



## VISION OF A ZERO CARBON FUTURE - INTRODUCTION

The following document provides some background information which might help you produce your art.

- This **VISION** has been created through meetings of climate scientists, engineers, artists and members of the public including school children. The meetings took place in Leeds, 2018-2019, supported by the Royal Academy of Engineering INGENIOUS scheme <https://www.raeng.org.uk/grants-and-prizes/ingenious-grant>
- This **VISION** doesn't represent the views of any organisation, instead it has been developed through discussions between the people above. Many other visions of the future have been produced, however, this is the one that should form the inspiration for your art.
- This **VISION** is not about trying to predict the future. It is a story of one possible future as a thought experiment.
- This **VISION** is intended to be *optimistic*. We want to start a different conversation about the future rather than focusing on doom and gloom. However we don't think human nature will change so no doubt there will still be conflicts and problems. This project is not about imagining paradise; we are interested in the future as a place where real people might live.
- This **VISION** considers how we arrived at a *zero carbon future*, in order to tackle the problem of climate change. Other aspects of life, such as religion, politics, fashion, art or sport will be affected by this change in unknown ways, this is for you to decide and express through your art.
- Your art should consider real places as much as possible. Achieving a zero carbon future will involve changing our existing way of life, not inventing a new society from nothing. For example, some roads, bridges and historic buildings in the UK are hundreds of years old, and are likely to be around for many years to come. You should consider carefully how this could affect what you might draw. Some specific places in the north of England are mentioned. If you are from elsewhere feel free to consider how our **VISION** might affect other areas.
- Your art should NOT feature any of the following: *zombies, aliens, intergalactic space travel, meteor strikes, world wars*. We are looking for plausible, optimistic, positive ideas about the future based on our **VISION**.
- This **VISION** takes the form of: a summary of key points and a timeline from the year 1700 onwards into the future. Historical events are included in the timeline to give some helpful background.
- Your art can be based on any part of the **VISION** timeline: we suggest any time from about 2030 onwards. For example, you could draw a picture showing life in 2050, or 2100 (or both). You could illustrate a sequence of events spanning a lifetime.

## VISION SUMMARY

*Note: a 'zero carbon' future is one where no greenhouse gases (that cause climate change) are emitted through burning fossil fuels. Most scientists believe it will not be possible to achieve zero emissions in all areas, so some technologies that actually capture and store greenhouse gases are proposed. These are called negative emissions technologies. Using these may enable us to get to zero emissions overall (or even negative emissions overall). For simplicity, we call our future vision a 'zero carbon future'.*

From 2019, a huge positive change takes place across the world as people wake up to the reality of climate change. Enormous efforts are made to replace fossil fuels with renewable energy technologies, to change behaviour to reduce our carbon emissions, and to move our economy to a more sustainable model.

By 2050, these efforts mean that we have reached *zero carbon emissions*. Later in the 21<sup>st</sup> Century, continuing efforts to remove carbon dioxide from the atmosphere e.g. by using technologies such as Bioenergy with Carbon Capture and Storage (BECCS), mean that more greenhouse gases are being removed than added – this is called 'net negative emissions'.

By 2120 (100 years in the future), global temperatures are – just about – holding to 1.5°C above 1850 levels, as hoped for in the 2015 Paris Climate Agreement. Greenhouse gas emissions are falling, population levels are gradually falling, prosperity is growing, and biodiversity is rising due to re-wilding and the growth of billions of trees in newly planted forests. For the first time since the start of the Industrial Revolution, humans have learned to live prosperously in a sustainable way, thus ensuring future generations will inherit a habitable planet.

However... things are not all rosy. Due to the greenhouse gases put into the atmosphere up to 2050, and the 1.5°C global temperature rise, profound changes have taken place, with environmental impacts including droughts, floods, storms, sea level rise due to melting ice sheets, and migration of tropical diseases to new areas. Although it is often sudden extreme events that grab headlines, it is important to remember that throughout history it has often been drought that has the largest negative impact on human societies.

