RENEWABLE ENERGY IN TASMANIA

RESOURCE PACKAGE

YEARS 7-10

Department for Education, Children and Young People

Tasmanian Government

Introduction to the resource

This resource package supports understanding Tasmania's renewable energy capability and explores different technologies, types of energy sources and the actions being taken by our state to remove dependency on fossil fuels. It links to the Australian Curriculum: Science and Sustainability as a cross curricular priority. It specifically covers different types of renewable energy, explains how green hydrogen and pumped hydro work, and how renewable energy can support action on climate change by reducing greenhouse gas emissions. It includes background information for teachers, activities for students, plus stories on careers and what skills are required to work in the renewable energy industry. For local context, the resource package includes information from the State Government's Tasmanian Renewable Energy Action Plan (TREAP).

HOW TO USE THE RESOURCE

The resource uses the 'Five Es' instructional model designed by Biological Sciences Curriculum Study, an educational research group in Colorado. It has been found to be extremely effective in engaging students in learning science and technology. It follows a constructivist or inquiry-based approach to learning, in which students build new ideas on top of the information they have gained from previous experience.

The resource package is designed to provide a variety of activities and information to give you flexibility in the classroom. You and your students can choose to use all or any of the sections, adjust them for your classroom or choose one for a deep dive into a certain topic. It includes:

- A curriculum overview mapping the years 7–10 Australian Science Curriculum
- Background information
- Student activities, including a matrix of curriculum-linked activities that allows teachers to provide a range of short and long classroom activities for flexible delivery of the program
- Career profile
- Further reading and resources.

THE COMPONENTS OF THE FIVE E'S ARE:

ENGAGE
Students are asked to make connections between past and present learning experiences and become fully engaged in the topic to be learnt.

EXPLORE
Students actively explore the concept or topic being taught. It is an informal process where the students should have fun manipulating ideas or equipment and discovering things about the topic.

EXPLAIN
This is a more formal phase where the theory behind the concept is taught. Terms are defined and explanations are given about the models and theories.

ELABORATE
Students have the opportunity to develop a deeper understanding of sections of the topic.

EVALUATE
Both the teacher and the students evaluate what they have learnt in each section.

Australian Curriculum: 7–10 Science 9.0

Area	7	8	9	10
SU - Science Understanding: **PS** - Physical Sciences	Investigate and represent balanced and unbalanced forces, including gravitational force acting on objects, and relate changes in an object's motion to its mass and the magnitude and direction of forces acting on it (AC9S7U04)	Classify different types of energy as kinetic or potential energy and investigate energy transfer and transformations in simple systems (AC9S8U04)	Classify different types of energy as kinetic or potential energy and investigate energy transfer and transformations in simple systems (AC9S8U04)	Investigate Newton's laws of motion and quantitatively analyse the relationship between force, mass and acceleration of objects (AC9S10U05)
SU - Science understanding: **CS** - Chemical Sciences	Use particle theory to describe the arrangement of particles in a substance, including the motion of and attraction between particles, and relate this to the properties of the substance (AC9S7U05)	Classify matter as elements, compounds or mixtures and compare different representations of these, including 2- and 3-dimensional models, symbols for elements and formulas for compounds (AC9S8U06) Compare physical and chemical changes and identify indicators of energy change in chemical reactions (AC9S8U07)	Explain how the model of the atom changed following the discovery of electrons, protons and neutrons and describe how natural radioactive decay results in stable atoms (AC9S9U06)	Explain how the structure and properties of atoms relate to the organisation of the elements in the periodic table (AC9S10U06)
SU - Science understanding: **ESS** - Earth & Space Science			Represent the carbon cycle and examine how key processes including combustion, photosynthesis and respiration rely on interactions between Earth's spheres (the biosphere, geosphere, hydrosphere and atmosphere) (AC9S9U03)	Use models of energy flow between the biosphere, geosphere, hydrosphere and atmosphere to explain patterns of global climate change (AC9S10U04)
SHE - Science as a Human Endeavor	Explain how new evidence or different perspectives can lead to changes in scientific knowledge (AC9S7H01) Investigate how cultural perspectives and worldviews influence the development of scientific knowledge (AC9S7H02)		Explain how scientific knowledge is validated and refined, including the role of publication and peer review (AC9S9H01) Investigate how advances in technologies enable advances in science, and how science has contributed to developments in technologies and engineering (AC9S9H02)	

Renewable energy in Tasmania

Tasmania has a rich history in renewable energy. Over 100 years ago, Tasmania's statewide hydroelectric power scheme transformed our state's economic development. Hydro Tasmania owns and operates 30 hydropower stations and 54 major dams, and manages a significant amount of related infrastructure. Today, renewable energy (still mostly hydropower and wind) remains a key part of our economy and provides reliable, clean power to Tasmania and other Australian states. Tasmania generates 50% of Australia's hydro energy (source: Energy.gov.au) — see Figure 1 for more statistics.

Tassie is known for being Australia's leading renewable energy state. On 27 November 2020 we celebrated a significant achievement by reaching our 100% renewable electricity target. Tasmania is now one of only a handful of places worldwide that can confidently claim it has the capacity to meet our renewable energy needs. Growing our state's renewable energy resource industry can attract investment, create jobs, and support Australia to transition away from fossi fuels (coal-fired power stations and gas).

Moving away from fossil fuels helps us take action on climate change by reducing our greenhouse gas emissions. Tasmania was the first Australian jurisdiction to achieve net zero emissions. Once we reached the target of 100% self-sufficiency in 2020, we then legislated a Tasmanian Renewable Energy Target to double that production. This means our target is to produce 21,000 gigawatt hours of electricity in one year, by 2040. This is 200% of our 2020 demand.

Building Tasmania's capability to support more renewable energy resources requires significant planning and coordination. To help this process, the government released its Tasmanian Renewable Energy Action Plan (TREAP) which sets out how to put this into action. Tasmanian educators and students have an important role to research, design, create, build, problem-solve, communicate, educate and support Tasmania's renewable energy future and our action on climate change. Table 1 outlines the three priority areas of the TREAP.

Table 1

Priority	Main ideas / projects
1. Transforming Tasmania into a *global* renewable energy powerhouse	• Tasmanian Renewable Energy Target (200%) • Battery of the Nation • Project Marinus • Green Hydrogen
2. Making energy work for the Tasmanian community	• Access to reliable, secure and affordable energy • Advocacy for use and knowledge of energy tools, products and services • Continue support for energy efficiency programs
3. Growing the economy and providing jobs	• Maximise local business and employment opportunities for renewable energy projects • Continue to promote Tasmania as a premier investment destination for businesses wanting competitive, clean, reliable energy • Support roll-out of the Energising Tasmania skills and training program

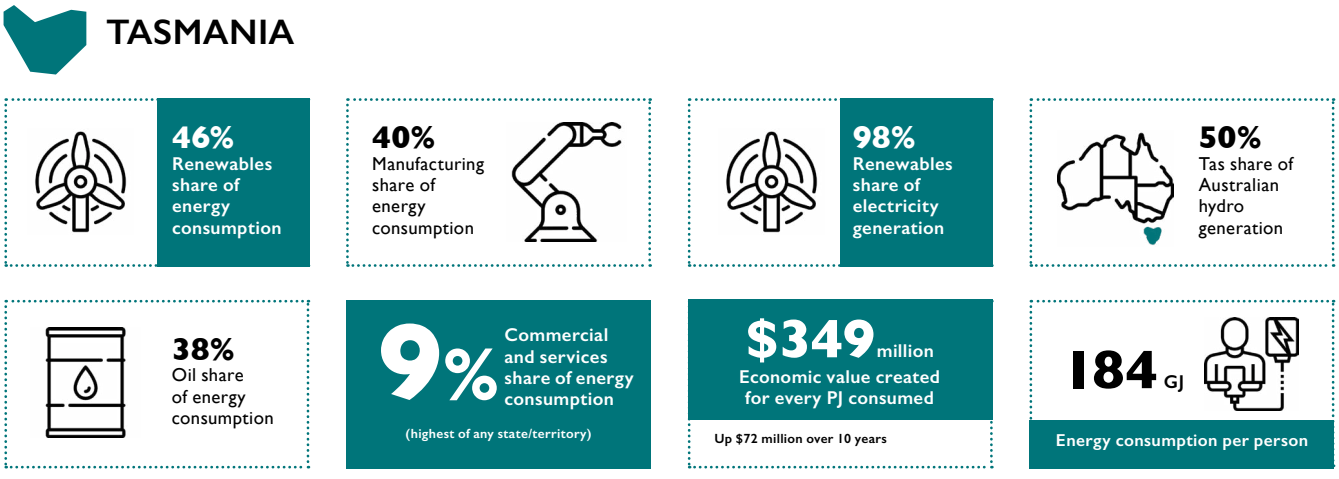


Figure 1: Tasmania's Energy Statistics. Source: https://www.energy.gov.au/publications/australian-energy-statistics-state-and-territory

RENEWABLE ENERGY AND CLIMATE CHANGE

Investment in renewable energy isn't just good for the economy. Renewable energy is clean, sustainable and can help us take action on climate change by reducing our greenhouse gas emissions. Because renewable sources of energy do not rely on burning fossil fuels, they can help to reduce emissions, and mitigate climate change.

Less reliance on fossil fuels like coal, natural gas (methane) and crude oil (for petrol) — all non-renewable resources — to power our lifestyles means reducing carbon-based emissions (such as carbon dioxide (CO_2) and methane (CH_4) entering the atmosphere. That's a great reason to move to more renewable sources of energy for our power generation.

Renewable electricity generation has more than doubled over the last decade. On average, hydropower has grown by 15.4% per year, while solar has grown by 29.8% per year. Source: www.energy.gov.au/data/renewables

Image: Hydro Tasmania

Other sources of renewable energy include geothermal (heat from the Earth), bioenergy (or biomass) and, more recently, green hydrogen, which is produced using renewable energy. Work carried out by Geoscience Australia has identified Tasmania as having very high potential for renewable hydrogen production. This is due to: strong renewable energy resources dominated by existing hydropower and wind, abundant fresh water, and good access to existing infrastructure.

The Tasmanian Government led a consortia to secure funding from to the Australian Government's Clean Hydrogen Industrial Hubs grants program. In May 2022 it was announced that the Bell Bay Hydrogen Hub had secured $70 million of support from the Australian Government and discussions have commenced to finalise funding arrangements for the hub. The Green Hydrogen Hub project is located at Bell Bay and has already attracted interest from several large energy companies proposing projects that use hydropower and wind power to produce hydrogen. Hydrogen can be used as a form of renewable energy which can replace fossil fuels like petrol, diesel and methane.

Two major Tasmanian projects include the Battery of the Nation and Project Marinus. The Battery of the Nation includes redeveloping existing hydropower schemes and adding pumped hydro (a flexible technology that can respond to various electricity demands). Project Marinus is an electricity and telecommunications interconnector between Tasmania and Victoria that is a critical part of Tasmania's energy future.

