

TIMELINE OF SUSTAINABLE DEVELOPMENT

Emergence of the Anthropocene

About 11,700 years ago, the last Ice Age ended giving rise to the start of the Holocene, and flourishing of humanity. About 10,000 years ago, some animals were domesticated and others extirpated as human impacts on the earth gradually grew. Global population increased slowly, not reaching 1 billion until 1820. Wealth and life expectancy remained modest: in 1800 and 1900, average life expectancy was 40 and 48 years and wealth was \$200 and \$680 per person respectively. The 1950s ushered in the 'great acceleration,' as energy and material consumption grew significantly, so too did planetary impacts. By 2000, life expectancy was 78 years and global wealth grew to a staggering \$6500 per person (with a global population in excess of 6 billion). Atmospheric CO₂ concentrations that were a stable 280 ppm prior to the Industrial Revolution now exceed 419 ppm, a level not seen since the Pliocene 3.6 million years ago (when average temperatures were about 7°C higher).

The concept of sustainable development can be traced back to at least 1713. The term rose to prominence in 1987 with publication of *Our Common Future*. Progress is mixed with significant gains in reduced poverty but with growing inequality, severe losses of biodiversity, threatening climate change, and unsustainable use of synthetic fertilizers and land-use changes.

Permian-Triassic boundary and "Great Dying" with 90 per cent of land species lost - likely due to massive CO₂ buildup from volcanic eruptions.

252
million
years
ago

~ 200,000
years ago

Appearance of modern *Homo sapiens*.

~ 74,000
years ago

Mt. Toba, Indonesia massive volcanic eruption - believed to have contributed to 1,000 year 'volcanic winter' and global cooling of some 3°C. Population decline; genetic 'bottleneck' with less than 10,000 humans worldwide.



**50,000
to
10,000
BCE**

Quaternary Period (Pleistocene to Holocene within the Cenozoic Era) megafauna extinctions (more than half of all species >40kg, especially Australia and Americas). ~11,700 years ago, last Ice Age ends giving rise to modern climate era and flourishing of humanity (considered start of the Holocene); sea level 120 m below current levels. Rock pigeons believed to be first domesticated animals about 10,000 years ago. 15,000 - 12,000 years ago, human migration across Bering Strait into the Americas.

~ 11,500 BCE Neolithic Revolution evident through increased erosion in the Levant.

~ 10,000 BCE Mesopotamia (approx. Iraq, Kuwait, Syria) further shift to village life with nearby crops and livestock. Animal pathogens, including TB and smallpox, jump to humans. Horses disappear from North America.

7,000 BCE Jericho (pop 2,000) thought to be longest continuously inhabited city.

~ 4,500 BCE Ox-drawn plow invented in Mesopotamia.

4,000 BCE Feng Shui philosophy of harmony between environment and physical landscape.

3,500 - 1,500 BCE Invention of writing in Mesopotamia, Egypt and central China.

3,000 BCE Knossos, Crete believed to establish first landfill (midden); ~ invention of the wheel in Southeast Asia; Earliest human whose name we know (Pharaoh Iry-Hor in Egypt); Earliest use of iron; start of Bantu expansion from West-Central Africa.

~750 BCE Rise of Greek city-states.

~ 650 BCE First large scale use of currency (coins) in Lydia (now Turkey) - use of coins also developed separately in China, India and cities around the Aegean Sea.

600 BCE Construction of Rome's Cloaca Maxima sewer to drain surrounding marshes and flush waste into the Tiber River (sewer expanded over the years and still in use).



**5,500
BCE**



First appearance in print of numerical analysis by mathematicians al-Khwarizmi and al-Kindi (introduction of algebra, trigonometry - imported from Baghdad to Italy by Fibonacci 300 years later).

c. 825

- 600 ~ 400 BCE Birth of Siddhartha Gautama, Buddha, in Lumbini, Nepal.
- 500 BCE Athens introduces law requiring waste to be dumped at least one mile from city; Sun Tzu's *The Art of War* and strategy resource use and planning; noticeable ecological decline of the Fertile Crescent.
- c.500 BCE End of compilation of the Jewish Torah.
- 220-206 BCE Qin Shi Huang, the first Emperor, builds major part of the Great Wall of China - some parts constructed as early as 7th century BC.
- 202 BCE Travel begins on the silk road.
- 200 BCE Golden Age of Hinduism begins.
- 100 Population of Rome believed to reach one million.
- 350 First complete copy of Bible with New Testament
- 376 Influx of Goths into Roman Empire - thought to be pivotal point in decline of the Empire.
- 632 Death of Prophet Muhammad; leads to schism between Sunni and Shia denominations.
- 650 Quran first compiled by Uthman, the third Caliph.
- 859 Fatima al-Firhi founds first degree-granting university in Fez, Morocco.
- 960-1279 Song dynasty flourishes in China, thought to be first to use of paper currency, earliest use of inoculations against smallpox, spreads to Ottoman Empire (becomes widespread post-1721 when Mary Wortley Montagu - wife of British Ambassador to Turkey - inoculates her own children).

