained in the tutorials.

Remember: Your parents will want to know any ways you learn to make the electricity bill cheaper!

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

	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 ○ 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 ○ 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 ○ 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	
					Overall Mark (average of the 6 marks from the criteria above)	

Baseline Assignment (essay based): Pupil Feedback Report

Name of Pupil	
Name of School	Nottingham Girls Academy
Name of RIS teacher	Dr H Wyman-Pain
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	Nottingham Girls Academy
Name of RIS teacher	Dr H Wyman-Pain
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
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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
Generation	The conversion of any form of energy into electricity.	
Renewable Generators	Electricity generators using a fuel source which will not be exhausted, such as wind and hydro power. There is a disagreement on whether biomass is included.	
Fossil Fuel	A natural fuel source made from the remains of creatures, such as gas or coal.	
Emissions	The unwanted output from a power station when generating electricity. This typically contains pollutants, such as carbon dioxide and sulphur dioxide.	
Thermal Generators	Electricity generators using steam in the generation of electricity, such as CCGTs and biomass power stations.	
Coal Fired Power Station	An electricity generator converting energy stored in coal into electricity.	
Combined Cycle Gas Turbine (CCGT)	An electricity generator converting energy stored in gas into electricity.	
Wind Turbine	An electricity generator converting wind energy into electricity.	
Photovoltaic (PV)	A panel converting solar energy into electricity.	
Solar Panel	A panel converting solar energy into heat or electricity.	
Hydro Power Station	An electricity generator using the movement of water to generate electricity.	
Pumped Storage	A type of hydro power station which can be used to store electricity.	

Demand	The electricity required at a particular point in time.	
System Frequency	A measure of the balance between generation and demand. The standard value in Britain is 50Hz.	
Frequency Response	A change in generation or demand due to the recorded system frequency.	
Frequency Events	When the system frequency goes beyond a set limit. The operational limits in Britain are 49.8Hz and 50.2Hz.	
Flexible Generators	Electricity generators able to quickly and cheaply change their output.	
Electricity System Operator (ESO)	The controller of the highest level of the electricity system, in Britain it is National Grid. They are responsible for making the generation and demand match.	
Alternating Current (AC)	Electricity with current that switches between a positive and negative peak, setting the system frequency by the number of peaks each second.	
Direct Current (DC)	Electricity with a constant current level. This is output by PV and batteries, requiring conversion to AC before it can be included into the electricity system.	
Variable Renewable Generation	Renewable generators which change their output based on external conditions, such as the weather. They typically increase the uncertainty of the system.	
Base-load Generation	Generators which remain at a constant output throughout the day due to their abilities or cost, such as nuclear power stations.	
Climate Change	A significant long-term change in weather patterns of an area, such as a change in temperature or wind patterns over tens of years. It is used when talking about the recent increase in global temperature.	

Regulation	A collection of rules participants of the electricity system must follow to be allowed to operate.	
Demand Side Management	Demand which is changed, typically reduced, to benefit the system, can be planned or responsive.	
Demand Side Response	Demand which can be changed as requested to aid the electricity system. Always responsive to the system, not proactive.	
Energy Storage	A method to store energy which can be converted to electricity when required.	
Batteries	A storage method using chemical energy.	