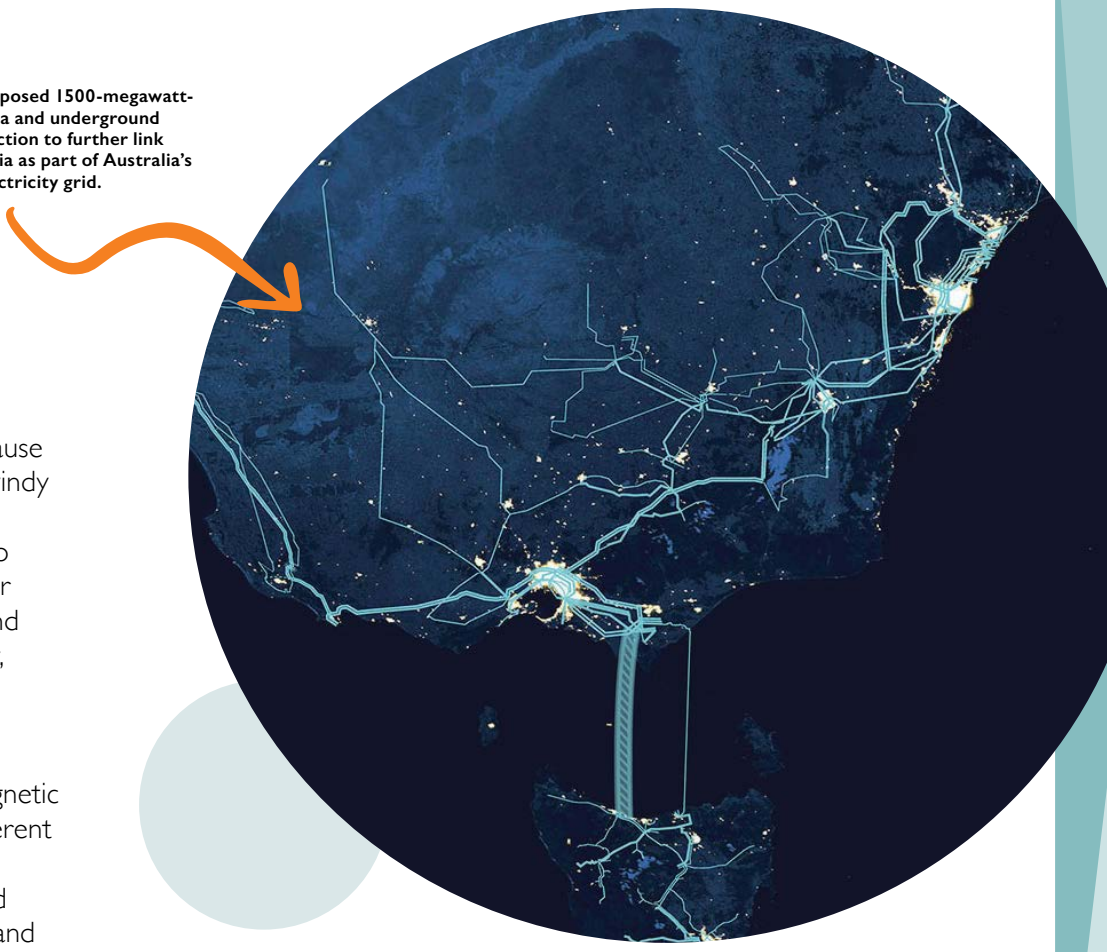
While batteries are not a direct source of renewable energy, they can store the electricity generated by renewables, so the energy can be used later. Batteries can be 'recharged' and have a long life. They help store energy for things like electric vehicles, and can be used in houses, apartments and commercial buildings. 'Big batteries' are spaces that link smaller batteries together, enabling more energy to be stored and then used in the energy grid.

THE SCIENCE OF RENEWABLE ENERGY

"Energy cannot be created or destroyed; it can only be transformed from one form to another."

The law of conservation of energy is the fundamental premise of any energy system. The same law applies to matter. This becomes important when electrolysis is used to produce hydrogen. In addition to this process, you can explore rates of reaction with your students. Since renewable sources of energy are being used to generate usable energy like electricity, it is also important to compare potential and kinetic energy.

With hydroelectricity, gravity comes into play, which means looking at Newton's laws. Distinguishing between force, energy, power and work is part of embedding scientific literacy, along with the various units of



Marinus Link is a proposed 1500-megawatt-capacity undersea and underground electricity connection to further link Tasmania and Victoria as part of Australia's future electricity grid.

measurement and scales. Because wind turbines need to be in windy areas, teachers can use these renewable energy examples to examine the role of friction, air resistance and surface area, and apply ideas of geomorphology, mapping and GIS.

Solar energy allows you to explore the whole electromagnetic spectrum, the uses of the different components, as well as wave and particle models, the speed of light and laws of reflection and refraction. Understanding the role of electrons in electricity and how to build an electric circuit allows you to also explore energy transformations and efficiency.

Using this guide, you can allow your students to use their critical and creative thinking skills to tackle the sustainability of sourcing and producing suitable infrastructure, and using the renewable resources to generate usable energy.
This guide also provides students with opportunities to explore social, environmental and economic issues, and to take a systems-thinking approach, as well as understand the importance of STEM thinking and the applications of STEM. Specifically, exploring Tasmania's renewable energy sector growth and the consequences for our state shows how science can help to shape and create our current and future worlds.

CREATING A DIVERSE ECONOMY THROUGH RENEWABLE ENERGY

Existing and potential developments in the renewable energy industry involve many different stages and operating models that will determine economic benefits. There are large-scale renewable energy projects underway in Tasmania that will have direct and indirect outcomes for our state's economy (for example, jobs in the supply chain, or a local business or town benefiting from increased trade during construction). Examples of this are taken from the major projects highlighted in the TREAP.

Project Marinus

Project Marinus (also referred to as 'Marinus Link') is a proposed 1500-megawatt capacity undersea and underground electricity interconnector between Tasmania and Victoria that would allow Tasmania to export more of its renewable, reliable energy resources. Interconnectors are integral to the operation of Australia's energy grid as they enable the efficient transfer of high-voltage electricity between different regions. In Australia, the electricity grid consists of:

- Transmission grids that transmit electricity across large distances at very high voltages.
- Distribution grids that deliver electricity from the transmission grid to households and businesses.

High voltage electricity needs transmission grids (interconnectors) that go to distribution grids

Image: Hydro Tasmania

As Australia's coal-fired power stations are being closed down, we need more variable renewable energy, such as wind and solar, to take its place.

(converter stations) to provide the electricity needed to power homes, businesses and industries at different voltages (through poles and wires).

Project Marinus modelling shows it will generate many jobs in Tasmania and Victoria throughout its development, construction, and operation phases, as a skilled workforce will be needed to design, develop and maintain an affordable, reliable and secure energy grid. This requires engineers (civil, environmental, mechanical, electrical), builders, and electricians, in addition to entrepreneurs and government employees, loan managers, business managers, computer programmers, data analysts, project managers, energy assessors, technicians, customer service representatives, marketing and communications specialists, and many more employees across a wide range of sectors.

The National Energy Market

The National Energy Market (NEM) is a wholesale electricity market that connects the Australian electricity network from Queensland to South Australia and Tasmania via the Basslink interconnector — currently the sole electricity interconnector between Tasmania and Victoria. The NEM allows generators of electricity, transmitters and electricity retailers to work together to get electricity exactly where it's needed at the best possible price.

Marinus will add an additional interconnector between Tasmania and Victoria — allowing Tasmania export more renewable energy to the mainland, and also ensuring there's always electricity exactly when we need it.

Pumped hydro

Hydropower converts the energy of moving water into electricity. It uses a number of generation and storage technologies; mainly hydroelectricity and Pumped Hydro Energy Storage (PHES). PHES technology enables excess energy from the grid or a renewable energy source, such as a wind or solar farm, to be used during low-demand periods to pump water from a lower dam to a higher one, essentially converting the upper reservoir into a giant battery. The Pumped Hydro project is often referred to as the 'Battery of the Nation'.

Green hydrogen

Hydrogen produced from renewable energy will be an important part of decarbonising global, national and local economies. Tasmania is well placed to develop a large-scale renewable hydrogen production and distribution industry using competitively priced existing and new renewables, including high-capacity wind farmed by wind and hydropower generation.

Tasmanian renewable hydrogen can supply both export and domestic markets. Using renewable hydrogen in Tasmania can provide valuable economic, energy security and environmental benefits by reducing our dependence on imported fossil fuels.

Flick a switch

HAVE YOU EVER WONDERED HOW THE ENERGY THAT RUNS YOUR DEVICES WORKS AND WHERE IT COMES FROM?

1. Conduct an individual brainstorm to identify as many concepts as possible, including what you already know about how energy works and where it comes from.

2. Share your ideas in a small group. Add to your own brainstorm if any new concepts pop up.

3. Use the suggested sources of information below to help you think up as many questions as possible. Number each question.

   The best way to do this is using sticky notes — one for each question.

   i. **Source 1: Watch** — Energy Innovators of the Huon Valley

   ii. **Source 2: Explore** — Student Energy: Energy System Map

   iii. **Source 3: Examine** — Our World In Data: Renewable Energy

4. Individually classify your questions into categories: closed questions (normally answered with a yes/no response or very short fact) and open questions (the response usually requires further research and potentially experiments).

5. In a small group, compare your questions and classify them using your own categories. Identify the main themes. Compare your group with others in the class. Are there similar questions but in different themes, or similar themes with different questions?

6. In small groups, brainstorm all the different areas of science, technology, engineering, maths and sustainability needed for studying energy resources and climate change. This may generate more questions. Will some of these areas also help you answer your questions?

7. Individually or in small groups, choose five questions you want to find answers to. Using reliable sources of information, conduct your research to investigate (first or second-hand) the answers.

8. Present one of your responses to your group/class using a 90-sec pitch-style presentation.

NOTES TO TEACHER:

This activity is based on the **Question Formulation Technique** (QFT) resources. Suggest using Source 1 as a whole class activity. Provide time limits (15 min each) for sources 2 and 3.

The categories are suggestions only. Feel free to choose your own. Others include: science-based, technology-based, sustainability, practical, theoretical.

Renewable STEM

STEM HELPS US TO BUILD, DEVELOP AND MAINTAIN RENEWABLE SOURCES OF ENERGY.

The study of energy and renewables brings together the fundamentals of physics, chemistry, technology and engineering. It's important to remember the basis of all this is maths! The STEM opportunities in renewables are huge, and the ways you can use STEM in renewable energy is up to your imagination! As Albert Einstein said: *"Imagination is more important than knowledge. Knowledge is limited. Imagination encircles the world."* Where will your study into the renewables industry take you?

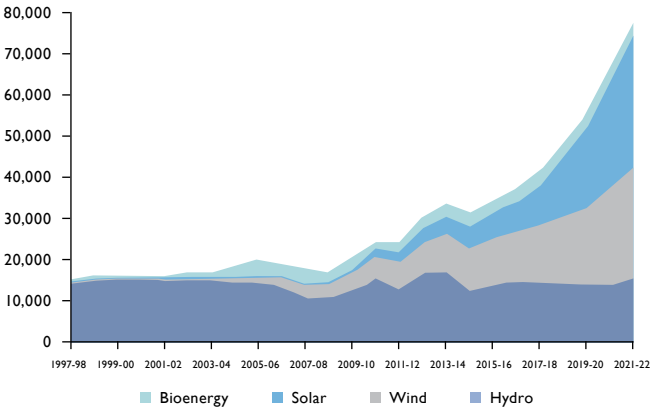
RENEWABLE ENERGY USE IN AUSTRALIA

In Tasmania, our energy generation is predominantly from renewable sources: hydropower and wind. On the mainland, the use of renewables for electricity is on the rise, but the rest of Australia relies mostly on coal-fired power generation. In 2022, 32% of Australia's total electricity generation was from renewable energy sources, including solar (14%), wind (11%) and hydro (6%). (source: energy.gov.au).

Image: Hydro Tasmania

Find out more about renewable energy: hydro.com.au

Australian electricity generation: renewable resources



Australian electricity generation from renewable sources in gigawatt hours from 1997 to 2022. Generation from renewable energy sources has risen over the last 10 years and the mix of renewable energy sources has also diversified.