Magna Carta establishes English constitutional tradition, followed by the Charter of the Forests in 1217 giving free men access rights to royal forests.

1215

- 1142 Iroquois Confederacy allegedly created by the 'Peacemaker' bringing together five nations south of the Great Lakes, North America: Constitution integrates consideration for the 'Seventh Generation' in governance.
- 1271 Marco Polo, aged 17, sets off to Asia with his father and uncle.
- 1347 Stora Kopparberg, Sweden, oldest commercial corporation, receives Royal Charter.
- 1348 Bubonic plague (Black Death) sweeps across Europe. Many cities restrict movement of residents; Venice, Florence and Lucca impose quarantine.
- c. 1350 Middle Ages end and the Renaissance begins in Europe (ends ~ 1550).
- 1366 City of Paris forces butchers to dispose of animal waste outside of the city.
- 1388 English Parliament forbids throwing of garbage into ditches, rivers and waters.
- 1400-1800 Hanseatic League of cities, northern Europe, supported commerce and defense; replaced largely by emergence of nations, e.g. Sweden, Denmark, Netherlands, UK, Germany.
- 1413 University of St. Andrews founded, likely the first to issue professional degrees (MD).
- 1440 Gutenberg's printing press established (the Bible first book printed).
- c. 1450 Haudenosaunee Confederacy (Iroquois League) resolves disputes among member nations in Great Lakes region.
- 1453 Fall of Constantinople (Istanbul).



Columbus lands on Hispaniola, sets up first New World settlement at Santo Domingo.



Nicolaus Copernicus publishes *De revolutionibus orbium coelestium* (On the Revolutions of the Heavenly Spheres).

1492

1543

1602

1445 Portuguese Prince Henry the Navigator first establishment of trading posts for slavery in Africa. Prior to European colonization, Africa at its peak estimated to have up to 10,000 different states and autonomous groups with distinct languages and customs.

1472 Italy's Banca Monte dei Paschi di Siena opens (oldest surviving bank).

1493 The papal Inter Caetera – the “Doctrine of Discovery” – gives arbitrary legal title to land in the “new world”.

1500 Approximately 14,500 languages spoken in the world - less than 5,000 today; per capita GDP ~\$130; average life expectancy 33 years; less than 40 million urban residents.

1517 Martin Luther begins the Protestant Reformation.

1522 Magellan ends first voyage around the world.

1532 Niccolò Machiavelli's *The Prince*.

c. 1540 Evidence of atmospheric pollution from colonial mining in Peru and Bolivia.

1570 - 1620 Noticeable drop in CO₂ emissions linked to death of some 50 million indigenous Americans, triggered by arrival of Europeans, and forests reclaiming 65 million Ha of abandoned agricultural lands.

1600 Per capita GDP ~\$150; average life expectancy 35 years; less than 50 million urban residents.

Dutch East India Company founded, leading to the world's first stock exchange in Amsterdam (shares returned approx. 16 per cent p.a. 1602-1650).

1607 Founding of Jamestown VI, oldest of the original 13 colonies and key conduit for invasive species, e.g. dandelions, tobacco, earth worms, honey bees, purple loosertrife, common sparrow.



Extinction of the dodo bird, Mauritius.

1662

- 1609 Bank of Amsterdam established - thought to be the first modern central bank; Hugo Grotius publishes *Mare Liberum* proposing international waters, leading to UK and France declaring territorial waters of five km (effective cannon range).
- 1637 Height of tulip mania; single bulbs sold for as much as ten-times annual salaries (generally recognized as first example of a 'speculative bubble').
- 1640 Isaac Walton *The Compleat Angler* (fishing and conservation); the first global convergence of the value of silver, standardizing the metal's value.
- 1648 Treaty of Westphalia and the rise of modern system of states; end of *Thirty Years' War*.
- 1651 Thomas Hobbes *Leviathan*.
- 1661 John Evelyn presents King Charles II with *Fumifugium* - a discussion on air pollution in London likening the city to the "suburbs of hell" (recommends switch to cleaner fuels).
- 1664 John Evelyn publishes *Sylva, or A Discourse of Forest-Trees and the Propagation of Timber in His Majesty's Dominions* (highly influential for timber management).
- 1665-66 London's 'great plague' kills 100,000; 'great fire' begins 2 Sept. 1666 in Pudding Lane, burns for four days leaving some 200,000 homeless.
- 1670 Hudson Bay Company established (world's largest landowner with 15 per cent of North America).
- 1672 Isaac Newton elected a Fellow of the Royal Society.
- 1679 Antoni van Leeuwenhoek in a letter to Royal Society suggests Earth's maximum carry capacity is 13.4 billion humans.

