Introduction – Resources and sustainability

A **value** is a deeply held belief about what is important or valuable.

Activity 1: Values continuum

1. Your teacher reads the following statement and students arrange themselves in a line, ranging from **totally agree** at one end to **totally disagree** at the other.

Statement: "Human needs and requirements are more important than the protection of the environment. Resources should be fully exploited for human development."

Place yourself on the following continuum:

totally agree ⟷ totally disagree

2. Why do you hold this point of view?

Sustainable development

The most often-quoted definition of sustainable development is:

'Development that meets the needs of the present without compromising the ability of future generations to meet their own needs'.

Sustainable development must maintain a delicate balance between the human need to improve lifestyles and the preserving of natural ecosystems and cultural processes (or cultural practices) and the preserving of natural and cultural ecosystems. We must not prevent future generations from enjoying a quality of life at least as good as our own.

Activity 2: Resources and sustainability

Answers – see RESOURCES

1. Matching columns

Match the *Definition* of each of the following with the correct *Meaning*.

- Biodiversity
- Carbon footprint
- Climate change
- Conservation
- Degradation
- Ecosystem
- Emissions
- Endangered
- Extinction
- Global warming
- Greenhouse gas
- Recycle
- Renewable resource
- Sustainability

Definition	*Meaning*
	The variation of life at all levels (genes, species and ecosystems)
	A community of living organisms (plants, animals and microbes) living in their physical environment
	Death of last of a species (there is no ability to reproduce and create a new generation)
	Protection and management of biodiversity, energy, habitat, wildlife and marine, soil and water resources
	A resource that is replaced naturally and can replenish with the passage of time
	An increase in the average temperature of the Earth's atmosphere that causes changes to climate
	The sending out of gases into the atmosphere or pollutants into water
	A measure of the total amount of carbon dioxide and methane emissions created by an entity
	A change or disturbance of the environment that makes the environment worse
	Something that is threatened and likely to become extinct
	To provide for basic human needs without degrading or destroying the natural environment
	A significant change in weather patterns over a period of time
	To take material already created but that is no longer used and change it into new products to prevent waste of useful resources
	A gas in the atmosphere that changes the wavelength of radiation from the Sun so it is heat (infrared) energy *and/or* reflects infrared radiation from the Earth back to the Earth

Saving our oceans and seas

The oceans and seas are of great importance to Earth and they dominate our planet. Three-quarters of Earth is covered by water. The biodiversity of the oceans and seas is enormous, as they contain over 80% of all known life forms. But our oceans and seas are being **polluted** and over-exploited and their resources must be sustained.

The oceans and seas are under threat from a range of man-made problems. Every day, rivers of pollutants and toxins such as chemicals, fertilisers and human and animal **waste**, pour into the oceans and seas poisoning everything in their path. Furthermore, millions of tonnes of plastic and garbage also find their way into the oceans and seas to entangle or suffocate, or be eaten by marine life. Pollution is a *huge* problem.

To make matters worse, global warming is causing the acidification of the oceans. As atmospheric carbon dioxide increases, so too does the acidity of the oceans, making them less hospitable for marine life. As the oceans become more acidic and warmer, the habitats of many species are threatened.

Fish stocks are rapidly declining. **Overfishing** is depleting Earth's **marine resources** at an alarming rate. Wildlife is being hunted and gathered from the oceans and seas at rates too high for populations of marine species to be maintained. If fishing rates continue, the ability of the oceans to supply enough fish will collapse by 2050. It has been estimated that about 70% of Earth's fisheries are already fully exploited, overfished or depleted. Only 3% have been left alone to recover.

In 2013, worldwide fish consumption hit a record high of 17 kilograms per person per year. On average, people eat four times more seafood now than they did in 1950. As the human demand for fish increases, Earth's fisheries are declining fast.

Marine resources provide about 20% of all animal protein eaten by humans, and hundreds of millions of people depend on the oceans and seas for their daily livelihoods. The Earth's oceans and seas are being polluted and overfished at an alarming rate.

Activity 1: Our oceans

Answers – see RESOURCES

1. Using an atlas, name the Earth's five oceans.

2. In pairs, discuss ways in which the oceans and seas are important in your lives. Write the outcome of your discussion below.

Worldwide, about 90% of stocks of large predatory fish are already gone. The balance of the marine ecosystem has been upset and small foraging types of fish have replaced the increasingly rare large predators.