Source: https://www.energy.gov.au/data/australian-electricity-generation-renewable-sources

YEAR 7: EXPLAINER VIDEO

6 forms of renewable energy

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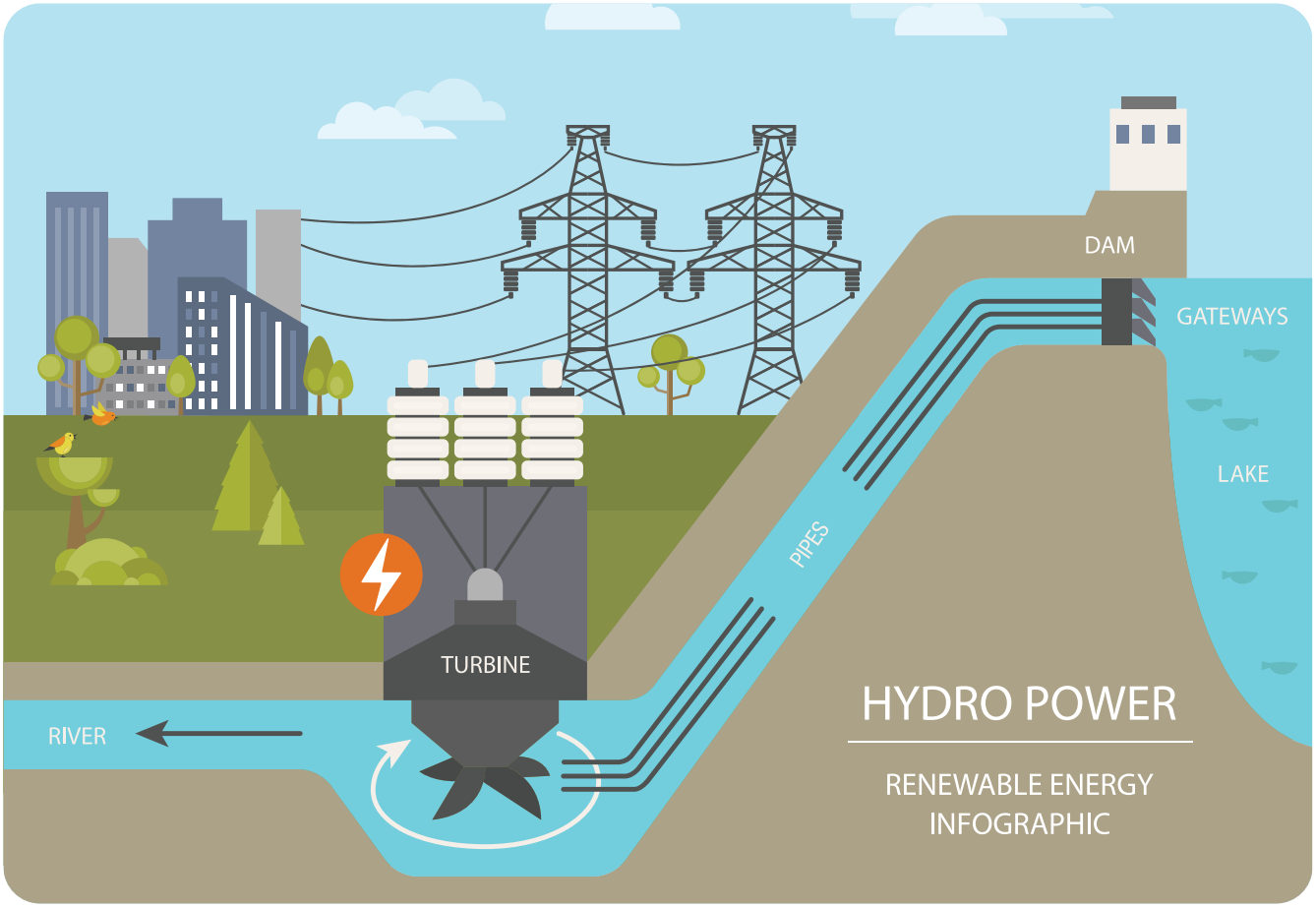


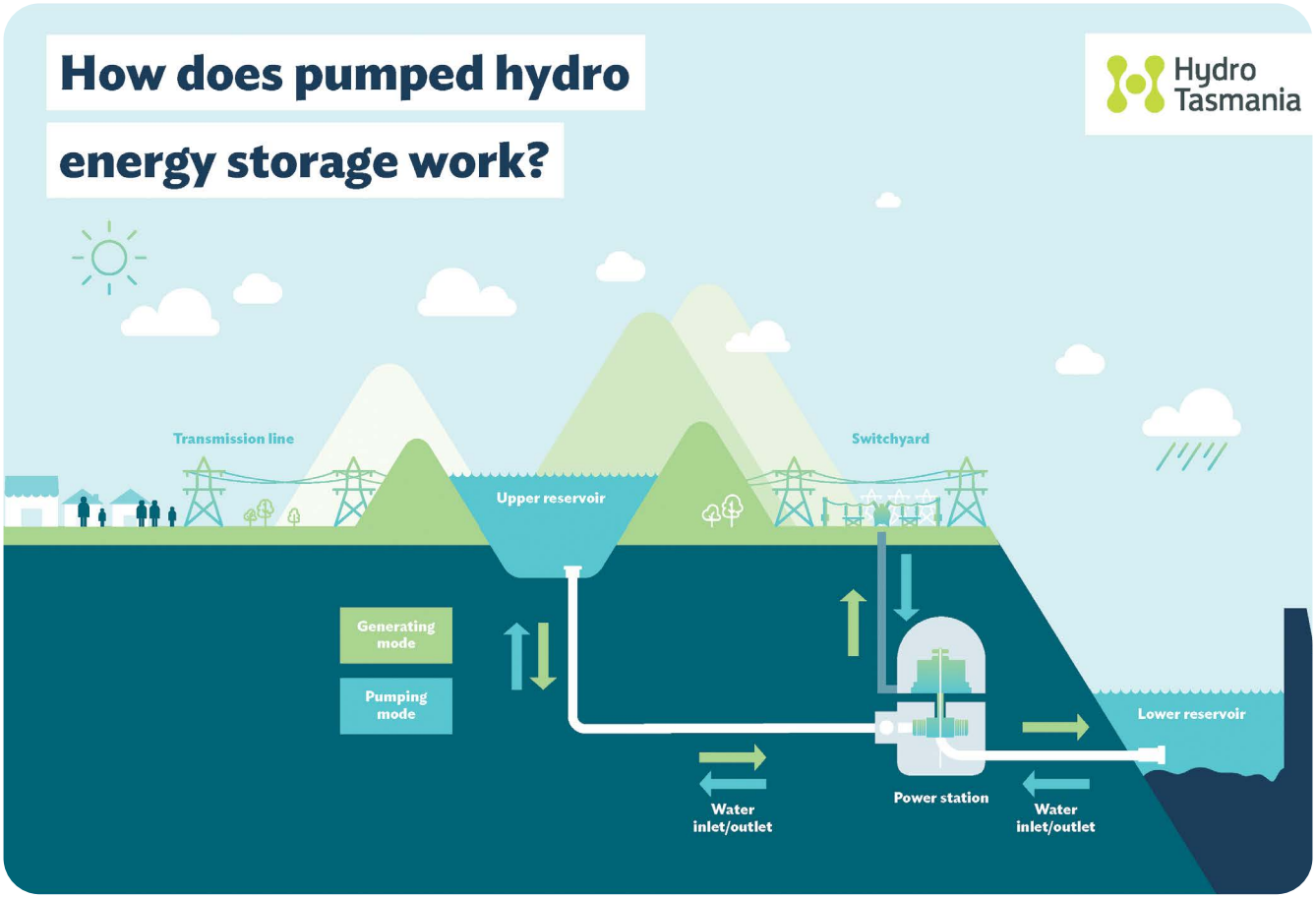
Image: SHUTTERSTOCK

HYDROELECTRIC POWER

Hydroelectric power is one of the oldest, most mature energy technologies and has been used in various forms for thousands of years. It now provides some level of electricity generation in more than 160 countries. Here's how it works.

1. Water stored in a dam or reservoir at a height is released.
2. Gravity makes the water accelerate as it runs downhill (at 9.8m per second per second) through a pipe towards turbines, which are connected to a generator.
3. The force with which the water hits the blades causes the turbines to spin, generating electricity. But how? In 1832, scientist Michael Faraday discovered that electrical charge is created when an electric conductor is moved in a magnetic field. The rotating elements in the generator are surrounded by a large magnet and copper wire. As the magnet rotates, a stream of electrons is released.
4. The whole process converts gravitational potential energy (water high up on a hill) to kinetic energy (the movement of the turbines), which is then transformed into electricity. The electricity is fed into a transformer and then transmitted directly to a substation and from there to households and businesses around Tasmania.

Hydroelectricity can also be generated through a pump system (which can be referred to as 'pumped hydro'). This uses wind or solar energy to pump water up from a lower reservoir when electricity is in low demand (called low-peak times) to the high reservoir for storage, making



Source: https://arena.gov.au/assets/2019/08/pumped-hydro-storage-infographic-how-it-works.pdf

the water body one big battery (remember: batteries are energy storage devices).

Hydroelectricity can be generated almost immediately and at any time, making it possible for the power to be fed into the grid when it is needed, to help reduce surges, avoid blackouts or meet spikes in electricity demand. Pumped hydro systems can also produce large amounts of electricity over a long period, to provide reliable and dispatchable energy generation.

EXPLAINER VIDEO

How does hydropower work?