1700

Per capita GDP ~ \$170; average life expectancy ~ 36 years; the start of tea as a major commodity in England; less than 60 million urban residents; ~5 per cent of global ice-free land intensively used by humans

1690 Gov. William Penn requires Pennsylvania settlers to preserve one acre of trees for every five acres cleared; publication of John Locke, *Two Treaties* and *Essay Concerning Human Understanding*.

1712 Thomas Newcomen's atmospheric (steam) engine begins dewatering Conygree Coalworks, UK.

c. 1713 Hanns Carl von Carlowitz suggests Nachhaltiger Ertrag (sustained yield) for timber supply.

1720 In India hundreds in Khejadali killed trying to protect trees from the Maharaja of Jodphur (considered origins of 20th century Chipko movement).

1755 Immanuel Kant *Universal Natural History and Theory of Heavens*; 'Great Lisbon Earthquake' (informal start of seismology).

1762 Jean-Jacque Rousseau argues in *The Social Contract* for city-states and personal freedoms. Voltaire's writings (1731-1764) critique European policies (esp. French).

1775 Percival Pott, an English surgeon, observes that chimney sweeps develop cancer through contact with soot (first recognition of environmental factors and cancer); American Revolution begins (ends 1783).

1776 Adam Smith, *The Wealth of Nations* published.

1770s to 1830s Launch of Industrial Revolution in Britain (textiles, steam power, iron); peak of transatlantic slavery with an average of some 78,000 enslaved people brought to the Americas each year.



John Smeaton (who built Eddystone Lighthouse) declares himself first 'Civil Engineer'.

1771

- 1779 Ned Ludd allegedly destroys textile machinery giving rise to *Luddite* movement; Johann Friedrich Blumenbach divides the human species into five races (Caucasian, Mongoloid, Malay, Negroid, American - Australoid added 1940s and Capoid early 1960s).
- 1781 James Watt patents a steam engine.
- 1788 James Hutton *Theory of Earth*; or an *Investigation of the Laws observable in the Composition, Dissolution, and Restoration of Land upon the Globe*, Royal Society of Edinburgh (credited as start of modern geology although Abu al-Rayhan al-Biruni, AD 973-1048, was one of the earliest geologists, whose works included writings on the geology of India).
- 1789 French Revolution begins (ends 1794).
- 1790 First patent granted to Samuel Hopkins for a method to produce potash.
- 1791 Le Chapelier Law abolishes guilds in France; France becomes first country to decriminalize homosexuality.
- 1795 Immanuel Kant, *Perpetual Peace* published.
- 1798 Thomas Malthus, *An Essay on the Principles of Population*.
- 1800 Per capita GDP ~ \$200; average life expectancy ~ 40 years; less than 100 million urban residents.
- 1815 Mount Tambora, Indonesia erupts, killing 90,000, globally precipitating 'year without a summer'; Congress of Vienna and the end of Napoleonic Wars in Europe; William Smith publishes geological map of Great Britain; Rhine Commission established - world's oldest international organization.
- 1817 First roller coaster (opens in Paris - with wheels locked to track; prior to that similar ice sled rides in St. Petersburg).



Britain bans African slave trade; steamship invented.

1807



1820

1818 Baron von Drais patents *Laufmaschine* (bicycle) developed to replace horses that starved during Mt. Tambora's volcanic winter.

Approximate start of fossil fuel (coal) driven aspects of Industrial Revolution; atmospheric CO₂ concentration ~ 280 ppm; Spanish ban on the slave trade takes effect; global population 1 billion.

1824 and 1827 Joseph Fourier publishes articles giving rise to concept of greenhouse effect for planet earth.