Tutorial 1 – Generation and Demand

Welcome to Engineering

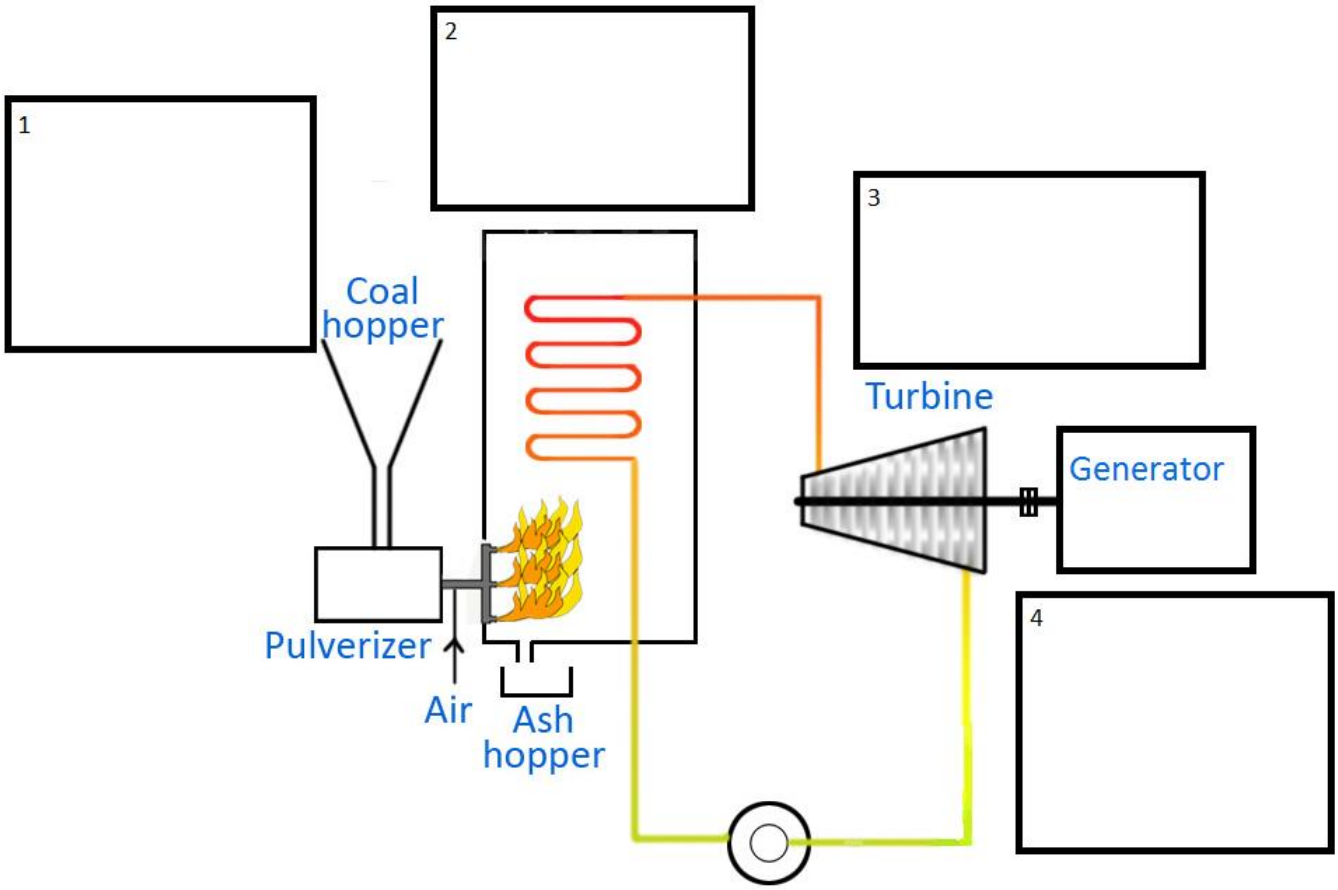
Tutorial 1 Objectives

By the end of this tutorial I will be able to:

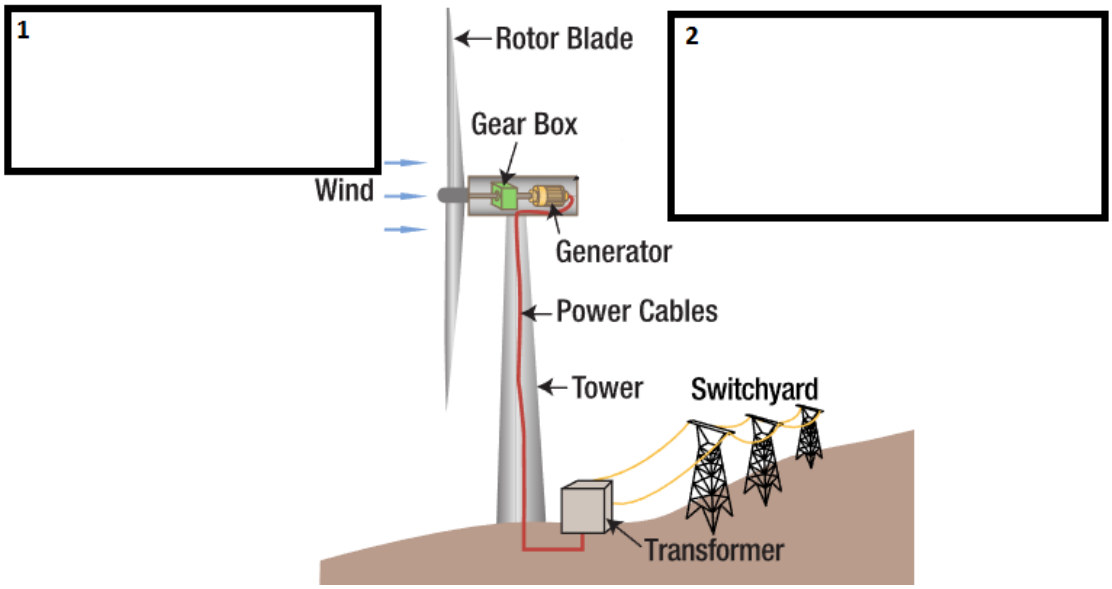
- Define the keywords
- Explain at least three ways we generate electricity
- Talk about different ways we use electricity, how much and when