CLICK HERE

HOW SOLAR CELLS WORK

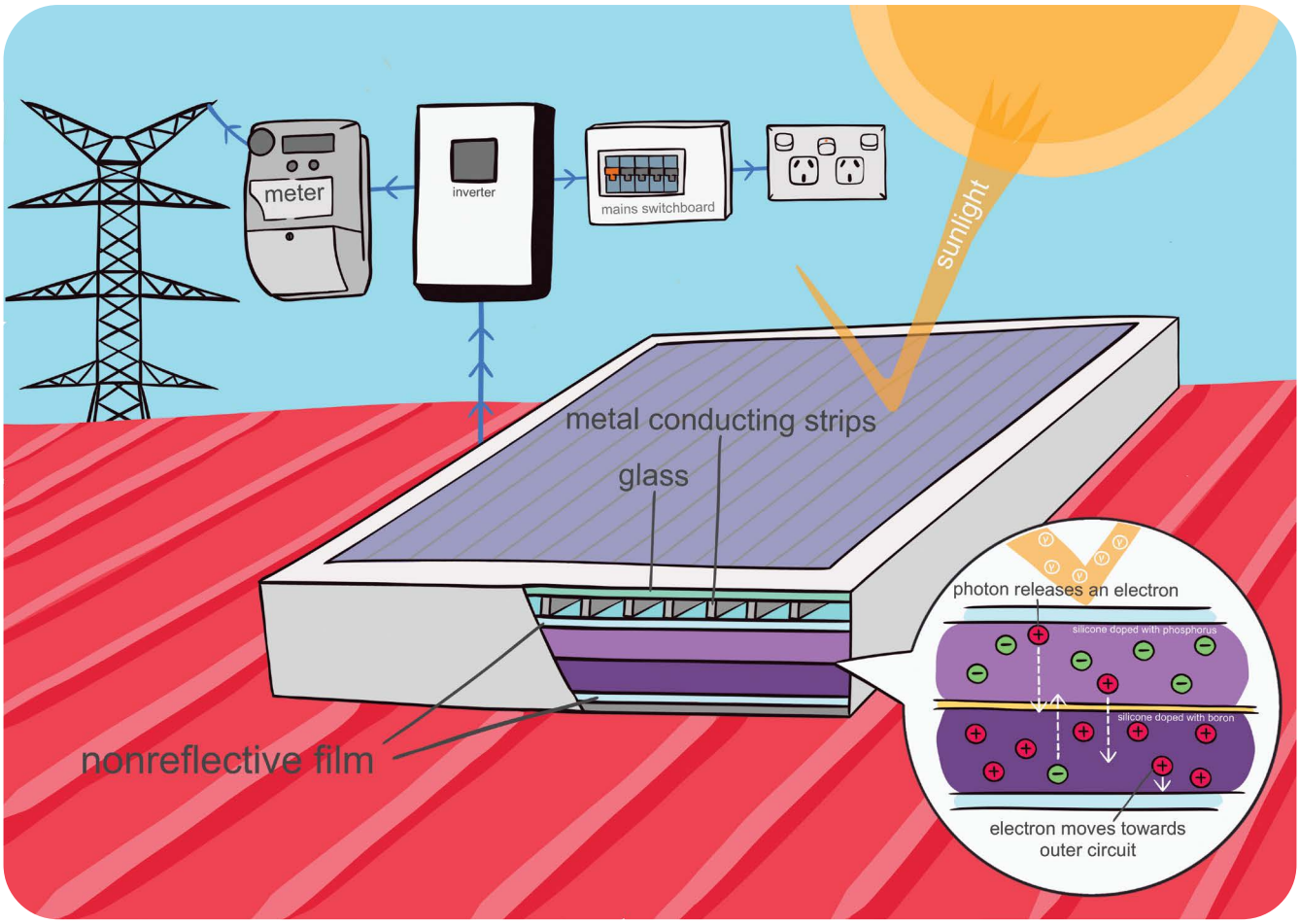


Image: Rachael Bolton/Refraction Media

Source: https://stelr.org.au/additional-info/solar-cells-theory/#

SOLAR

Energy from the heat and light of the Sun is called solar energy. When solar energy is converted into electricity or used to heat air, water or other substances, it produces solar power. Solar energy can also be used to create fuels such as hydrogen. There are two main types of solar power technology: solar photovoltaic and solar thermal.

Solar photovoltaic (also known as solar PV) converts sunlight directly into electricity using a technology known as a semiconductor cell or solar PV cell, which is made out of silicon (see above). These are usually put in glass cases, with an aluminium frame to form a solar panel. One or more panels can be installed to power a single light, cover the roof of a house or be combined into a large-scale solar farm generating hundreds of megawatts of electricity.

Solar thermal converts sunlight into heat (also known as thermal energy). It can be used for a variety of purposes, including producing steam from water to drive an electricity generator. This energy can be used to drive a refrigeration cycle to provide solar-based cooling. There are two main types of solar thermal technologies:

- Small-scale thermal technology is used to heat space or water (such as in a solar hot water system).
- Concentrated solar thermal harvests the Sun's heat to produce large-scale power generation. It uses a field of mirrors to reflect sunlight onto a device called a receiver, which transfers the heat to a thermal energy storage system. Energy can then be released from storage as required.

WIND

Wind is a form of solar energy caused by a combination of three events at the same time:

- The Sun unevenly heating the atmosphere
- Irregularities on the Earth's surface
- The rotation of the Earth.

Wind turbines use the energy of the wind to spin an electric generator, which produces electricity. Wind turbine technology has advanced a lot in the last decade which means it has become much more cost-effective and reliable as a source of renewable energy generation.

While often seen on hilltops, wind 'farms' are built in locations where wind speed, wind direction and wind quality meet specific industry specifications. This means they can be sited on land but they have also been built in the ocean, either floating on the surface or installed on giant pylons extending down to the sea floor.

Wind turbines come in two main designs: horizontal axis (the most common) and vertical axis. Horizontal axis means the rotating axis of the wind turbine is parallel with the ground. They mostly have three blades and operate upwind.

With vertical axis wind turbines, the rotational axis of the turbine stands perpendicular to the ground.

Wind turbines are tall and getting taller, and more efficient, all the time. Their height lets the turbines capture strong winds. They can start generating electricity even in light breezes.

Wind flows over the blades like air flowing over an aeroplane wing. This air flow causes a difference in air pressure between the top and bottom of the blade, creating both lift and drag. The force of the lift is stronger than the drag and this

HOW WIND TURBINES WORK

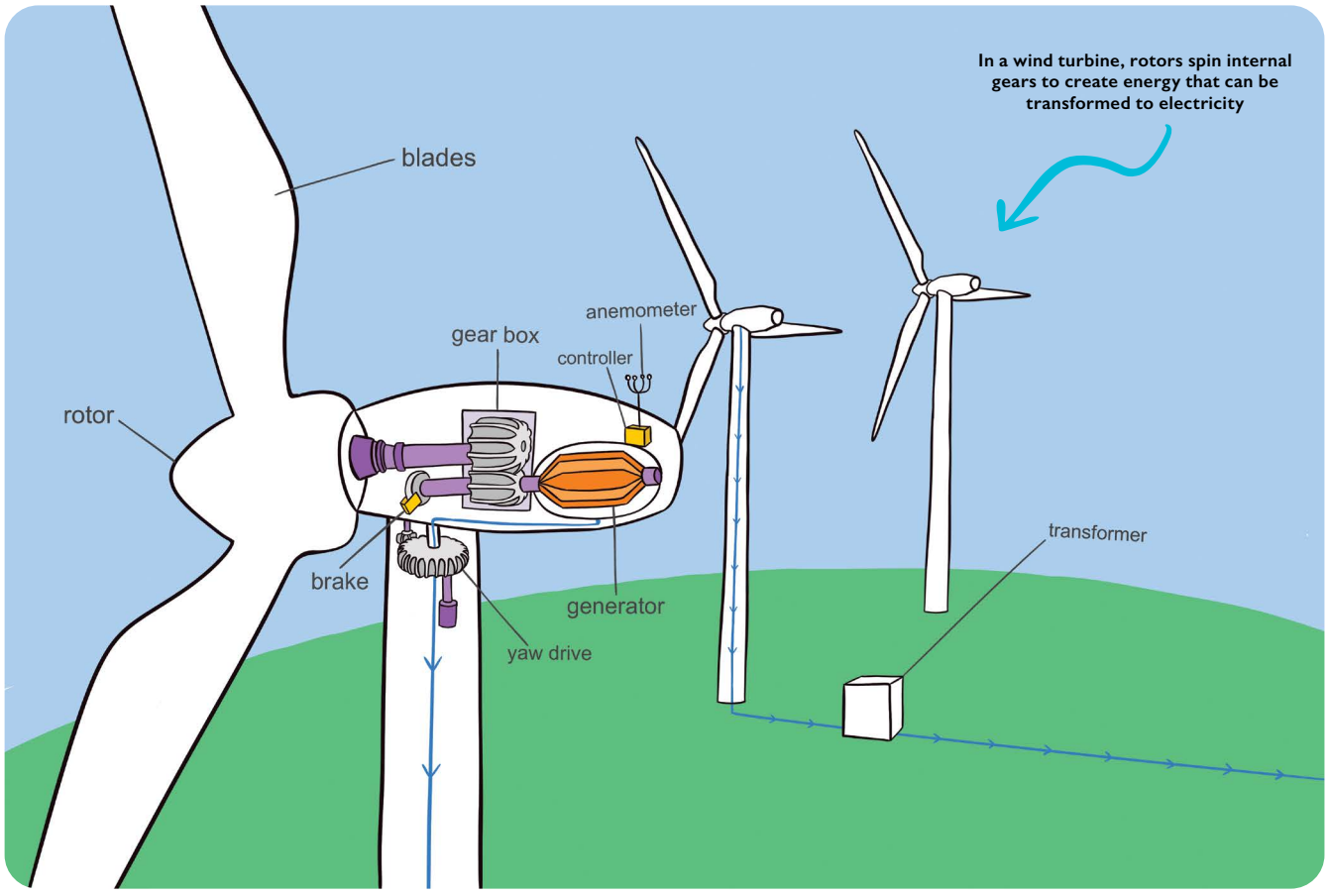


Image: Rachael Bolton/Refraction Media

DID YOU KNOW?

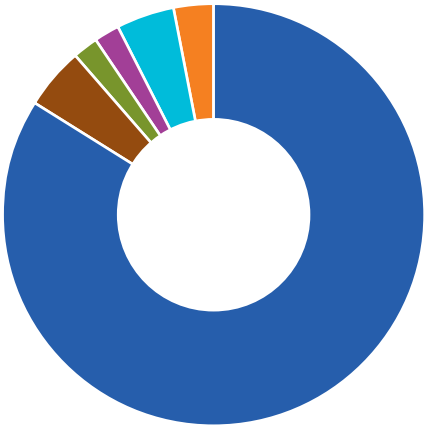
On 27 November 2020 we celebrated a significant achievement by reaching our 100% renewable electricity target. Tasmania is now one of only a handful of places worldwide that can confidently claim it has the capacity to meet our renewable energy needs.

causes the rotor to spin. The rotor drives a generator that produces energy to export to the electricity grid. Turbines can orient themselves to keep facing into the wind by rotating the nacelle (the cover that houses the generating parts). The megawatt capacity of wind turbines depends on the design and where they are placed.

GREEN HYDROGEN

Water is one of the most versatile chemicals on the planet and often referred to as the 'universal solvent'. Without water, life on Earth

Tasmania's 100% Renewable Energy Generation



YEAR 8: EXPLAINER VIDEO

What is Green Hydrogen?

CLICK HERE

wouldn't exist. A water molecule (H_2O) is two atoms of hydrogen bonded covalently to one atom of oxygen. Because it's a polar molecule (with one area more negatively charged and the opposite more positively charged), water can also hold an electrical charge. Using a process called electrolysis, where an electric current is passed through water, the bonds can be split to separate the oxygen molecules (O_2) and hydrogen molecules (H_2). Hydrogen can be compressed and transported anywhere in Australia or the world.

What makes this hydrogen 'green'? The electricity used to split the water molecule comes from renewable wind, solar and hydroelectric power. While hydrogen is used in a fuel cell electric vehicle, it doesn't emit CO_2, only O_2 and water, so there are no greenhouse gas emissions.

Hydrogen production has been around a long time, but innovations in technology to produce hydrogen are changing. Tasmania is competitively placed to lead the nation in green hydrogen production, using hydropower and wind or solar. The production opportunity of green hydrogen is in high demand, with markets around the world looking to transition to low-carbon energy sources.

RENEWABLE ENERGY TIMELINE

1914 – 1916
The Tasmanian Government bought a small electricity company and created the Hydro-Electric Department. By 1916 the Waddamana Power Station was operational.

1920 – 1950
Hydroelectric power was revolutionising Tasmanian farms, mills, mines and factories, but electricity was not yet widely available for households. After the Second World War, large numbers of international migrants were recruited to construct dams and power stations.

1950 – 1980
During the 1950s, the demand for electricity stretched supplies to the limit. Tasmania's industries had boomed, and most ordinary Tasmanians were now enjoying fully electric homes. By 1968, after severe drought, a major development planned for the Gordon River sparked Tasmania's greatest environmental conflict and gave rise to Australia's environmental movement. In 1983 the High Court prevented the Franklin River dam from being built.

1980 – 2022
Several wind and solar farms were established across Tasmania, some using diesel for back-up. In 2005, the BassLink interconnector to Victoria was operational. On 27 November 2020, we celebrated a significant achievement by reaching our 100% renewable electricity target. Tasmania is now one of only a handful of places worldwide that can confidently claim it has the capacity to meet our renewable energy needs.

2023 – 2040
Once we reached the target of 100% self sufficiency in 2020, we then legislated a Tasmanian Renewable Energy Target to double that production. This means our target is to produce 21,000 gigawatt hours of electricity in one year, by 2040. This is 200% of our 2020 demand.

Renewable careers

Australia's coal-fired power plants are being retired faster than expected, which will require more renewable energy generation and storage to replace them. The renewable energy industry needs a huge range of STEM professionals in research, trades, office and field-based roles, as well as communications and marketing professionals, business managers, educators and tour guides.

