Pilot Programme 2026

RESEARCH PROJECT TEACHER GUIDE & EXAMPLES

From National Grid

A Teacher Guide to DDOE, HEDDIW, YFORY (Pilot Programme)

Ddoe, Heddiw, Yfory is designed around 5 STEM related fields* which have shaped modern Wales and continue to support its evolution as a nation and its cultural identity – *Transport, Energy, Industry, Defence* and *Communication*.

These 5 fields have been chosen as rich areas of exploration which provide both historical and modern examples of how engineering and industry have directly impacted the development of Welsh culture and identity across Wales. They are also designed to link to themes that run throughout the Curriculum for Wales, allowing schools to select a theme most appropriate to them.

Transport – eg. Bridges, railways, viaducts, roads, vehicles

Energy – eg. Coal mining, oil refineries, renewable energy options, electrical grid

Industry – eg. Steel, iron and copper industries, compound semiconductors, services industries.

Defence – eg. Castles, military defence sites and technology, cyber security, data protection.

Communication – eg. the development of the Welsh language, the impact of the printing press, legends and storytelling, BBC Wales, S4C, social media and the impact of "fake news".

**You are not limited to these themes, and EESW would welcome suggestions for other themes that would link well to your curriculum*.

There are two key elements to this project. A research and design project and a coding challenge. During the pilot programme class teachers are asked to lead the research and design project, guided by EESW resources and the coding challenge will be delivered as two hour in-school coding workshop, led by EESW team members.

Research and Design Project

Pupils are tasked with exploring one of more of these areas through using the structure provided by Ddoe, Heddiw, Yfory. Schools are welcome to select any example though a few examples, linked to each of the themes, are provided as guidance or as a starting point for further research.

Ddoe – Identify an example of engineering within your community. This could be the school community, the local village or town community, the wider region or at the national level. They can choose an example specific to your school or area, or you can use one of the examples provided or even something that's a combination of the two.

Research and outline the example itself and the problem it was designed to overcome.

Analysis – what problem it solved?

Identification – what was the solution?

Understanding – what types of engineers would have been involved?

Impact on Welsh culture and identity – was the problem created by a change in Welsh in culture or how did the solution impact Welsh culture.

Heddiw – Does the problem still exist today and is the previous solution still fit for purpose?

Evaluation – what aspects of the previous solution are still relevant today or still work well today and which could be improved? Is the problem today something different?

Yfory – Design a modern solution that will have a positive impact on the community.

Design – Design a different solution using modern materials or technology.

Understand – What types of engineers might need to be involved?

Impact – How would the modern solution better serve the community, and does it contribute to a celebration of Welsh culture and identity, if so, how?

Pupils are invited to summarise their findings and ideas in whatever format is most appropriate. This could be a short video, a poster, a written report, portfolio or a short presentation. Pupils can work individually, in teams or as contributors to a whole class project. You are invited to share these outputs with EESW and National Grid. Examples that don't currently feature on our STEM map of Wales will be added to it.

The examples provided in this pack are not written in style that would be appropriate for many pupils but if you do choose to use one of these as the basis for your project you are welcome to adapt the text provided as you see fit.

In-school Coding Workshop

EESW will lead pupils through a 2-hour robotic coding challenge. Pupils will work in small teams to first learn the basics of how to control the movement of a small programmable robot, before then coding it to navigate a map and activate a small model that represents one of the many examples of engineering for Wales.

ENGINEERING FOR WALES

Identify an example of engineering within your community. This could be the school community, the local village or town community, the wider region or at the national level. You can choose an example specific to your school or area or you can use one of the examples provided or even something that's a combination of the two.

DDOE – YESTERDAY

Briefly outline the example and the problem it was designed to overcome.

Example: Railway bridges and viaducts around **Barry Docks** (late 19th century)

Barry grew rapidly in the late 1800s when engineers built Barry Docks to export coal from the South Wales Valleys to the rest of the world. Railway bridges and viaducts were constructed to carry heavy coal trains across roads, rivers, and uneven ground into the docks.

Analysis

Problem it solved:

- Coal needed to be moved quickly from the Valleys to ships
- Existing ports were overcrowded
- Heavy trains needed strong, reliable crossings

Identification and understanding – what type of engineers would have been involved?

Engineering involved:

- Civil engineers designed stone, brick, and steel bridges
- Mechanical engineers worked on locomotives and rail systems

Research Welsh cultural history at the time of this problem, was the problem created by change in culture?

Impact on Welsh culture and identity:
Barry became one of the largest coal-exporting ports in the world. The docks brought jobs, growth, and people from across Wales and beyond, shaping Barry's identity as a hardworking dock and railway town.

HEDDIW - TODAY

Evaluation - Does the same problem still exist in the community today? Is the previous solution still fit for purpose?