Generation

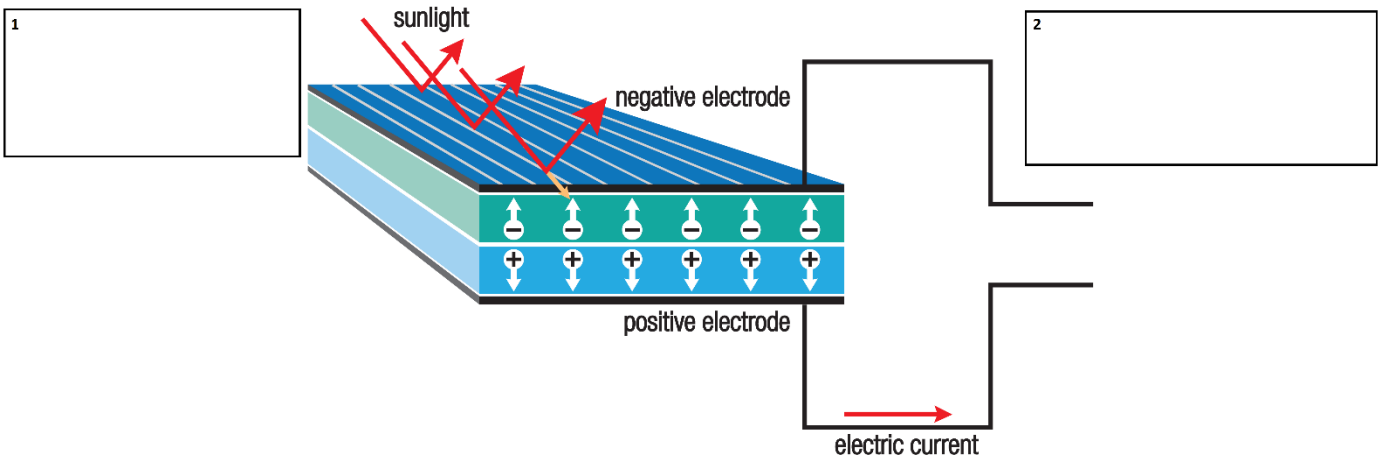
Coal fired power station



Wind turbine



Photovoltaic



Other generators

Demand

Appliance	Usage (total time of use)	Time
Electric hobs	1kWh	30mins
Electric oven	1.1kWh	30mins
Microwave	0.25kWh	10mins
Slow cooker	1.3kWh	8hours
Kettle	0.1kWh	3mins – one boil
Washing machine	0.75kWh	1hour wash
Dryer	1.5kWh	1hour
Dishwasher	1.5kWh	1hour wash
Electric shower	0.7kWh	6mins
Desktop computer	0.2kWh	2hours
Laptop	0.04kWh	2hours
Gaming console	0.15kWh	1hour
DVD player	0.06kWh	1hour
Router	0.01kWh	1hour
LCD TV	0.2kWh	1hour
Smart phone (charging)	0.005kWh	1hour
Tablet (charging)	0.01kWh	1hour

References: https://www.ovoenergy.com/blog/lifestyle/power-hungry-appliances.html
https://www.npower.com/blog/2013/02/01/how-much-appliances-cost-to-run/
https://www.choose.co.uk/guide/how-to-calculate-household-appliance-energy-cost/

Time		Monday	Tuesday	Wednesday	Thursday
6pm	Appliances				
	kWh and £				
7pm	Appliances				
	kWh and £				
8pm	Appliances				
	kWh and £				
9pm	Appliances				
	kWh and £				

Baseline Assignment

Baseline Title: Describe three ways we use electricity every day

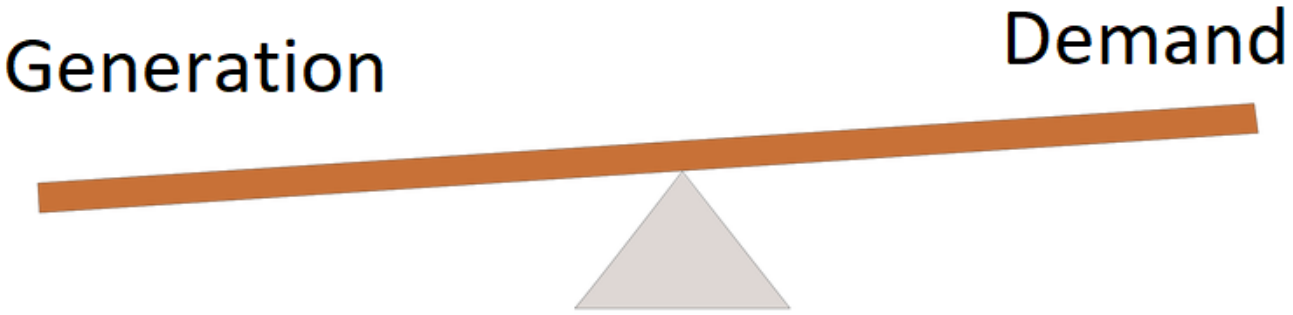
Baseline assignment instructions: Explain three ways you or your household use electricity at home or school

- Explain when and approximately how much electricity is used for each of the three ways. You can use volumes or cost to quantify the electricity used, the table above can help you, and a useful comparison for standard appliances is provided by Ovo energy at https://www.ovoenergy.com/blog/lifestyle/power-hungry-appliances.html or npower at https://www.npower.com/blog/2013/02/01/how-much-appliances-cost-to-run/
- Could less electricity be used or could it be used at a different time for each of the three ways? Why?
- Does the weather or time of year have an effect on how much or when the electricity is used for each of the three ways? Why?