If you're keen on working in renewable energy, the variety of careers is huge – and you don't have to leave Tasmania to work in one of these exciting roles.

SUSTAINABLE SPARKY

APPRENTICE ELECTRICIAN KATRINA RUSSELL SHARES WHAT IT'S LIKE TO WORK IN RENEWABLE ENERGY

While looking for awesome apprenticeship opportunities in Launceston and north-east Tasmania, Katrina came across Hydro Tasmania, Australia's largest generator of renewable energy. After scrolling through their website, her interest in renewable energy was sparked. She applied for their apprentice program and landed the gig.

As an apprentice electrician at Hydro Tasmania, Katrina works with various tradespeople and engineers to install, test, problem-solve and fix electrical equipment.

"I also perform routine maintenance on our power stations in Trevallyn, Poatina and the yingina/Great Lake area," she explains, adding she also loves learning from skilled mentors at work and TAFE.

Katrina is currently working on a major refurbishment of a generator at Trevallyn Power Station. "This involves all AC and DC wiring systems being upgraded, and new transformers and instrumentation installed," she explains. The refurbishment will extend the life of the 66-year-old machine to make sure it keeps generating electricity reliably for another 30 years.

If you're keen on working in renewable energy, Katrina says the variety of roles in this sector is huge – from finance and IT, to engineering and trades. "And you don't have to leave Tasmania to work in one of these exciting roles," she adds.

So what can you do now to set yourself up for future career success? Katrina believes you should look at options that match your interests and choose college courses that will challenge you.

"In Grade 10, I never would have thought I would be doing an apprenticeship," she says. "It wasn't until Grade 12 when completing my Certificate II in Electrotechnology that I thought, 'This is fun. I want a career in this field'."

KATRINA'S EDUCATION PATH

Certificate II in Electrotechnology, Launceston College ›

Basic Aeronautical Knowledge Certificate, Launceston College ›

Tasmanian Certificate of Education, Launceston College ›

Public servant, Department of Finance ›

Electrical Apprenticeship with Hydro Tasmania (Certificate III in Electrotechnology, TasTAFE)

WHAT KINDS OF CAREER OPPORTUNITIES DO RENEWABLES BRING?

Engineers solve problems, design new equipment, maintain or replace old equipment and keep machines operating safely and effectively. They also ensure dams and civil infrastructure are structurally sound and safe. A qualification in engineering can lead to project management, energy trading or other senior management positions.

Electricians test the electrical equipment to ensure that it's working safely and effectively. If they find a fault, they fix it. Maintenance assistants perform a variety of support tasks for the operations and maintenance teams.

Scientists mainly focus on water and the environment. Environmental scientists ensure that the operations are having as little impact on the natural environment as possible, and specialist water scientists (also called hydrographers or hydrologists) study the flow of water from rivers, lakes and catchments, to ensure the right water flow through the hydropower schemes while minimising environmental impact. Physicists and chemists are involved in the research and development of green hydrogen.

Commercial analysts use mathematical and/or economic modelling skills to analyse large data sets and help generate the most value from generating and trading electricity.

Business analysts work with various parts of business (especially IT) to analyse processes and identify more effective and efficient ways of doing things.

Image: Hydro Tasmania

SKILLS AND TRAINING IN RENEWABLE ENERGY

Energising Tasmania

Skills Tasmania, on behalf of the Tasmanian Government, is responsible for administering a $16.1 million project agreement for Energising Tasmania with the Australian Government. This is a four-year commitment to support Tasmania in developing a skilled workforce equipped with the expertise needed for the Battery of the Nation initiative and, more broadly, the renewable energy and related sectors in Tasmania.

YEAR 10: EXPLAINER VIDEO

Careers in Renewable energy

CLICK HERE

Taking action on climate change through renewables


Image: Hydro Tasmania

THE IMPACT OF CLIMATE CHANGE ON NATURAL AND BUILT ENVIRONMENTS IS ONE OF OUR GREATEST CHALLENGES.

Human activities, such as burning fossil fuels, release gases into the atmosphere — particularly carbon dioxide, as well as methane and other gases. These gases trap more of the Sun's energy in Earth's atmosphere and warm the planet, causing our climate to change. An exponential increase in greenhouse gases, particularly CO_2, since the Industrial Revolution, means the temperature is rising much more quickly than it has done before. Climate change causes a change to the usual weather of a place, and can include extreme weather events like heatwaves, floods, fires, more intense storms and sea level rise.

Earth's temperature has risen by 0.08°C per decade since 1880. Averaged across land and ocean, the 2021 surface temperature was 0.8°C warmer than the 20th century average of 13.9°C and 1°C warmer than the pre-industrial period (1880–1900) (source: Climate.gov).

We all have high energy demands in common – in our houses, industries, businesses, transport systems, devices, clothes and lifestyles. This means that while reducing carbon in the energy sector (decarbonisation) requires action on a global scale, the shift to more renewable energy resources is more important than ever.

Growing our renewable energy

Cleaner, greener energy is attracting investment in renewable energy development projects across Australia (such as generation through wind, solar and/or pumped hydro, as well as transmission projects — interconnectors and the poles and wires that transfer electricity). Globally, renewable energy is transforming industry sectors and creating jobs and economic diversity.

Growing Tasmania's renewable energy potential will lead to increased jobs and skills development, and support Tasmania's clean economy over many years. Once we reached the target of 100% self-sufficiency in 2020, we then legislated a Tasmanian Renewable Energy Target to double that production. This means our target is to produce 21,000 gigawatt hours of electricity in one year, by 2040. This is 200% of our 2020 demand. We also have an interim target to produce 15,750 gigawatt hours of electricity in one year by 2030.
This will secure our industry and guarantee low-cost, reliable, and clean energy for all Tasmanians. At the same time, we'll have enough

Image: Hydro Tasmania

renewable power to share with mainland Australia, moving the entire nation in the direction of positive change.

Tassie's existing BassLink interconnector has a 500-megawatt capacity and has been operating since 2006. Project Marinus is a proposed 1500-megawatt capacity high voltage, undersea and underground electricity interconnector between Tasmania and Victoria. This new interconnector (also known as MarinusLink) would allow Tasmania to export more of its renewable and reliable energy resources into Australia's electricity grid.

These projects will need a STEM-skilled workforce at all stages, and those skills and qualifications can be used across the world.

The transition to a low-carbon future

More interconnection between Tasmania and the rest of Australia could see abundant low-cost, reliable and clean energy moving between Tasmania and Victoria, helping Australia's transition away from coal-fired power generation to a low-carbon future. It is estimated that MarinusLink will cut at least 70 million tonnes of CO_2 by 2040, the equivalent of taking approximately half a million cars off the roads.

Increasing the amount of renewable energy in the electricity grid means there will be less need for coal and other fossil fuel-based resources to generate electricity. This reduction of the carbon-based energy grid means lower carbon-based emissions, which in turn slows the rate of climate change, helping to mitigate its impacts on humans and the environment.

Innovative renewable energy projects can support our action on climate change. How will you help change the future of Tasmania, Australia and the world?

List of resources

- Project Marinus (Marinus Link)
- Battery of the Nation — Hydro Tasmania
- Energising Tasmania — Skills Tasmania
- 100% Tasmanian Renewable Energy Target
- Tasmanian Renewable Energy Action Plan | Renewables, Climate and Future Industries Tasmania
- Curious Climate
- Geoscience Australia

YEAR 9: EXPLAINER VIDEO

Growing Tasmania's renewable energy

CLICK HERE

Matrix of student activities

Year	7	8	9	10
Science	Design an experiment to investigate how increasing mass affects friction by measuring the force required to move an object. How do the results of your experiment relate to pumped hydro and other renewable sources of energy?	Design a model (physical or digital) to demonstrate how hydrogen is produced and how it can be used as an energy source to 'do work'. Describe all the energy transformations that are taking place in the process.	Explore the energy system map developed by Student Energy. Use this and the content in this guide to develop an energy system map that will help the community understand the role of energy sources and Tasmania's need for efficient and clean energy.	Create a comic strip or infographic describing the development of and the transportation of green hydrogen. Use Newton's three laws of motion and/or energy transformations as part of the story.
Science as a Human Endeavour	Aqueducts have been used since the Roman Empire and the first dam dates back to ancient Egypt. Hydroelectricity has been used since the 19th century. Develop a game that can be used to teach primary students about 'force and energy'. Embed some history into the game to teach them about the present and create a scenario about future energy. The game can be physical or digital.	Laws and theories in science and maths have helped shape our understanding of the world and have led to new inventions and innovations. Research the work of Sir Isaac Newton and Albert Einstein. Develop a set of interview questions that you would ask them to help you understand how they developed their laws and theories.	Using the laws that explain the behaviour of light, develop a model to show how these laws are used to explain how solar panels work. Use this model to develop an advertisement to promote the use of solar and battery storage by individuals, industry and communities in Tasmania.	You have been appointed as Tasmania's Chief Engineer. Conduct research on the 'build back better' movement and create a series of social media posts to show the community the difference between renewable energy and non-renewable sources. Include other aspects of a 'new green economy' and the importance of science in the development of new technologies and engineering.
Cross Curricular Priority: Sustainability	You are working for the Tasmanian Museum and Art Gallery and your role is to create a new exhibit that shows the importance of water and Songlines in the survival and culture of Aboriginal and Torres Strait Islander people. Conduct some research and create a model/diorama/visual representation to pitch your ideas to the museum director.	Use the World Wide Fund for Nature's Ecological Footprint Calculator to calculate your carbon footprint. Compare your own results with other's in your class. Explore the data and solutions information and develop an action plan for how you and your family/school/community can decrease your carbon footprint. Design a carbon footprint pledge wall for your class.	The use of fossil fuels is linked to climate change. Create an infographic that shows how the extraction and use of non-renewable resources affects natural environments and has contributed to the accelerated rate of climate change and biodiversity loss.	Design an infographic to compare and contrast hydrogen-fuelled vehicles, electric vehicles and petrol-based vehicles. Consider their whole life cycle, from sourcing materials to their end of life. Compare their performance and their emissions. In your infographic explain how more sustainable modes of transport are forms of climate action. Evaluate which one is the best sustainable mode of transport.

	7	8	9	10
General Capabilities	Create an online trivia game that tests your classmates' knowledge and skills in the STEM behind Tasmania's renewable energy. Make sure you add some tricky questions in there to really test who has been paying attention. Create three rounds and have a prize ready to go for the winning team! Remember to use facts, stats and images in your trivia.	Conduct a home or school energy audit. Use a spreadsheet to collect the data. Read your home energy bill and compare energy use and costs across the class. Create a new tab in your spreadsheet and calculate the average home energy use for the class. Identify where energy use can be decreased, or efficiency can be improved. Develop an action plan that tackles behaviour change to help improve energy efficiency. Track this over time and see whether energy use decreases (if you have a smart meter, you can see real-time energy use).	You have been appointed as the new communications manager for the Marinus Link project. Develop a presentation that can be used to help pitch the idea and explain it to members of the Tasmanian community. Include the economical, ecological and social benefits of the project. Also outline alternatives and justify why the Marinus Link project is the most beneficial project to develop.	You have been asked to debate the topic: "Carbon is not the enemy. It is humans that have made carbon toxic. Carbon in the right place is a resource and a tool." Use your knowledge about global systems, the carbon cycle and human activities to support or refute this statement. Your response should also refer to accelerating climate change and impacts on biodiversity.
STEM	Using the information in this guide, write an article for *The Mercury* to explain the importance of STEM for the development of society.	It's 2030 and you are the careers guidance counsellor at an educational institution. Develop a timeline of 'energy careers' from 2000–2050 showing how the careers have changed over time. In the 2025–2050 section, predict some new career pathways that might emerge and identify the type of STEM knowledge and skills that might be required to do these jobs.	You're working for a game developer and your task is to design a STEM quest that takes the gamer on a journey around Tasmania. It should explore the geological features, ecological communities and technological advancements that are leading to Tasmania's Renewable Energy Action Plan. Create a prototype of the game that brings together the STEM of Tasmania. Use Minecraft, PowerPoint, Canva or another digital space for your creation.	Watch: **The World's Biggest Battery Looks Nothing Like a Battery**. Using the information from this guide, your own knowledge and research, and the video, **develop a 6-frame storyboard** for a new video that explains Tasmania's 'Battery of the Nation' project highlighting the importance of STEM knowledge and skills for its development and maintenance.