There is growing international concern about the state of global fisheries. Collapsing fish stocks have created large ecological dead zones in the oceans and seas where fish have been replaced by jellyfish and shrimp.

Large areas of the seabed in the Mediterranean and North Sea now resemble a desert – the seas have been stripped of all marine life due to fishing methods such as bottom trawling. European fishing fleets have turned to West African seas where each trawler can scoop up thousands of fish in a day. All West African fisheries are now over-exploited and coastal fishing is becoming increasingly difficult for local fishermen.

Marine ecosystems are in danger of collapsing. An ecosystem is the delicate relationships that connect a group of plants and animals and the environment in which they live. All organisms are interconnected through a series of checks and balances. Damage to the ecosystem, such as the removal of a predator or overfishing of mature breeding fish, will upset the natural balance and damage may be irreversible. This is happening to the Earth's oceans and seas.

Humans are hunting rays and sharks, as well as sea creatures such as turtles and marine mammals, to the brink of extinction. Shark numbers have declined 80% worldwide. Furthermore, it is estimated that, every year, millions of seabirds get caught on fish

Managing e-waste

It has been estimated by the United Nations that every year about 7 kilograms of **e-waste** is produced for every man, woman and child on the planet. That's a lot of e-waste!

E-waste can be defined as anything with a battery or a cord. It includes computer hard drives and monitors, printers, scanners, televisions, refrigerators, mobile phones, medical devices and some toys. Every year, for example, people in the USA throw away 120 million mobile phones and 30 million computers. What happens to this waste, where does it end up?

The problem is getting worse, and the total amount of e-waste is expected to increase by about 30% during the next five years. How can this dangerous and **toxic** waste be controlled and managed?

The rapid rise in the amount of e-waste is caused by people throughout the world constantly upgrading their electronic equipment as they try to keep pace with rapid advances in technology. Falling prices make new equipment more affordable and planned obsolescence gives certain electronics a short lifespan. People replace their equipment rather than repair it.

E-waste poses a huge problem because it contains substances that are harmful to humans and the environment if not properly treated. Heavy metals and toxic materials contained in e-waste include gold, copper and lead. Complex electronic equipment can contain up to sixty elements.

Much e-waste is simply dumped in rubbish bins and ends up being used in **landfill**. This is very bad for the environment, as toxic substances **leach** out and **pollute** the groundwater, air and surrounding soil. Pollution from e-waste ends up in the food chain, poisoning crops, drinking water, land and sea animals and eventually can cause health issues for humans.

Unfortunately, much e-waste is being dumped in poor countries. Ghana, Mexico and Venezuela are e-waste importers. Millions of old televisions and computers from the United States end up in these countries. The city of Guiyu, in China, is widely regarded as the e-waste capital of the world. 150 000 people work in poor conditions and for low pay to extract (separate out) materials from e-waste.

Albatross chick remains – the plastic it ingested is obvious.

E-waste pile, Guiyu

Workers separating materials in a recycling facility

Mountains of e-waste litter the planet.

Much of the **recycling** business is primitive and methods like open burning, acid baths and shredding are used to extract valuable minerals from e-waste. The fires give off noxious fumes and liquids leach into the soil and ground water. People who work with the recycling of e-waste exhibit many health problems, such as respiratory and skin problems and there is an increased incidence of birth defects aong their babies. Recycling and disposal of e-waste may involve considerable risks to workers, their families and communities. Great care needs to be taken to avoid unsafe exposure.

Most e-waste, however, can be profitably **recycled**. **Recovery systems** can be introduced along the waste supply chain, and the recovery of valuable materials can be promoted. E-waste can be sorted, dismantled and materials removed and recycled.

New Zealand generates an enormous amount of e-waste. The lifespan of a computer in New Zealand is just five years – and getting shorter. The recent switch to digital TV resulted in 400 000 old television sets being dumped. Most New Zealand e-waste ends up in landfills, with only 20% being recycled. Cathode ray tubes (which originally were used in computer monitors and televisions) and circuit boards are rich in precious metals such as gold and copper. These items are exported to Japan to be refined and the minerals extracted safely. However, New Zealand could be doing more to protect its environment from e-waste.

Activity 1: E-waste

Answers – see RESOURCES

1. In pairs, write a definition of e-waste.

2. In groups, and using your own paper, create a collage of images and captions to show a variety of e-waste products. You will need at least six images of equipment that causes e-waste. Write captions to explain each image.
3. What are three causes of the rapid increase in e-waste?