1825 Work begins on Isambard Brunel's first engineering project, Thames Tunnel, London (opens 1843).

1830 Charles Lyell *Principles of Geology* published.

1831 UK Game Act protects game birds by establishing closed hunting seasons.

1836 Ralph Waldo Emerson, *Nature* published.

1842 Edwin Chadwick's report *Sanitary Condition of the Labouring Population of Great Britain* - supports his 1834 'Poor Act'.

1845 Alexander von Humboldt Volume I of *Kosmos* published.

1846 First mechanically drilled oil well, Baku, Azerbaijan (Oil Springs, ON dug by hand in 1858, and Titus, PN percussive drill and 'oil gusher' in 1859, led to today's commercial oil industry).

1848

Wave of democratic revolutions starting in Italy and France (more than 50 countries affected); Jules Dupuit (an economist and engineer) credited with first use of cost-benefit analysis; Public Health Act, Britain begins waste regulation (amended 1875 assigning duty to local authorities); Karl Marx and Friedrich Engels, *The Communist Manifesto*.

Limited Liability Act, UK; Thomas Cook offers first international tour package.

1855

- 1850 First submarine cable (English Channel), Atlantic Ocean bridged eight years later (Newfoundland to Ireland).
- 1853 First international meteorological conference (Brussels); US Navy recommends standardized measurement protocols (US Weather Bureau established in 1870, Meteorological Services Canada in 1871, International Meteorological Organization in 1873).
- 1854 Chief Seattle's famous open letter (speech), including, "*Man did not weave the web of life, he is merely a strand in it. Whatever he does to the web, he does to himself*"; Elisha Otis demonstrates his 'fail safe platform' at the New York's World Fair - start of modern elevators (first passenger elevator 488 Broadway, NY, 1857); Henry David Thoreau retreats to the woods near Concorde, MA, pens **Walden**; John Snow produces London's 'ghost map' linking cholera to contaminated water source.
- 1858 Alfred Wallace publishes on natural selection - Charles Darwin, **The Origin of Species** (1859); year of the 'Great Stink' Parliament commissions Joseph Bazalgette to build London's sewer system (completed 1875 - London never experiences another cholera epidemic).
- 1862 First products made from plastic (widespread manufacture begins in the 1930s); John Ruskin **Unto This Last**; Louis Pasteur establishes germ theory.
- 1863 London's Underground opens (first in world); John Tyndall gives public lecture, **On Radiation Through the Earth's Atmosphere**, explaining the greenhouse effect; International Committee of the Red Cross, one of the first global NGOs.
- 1864 George Perkins Marsh, **Man and Nature: Physical Geography as Modified by Human Action** published.



American bison face extinction, likely less than 1,000 animals (est. 60,000,000 in 1491).

1890

1893

New Zealand becomes first country to give women the right to vote.

- 1865 International Telegraph Union - first global regulatory agency.
- 1866 Ernst Haeckel, a German zoologist, coins the term *ecology*.
- 1869 Suez Canal opens.
- 1872 Yellowstone Park established (Yosemite in 1890); Robert Smith describes acid rain.
- 1884 Greenwich Mean Time established.
- 1885 Banff Park established; Canadian Pacific Railway completed; ten-storey Home Insurance Building opens in Chicago - world's first skyscraper; uses metal frame, enabling high-density city living.
- 1886 George Grinnell founds the Audubon Society.
- 1888 Nikola Tesla sells his patent for polyphase AC induction motor to George Westinghouse (Westinghouse and Tesla win bid, over Edison and DC power, to light World Expo in Chicago, 1893).
- 1889 Eiffel Tower (324 m) overtakes Washington Monument as world's tallest structure; overtaken in 1930 by the Chrysler Building, New York.
- 1889-90 Global flu pandemic (1,000,000 dead).
- 1891 Telluride, CO first community to receive AC supplied (hydro) electricity.
- 1892 Sierra Club starts (Henry Senger of Berkeley and John Muir).

- 1895 Gillette invents first disposable razor.



Wright Brothers
inaugural flight.

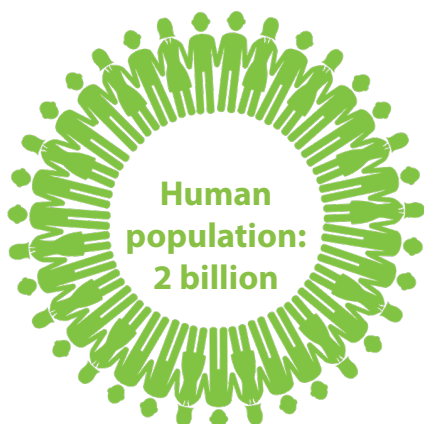


Ford's first Model T.