Linked Activity 1

This activity is suitable for years 7 – 10 and links to the Sustainability Cross Curriculum Priority, General Capabilities and Science as a Human Endeavour

SUSTAINABLE ENERGY ACTION NOW!

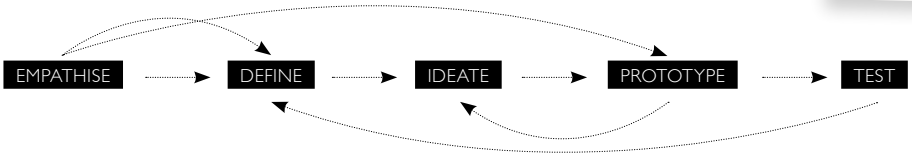
Scenario: Your school community uses too much energy. It needs to improve its efficiency and reduce its emissions footprint and running costs. The first aid nurse noticed that on really cold days, when the gas heater is turned on, many students come to the first aid room suffering from nausea. On hot days, you notice a lot of tradespeople at the school fixing broken air conditioners. There are not many shady places in your school for you and your friends, and barely any green spaces. Your school has no bike racks/storage areas.

Mission: Using design thinking, develop a solution that will help your school community take immediate action to ensure that it's using energy sustainably (sustainability relates to social, environmental, wellbeing and economic issues).

Human-centred design thinking is used across all industries and organisations to help people design better solutions for the many challenges we face. It's a methodology for creative problem-solving.

1. Form groups of four.
2. Each group member will work to become a expert on one area of renewable energy, then teach the others. Decide from one of the following:
   a. Environmental
   b. Social
   c. Health
   d. Economic.
3. Use the research template below to gather your information.

The main stages of design thinking are:



Topic Question	Facts	Stats	Ideas
Environmental impact: What is the impact of different types of energy resources on climate change, including renewable and non-renewable energy sources?			
Social impact: What energy challenges do different people encounter and how are these overcome?			
Health impact: What are the negative and positive health impacts of different types of energy sources?			
Economic impact: What are the current and future impacts on the Tasmanian economy if only renewable energy is used?			

RESEARCH TIPS

1. Reliable statistics can be a powerful way to convey information. Is there a dataset that lets me see how people use energy in my city/town/country?
2. Think global – what's happening around the world? But then, think local – who is affected by this problem at our school or in our community?
3. How can I explain the information I gather logically and clearly?
4. What important words do I need to include and define?
5. Starting with the expert researching question one, take turns to teach the information to your team members – aim for three minutes each.
6. Keep a record of what you learn on the research template.
7. As a group, develop a problem statement that helps you frame the problem, considering the different perspectives of the problem and the people involved.
8. As a group, brainstorm solutions that will help your school community use energy sustainably and have positive impacts for the whole community. See what other schools are doing to solve this problem – are these solutions viable for your school?
9. Choose one solution to explore and develop a prototype that can be tested. This doesn't have to be a physical solution – it can be digital. Your prototype can be in the form of a storyboard or a plan.
10. Test your prototype out with several members of the school community. Gather their feedback and iterate your solution if needed.
11. Develop a 90-second pitch you would use to present to the school principal and executive to persuade them they need to act on sustainable energy solutions for the school.
12. Use your group's new-found expertise and follow the scaffold provided to develop your pitch.
13. Present your team's pitch to the class.
14. Continue on your design thinking journey!

90-SECOND PITCH TEMPLATE

What	Time flow (seconds)
Draw us in with an opening statement	0 – 10
What is the problem that needs to be solved?	10 – 30
Your group name. Explain the problem in detail and the need to act – share who's involved in causing the problem, what aspects help or make it worse, what the statistics say	30 – 60
Where are the big opportunities for students and the school community to tackle the problem?	60 – 80
Memorable closing statement	80 – 90

This activity is suitable for years 7 – 10 and links to both Physical and Chemical Science Understanding

Linked Activity 2

IT'S ELECTRIFYING!

ELECTRICITY IS USED EVERYWHERE, FROM CHARGING YOUR DEVICE TO BAKING A CAKE. BUT HOW CAN IT BE USED TO ACHIEVE DIFFERENT OUTCOMES?

Purpose: Design an investigation to demonstrate the difference between physical and chemical changes and, in the process, produce water vapour, hydrogen gas and oxygen gas.

- Work in a small group, using the suggested materials to design a fair test that generates reliable results.
- You must develop a risk assessment and identify how you will ensure that your method is safe.
- Your method should include conducting a 'pop test' for the gases that are released during your experiments.
- You will need to do some research to figure out how the suggested materials can be used to demonstrate the purpose. Use the information within this booklet to help you.
- Before you conduct your experiments, compare your method with others in the class and get your teacher to check it. Modify your method if you need to.

Materials that can be used:

- Electric hotplate
- Beaker
- Measuring cylinder/electronic balance
- Thermometer
- Matches/lighter
- Wooden flint
- Electrolysis kit
- Water

Observations: Use a Venn diagram to compare and contrast the results from your two experiments

1. **Reflection:** Which of the experiments demonstrated physical or chemical changes? Explain your response.
2. What was the purpose of the matches and the wooden flint?
3. Describe the energy transformations or energy changes in both experiments.
4. Use your knowledge of chemistry and physics to explain your observations.
5. Explain how both experiments are used in renewable energy generation.
6. How could you modify your method to demonstrate the production of 'green hydrogen'?

This activity links to Year 7 Science Understanding: Physical Sciences

Linked Activity 3

ROLLER COASTER

Purpose:
Using the ideas and concepts of physics, design a rollercoaster made up of several simple machines that can move a marble 2–5m so it can fall into a cup.

Each team can have the following items, but you don't have to use everything:

- 1 x single pulley
- 1 x double pulley
- 2 x mass carrier
- 5 x 50g mass
- 2 x 25g mass
- 1 x metal spoon
- 1 x plastic spoon
- 1 x trolley
- 1 x wedge
- 1 x bar magnet
- 2 x screw
- 1 x screwdriver
- 2 wooden blocks
- 15–30cm of stiff wire that can be bent into shape
- 5 cardboard straws
- 5 paddle-pop sticks
- 10 paperclips
- 5 rubber bands
- 1 reel of masking tape/sticky tape
- 4m string
- 2 x recyclable cup
- 1 x ping-pong ball
- 2 x retort stands
- 2 paper towel rolls

Your design must include the following:

- A schematic outlining the STEM knowledge behind the plan and how any risks will be mitigated.
- Gravity
- Friction
- Marble
- Lever
- Inclined plane
- 1 x rubber band

Rules:

1. Once the marble starts moving, you may not touch anything on your device. The marble must move from point A to point B (the plastic cup) without human assistance.
2. Any combination of simple machines may be used.
3. Only two consecutive simple machines may touch in any way, so choose wisely.
4. Your device should have a theme.

Suggested timing:

- 30 minutes planning and prototyping
- 10–15 minutes making and testing
- 10–15 minutes redesigning/modifying
- 10–15 minutes presenting

Reflection:

1. Outline all the energy transformations taking place in your model.
2. Explain how the rollercoaster design can also be used as a model to demonstrate how pumped hydro works.
3. Explain how and why teamwork was important in this activity and in achieving the purpose.
4. Explain why using models is important in STEM.

This activity links to Year 7 Science Understanding: Physical Sciences

Linked Activity 4

INSPIRED BY NATURE

OBJECTS MOVE DUE TO UNBALANCED FORCES ACTING UPON THEM. FOR OBJECTS TO MOVE, THEIR INERTIA NEEDS TO BE OVERCOME.

Scientists and engineers use nature as a source of inspiration to solve problems all the time. This is called biomimicry (to copy or replicate nature). Perhaps the most famous invention inspired by nature is VELCRO®, the 'hook and loop' fastening system modelled after the way dry seeds like bindis stick to dog fur or clothes. When the seed is stuck and you try to pick it off your clothes, you apply a force to overcome its inertia. Biomimetic design can be found in almost every industry. Think: aeroplanes!

Challenge

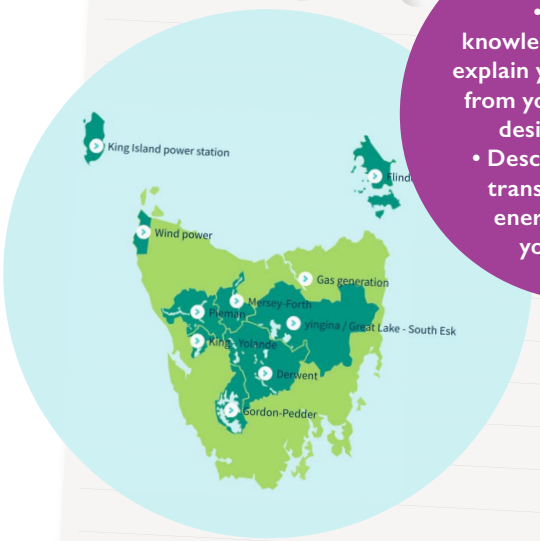
Use the information in the 'Explain – Article 1: Wind' section and your own research to design and test two types of wind turbines at scale. You could choose one of these things to test, or choose your own:

- Compare and contrast horizontal and vertical turbines
- Design different style blades
- Change the height of the blades
- Change the number of blades.

Work in a small group to:

1. Conduct research to design a fair test that generates reliable results;
2. Outline the equipment you need and develop a schematic of how you will use it;
3. Develop a risk assessment and identify how you will ensure that your method is safe;
4. Outline how you will collect and represent your results.

Connect:
- Use your knowledge of physics to explain your observations from your wind turbine designs and tests
- Describe any energy transformations or energy changes in your designs.



Consider:

1 Use this interactive map to explore the locations of wind farms in Tasmania. Think about the Tasmanian climate and terrain. Are there features of the environment that could hinder the function of wind turbines and wind farms?

2 How can you use nature to improve the design of wind turbines? Explore these sites and videos for inspiration:
- IP.com: 3 Inventions Inspired by Nature
- Biomimicry.org: Frost Safe Wind
- Asknature.org: Schools of Fish and Wind
- Asknature.org: Collections

3 In your small group, use your new knowledge to brainstorm how your designs could be changed and improved. Compare your designs across the class.

4 As a whole group, identify the best design features that will enable the most effective function of wind turbines in Tasmania.

This activity links to Year 7-8 Cross Curricular Priorities: Sustainability and Aboriginal and Torres Strait Islander Histories and Cultures

Linked Activity 5

CARING FOR COUNTRY

USE FIRST NATIONS SCIENCE IN DEVELOPING SUSTAINABILITY PRACTICES.

Tasmania and the rest of Australia continue to increase their investment in renewable energy and reduce their reliance on the fossil fuels industry. As industries develop and grow, this increases pressure on our already threatened natural environment. Sustainable resource and land management is important, now and into the future. Caring for Country using Aboriginal and Torres Strait Islander knowledge combined with modern science is part of an effective conservation strategy to ensure that we protect biodiversity and regenerate our planet.