How do we view this engineering now?

The bridges and rail infrastructure were very strong, but they were designed for an industrial age focused on coal.

Modern evaluation:

- High carbon industry

- Infrastructure not designed for modern transport needs
- Some bridges now used differently or no longer needed

Modern engineering ideas:

- Repurposing old railway bridges for walking and cycling
- Using modern materials to strengthen historic structures
- Monitoring structures for safety

YFORY - TOMORROW

Consider a modern solution to the same problem or identify a modern day problem within the same community

Identify the problem

Local problem:
Barry needs safe, sustainable transport routes that connect communities, the waterfront, and town centre.

Design a solution

Future solution idea:
Design a modern pedestrian and cycle bridge that links key areas of Barry, encourages active travel, and celebrates the town's dockland history.

What types of engineers might be involved in such a solution?

Engineers who could help:

- Civil engineers (bridge design)
- Environmental engineers (coastal and flood protection)
- Electrical engineers (lighting and safety systems)
- Software engineers (smart traffic or sensor systems)

How would the modern solution help the community, and does it help to celebrate Welsh culture and identity – if so, how?

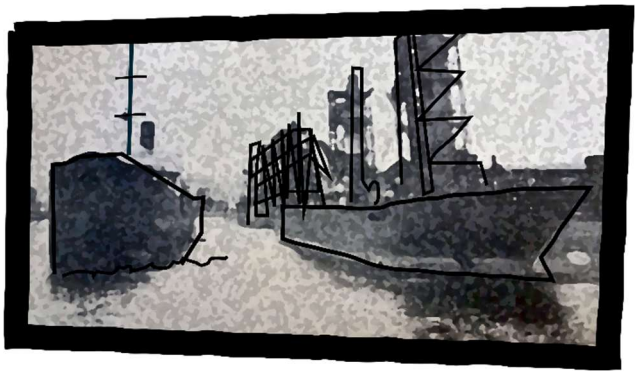
Link to Welsh culture and identity:
Reusing and celebrating historic engineering helps Barry honour its role in Welsh industrial history while building a healthier, greener future.

Reflection

Engineering helped turn Barry into a global port that supported Welsh mining communities. By learning from these bridges and adapting them for the future, engineers can help Barry continue to grow while protecting its heritage.

ENGINEERING FOR WALES

Example 1: Engineering in South Wales TRANSPORT



Barry Docks Railway Bridges & Viaducts

DDOE - YESTERDAY **– Why were these bridges built?**

Example: Railway bridges and viaducts around **Barry Docks** (late 19th century)

Barry grew rapidly in the late 1800s when engineers built Barry Docks to export coal from the South Wales Valleys to the rest of the world. Railway bridges and viaducts were constructed to carry heavy coal trains across roads, rivers, and uneven ground into the docks.

Problem it solved:

- Coal needed to be moved quickly from the Valleys to ships
- Existing ports were overcrowded
- Heavy trains needed strong, reliable crossings

Engineering involved:

- Civil engineers designed stone, brick, and steel bridges
- Mechanical engineers worked on locomotives and rail systems

Impact on Welsh culture and identity:
Barry became one of the largest coal-exporting ports in the world. The docks brought jobs, growth, and people from across Wales and beyond, shaping Barry's identity as a hardworking dock and railway town.

HEDDIW - TODAY **– How do we view this engineering now?**

The bridges and rail infrastructure were very strong, but they were designed for an industrial age focused on coal.

Modern evaluation:

- High carbon industry
- Infrastructure not designed for modern transport needs
- Some bridges now used differently or no longer needed

Modern engineering ideas:

- Repurposing old railway bridges for walking and cycling
- Using modern materials to strengthen historic structures
- Monitoring structures for safety

Types of engineers involved:
Civil engineers, structural engineers, environmental engineers.

YFORY - TOMORROW **– Solving a problem in Barry today!**

Local problem:
Barry needs safe, sustainable transport routes that connect communities, the waterfront, and town centre.

Future solution idea:
Design a modern pedestrian and cycle bridge that links key areas of Barry, encourages active travel, and celebrates the town's dockland history. Sketch different ideas and develop your ideas to create a final design.

Engineers who could help:

- Civil engineers (bridge design) – Look at existing bridges from around the world for inspiration.
- Environmental engineers (coastal and flood protection) – Will your design cross water or land?
- Electrical engineers (lighting and safety systems) – How could you use lighting to make your design look better or to make it safer to use? Will any parts of your design move?
- Software engineers (smart traffic or sensor systems) – If your bridge will be shared by drivers, riders and walkers, could technology be used to keep everyone safe?
- Structural engineers – Make a model of your bridge and test how stable it is.