1903

1908

- 1896 Svante Arrhenius, a Swedish chemist, calculates how changes in levels of atmospheric carbon dioxide could alter temperature through the greenhouse effect (Nobel Laureate 1903); Hamilton, ON and Buffalo, NY receive transmitted AC (hydro) electric power (from DeCew Falls and Niagara Falls respectively - ends the first 'standards war' in favour of AC transmission over DC); first modern Olympics.
- 1898 Gifford Pinchot, US Secretary of Interior encourages 'wise use'.
- 1899 Thorstein Veblen coins the term *conspicuous consumption*.
- 1900 Global GDP \$2 trillion (about \$680 per capita); average life expectancy ~ 48 years; less than 15 per cent of world's population urban (320 million).
- 1901 First awarding of Nobel Prizes.
- 1902 Willis Carrier invents air conditioning.
- 1905 The term *smog* coined by Henry Des Voeux in London.
- 1906 Vilfredo Pareto (Italy) observes that 80 per cent of land is owned by 20 per cent of his compatriots.
- 1907 Francis Galton after visiting a London livestock fair publishes in *Nature* on the uncanny accuracy of 'crowd sourced' weight estimate of an ox (1,198 lb vs. mean of 1,207 lb).
- 1909 Canada-US Boundary Water Treaty, leads to International Joint Commission in 1912, and Niagara River Water Diversion Treaty 1950; President Theodore Roosevelt convenes North American Conservation Conference (US, Canada, Newfoundland, Mexico).



1927

- 1912 Alfred Wegener introduces concept of 'Continental Drift', corroborated by Tuzo Wilson, in ***Theory of Plate Tectonics*** ("Evidence from Islands on the Spreading of Ocean Floors". ***Nature*** 1963. Term *Pangaea* coined in a 1927 symposium); Corrado Gini publishes ***Variability and Mutability*** (leading to Gini coefficient).
- 1913 First household refrigerator; Suffragette Emily Davidson steps in front of King George V's horse - dies four days later.
- 1914 Panama Canal opens; last known passenger pigeon, a female named Martha, dies at Cincinnati Zoo; first scheduled commercial passenger flight; World War I begins (ends 1918).
- 1915 Ecological Society of America - Ecologists Union (1946) - Nature Conservancy (1950).
- 1917 October (Bolshevik) Revolution in Russia.
- 1918 Fritz Haber receives Nobel Prize for the synthesis of ammonia.
- 1918-20 Global flu pandemic (75,000,000 dead).
- 1920 League of Nations established by Treaty of Versailles (US abstains).
- 1923 George Washington Carver receives Spingarn Medal for achievements in agricultural science; Cayuga Chief Deskaheh, Six Nations of the Iroquois, travels to the League of Nations, Geneva to plead the case of his people (waited a year, was not received).
- 1925 General Motors and Standard Oil spokesmen claim in Public Health Service hearings there are no alternatives to leaded gasoline as an anti-knock additive (Scientific American reported in 1918 that alcohol-gasoline was 'universally expected for anti-knock').



Mahatma Gandhi leads Salt March from Ahmedabad to Dandi.

1930

- 1927 Sir Arthur Tansley coins the term *ecosystem*; global population 2 billion; development of the television.
- 1929 Aluminum foil invented; Swann Chemical Company develops PCBs; Wall Street crash; Alexander Fleming discovers penicillin.
- 1930s Franklin D. Roosevelt's New Deal includes strong ecological component (designed to overcome soil erosion).
- 1930 Sigmund Freud publishes *Civilization and Its Discontents*.
- 1931 Floods in China (up to four million deaths).
- 1933 Gerhard Domagk synthesizes prontosil (Nobel Laureate 1939) ushering in wide spread use of antibiotics; convention on the preservation of fauna and flora.
- 1936 US Corps of Engineers initiates use of cost benefit analysis (e.g. Federal Navigation Act).
- 1937 Last known Balinese tiger shot; Hindenburg crash.
- 1939 First jet plane, German He 178; World's Fair, New York, General Motors promotes 'Futurama', the 'new and attractive' (car-dependent) suburbs; World War II begins (ends 1945).
- 1942 Joseph Schumpeter publishes, *Capitalism, Socialism and Democracy*, and coins the term *creative destruction*; Oxfam founded; invention of the computer.
- 1944 Bretton Woods Conference, IMF and World Bank created (GDP becomes a standard metric for a country's economy); von Neumann and Morgenstern, *Theory of Games* and *Economic Behavior* published.