Baseline assignment success criteria:

- Include key words from the glossary correctly
- Include references to the sources of information you have used
- Organise your assignment into a logical structure with an introduction and conclusion
- Include logical reasons for why or why not changes can be made to electricity usage e.g. 'to have a hot, family dinner at 6pm the oven must be used between 5 and 6pm' or 'the oven is not necessary for every family meal. Alternative cooking appliances with a lower electricity could be used for a few meals each week, saving at least 7p each meal by switching to using a slow cooker [reference]'.

Tutorial 2 – Balancing the System



Tutorial 2 Objectives

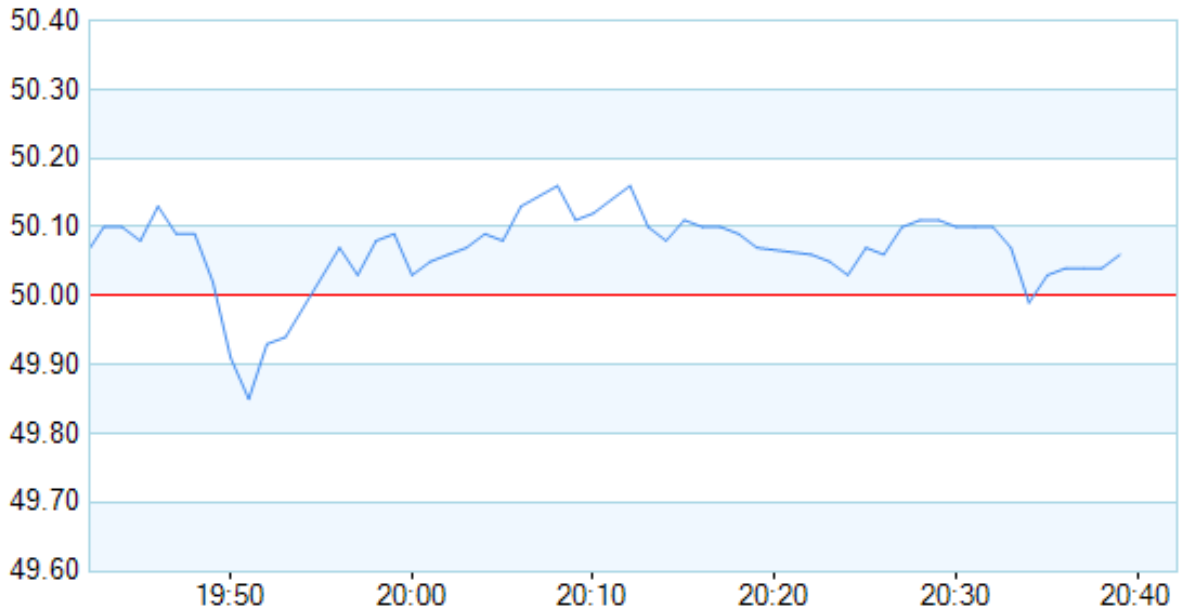
By the end of this tutorial I will be able to:

- Define the key words
- Explain to a partner why we balance generation and demand
- Draw a graph showing a typical demand pattern across the day, highlighting the times when demand peaks occur

Frequency events

Causes

England and Tunisia World Cup Game 2018



Predicting Demand

Homework Assignment

Homework Title: Changing demand patterns in the future

Homework assignment instructions: With the introduction of new technology, such as electric cars and on demand TV, will the typical demand curve from tutorial 2 still work in the future? Why?

Homework assignment success criteria:

- Include key words from the glossary correctly
- Include references to the sources of information you have used
- Organise your assignment into a logical structure with an introduction and conclusion
- Include the demand curve and highlight any changes you think would happen on the curve in your assignment