Link to Welsh culture and identity:
Reusing and celebrating historic engineering helps Barry honour its role in Welsh industrial history while building a healthier, greener future.

Reflection

Engineering helped turn Barry into a global port that supported Welsh mining communities. By learning from these bridges and adapting them for the future, engineers can help Barry continue to grow while protecting its heritage.

ENGINEERING FOR WALES

Example 2: Engineering in Mid Wales, TRANSPORT

Devils Bridge

DDOE - YESTERDAY **– Why was it built?**

Example: People have needed to cross from one side of the River Mynach for centuries, and rather than tear the old bridges down when they fell into disrepair, people just built new ones on top! The bridges are a Medieval stone arch bridge, a Georgian stone arch bridge and an iron bridge constructed in 1901.

Problem it solved:

- Getting from A to B
- Making use of existing structures
- Adapting the bridges for modern usage.

Engineering involved:

- Civil and structural engineers designing a new bridge incorporating the existing historical bridge.

Impact on Welsh culture and identity:
There are a few local legends about the history of Devil's Bridge, leading tourists to visit the nearby village. It is an important area for Welsh Folklore.

HEDDIW - TODAY **– How do we view this engineering now?**

The most recent repair of the bridge was in 1971. Cars and public transport have changed a lot in the more than 50 years since. Is the bridge due for a makeover?

Modern evaluation:

- Outdated – bigger lorries and cars require more space, and do more damage to road surfaces.
- The bridge will inevitably need repair or decommission.

Modern engineering ideas:

- Refurbishment of the site, adapt the bridge while keeping things the same.
- Demolition to build a new bridge.
- Carry on the local tradition and build a fourth bridge on top!

Types of engineers involved:
Civil engineers, structural engineers

YFORY - TOMORROW **– Keep moving forward**

Local problem:
Devil's Bridge is aging, and something needs to be done to keep people and traffic moving.

Future solution idea:

Do you think the bridge should be modified again or do you think a new bridge should be built so the existing one can be protected? Either design an upgrade or an alternative bridge.

Think about how your design could help tell the story behind Devils Bridge to visitors? You could build a model and test how stable it is.

Engineers who could help:

- Civil engineers (structural design) – Look at bridges from around the world for inspiration.
- Environmental engineers (ensuring protection for local wildlife)
- Structural engineers – Make a model of your bridge and test how stable it is.

Link to Welsh culture and identity:
By preserving the bridge we can keep this historical site for future generations, and allow tourists to visit this key location in Welsh folklore.

Reflection

Devil's Bridge is an important piece of Welsh folklore and a tourist attraction. It demonstrates a unique approach to infrastructure; updating with the times while also keeping the history and character of the existing structure.

ENGINEERING FOR WALES

Example 3: Engineering in North Wales, TRANSPORT

Menai Bridge

DDOE - YESTERDAY – Why was it built?

Example: Crossing the Menai Strait was dangerous as the tides were very strong. A safe and reliable transport link to the mainland was required, as Anglesey's main export was cattle. A ferry port between Dublin and Holyhead was also in operation, so a bridge would make trade easier.

Problem it solved:

- Getting from A to B
- Less goods lost to treacherous waters
- No need to wait for more favourable tides.

Engineering involved:

- Civil and structural engineers designing a new bridge to carry foot and road traffic

Impact on Welsh culture and identity:
The bridge was one of the world's first suspension bridges, and the second bridge designed for road traffic.

HEDDIW - TODAY – How do we view this engineering now?

Although very advanced for its day, the needs of modern cars are causing damage to the bridge.

Modern evaluation:

- Outdated – bigger lorries and cars are heavier than the ones the bridge was intended for.
- The bridge will inevitably need repair or decommission.

Modern engineering ideas:

- Refurbishment of the site, adapt the bridge while keeping things the same.

Types of engineers involved:
Civil engineers, structural engineers

YFORY - TOMORROW **– Keep moving forward**

Local problem:
Menai Bridge is aging, and something needs to be done to keep people and traffic moving.

Future solution idea:

- Design a brand new bridge that will take the pressure off the original bridge.

Engineers who could help:

- Civil engineers (structural design) – Look at examples of bridges from around the world for inspiration.
- Environmental engineers (ensuring protection for local wildlife) – What wildlife are found in the area and how can they be protected or even helped by your design?
- Structural engineers – Make a model of your bridge and test how stable it is.

Link to Welsh culture and identity:
By preserving the bridge we can keep this historical site for future generations.

Reflection

The Menai Bridge is an important piece of global engineering history, and preserving it is important for tourism. It is a piece of living history we can still use if we maintain it.

ENGINEERING FOR WALES

Example 4: Engineering in South Wales - TRANSPORT

Newport Transporter Bridge

DDOE - YESTERDAY – Why was it built?