Sustainable Samso Island

The world could learn a lot from tiny, windswept **Samso Island**. This small island, to the north of Denmark, has become a model renewable energy community. Samso's social and economic experiment in energy sustainability has been a great success and an example to the world.

Samso is small, just 112 square kilometres. Samso has a population of only 4 000 people, but every year more than 6 000 politicians, journalists, students and travellers visit the island to learn about its efforts to become **carbon neutral**. Samso's *Energy Academy* hosts seminars, conferences and workshops for those wanting to learn more.

Samso provides all of its own energy needs and even exports electricity to mainland Denmark. The island does this through a series of windmills. Ten giant land-based turbines rising 50 metres and with blades that stretch 27 metres from end to end, plus eleven larger sea-based turbines (63 metres tall with blades stretching 40 metres), work day and night to provide renewable wind energy.

Samso's experiment in sustainability began in 1997, when the island won a contest sponsored by the Danish government. The aim of the contest was to create a carbon-neutral community within a decade. Samso has achieved this goal.

About $NZ60 million dollars have been invested in producing clean energy through a series of windmills, solar panels and four central heating stations. The heating stations burn locally-grown straw and wood pellets and use solar energy to provide the hot water requirements for 250 houses.

Everyone on Samso is expected to work together on sustainability, and one in ten islanders holds shares in the wind turbines. Each year they earn huge profits from the sale of surplus electricity. Many new jobs have also been created, with 10% of the island's population employed by the energy sector.

Many islanders, however, still live a traditional lifestyle as farmers, but these days they practise organic farming. Many

Twenty-one wind turbines produce more electricity than Samso can use. The people of Samso also use solar panels to capture energy from the Sun. Every year, the island sells almost $NZ10 million worth of electricity to Denmark. Since 2005, the island has produced more energy than it uses, so it sells the surplus.

Houses have been insulated using old newspapers. Straw is a very efficient type of fuel, as one straw bale represents the heating equivalent of one barrel of oil. The ash from the straw and wood is returned to the soil to improve the land's fertility.

farm vehicles are powered by biofuel made from island-grown rapeseed.

The islanders are proud that they use so little fossil fuel. The only **carbon emissions** produced from fossil fuels comes from tractors, cars, and a diesel-powered ferry to the mainland. These emissions are easily offset by the energy produced by the wind turbines. Efforts over the years to introduce electric cars have not been successful; most people choose to walk or cycle.

Samso still faces some challenges. It has so far failed to eliminate the use of small amounts of fossil fuel. Secondly, the wind turbines have no storage capacity, so when the wind does not blow, the islanders need to burn coal.

Islanders try to avoid using vehicles powered by fossil fuels.

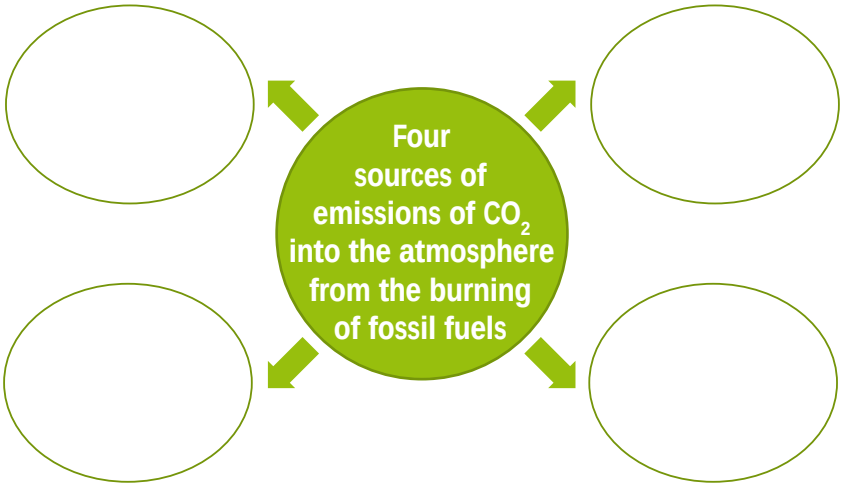
Every year, humans create carbon emissions amounting to an incredible 30 billion metric tons. All of this is poured into the atmosphere. Across the planet, energy consumption continues to increase, and atmospheric carbon dioxide, CO_2, is rising rapidly. Many consider that the outcome of this will be global warming. Samso island is one of the few places on Earth to be carbon neutral and therefore make no contribution to atmospheric CO_2.