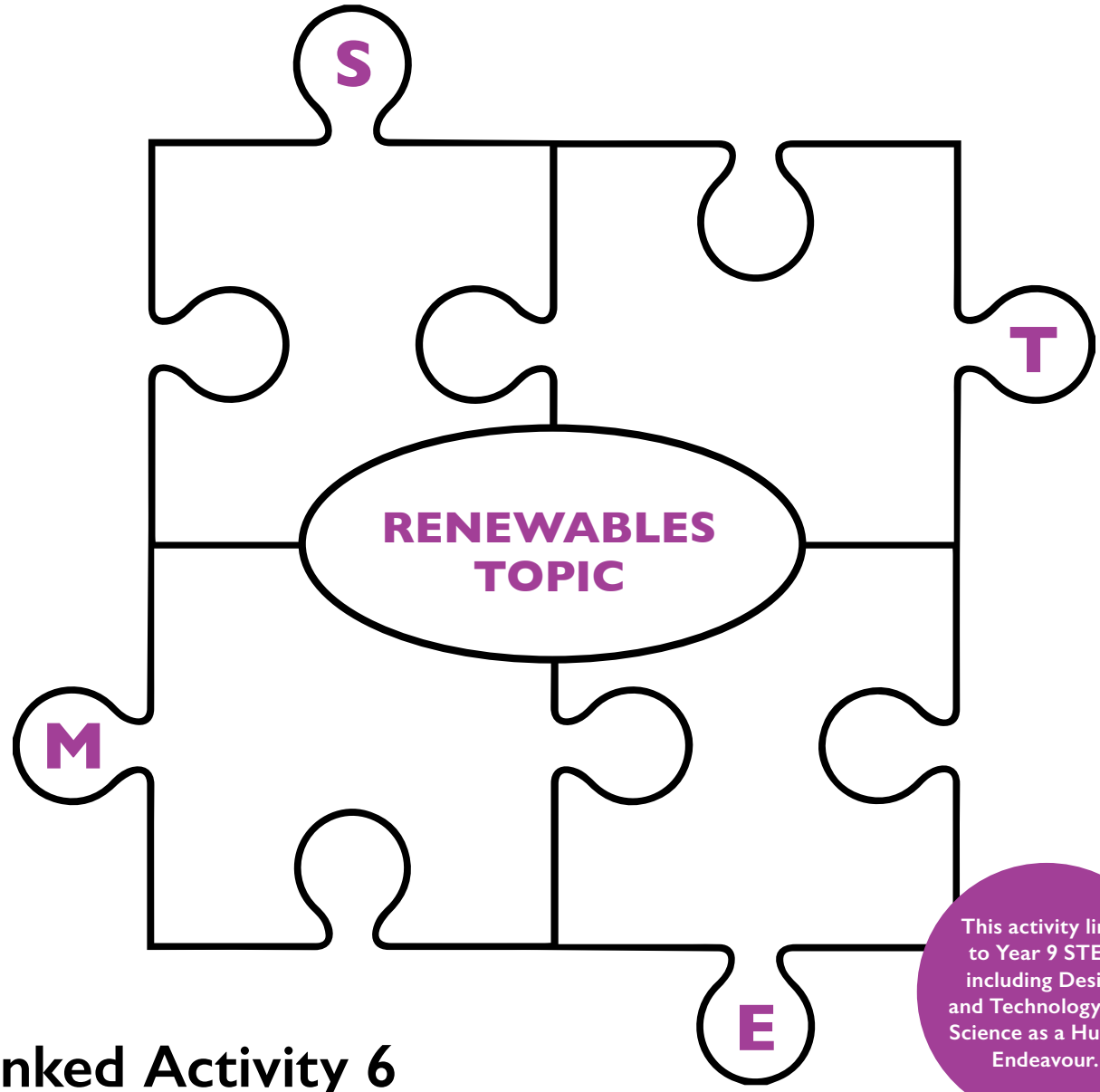
Challenge

The Tasmanian Government has decided to create a new job: Caring for Country and Sustainability Director. You have been appointed to write a job description and advertisement to recruit the best person to manage a small team and implement several key projects, working with different government departments and industries.

1 Use information within this booklet and conduct research to investigate:
- Similar roles that exist across government and industry
- How cultural perspectives and worldviews influence the development of scientific knowledge
- Aboriginal and Torres Strait Islander knowledge and practices that have been used and reintroduced to help manage land and care for country
- Different conservation, sustainability and environmental roles that exist in the Tasmanian Government and businesses
- Different conservation and cultural issues that need to be considered.

2 Use your research to:
- Create a context for the new role – explain its need and importance
- Create a job description for the Caring for Country and Sustainability Director – what will the person be doing?
- Outline the key education, knowledge, skills and experience that the Caring for Country and Sustainability Director will need to be successful in this role. This is called the 'selection criteria' that candidates will have to demonstrate they have in their job application.
- Develop the job advertisement for the role. Include how you would like the candidates to apply, what they need to submit and the closing date.

3 Once you have developed your job advertisement, test it out with a few adults to get some feedback. Create an evaluation checklist for them to ensure that your advertisement is clear enough for them to understand what the role is, what they need to demonstrate and how to apply.



This activity links to Year 9 STEM including Design and Technology and Science as a Human Endeavour.

Linked Activity 6

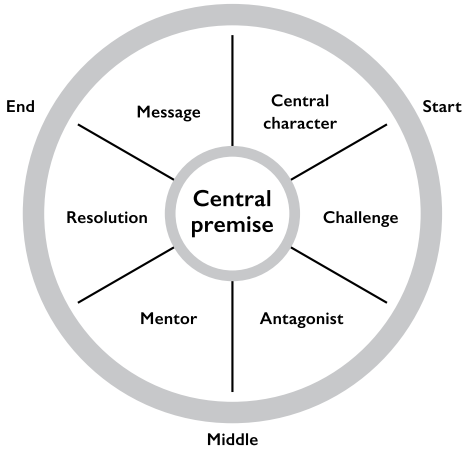
WTS? WHAT THE STEM

USE YOUR SOCIAL SMARTS TO SELL

The folks at **CareerswithSTEM.com** are launching a new TikTok channel called WTS – What the STEM – and they need your help to create student-generated content for other students to unpack the STEM that interests you across a range of topics. The first topic is called 'All Things Renewable'.

Using information from this booklet and your own research, choose a topic related to the renewables industry and create a video that can be submitted for the Careers with STEM TikTok channel.

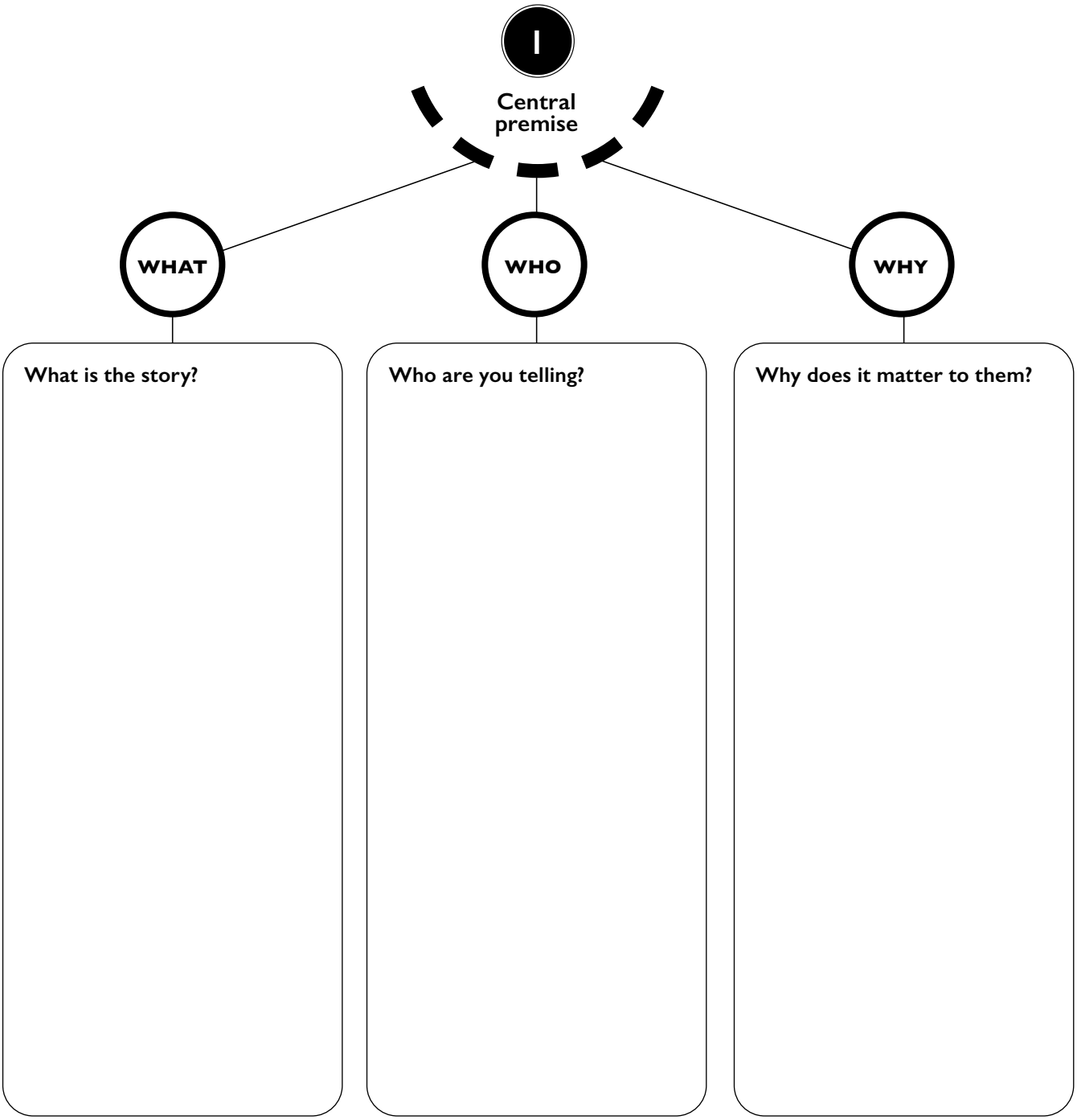
1. Use the STEM map to conduct your research to outline 'What the STEM' about your chosen topic.
2. Using the story wheel, develop a narrative for your video.
3. Present facts – no misinformation! Your information must be sourced from reliable and credible sources.
4. Present an opinion if you have one, but make sure you justify it! Your research and presentation should explain the relationship between science, technology, engineering and maths and analyse the different ways in which STEM are interconnected with society.
5. Keep in mind your audience is other high school students – you want them to be inspired!