Example: Newport Transporter Bridge (opened 1906)

In the early 20th century, Newport was a busy industrial town with docks along the River Usk. Ships needed to travel up and down the river, but people and goods also needed to cross it. A normal bridge would have blocked tall ships, and a tunnel would have been expensive and difficult to build.

The Newport Transporter Bridge was designed as a solution, allowing people, vehicles, and goods to cross the river without stopping ship traffic.

Problem it solved:
- Need to cross the River Usk easily
- Ships needed clear space to pass underneath
- Growing industry required fast transport links

Engineering involved:
- Civil engineers designed the tall steel towers and cables
- Structural engineers ensured the bridge could carry loads safely
- Mechanical engineers developed the moving gondola (platform) system

Impact on Welsh culture and identity:
The bridge became an important symbol of Newport's industrial strength and innovation. It supported trade and daily life, showing how engineering helped Wales grow during the industrial period.

HEDDIW - TODAY – How do we view this engineering now?

The Newport Transporter Bridge is now a rare and historic structure, with only a few like it left in the world.

Modern evaluation:
- Recognised as an important heritage structure
- No longer used as a main transport route
- Requires ongoing maintenance and restoration

Modern engineering ideas:
- Preserving and restoring historic structures
- Using modern materials to strengthen the bridge
- Monitoring safety with sensors and inspections

Types of engineers involved:
Civil engineers, structural engineers, mechanical engineers, heritage engineers.

YFORY - TOMORROW **– Keep it moving!**

Local problem:
Newport needs modern, efficient transport systems while protecting important historic landmarks like the Transporter Bridge.

Future solution idea:
What could the transporter bridge be used for today? How could attract more tourists?

Engineers who could help:
• Civil engineers or structural engineers – will you need to add any new buildings or structures?
• Electrical engineers (lighting and safety systems) – will you add any new lighting or need any sounds?
• Software engineers (visitor systems and monitoring technology) – could you use technology to make the visitor experience more interactive?

Link to Welsh culture and identity:

The Newport Transporter Bridge is a powerful symbol of Wales' engineering past. Keeping it in use helps people connect with the country's industrial history while adapting to modern needs.

Reflection

The bridge shows how creative engineering solved real transport problems in the past. By preserving it today and planning for the future, engineers can protect this unique landmark while supporting Newport's development.

ENGINEERING FOR WALES

Example 5: Engineering in South Wales, INDUSTRY

Blaenavon Ironworks

DDOE - YESTERDAY **– Why was it built?**

Example: To experiment with iron extraction using the Gilchrist-Thomas extraction method. This allowed for iron to be extracted from lower quality ores.

Problem it solved:

- Improved extraction of pig iron into better quality iron

Engineering involved:

- Civil and structural engineers constructing blast furnaces and water lifts
- Chemists experimenting with iron extraction

Impact on Welsh culture and identity:
One of the most important sites of the industrial revolution, now a UNESCO world heritage site. The population of the area grew massively as people moved from rural areas of Wales to work in the iron industry or to support the needs of the people that worked there.

HEDDIW - TODAY **– How do we view this engineering now?**

The ironworks revolutionised the iron industry, although more modern and efficient techniques are now in use.

Modern evaluation:

- Outdated – the extraction process has improved over time.
- Converted to a museum to celebrate the importance of the things accomplished there.

Modern engineering ideas:

- Construction of modern furnaces to extract iron

Types of engineers involved:
Civil engineers, structural engineers, chemical engineers, metallurgists.

YFORY - TOMORROW **– Making it happen!**

Local problem:
The site is now a museum, how have other buildings in the area that were once part of the iron industry or the community that relied on the iron industry been repurposed?

Future solution idea:
Identify an old building or structure in the community and design a new use for it. What resources and services does the community already have and what does it need to make it an even better place to live? Identify a building and design a new building plan.

Engineers who could help:

- Civil engineers (structural design) - Will changes need to be made to the buildings or structures?
- Environmental engineers (ensuring protection for local wildlife) – How can your design help any local wildlife?
- Renewable energy engineers – Could your design generate its own electricity?

Link to Welsh culture and identity:
The new site could be used as a tourist attraction to educate visitors about the history of iron production in the area. Spaces used regularly by communities can help to revitalise areas and provide a jobs for local people.

Reflection

The Blaenavon Ironworks is one of the most important industrial sites in history, having revolutionised iron production during the industrial period.

ENGINEERING FOR WALES

Example 6: Engineering in South Wales, INDUSTRY

Hafod Copperworks

DDOE - YESTERDAY **– Why was it built?**

Example: Hafod Copperworks (early 19th century)

The Hafod Copperworks was established in 1810 along the River Tawe in Swansea, which became known as "Copperopolis." Swansea was ideal for copper smelting because it had easy access to imported copper ore, local coal for fuel, and a port for global trade.