Many of the above changes have meant that millions of people have become climate refugees. Some areas are more badly hit than others. The milder coastal areas of northern Europe including the UK have become a refuge. Accommodating millions of climate refugees causes major societal problems, however by 100 years in the future, these problems are becoming less pressing, as conditions are slowly improving.

Our **VISION** is intended to be positive and optimistic, but as you can see, we cannot hope for a perfect future. We can only hope to prevent a truly catastrophic situation, through taking positive action over the coming decades.

### Key points to bear in mind:

1. World population growth levels off and then begins to fall (gradually – there is no population crash). However, there are large movements of climate refugees from areas that are most affected – so population in some areas including the UK rises as a result.
2. New measures of the health of society are developed e.g. 'Gross National Wellbeing' rather than 'Gross National Product'. Humanity moves away from using ever more energy and resources to produce ever more consumer items, to focus on improving wellbeing. Improving wellbeing\* is thought to include enabling people to: 1. *Connect to others*; 2. *Be active*; 3. *Take notice of their surroundings*; 4. *Keep learning*; 5. *Give to others*.
3. We develop a true 'circular economy' based on imitating living systems, where waste from one process feeds another. Wastes of all kind are minimised through better design, maintenance, repair, re-use, repurposing and recycling.
4. We use renewable energy, mainly solar and wind backed up by energy storage (e.g. batteries); but also including large-scale Bioenergy with Carbon Capture & Storage, which removes carbon dioxide from the atmosphere (this is controversial, as it may conflict with using land for growing food). There is generally a move from large centralised national energy grids to local communities generating their own power.
5. We move to sustainable transport, with great emphasis on walking and cycling in cities, zero-carbon buildings and urban community food-growing.
6. We move to a mostly meat-free diet, with some use of lab-grown 'meats' and insect protein. Some aspects of agriculture become more intensive to keep up with a growing population at the same time as capacity for food growing diminishes due to loss of soils, scarcity of important nutrients and sea level rise (drowning areas of valuable farmland). New varieties of very productive and disease-resistant crops are developed, however there are major problems providing enough for everyone to eat.
7. We use advanced communications technology to enable global cooperation
8. We re-wild the world, including planting billions of trees and re-introducing locally extinct plant and animal species to restore ecosystems. Vast areas of the oceans are protected as marine reserves, allowing fish stocks to recover. Restored mangroves and peatlands act as carbon storage.
9. Through doing all of the above, it becomes possible to reduce the chance of causing catastrophic climate change. However, we also have to *adapt* to climate change impacts that are already occurring e.g. droughts, flooding, and other extreme weather events. Some adaptations e.g. planting trees, will help to both tackle climate change and reduce extreme temperatures and/or flooding at the same time.