Tutorial 3 – Changing the Generators

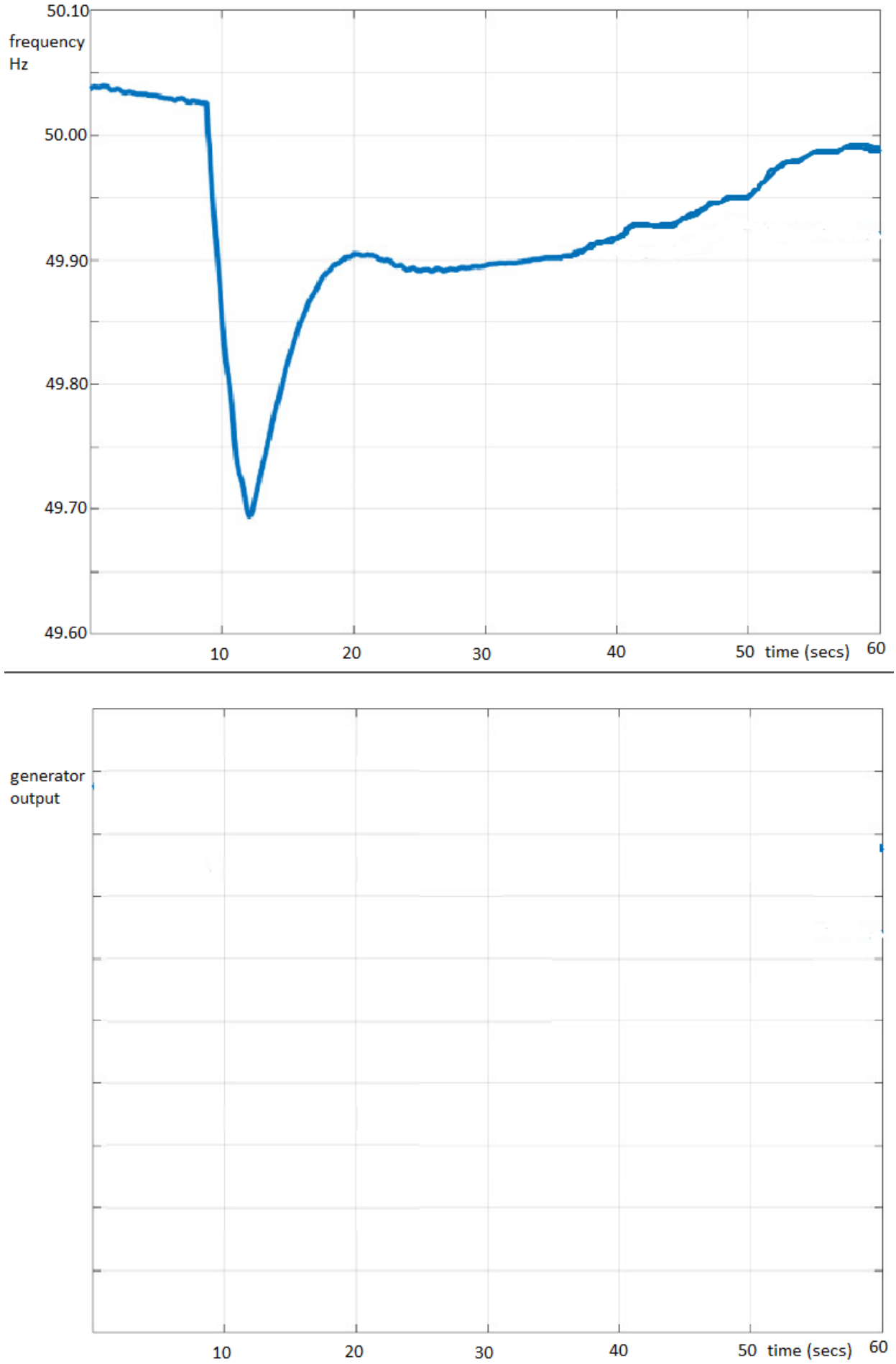
Tutorial 3 Objectives

By the end of this tutorial I will be able to:

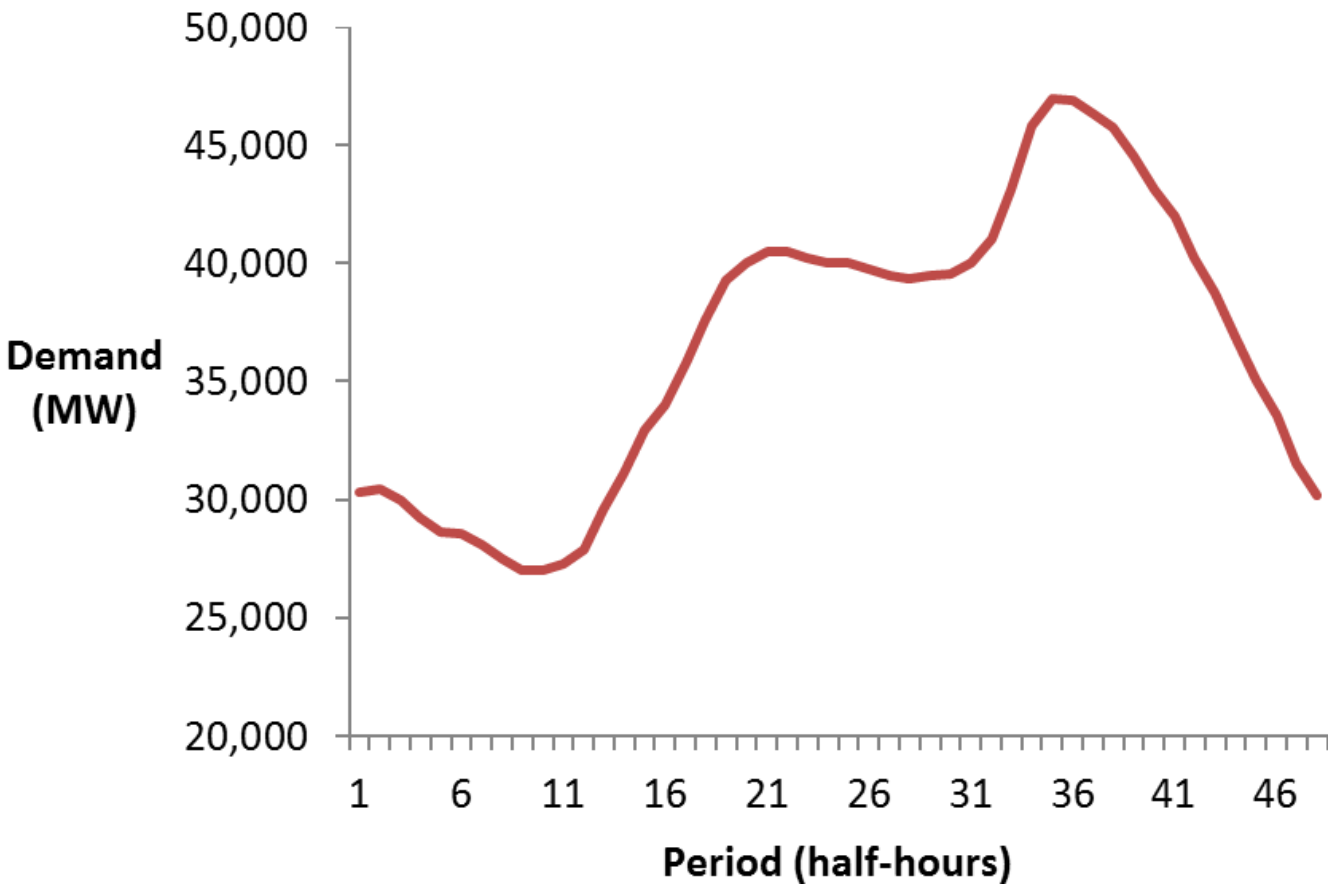
- Define the key words
- Explain the changing generator mix to a partner
- Describe the process of generators changing their output in response to the system frequency through a timeline from before the event through to the system recovery

Changing generation mix

Frequency event timeline



Generator capabilities



	Causes frequency events	Responds to frequency events
Flexible		
Baseload		
Variable		

Homework Assignment

Homework Title: Which is better: A mix of generator types or just one?

Homework assignment instructions: Pick one type of generator you think could meet our demand on its own and explain why.

Compare this to using a mix of generator types and explain which options is better and why.

Homework assignment success criteria:

- Include key words from the glossary correctly
- Include references to the sources of information you have used
- Organise your assignment into a logical structure with an introduction and conclusion
- Explain the process for the generator type you have chosen to match the demand and how this is different from using a mix of generator types to meet demand