Problem it solved:
- Copper ore needed to be smelted efficiently into usable metal
- Large amounts of fuel (coal) were required for smelting
- Industry needed to be located near transport routes (river and docks)

Engineering involved:
- Civil engineers designed furnaces, chimneys, and industrial buildings
- Mechanical engineers developed smelting processes and machinery
- Early industrial engineers improved production efficiency

Impact on Welsh culture and identity:
Swansea became the world centre for copper production in the 19th century. The industry brought jobs and international connections, shaping the city's identity as a major industrial powerhouse and contributing to Wales' global reputation during the Industrial Revolution. Lot's of people moved from rural communities to work in these industries.

HEDDIW - TODAY **– How do we view this engineering now?**

The copperworks was highly successful but part of a heavy industrial system that had environmental consequences.

Modern evaluation:
- Industrial pollution affected air, land, and water
- Many original structures fell into disrepair after industry declined
- The site is now recognised as an important heritage location

Modern engineering ideas:
- Restoration and preservation of historic industrial buildings
- Regeneration projects to reuse the site for education and community use
- Environmental clean-up of contaminated land

Types of engineers involved:
Civil engineers, structural engineers, environmental engineers, heritage engineers.

YFORY - TOMORROW **– Making it happen!**

Local problem:
Some former industrial areas in Swansea still need regeneration and better connection to the community, while also dealing with environmental damage from past industry.

Future solution idea:
Develop the Hafod Copperworks site into a sustainable heritage and innovation hub, combining green spaces, education centres, and community facilities while preserving historic structures.

Engineers who could help:
• Civil engineers (site redevelopment and infrastructure) – where would you position the road? How would you connect the buildings? Would you add any new buildings to the site?
• Environmental engineers (land remediation and sustainability) – How can the design help the local wildlife?
• Structural engineers (restoring historic buildings safely) – Which parts of the original building would you keep and which would you replace with a more modern structure?
• Electrical engineers (renewable energy and lighting systems) – How could the site generate its own electricity?

Link to Welsh culture and identity:

Preserving the Hafod Copperworks helps Swansea celebrate its role as “Copperopolis” and reminds people of Wales’ global industrial influence. Regenerating the site connects past achievements with a sustainable future.

Reflection

Engineering at the Hafod Copperworks helped make Swansea a world leader in copper production and supported communities across Wales. By restoring and reusing the site today, engineers can protect this important heritage while creating new opportunities for future generations.

ENGINEERING FOR WALES

Example 7: Engineering in South Wales, ENERGY

Pen y Cymoedd Wind Farm

DDOE - YESTERDAY **– Why was it built?**

Pen y Cymoedd Wind Farm

DDOE – YESTERDAY – Why was it built?

Example: Pen y Cymoedd Wind Farm (opened 2017)

South Wales has a long history of producing energy, especially through coal mining during the Industrial Revolution. However, burning coal created pollution and contributed to climate change. As coal use declined, there was a need to find cleaner ways to produce energy.

Pen y Cymoedd Wind Farm was built on former industrial upland areas to generate renewable electricity using wind power.

Problem it solved:
- Need to reduce carbon emissions from energy production
- Decline of coal industry left a gap in energy supply
- Demand for sustainable and renewable energy sources

Engineering involved:
- Civil engineers prepared the land and built access roads and foundations
- Structural engineers designed tall, stable wind turbines
- Electrical engineers developed systems to generate and transfer electricity to the grid

Impact on Welsh culture and identity:
The wind farm represents a shift from Wales' past as a coal-producing nation to a future focused on renewable energy. It shows how Wales is adapting its industrial heritage to meet modern environmental challenges.

HEDDIW - TODAY **– How do we view this engineering now?**

Pen y Cymoedd is one of the largest onshore wind farms in the UK and plays an important role in clean energy production.

Modern evaluation:
- Provides renewable electricity for thousands of homes
- Reduces reliance on fossil fuels
- Some concerns about visual impact on the landscape

Modern engineering ideas:
- Improving turbine efficiency and lifespan
- Using data and sensors to monitor performance
- Balancing energy needs with environmental protection

Types of engineers involved:
Renewable energy engineers, civil engineers, electrical engineers, environmental engineers.

YFORY - TOMORROW **– Keeping the lights on!**

Local problem:
South Wales still needs more clean energy while protecting natural landscapes and supporting local communities.

Future solution idea:
Some people think the switch to wind power is a good idea, but others don't like them.

- Design a poster or write a magazine style article that will help communities understand the pros and cons of wind farms.
- Identify a suitable location for a wind farm in your area or even in your school grounds.
- One of the reasons people often don't like wind farms is because of the pylons used to transfer the energy produced. Design a new style of electricity pylon. You could even build a model and see if it is stable.
- Pen y Cymoedd is an onshore wind farm. Design an offshore wind farm for South Wales. Where would you put it and why?