*\*according to research by the New Economics Foundation*

## VISION TIMELINE

Timeline	Environment & Climate Change	Energy	Food, Water & Waste	Transport & Built environment	Historical Events / Social change / Technology & Economy
1700	'Little Ice Age' – cool weather in northern Europe 1600-1800; 1783 - Laki and Grimsvotn volcanic eruptions in Iceland, atmospheric pollution as a result; 1772—Joseph Priestley discovers biological carbon cycle	1698 - First steam engine – Thomas Savery Steam pump, 1712 – Newcomen steam engine; 1769 – James Watt steam engine – start of fossil fuel era	Crop failures and famine in Europe in 1780s perhaps due to volcanic eruptions	Travel improved through Turnpike (toll) roads (unpopular in many areas) and canal network; improvements in navigation and diet on ocean-going ships; first flight - hot air balloons; first rail vehicles for hauling coal; 1779 – 1 <sup>st</sup> iron bridge built at Iron Bridge over River Severn	Beginnings of the Industrial Revolution; the “Age of Enlightenment” – scientific discoveries; Enclosures Acts force common people off the land, mass migration to cities; 1776 – Adam Smith writes 'The Wealth of Nations'; 1776 – American Declaration of Independence; 1788 – foundation of penal colony, Sydney, Australia; 1789 – French Revolution
1800	1816—“The year without a summer”—global temperature dip as a result of Tambora Volcanic Eruption; <b>World population = 1 billion</b>	1801 – gas lighting on public display in Paris; 1814 – first gas street lights in London	1810s – famines in Europe	1801 – First demonstration of steam transport; 1829 – Rocket Steam Engine; first bicycles: 'Dandybikes'; steamships	1807 – Slave Trade abolished in British Empire; 1815 – Battle of Waterloo; 1838 – 1 <sup>st</sup> electric telegraph; 1840 – 1 <sup>st</sup> postage stamp; Charles Babbage invents the concept of a computer; 1844—Rochdale Society of Equitable Pioneers—1st Co-operative society, 1848 – Revolutions in Europe; Karl Marx writes 'The Communist Manifesto'
1850	1860s – John Tyndall recognises greenhouse effect; 1872 – creation of first national park (Yellowstone, US); Mt Everest recognised as the world's highest mountain	1859 – Edwin Drake drills for oil, Titusville Pennsylvania,	1854 – John Snow proves cholera is a water-borne disease	Massive development of rail travel in UK and America (transcontinental railways); first railways in India; 1860s – First bicycles; “The Great Stink” of 1858 in London – Joseph Bazalgette builds sewer network for London in 1860s-1870s; 1869 – Suez Canal opens	1851 – Great Exhibition; 1856 – Bessemer process enables mass production of steel; 1857 – Indian 'Mutiny' – Britain begins to rule India directly; 1859 – Darwin publishes 'Origin of Species'; 1861-1865 – American Civil War (the first to feature railways and modern artillery and communications); 1865 – James Clark Maxwell theory of electromagnetism; 1866 – First Atlantic Telegraph Cable laid; 1870 – Franco-Prussian War (rail transport proves decisive); 1871 – Unification of Germany; 1876 – 1 <sup>st</sup> telephone call (Alexander Graham Bell)
1880	1883 – Eruption of Krakatoa; 1887 – Yellow River floods in China kill thousands; 1896 – Svante Arrhenius theorises that humans are causing climate change	1881—World's first electricity supply driven by water wheel—Godalming, Surrey, UK; 1882— Rockefeller founds Standard Oil		1886 – Karl Benz – 1 <sup>st</sup> motor car; 1889 – Exposition Universelle and building of the Eiffel Tower	1884 – Berlin conference: “Scramble for Africa” by European imperial powers; 1890 – First long distance AC transmission; 1892 – General Electric company created; 1896 – modern Olympic Games held for the first time; 1897 – Klondike gold rush;

		company			
1900	1906 – San Francisco earthquake			1903 – First heavier than air flight – Wright Brothers; 1908 – Model T Ford first produced	Height of the British Empire; 1899-1902 - Boer War; 1908 – Boy Scouts founded
1910			1913—Haber-Bosch Process first used to produce ammonia fertiliser, enabling huge increase in food production – and resulting carbon emissions and nitrate pollution	Model T Ford car revolutionises personal transport; first use of aeroplanes in war	Einstein develops theory of relativity, revolution in physics; 1911 – Amundsen reaches South Pole; 1914 – 1918 World War I; the victorious allies impose financial penalties on Germany resulting in the eventual rise to power of the Nazis; 1917 – Russian Revolution; 1918 Arab Revolt
1920					Economic boom following WWI; 1920 – League of Nations founded; 1928 – Women get full voting rights in UK; 1929 – Wall Street financial crash followed by Great Depression
1930	<b>World population = 2 billion</b> 1931 – Floods in China kill millions; 1933 – ‘Dust Bowl’ drought in North America		1932-1933 Famine in Ukraine		1932 – Kingdom of Saudi Arabia founded; 1933 – Hitler comes to power in Germany; 1936 – Spanish Civil War breaks out; 1939—Outbreak of World War II
1940		1943 – Battle of Stalingrad – Hitler fails to gain access to Soviet oil; development of Fischer-Tropsch process (synthetic gas from coal) as a replacement for oil	1942—Beveridge introduces rationing of food in UK during WWII	Development of jet aircraft	Development of nuclear weapons during WWII, 1945 – atomic bombs dropped on Hiroshima and Nagasaki, Japan, ending WWII; 1948 – creation of National Health service in UK; post-war economic boom and reconstruction following WWII; ‘Iron Curtain’ created across Europe: start of ‘Cold War’ between Soviet Union and Western countries
1950	1951 – UK Clean Air Act; 1952 – “Great Smog” event in London; 1953 – North Sea floods; 1958 – Measurements of rising carbon dioxide in atmosphere (Keeling Curve)	1950s-1960s – development of nuclear power; 1957— Windscale and Kyshtym nuclear accidents	1959 – Great Leap Forward and famine in China causes tens of millions of deaths; rise in consumption of meat and dairy in affluent areas of the world	Development of suburban living enabled by car transport; 1957 – Sputnik – 1 <sup>st</sup> artificial satellite	1950s – ‘Baby Boom’ following WWII – most affluent generation in history; widespread uptake of new time-saving technologies in the home (vacuum cleaners, washing machines etc); 1956 Suez Crisis – signals the decline of Britain as a major world power; USA and Soviet Union become the two superpowers; 1957 – first satellite (Sputnik I) launched by Soviet Union
1960	1968 – Earth rise photograph taken by Apollo astronauts –	1960s/70s – Change from ‘town’ gas to	1960s – Green Revolution provides food in developing	Growth of motorways in UK; growth of commercial air travel	1962 – Cuban Missile Crisis; Vietnam War and anti-war movements; Civil Rights movement; end of colonial rule