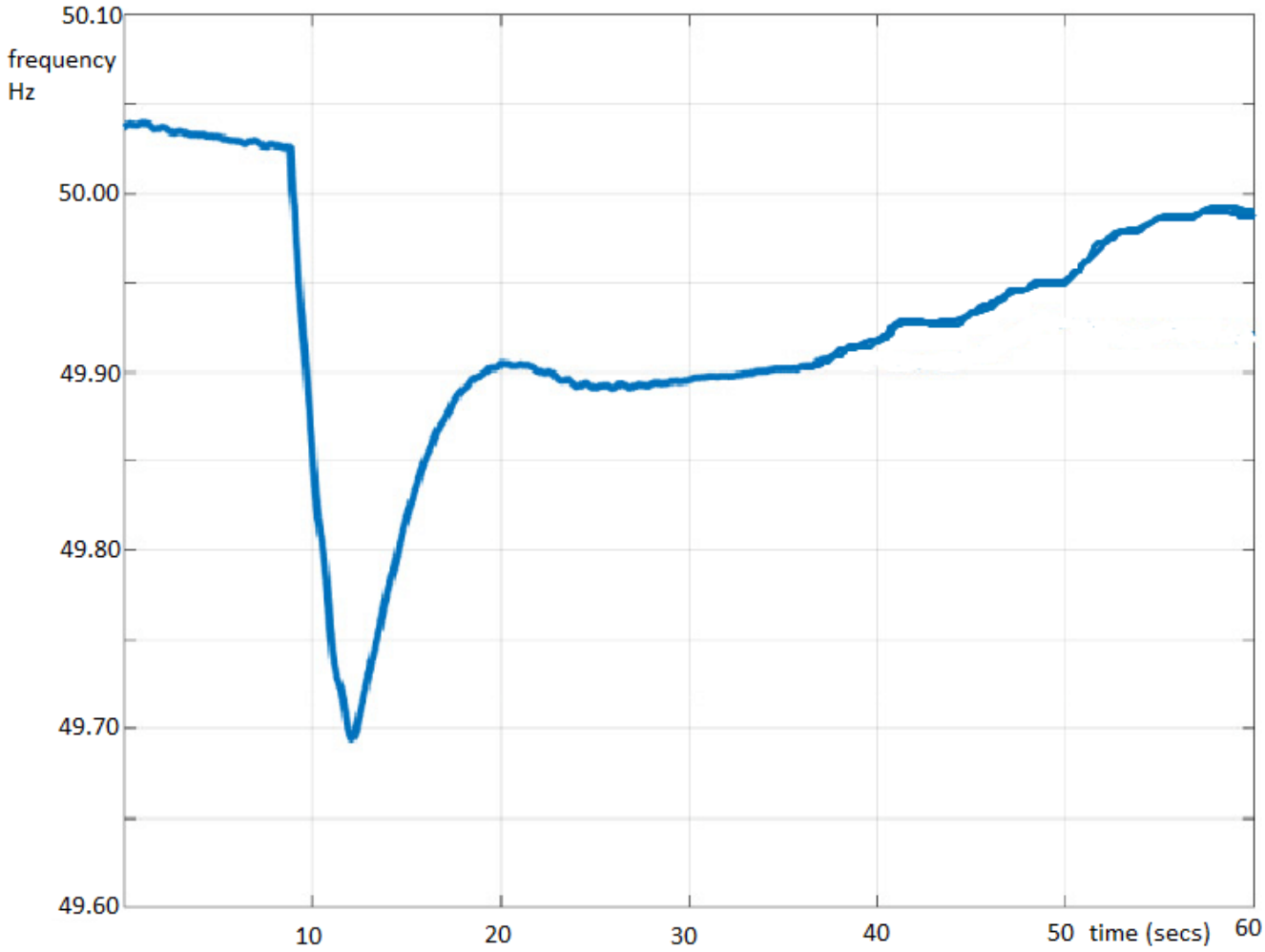
Tutorial 4 – Storage and Demand

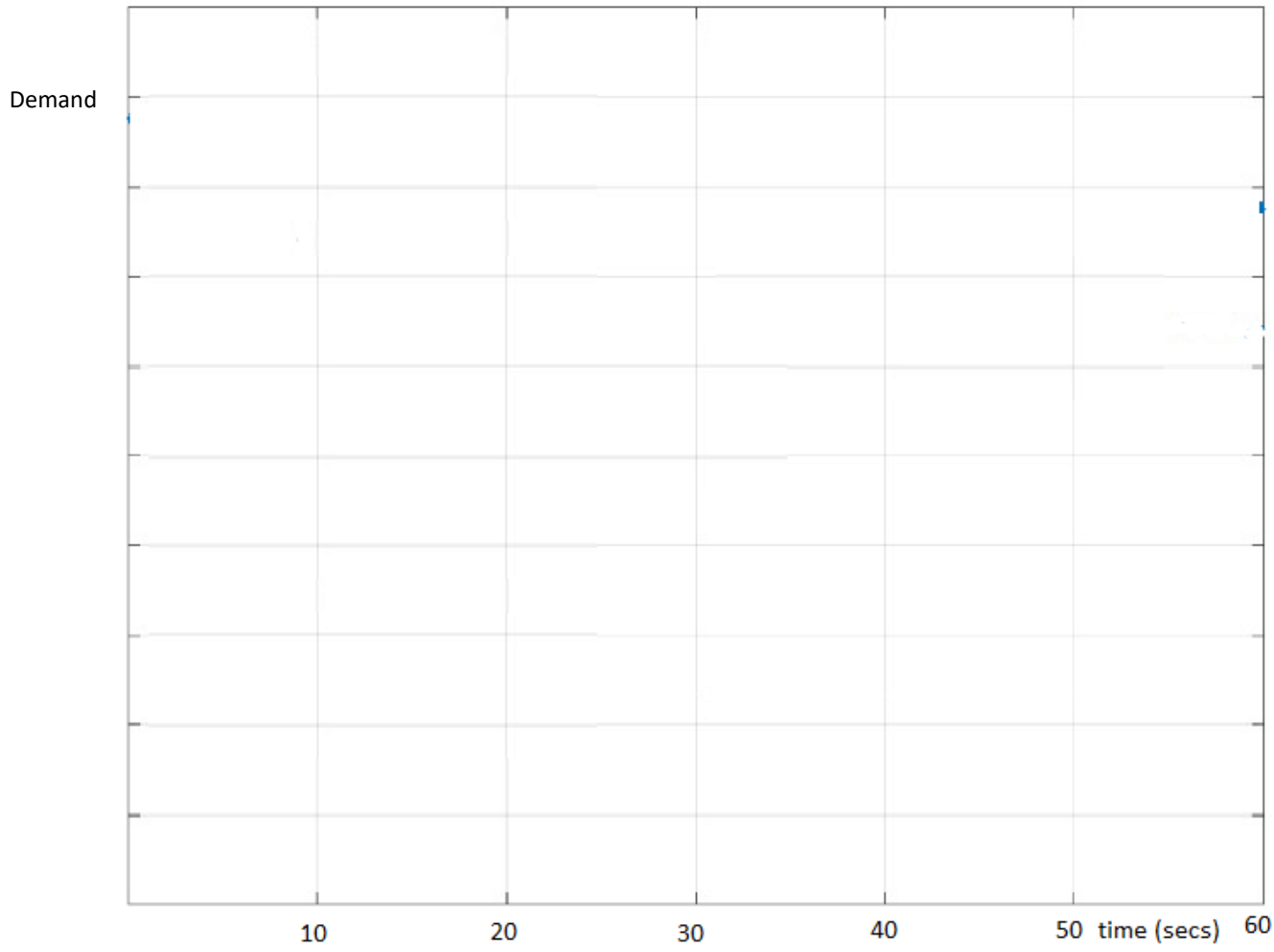
Tutorial 4 Objectives

By the end of this tutorial I will be able to:

- Define the key words
- Explain demand side response to a partner
- Describe at least two forms of energy storage

Demand Side Response and Demand Side Management


50.10
frequency
Hz
50.00
49.90
49.80
49.70
49.60
10
20
30
40
50
time (secs)
60


Demand
10
20
30
40
50
time (secs)
60

Storage

	Electricity is cheap	Electricity is expensive	Generation is below demand	Generation is above demand
Fully charged				
Half charged				
Empty				

Homework Assignment

Homework Title: Energy Storage in Our Lives

Homework assignment instructions: Describe two forms of energy storage which are in use in your life. Why is the energy stored in this form and why is it limited to the storage capacity that it has?

Homework assignment success criteria:

- Include key words from the glossary correctly
- Include references to the sources of information you have used
- Organise your assignment into a logical structure with an introduction and conclusion

Tutorial 5 – Which is Best?

Tutorial 5 Objectives

By the end of this tutorial I will be able to:

- Define the key words
- Use cost/benefit analysis to compare options (costs, benefits, assign value to each, compare totals between options)
- Explain cost/benefit analysis to a partner

Cost/Benefit analysis

Wind

	Costs		Benefits	
	Item	Value	Item	Value
Total				

Flexible Generation

	Costs		Benefits	
	Item	Value	Item	Value
Total				

Demand Side Response

	Costs		Benefits	
	Item	Value	Item	Value
Total				

Storage

	Costs		Benefits	
	Item	Value	Item	Value
Total				

Final Assignment

Final Title: Define energy storage, flexible generation and demand side response in terms of balancing the electricity system and provide an argument on which should be prioritised in the future.

Final assignment instructions:

- Explain the background of why the generation and demand must be balanced and why this may become more difficult in the future
- Describe the three options: energy storage, flexible generation and demand side response
- Provide a logical argument – both positive and negative aspects of each option – on which you believe should be prioritised in the future