Samso is an experiment in sustainability and self-sufficiency. The islanders believe that they can save an area but not the world. They provide an example of what is possible.

Activity 1: Samso Island

Answers – see RESOURCES

1. In pairs, complete the diagram to describe four sources of emissions of CO_2 into the atmosphere from the burning of fossil fuels.



New Zealand's declining water quality

One of the worst threats to New Zealand's natural environment is the degradation of the country's streams, rivers and lakes. Many **freshwater systems**, that were until recently clean and unpolluted, have become choked with weeds, slime and algal blooms. Aquatic life, insects and birds have all been adversely affected. There is increasing concern about the quality of New Zealand's water.

The main **contaminants** of New Zealand's freshwater systems are sediment from the erosion of hills and river banks, nutrients from fertilisers such as **nitrogen** and **phosphate**, and vehicle and household liquids such as **oil**, detergents, paints and sewage.

Water quality can be measured in a variety of ways. The highest quality water is clear, with high oxygen levels, and free of wastes and contaminants. Contaminants such as nitrogen, phosphate, and wastes lead to algal growth and poor quality water – i.e. the water is murky with low oxygen levels.

The discharge of waste from urban centres into New Zealand's waterways is one reason for the decline in water quality. Every day, detergents, waste oil, litter and sewage are discharged into streams, rivers and lakes. Think about what goes down the drain at your home.

Water run-off from roads is another cause of degraded water quality. Pollutants such as zinc, copper, lead and hydrocarbons from vehicle wear, vehicle emissions and the road surface itself are washed into our waterways daily.

Although there are tight controls and huge efforts made to reduce industrial waste, much industrial waste nevertheless finds its way into our waterways.

The major reason, however, for the pollution of our freshwater systems is pastoral farming and in particular the expansion of the dairy industry. The increase in water pollution is closely linked to the increase in intensive **dairy farming**. As New Zealand tries to squeeze maximum value out of its natural resources, our water resources are reaching their limits in some parts of the

Compared with most countries, New Zealand's water quality is very good.

country. New Zealand is struggling to provide environmentally sustainable land use.

Dairy products are New Zealand's biggest source of export dollars. Without the recent expansion of dairy farming, our economy would be a lot worse off and there would not have been the rejuvenation of some of our small towns.

Dairy farming has become more intensive, leading to a remarkable 60% increase in productivity (per hectare) over the last 20 years. This has been achieved by applying more water (i.e. through irrigation), more supplementary feed, and more nitrogen fertilisers to the land. While good news in terms of productivity and revenue, such **intensification** leads to increased run-off of pollutants into rivers.

Intensive dairy farming is degrading New Zealand's water quality.

Although intensification is an important factor in the degradation of our waterways, the conversion of more land to dairy farms is having a greater impact nationwide.

Cattle cause damage to **riparian** (streamside) habitats along the edges of streams, rivers, wetlands and lakes. This alters a freshwater system's ecology due to an increase in sediment and the removal of riparian (riverbank) plants. With plant cover reduced, fish and invertebrates have less shade. Without shade, water temperatures increase and oxygen levels drop – this puts stress on many species.

Recently, a report to Parliament concluded that New Zealand faces 'a classic economy versus environment dilemma'. The report states that unless New Zealand takes urgent steps to slow the expansion of dairying, many more rivers and lakes will be degraded. It appears that none of the steps currently being taken to lessen environmental impacts can reverse this trend in the near future.

Many dairy farmers are, however, taking steps to lessen the impact of their farm upon water systems. Measures include fencing streams and planting riparian strips along riverbanks. Other farmers have restored or created artificial wetlands as a way to filter contaminants, shade streams and exclude livestock

New Zealand's Exclusive Economic Zone

New Zealand's Exclusive Economic Zone (EEZ) is an area of sea and seabed that extends 200 nautical miles off the New Zealand coastline (about 370 kilometres). It is an enormous area of sea, measuring over four million square kilometres.

The New Zealand government has full sovereignty out to 12 nautical miles (22 kilometres) offshore and has special rights over the exploration and use of the marine resources for the area from 22 to 370 kilometres from New Zealand's coastline.