	encourages global awareness of environmental problems; <b>World population = 3 billion</b>	natural gas supply in UK, following development of North Sea oil and gas	world, enabling huge rises in population		in much of Africa; 1969 – Neil Armstrong becomes the first man to walk on the moon
1970	1970s-80s - Acid rain caused by pollution from coal fired power stations recognised as a serious environmental problem, many measures put in place to prevent it; massive deforestation occurring in tropical forests <b>World population = 4 billion</b>	1973 – OPEC oil crisis; 1979—Three Mile Island nuclear accident; energy crises lead to developments in renewable energy		Development of mass consumerism and building of shopping malls in western countries, led by US	1971 – Greenpeace environmental organisation founded; Space Station programme begins; Recession and strikes by workers in UK; growing feminist movement; 1978 – first baby born as a result of IVF treatment; First linking of computers through telecommunications (ARPANET)
1980	1988 – NASA scientist James Hansen alerts governments to climate change; 1989 - Montreal Accord banning CFCs comes into force to prevent destruction of the Ozone layer; Drought in many areas of Africa	1986—Chernobyl nuclear disaster	Famines in Africa receive worldwide attention; 1985 - 'Great Pacific Garbage Patch' discovered in the middle of the ocean	Development of maglev trains, particularly in Japan	1980s – Thatcher prime minister of UK, Reagan president of US - both implement privatisation of public services, cutting tax, deregulation of finance; UK miner's strike - decline of coal industry; 1984 - Bhopal Disaster (one of the world's worst industrial disasters)
1990	1992 – Rio Earth Summit; world population = 5 billion; 1998 – powerful El Nino event results in widespread coral bleaching due to high sea temperatures	1990s – Cubans adapt to fossil fuels being cut off due to collapse of USSR		Air travel doubles globally from 1980s -2000s	1991 – fall of USSR, end of 'Cold War'; Tim Berners-Lee invention of worldwide web; 1997 – computer Deep Blue beats Gary Kasparov, world chess champion; 1995-2002 – “Dot Com” bubble and financial crash
2000	2000s - serious droughts in Australia; 2004 – Boxing Day Tsunami in Indian Ocean; 2005 – Hurricane Katrina hits New Orleans; <b>World population = 6 billion</b>	Development of fracking (drilling for shale gas) in USA; Solar and wind power costs fall rapidly	60% of world rivers dammed, 500 million people affected downstream	Drone technology develops	2001 – 9/11 attacks, start of War on Terror; 2003 - human genome sequenced; computing power doubling every 18 months (known as Moore's Law); 2008 – Credit crunch financial crash, “austerity” policies as governments attempt to stabilise economies; Rise of social media and online shopping;
2010	2015 – severe floods in UK attributed to climate change; 2015 – Paris Agreement to limit global warming to 1.5°C rise; 2017 – 1.3°C rise reached; 2016 - warmest year on	2011—Fukushima nuclear disaster; rapid development of fracking in USA, but limited in UK and Europe; rapid development of	Campaigns to tackle obesity and reduce health impacts from sugar in rich countries; Recognition that 50% of global food is wasted; Campaigns against plastic waste	>50% of global population live in cities, this is predicted to increase  UK housing crisis  Sales of electric passenger	2011 – Arab Spring uprisings, start of Syrian Civil War; 2016 – UK Brexit vote; 2017 – 8 men own the same wealth as the poorest half of humanity; China overtakes US as the world's largest economy; High streets in UK in decline due to rise of online shopping;