Engineers who could help:
• Renewable energy engineers (designing new systems) – you'll need to research the technology to find out about the advantages and disadvantages.
• Environmental engineers (reducing environmental impact) – whats steps do wind farm companies take to try and protect wildlife?
• Software engineers (smart grids and monitoring systems) – wind farms are connected to the National Grid to distribute the power, how is power distributed from Pen y Cymoedd wind farm?

Link to Welsh culture and identity:

Pen y Cymoedd shows how Wales is moving from its industrial past to a greener future. It reflects a growing focus on sustainability while still recognising the country's history of energy production.

Reflection

Engineering once made South Wales a leader in coal production. Today, projects like Pen y Cymoedd Wind Farm show how engineering can help tackle climate change and create a cleaner future, while continuing Wales' role as an energy-producing nation.

ENGINEERING FOR WALES

Example 8: Engineering in North Wales, ENERGY

Gwynt y Môr Offshore Wind Farm

DDOE - YESTERDAY **– Why was it built?**

Example: Gwynt y Môr Offshore Wind Farm (opened 2015)

North Wales, like the rest of the UK, needed to reduce its use of fossil fuels such as coal and gas. These fuels produce carbon emissions that contribute to climate change. At the same time, there was a growing demand for clean, renewable electricity.

Gwynt y Môr Offshore Wind Farm was built in Liverpool Bay, off the coast of North Wales, to generate large amounts of renewable energy using wind power.

Problem it solved:
- Need to reduce carbon emissions and fight climate change
- Growing demand for electricity from homes and industry
- Need for large-scale renewable energy production

Engineering involved:
- Civil engineers designed offshore foundations in deep water
- Structural engineers ensured turbines could withstand strong sea winds and waves
- Electrical engineers designed systems to transfer electricity back to the mainland grid
- Marine engineers helped with installation in challenging sea conditions

Impact on Welsh culture and identity:
This project shows Wales moving from its industrial past (coal and steel) to a future based on renewable energy. It also strengthens Wales' reputation as a leader in sustainable engineering.

HEDDIW - TODAY **– How do we view this engineering now?**

Gwynt y Môr is one of the largest offshore wind farms in the UK and plays a key role in supplying clean energy.

Modern evaluation:
- Produces enough electricity for hundreds of thousands of homes
- Reduces greenhouse gas emissions
- Provides jobs in engineering and maintenance
- Some visual and environmental concerns from coastal communities

Modern engineering ideas:

- Improving turbine efficiency and lifespan
- Using better monitoring systems to detect faults early
- Minimising impact on marine wildlife
- Expanding offshore renewable energy networks

Types of engineers involved:

Renewable energy engineers, marine engineers, electrical engineers, environmental engineers.

YFORY - TOMORROW **– Keeping the lights on!**

Local problem:

Wales needs more clean energy while protecting marine environments and coastal landscapes.

Future solution idea:

Develop next-generation offshore wind farms – research structures and materials that float, why do some really big and heavy things like huge container ships float yet some really small or far lighter things sink. Use your research to design a floating wind turbine or a floating wind farm.

Engineers who could help:

- Marine engineers (floating turbine structures) – understanding how large ships float might be useful.
- Electrical engineers (grid connection and storage systems) – how will the turbines be connected to one another and to the land?
- Environmental engineers (protecting marine ecosystems) – how can we help wildlife in the area?

Link to Welsh culture and identity:

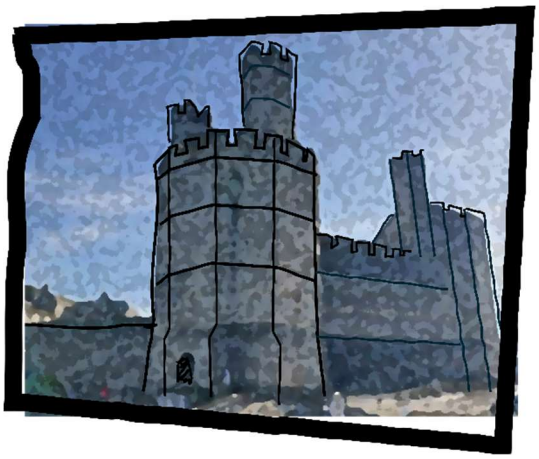
Gwynt y Môr represents modern Wales as a nation of innovation and sustainability. It connects Wales' industrial heritage with a cleaner, greener future.

Reflection

Wales was once known for coal mining and heavy industry. Now, projects like Gwynt y Môr show how engineering is helping Wales lead in renewable energy and climate solutions for the future.