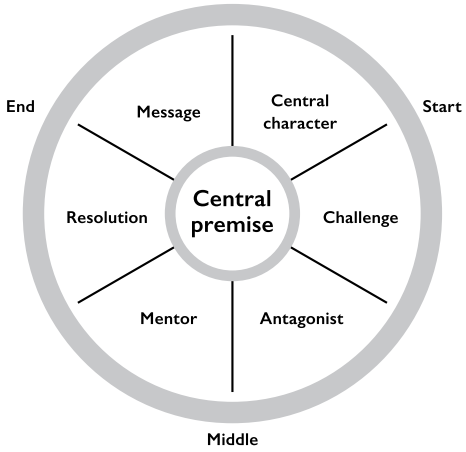


Linked Activity 6: Continued

STORY WHEEL FRAMEWORK

Step 1 – unpacking the central premise of your story





Linked Activity 6: Continued

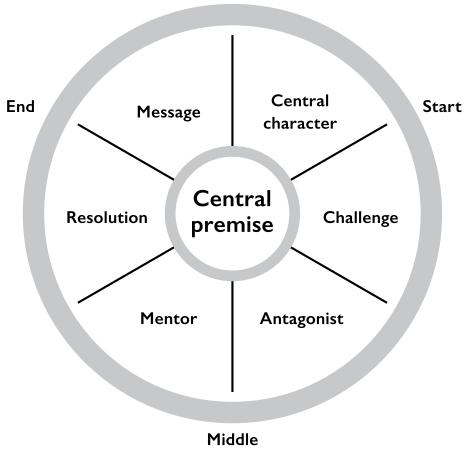
STORY WHEEL FRAMEWORK

Step 2 – unpacking the story and plot

2 **CENTRAL CHARACTER**
Describe the central character and the key things that define them in the context of the story.
Dot-point your ideas

3 **CHALLENGE**
Describe the problem or dilemma facing the central character.
Dot-point your ideas

4 **ANTAGONIST**
Describe the antagonist and how they are creating obstacles or conflicts for the main character.
Dot-point your ideas



Linked Activity 6: Continued

STORY WHEEL FRAMEWORK

Step 2 – unpacking the story and plot

5 **MENTOR**
Describe who or what guides the central character in solving the challenge.
Dot-point your ideas

6 **RESOLUTION**
Describe the solution the central character finds to meet the challenge.
Dot-point your ideas

7 **MESSAGE**
What is the single clear moral of the story?
Dot-point your ideas

Linked Activity 7

This activity links to Year 10 Science as a Human Endeavour.

HYPER-CONNECTED!

Background

We live in a material world. **The Periodic Table of Chemical Elements** is one of the most significant achievements in science, capturing the essence not only of chemistry, but also of physics and biology. Without our understanding of the elements and the trends and patterns in the periodic table, a vast array of industries and materials would not exist today, nor would they exist in the future.

As elements come, one that life on Earth owes credit to is carbon. Every living thing contains carbon. Carbon has **isotopes** and allotropes, as well as **its own cycle**! As a compound, it can exist in all three states of matter and has its own branch of chemistry – carbon chemistry (aka organic chemistry).

There are nearly 10 million known carbon compounds; from fuels to cosmetics, plastics, building materials, food, filtration systems, solar panels, pharmaceuticals, green chemistry, vehicles, super-strong lighter alloys and nanomaterials, carbon is perhaps the most versatile element. This versatility allows engineers to improve structural components in building, transportation and industry and to design better materials and products. Carbon and its many compounds also get a bad rap – blamed for global warming, the energy crisis, **microfibres**, environmental toxins, drug addictions, oil spills and increased taxes.

Chemistry is related to many fields in our life, thus is considered the centre of most other sciences. Scientists are developing new materials with extraordinary properties that may be used for improving various fields such as engineering, communications, medicine, the environment and transportation, all of which provide numerous human needs. At the heart of most of these materials is carbon.

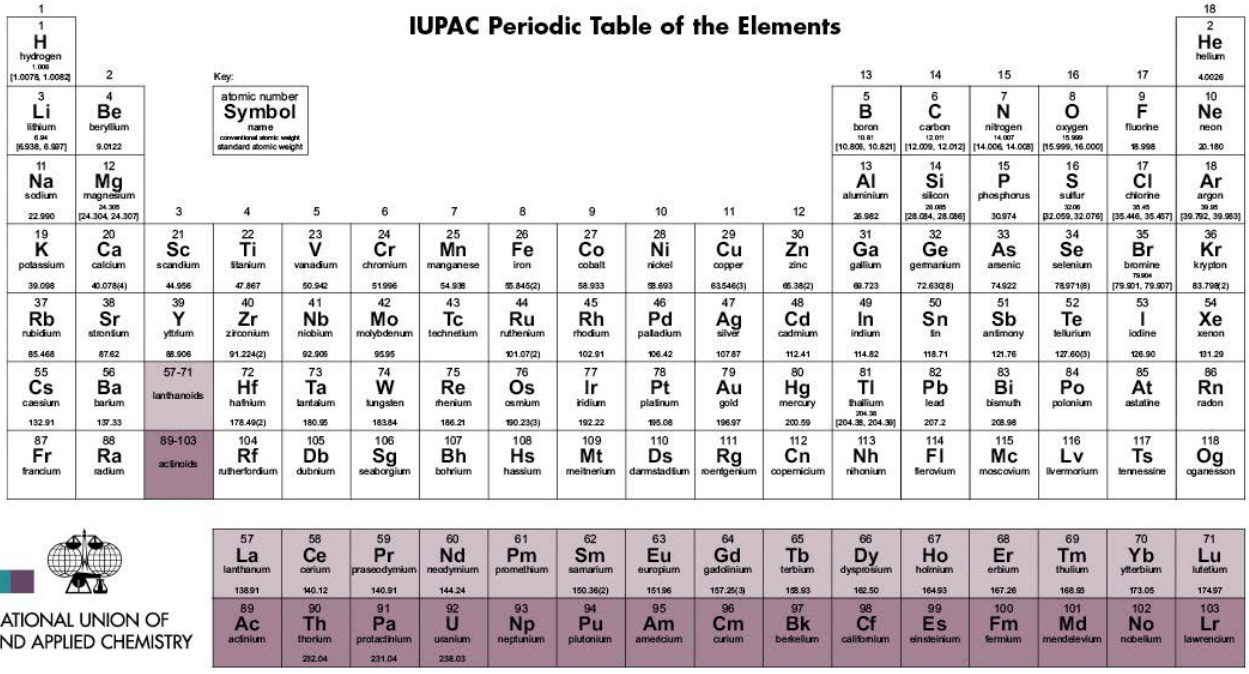
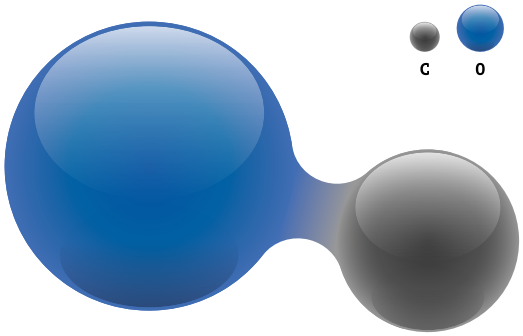


Image: The IUPAC Periodic Table of Elements source: **https://iupac.org/what-we-do/periodic-table-of-elements/**



CO

Linked Activity 7: Continued

Task
Develop a hypertext graphic essay of 700-1000 words. The background section of the activity on p33 is an example of a hypertext graphic essay.

Your hypertext essay should include tables, graphs and images which should link to the source. The use of subheadings should guide the reader through your essay. The hypertext can link to both internal and external information. Use reliable and valid sources of information for your research, including peer reviewed publications. Use hyperlinks as your 'in text reference'.

Introduction – Carbon
Conduct research into why carbon is so versatile. Your research should include, but is not limited to, the following points of information:
- Structure and allotropes
- Radioactivity and isotopes
- Type of bonding
- Physical and chemical properties.

Application – Carbon and its compounds
Conduct research to investigate the application of carbon and its compounds in our society.
Your research should:
- Focus on one carbon allotrope and three different carbon compounds
- Include the following points of information:
  - *Outline* the production processes of the allotrope and compounds;
  - *Outline* uses (past, present, future) and relate this to bonding, physical or chemical properties;
  - *Outline* the industries and technologies that use these chemicals.

Impact on society
Conduct research into how the use of carbon and its compounds has impacted society and affected our everyday lives. Using specific examples from your chosen carbon allotrope and compounds:
- *Discuss* any social, economic, cultural or ethical factors that may contribute to the continued use of carbon and its compounds or why their use should be reduced or discontinued;
- *Discuss* how advances in technologies enable advances in science, and how science has contributed to developments in technologies and engineering;
- *Evaluate* the impact on society. Include your own opinion with evidence to support your views.

A picture says a thousand words

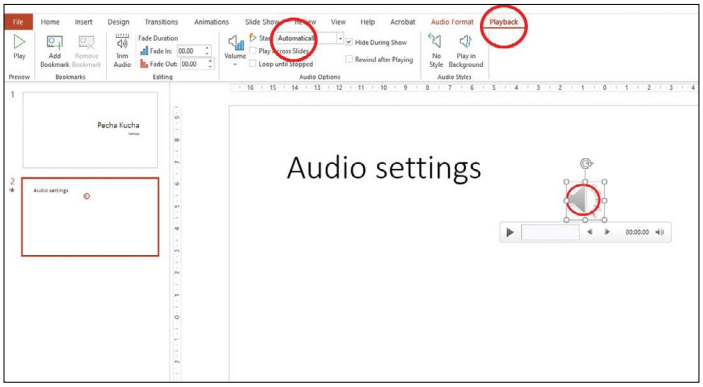
Develop a Pecha Kucha style presentation: 20 slides, images only, showing for 20 seconds each (6:40 total).

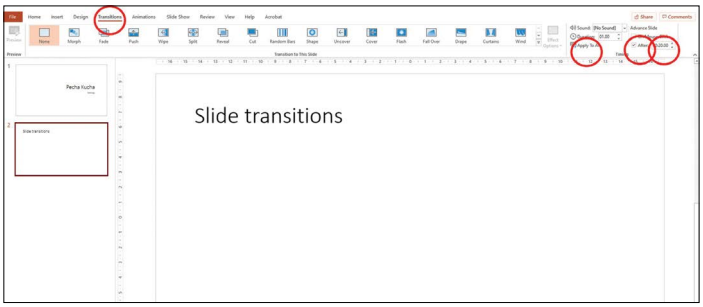
- Choose images that represent your learning journey through this unit. They can include screenshots from videos.
- You should insert a voiceover into the presentation, 20 seconds per slide.
- Set up your presentation with automatic transitions so that each slide presents for 20 seconds.
- Save your presentation as a PowerPoint Show (*.ppsx). This will automatically play the PPT once opened – like a video presentation, including your voiceover and the automatic transitions.

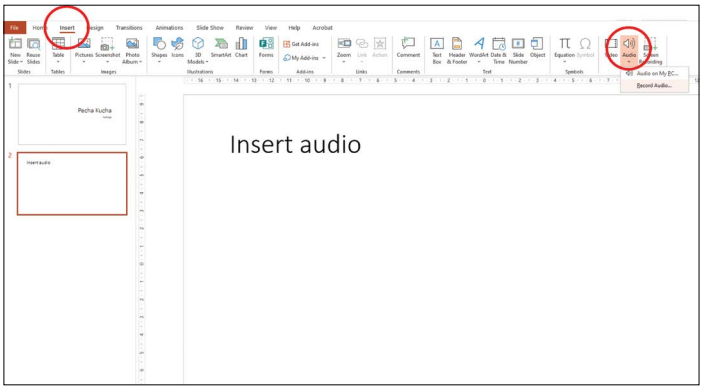
Your presentation is your final reflection of the unit and should address the following points:

1. What was your most significant learning from the unit?
2. What did you enjoy most about this unit? Why?
3. What did you enjoy least about this unit? Why?
4. How does the content and activities from this unit connect with your everyday life?
5. Which career pathways have been presented? If you had to choose one for your future, which would you choose and why?
6. If you had to recommend only one thing to further explore from this unit (for example a video, case study or activity) to a friend who hasn't completed it, what would it be? Why did you choose this?
7. Explain the importance of Science, Technology, Engineering and Maths to the continued development of our world.
8. If you had to summarise this unit using one phrase only, what would it be and why?

SETTINGS FOR THE PECHA KUCHA







Produced by Refraction Media on behalf of the Tasmanian Department for Education, Children and Young People. Written by Angela Crompton and Louise Meers. Edited by Heather Catchpole, Virginia Tressider, Karl Mayerhofer and Amelia Caddy. Designed by Jon Wolfgang Miller.

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Tasmanian Government