	record, 2017 warmest year without an El Niño; record low arctic ice cover; 50% of animals lost since 1970; <b>World population = 7 billion</b>	batteries for energy storage; 2017/18 – a few days with no coal being burned for electricity in UK (1 <sup>st</sup> time since 19 <sup>th</sup> C)		vehicles growing, Tesla develops electric trucks	
2020	Devastating natural disasters occur, forcing society to wake up to climate change e.g.; 2028 – Miami, Florida destroyed by Hurricane 'Donald'; 2029 – International Environmental Court established; Marine Protected Zones established in the oceans	2021 - Oil and gas prices shoot up and hit highest point; last coal fired power plants in UK shut down; large scale district heat networks created in UK; large-scale Bioenergy with Carbon Capture & Storage (CCS) developed	'Circular Economy' (recycling and repurposing wastes) established – across most of UK, Europe, US, China; Carbon footprint labels on all foods	Cycling boom across the world – throughout cities, and integrated into public transport; Cars (even electric ones) are barred from many areas in cities; car parks turned into public parks and food-growing spaces; Major programmes of retrofitting existing houses with insulation and carbon-saving technologies	'One Planet Living' becomes official policy; Development of 'Gross National Wellbeing' to replace 'Gross National Product' across most countries; development of Carbon Tax; development of 'Doughnut Economics' – fulfilling basic needs but not overshooting planetary boundaries; local communities are empowered; large landowners taxed based on sustainable land use. A 'Ministry of the Future' created in UK to consider long-term impacts of decisions
2030	<b>World population = 8 billion:</b> 'Greening' of the Sahel area in Africa and huge areas in Asia through planting millions of trees; global i-Tree programme to evaluate where best to plant trees in all areas; Arctic ice-free in summer for the first time;	The 'Energy Revolution' – rapid change to renewable energy with energy storage; Leeds one of the first cities to switch to hydrogen gas network	2035 – Nigeria famine; Agriculture across most of the world changes to become a 'carbon sink'; Most clothing now made from recycled materials; consumer products 100% zero plastic	Drones capable of carrying people used by the wealthy in some cities; Environmental taxes on aviation reduce availability of air travel to most people; Virtual Reality trips and gaming act as a substitute for cheap travel	Working week reduced in UK; Large-scale migration of climate refugees from Middle East, Africa, Southern Mediterranean to Northern Europe; Introduction of carbon 'rationing' quotas and allocations to protect vulnerable and elderly groups; 2031 - Scientists discover an exoplanet with unmistakable signs of life on its surface
2040	Large-scale reforestation of the Amazon and other previously forested areas; major re-wilding programmes in UK and Europe (e.g. lynx reintroduced in UK); Extinction of wild tigers; 2045 - collapse of part of Greenland ice sheet	1/3 of global energy demand is in India; 2047 – Nuclear accident in Eastern US	2046 – Middle East famine due to drought; Soil erosion being tackled in many areas through new farming techniques and a 'permaculture' approach; Meat consumption halves in comparison with the year 2000	Car fleet grows by 2 billion from 2000; only Electric Cars produced from this point; New buildings (including tall structures) are made from timber and natural materials, locking up additional carbon	Large-scale migration of climate refugees from Middle East, Africa, Southern Mediterranean to Northern Europe Introduction of Universal Basic Income, guaranteeing everyone a minimum standard of living 2042 – Mars Mission discovers fossilised microscopic life forms.
2050	1.5°C of global temperature rise reached; Major flooding in UK	Solar energy is dominant globally; 2051- Submarine nuclear disaster in	Zero food waste achieved in Europe; 2052 – food shortages in	2055 – large-scale development of Arcologies (self-contained giant buildings housing the wealthy);	Large-scale migration of climate refugees from Middle East, Africa, Southern Mediterranean to Northern Europe; Large numbers of jobs now automated (including highly