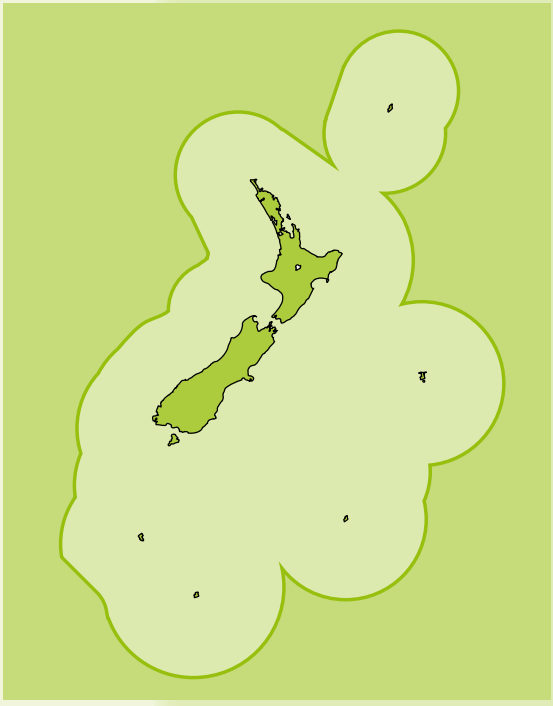
The EEZ contains a diverse range of marine ecosystems and thousands of different species. It is also home to many migratory species. The biodiversity within the zone is enormous. This is an environment that needs to be protected.

The EEZ also provides much to the New Zealand economy – especially fishing and oil and gas. Our main shipping routes pass through the zone, taking our exports to international markets. Communication cables run through the zone, linking us to the outside world.

The New Zealand government is currently offering permits for foreign oil companies to explore within the zone for new oil and gas reserves. This is causing a lot of argument.

If new reserves of oil or gas were to be discovered within the zone, this would be a huge boost to the New Zealand economy and provide thousands of new jobs. New Zealand would be a more prosperous country. Experts believe there is a high likelihood that enormous untapped reserves of oil and gas remain as yet undiscovered within the EEZ. It is only a matter of time before some will be discovered.

There is a lot of opposition to the government's policy of allowing oil and gas exploration within the zone. Opponents



New Zealand has one of the largest Exclusive Economic Zones in the world.

Our government needs to manage the resources of the zone carefully, as many of the resources are not renewable.

A rig drills for oil and gas in the sea.

Drilling for oil and gas is an expensive business, and can cost as much as one million dollars per day for deep-sea rigs.

Gulf of Mexico, Louisiana, 2010

Whale watching, Kaikoura

say that the government needs to do more to ensure that companies searching for **oil** and gas in the EEZ have enough rules and procedures in place to protect the environment should there be a blowout or leakage from any **drilling**.

Exploratory wells do carry some risk. A drill has to pass through up to three kilometres of water before reaching the ocean floor, then drill through sediment and rock for up to another nine kilometres without the drill snapping. Computers measure wind and waves and there are many early-warning systems. The oil companies say drilling is safe.

In 2010, BP's *Deepwater Horizon* rig suffered a blowout while exploring off the coast of the United States – causing almost five million barrels of oil to leak into the Gulf of Mexico. The impact on the environment was devastating, and the clean-up cost billions of dollars. It took 87 days to control the gushing of oil into the sea. What if this happened in New Zealand's waters?

There is another environmental concern. Some exploratory drilling is occurring near Kaikoura, a town whose prosperity is increasingly reliant on whale-watching tourism. Surveys for oil often use seismic methods and these are dangerous to whales – causing them social disruption, stress, hearing problems and even death. Kaikoura residents are concerned that their whale-watching tourism industry could be disrupted by oil and gas exploration.

What if the worst were to happen – how long would it take to bring a deep-water gushing well under control? Since the Gulf of Mexico disaster, massive capping stacks have been invented that can plug an uncontrolled well quickly. But it would take about a week to fly in a capping stack to New Zealand, then three more weeks to manoeuvre it into place.

An oil or gas discovery would add millions of dollars to the New Zealand economy and provide government with more money to improve social conditions. An accident would cause environmental impacts of a kind and on a scale that New Zealand has never seen before. Potential risks and consequences will have to be considered before any decision is made to allow drilling for oil and **natural gas** in New Zealand's EEZ.