Also need to prepare a 3minute presentation on the same topic to give to the group. Split it into a minute on why we need to balance the system, a minute describing the three options and your final minute explaining your choice. You can use a power-point slide with your talk.

Final assignment success criteria:

Knowledge and understanding	Include content that is relevant to the topic and the specific assignment/homework title or question. Make sure you answer the question which is set – the answer could be that no one knows! Include key words from the glossary and demonstrate that you understand them by explaining what they mean and how they relate to the topic. Examples will aid in demonstrating understanding.
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. At least one reference for each option considered.
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. Use the cost/benefit or alternative analysis technique to aid in your evaluation of options and provide a logical argument.

Critical evaluation	Include evaluation of what is being described and provide clear justification and reasoning. Select relevant research evidence to back up your thinking.
Structure and presentation	Organise your ideas in paragraphs with a logical structure. Include an introduction that clearly outlines what the assignment will contain and why it is important. Include a conclusion that summarises all the key points clearly, both why you have and have not chosen each option. Make sure that you have referenced everything correctly. Use the referencing guide included in your workbook.
Language and style	Make sure your spelling, grammar and punctuation are accurate. Use a formal style of writing that is appropriate for an academic essay or technical report.

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 – Peer Feedback

During each 3minute presentation given everyone will provide feedback to the presenter. This is good practice for giving feedback to others in the future and choosing how to react to feedback you are given.

We will use What Went Well and Even Better If with examples of feedback shown below.

What Went Well

- The speaker spoke clearly and kept to the time limit
- The explanation of why we must balance generation and demand was easy to follow
- The speaker used key words in the correct way

Even Better If

- The speaker spoke louder and clearer
- The speaker included less information as it was difficult to follow
- The speaker tried to include more key words

Notes

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