		English Channel; large-scale development of BECCS (Bioenergy with Carbon Capture & Storage) – draws carbon dioxide out of atmosphere	UK and Europe due to fungal crop pests	Many city areas redesigned for the purposes of capturing as much water as possible	skilled roles), but new jobs created. Some communities do better, some worse.
2060	<b>World population = 9 billion;</b> Migration of diseases northward from tropics– malaria outbreak in S. England	2061 – Saharopean Energy Union established – network of solar and wind energy across Europe and North Africa	Major expansion of food production in Africa and Middle East through development of C4 golden rice	2064 – last regular conventional aeroplane flights; establishment of airships as a common method of intercontinental travel	Large-scale migration of climate refugees from Middle East, Africa, Southern Mediterranean to Northern Europe 'Bio-regions' or 'catchments' begin to replace national and regional states as a natural unit of government;
2070	Collapse of parts of West Antarctic ice sheet; China and Arctic regions establish large-scale burial of greenhouse gases	Near zero carbon emissions achieved for first time;	Increasing problems with growing food due to lack of essential nutrients – nutrient conservation becomes vital		Major economic growth in Africa – millions lifted out of poverty. Nigeria becomes one of the world's most important economies
2080	Sea Level Rise of 1m; 2081 – Major floods in UK; parts of the Hull area permanently flooded; Thames Barrier breached but repaired; Improving catch from well-managed fisheries worldwide	Huge numbers of jobs created managing forests planted for Bioenergy with Carbon Capture & Storage, including tourism activities		First large-scale floating cities (Rotterdam/New Orleans);  Development of new eco-villages within city boundaries	2082 – Founding of PanArctica – Union of Arctic countries; Climate migration to northern Europe from overseas begins to fall as conditions improve in Africa and the Middle East; DREAM (Artificial Intelligence) technologies enable global cooperation in the face of increasing climate threats
2090	2092 – Hekla volcanic eruption devastates Iceland and affects much of NW Europe (cold summers for several years) <b>World population = 8 billion</b>	Exceptional storms cause major damage to wind farms in North Sea	2092-2099 – UK & Europe food shortages due to impact of Hekla eruption		2093 – some civil disorder in northern UK as some areas affected by sea level rise and high levels of migration earlier in the century experience poverty and neglect
2100	Sea Level Rise of 1.8m; 2103 – 'Gojira' Earthquake flattens Tokyo		2101 – recovery from food shortages	Floating cities, including re-purposed cruise liners, become common	2101 – order restored; a progressive government in the UK acts to reduce inequalities and address shortages
2110	Forest cover in northern England reaches over 30% (up from less than 10% in 2000); Biodiversity rising				High levels of migration from some deprived areas to PanArctica; most areas growing in prosperity



2120	<p>Sea Level Rise of 2m;  <b>World Population 7.5 billion;</b>  Record of 2 consecutive decades of declining CO2 levels; global temperature appears to be stabilising around 1.5-2°C  UK floods and droughts less severe due to reforestation</p>	<p>Renewable energy technologies continue to develop; including wearable technologies; energy supplies mainly secure</p>	<p>Mostly meat-free diet (globally), seasonal foods; zero waste, nutrient recovery technologies ensure farming is sustainable, and soils are regenerated</p>	<p>All housing is zero-carbon; most travel is by electric rail, light rail and trams, electric buses, cycling or walking</p>	<p>Societal decisions are based on sustainable principles including improving ecosystems, improving human wellbeing and taking care of vulnerable groups. Life expectancy, which stalled in the 21<sup>st</sup> Century, begins to rise again</p>
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