ENGINEERING FOR WALES

Example 9: Engineering in North Wales – DEFENCE



Caernarfon Castle

DDOE - YESTERDAY – Why was it built?

Example: Caernarfon Castle (built from 1283)

Caernarfon Castle was built by Edward I after he conquered Wales. It was part of a series of castles designed to control the Welsh population and defend against uprisings.

The castle was also built to show power and authority, with impressive walls and towers that made it look strong and important.

Problem it solved:
- Needed to control and defend newly conquered land
- Protect English settlers and officials
- Show strength to prevent rebellion

Engineering involved:
- Military engineers designed thick stone walls and towers
- Builders used strong materials like stone for defence
- Strategic design included gates, arrow slits, and battlements

Impact on Welsh culture and identity:
Caernarfon Castle is a symbol of both conflict and history in Wales. It represents English rule but is now also an important part of Welsh heritage and identity.

HEDDIW – TODAY – How do we view this engineering now?

Today, Caernarfon Castle is one of the most famous castles in Wales and a major tourist attraction.

Modern evaluation:
- Seen as an important historical and cultural site
- Attracts visitors from around the world
- Preserved as part of Wales' heritage

Modern engineering ideas:
- Conservation and restoration of stone structures
- Protecting the castle from weather damage
- Making the site safe and accessible for visitors

Types of engineers involved:
Civil engineers, structural engineers, conservation engineers.

YFORY – TOMORROW **– Defend yourself and your community!**

Local/global problem:
In the past, castles like Caernarfon were built to protect people from physical attacks using strong walls, gates, and towers. Today, many of the threats we face are no longer physical but digital. Personal data, money, and information can be stolen online by hackers and scammers.

Future solution idea:
Just as castles were designed to defend against physical attack and invasions, modern systems must be designed to protect digital information. This means creating secure ways to store and share data so that it cannot be easily accessed or stolen. Design a poster that will help people stay safe online. It could be aimed at everyone or a particular age group such as children or the elderly. It might help if people have greater understanding of how things like the internet work.

Engineers who could help:
• Software engineers (designing secure systems and apps) – what security systems are often built into apps to make them more secure?
• Cybersecurity engineers (protecting against hacking and scams) – how can people avoid being scammed? What is phishing?
• Data engineers (safe storage of information) – why is it important to keep data safe?

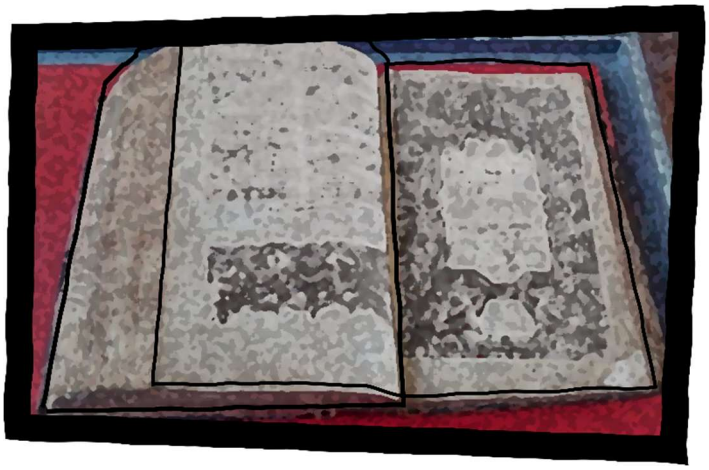
Link to Welsh culture and identity:

Caernarfon Castle shows how people in the past used engineering to stay safe. Today, Wales continues this tradition by using modern engineering to protect people in a digital world.

ENGINEERING FOR WALES

Example 10: Engineering in North Wales - COMMUNICATION

First printed Welsh Bible



DDOE - YESTERDAY **– Why was it built?**

Welsh Bible Printing Press

Example: Welsh Bible publication of 1588 using a printing press by William Morgan

In the 16th century, most religious texts were not available in Welsh. This made it difficult for Welsh-speaking people to understand the Bible. William Morgan translated the Bible into Welsh, and printing presses were used to produce copies.

The printing press was a key piece of technology that allowed many identical books to be made much faster than writing them by hand. It also helped to standardise the language – people started to consistently use spellings they saw in the bible. This also shaped the Welsh alphabet. Some sounds and therefore letters appear more often in one language than in another. The printers didn't enough letter 'k' so used a letter 'c' instead.

Problem it solved:
- People could not access the Bible in their own language
- Hand-copying books was very slow and expensive
- There was a need to spread religious knowledge widely

Engineering involved:
- Mechanical engineers developed the printing press system
- Movable type allowed letters to be arranged and reused
- Press mechanisms applied even pressure to print pages clearly

Impact on Welsh culture and identity:
The Welsh Bible helped protect and strengthen the Welsh language. It allowed people to read in Welsh and played a major role in keeping the language alive.

However, it did also affect how the language was recorded:
- Printing presses did not always have enough Welsh letters or special characters
- Some letters and sounds had to be adapted using available type
- Spelling became more standardised because printed books needed consistency
- Faults and limits in the printing process helped shape the modern Welsh alphabet and spelling system

HEDDIW - TODAY **– How do we view this engineering now?**

The printing press is seen as one of the most important inventions in history, helping spread knowledge and education.

Modern evaluation:
• Made books widely available for the first time
• Supported education, religion, and literacy
• The Welsh Bible is still an important cultural symbol

Modern engineering ideas:
• Digital publishing and e-books
• High-speed printing technology
• Preserving historic texts and printing methods

Types of engineers involved:
Mechanical engineers, materials engineers, software engineers (modern publishing).

YFORY = TOMORROW **– Spread the word!**

Local problems:
The Welsh language needs continued support to stay strong in a digital world. Today, information spreads very quickly through social media, but not all of it is true. Fake news and misinformation can spread easily and cause confusion.

Future solution idea:
Use modern technology to promote Welsh through apps, digital books, and online learning platforms, making the language accessible to younger generations. Come up with ways in which you can use technology to promote the use of the Welsh language or tell traditional Welsh stories in your community.

What steps can you take to make sure the information you are seeing online is reliable? Put together some guidelines that friends could follow to help them avoid “Fake News”.

Engineers who could help:
• Software engineers (apps and digital platforms) – could you develop a simple game that uses Welsh vocabulary, is inspired by a Welsh legend or helps people practice the language?
• Media and technology engineers (digital publishing tools) – can you use digital design programmes to produce posters, signs or other resources to help people use more Welsh?

Link to Welsh culture and identity:

The Welsh Bible is one of the most important reasons the Welsh language survived and grew. It helped unify people and strengthen national identity.

Reflection

The printing press allowed William Morgan to share the Bible in Welsh, helping the language survive. However, the limits of early technology also shaped how Welsh is written today.

In the future, engineers face a new challenge: making sure the information we share is trustworthy. Just as the printing press spread knowledge, modern technology must be used responsibly to protect truth and culture.

ENGINEERING FOR WALES

Example 11: Engineering in South Wales - COMMUNICATION

Vantage CWL1 Data Centre

DDOE - YESTERDAY – Why was it built?

Example: Vantage Data Centre CWL1

South Wales has a strong industrial past, with coal, steel, and heavy manufacturing. As technology developed, there was a shift towards digital industries. The rise of the internet, cloud computing, and online services created a huge demand for secure places to store and process data.

The Vantage CWL1 Data Centre was built to support this growing digital world, providing large-scale data storage and fast connections for businesses and global networks.

Problem it solved:
- Increasing demand for data storage and cloud services
- Need for fast, secure, and reliable digital infrastructure
- Replacement of traditional industry with modern technology jobs

Engineering involved:
- Civil engineers designed large, secure buildings
- Electrical engineers created reliable power systems with backup supplies
- Mechanical engineers developed advanced cooling systems to prevent overheating
- Network and software engineers built systems to manage and transfer data

Impact on Welsh culture and identity:
This shows how Wales is changing from heavy industry to a digital economy. South Wales is now part of global technology networks, helping to modernise the region and create new opportunities.

HEDDIW - TODAY – How do we view this engineering now?

Data centres like CWL1 are essential for everyday life, even if people don't always see them.

Modern evaluation:

- Supports services like streaming, banking, and communication
- Creates skilled jobs in engineering and IT
- Artificial intelligence needs access to huge amounts of data.
- Uses large amounts of electricity and resources.

Modern engineering ideas:

- Improving energy efficiency
- Using renewable energy sources
- Designing more sustainable cooling systems
- Increasing security and reliability

Types of engineers involved:

Electrical engineers, software engineers, civil engineers, environmental engineers, mechanical engineers.

YFORY = TOMORROW **– Spread the word!**

Local problem:

Data centres require a lot of energy and can impact the environment, so they need to become more sustainable. Modern life produces more and more data which is stored in centres like these and AI requires and produces large amounts of data and lots of the data that is stored is unlikely to be accessed again such old emails.

Future solution idea:

Think about how much data you generate and how you can encourage people to think carefully about the data they store or delete. Create posters or videos to help people ma

Link to Welsh culture and identity:

The Vantage CWL1 Data Centre shows how Wales is adapting to the modern world. It highlights a shift from traditional industries to advanced technology, helping shape a new national identity.

Reflection

South Wales once powered the world with coal and steel. Today, it supports the digital world through data centres. Engineering continues to drive change, helping Wales stay important in a modern, connected world.