1945

United Nations established (replaces the League of Nations, starts with 45 nations); UNESCO established (November convening conference held at Institute of Civil Engineers, London); first test detonation of atomic bomb (Trinity site, New Mexico, July 16) – nuclear testing provides clear global stratigraphic marker between 1945 and 1963, when Nuclear Test Ban takes effect after some 500 nuclear blasts; World War Two ends – more than two-thirds of today's 195+ countries did not exist as sovereign states or within existing boundaries.

1946 Ten Thousand Villages, Mennonite Central Committee begins selling locally-sourced socially preferable products; convention for regulation of whaling; Electronic Numerical Integrator and Computer, ENIAC, announced (based on Alan Turing's 1936 paper).

1947 International Organization for Standardization (ISO) founded in Geneva (replaces the International Federation of the National Standardizing Association founded in 1926); Canadian Wildlife Service; UN introduces international guidelines of economic indicators (by country); Marshall Plan announced; GATT formed.

1948 IUCN founded in Fontainebleau; IMF publishes first balance of payments manual; Organization for European Economic Cooperation (OEEC) created (mainly to administer the Marshall Plan) – reformed to Organization for Economic Cooperation and Development (OECD) in 1961.

1949 Aldo Leopold, *A Sand County Almanac* (introduces 'land ethics'); NATO established.

1950 84 countries worldwide; approximate start of 'the great acceleration' – massive increase in material use such as hydrocarbons, cement, and plastic; 30 per cent of world's population urban; Union Carbide staff invent polyethylene garbage bags.



London's 'great smog' leaves at least 4,000 dead.

1952

- 1953 Hooker Chemical sells Love Canal site to Niagara Falls School Board for \$1 with a deed that explicitly declares presence of waste. Niagara Falls Gazette extensively chronicles waste issue 1976-78. August 1978 President Carter declares the site a Federal Health Emergency (along with Times Beach, MI. Love Canal largely responsible for creation of US site remediation "Superfund").
- 1954 First nuclear power plant, Obninsk, USSR; Harrison Brown *The Challenge of Man's Future* published.
- 1955 Watson and Crick publish double helix structure of DNA; Bandung Conference launches Non-Aligned Movement; first McDonald's restaurant opens.
- 1956 Minamata disease (mercury poisoning) first discovered in Minamata, Japan; first use of intermodal shipping on *Ideal X* (Newark to Houston), now about 17 million containers worldwide regulated by ISO 668 (dimensions) and ISO 6346 (labelling); Hubbert's peak theory (and curve) introduced in *Nuclear Energy and the Fossil Fuels* to American Petroleum Institute.
- 1957 Thalidomide first marketed in Germany (causes more than 10,000 birth defects worldwide before drug sales discontinued in 1962); Asian flu leaves 2,000,000 dead; European Economic Community (EEC) replaces the European Coal and Steel Community (1951); Sputnik satellite launched.
- 1958 John K Galbraith, *The Affluent Society* published.
- 1959 Moses Abramovitz questions if GDP accurately measures a society's overall well-being; Antarctic Treaty.



1960

- 1960 Vance Packard, *The Waste Makers* published; OPEC founded by Iran, Iraq, Kuwait, Saudi Arabia and Venezuela; global population 3 billion; 91 countries worldwide.
- 1961 World Wildlife Fund (WWF), Switzerland – internationally changes names to World Wide Fund for Nature (1986), WWF US and Canada maintain original name; Lewis Mumford, *The City in History: Its Origins, Its Transformations, and Its Prospects* published; *Jane Jacobs, The Death and Life of Great American Cities* (introduces the term 'social capital'); Yuri Gagarin first person to orbit the earth.

1962

Rachel Carson, *Silent Spring* and Thomas Kuhn, *Structure of Scientific Revolutions* published; launch of the first communications satellite.



1963

Martin Luther King – 'I Have a Dream' speech, Washington, DC.

- 1963 Global human population growth peaks at 2.19 per cent per year; Edward Lorenz publishes a paper *Deterministic Nonperiodic Flow* giving rise to the 'Butterfly Effect'; issuance of the first Eurobond.
- 1964 Norman Borlaug director of International Wheat Improvement Program, Mexico (leads to 'Green Revolution', receives 1970 Nobel Peace Prize); Olivetti's personal computer (PC) launched at New York's World Fair; Beatlemania arrives in the US.
- 1965 Oxfam launches "Helping-by-Selling".
- 1967 Environmental Defense Fund (goes to court to stop Suffolk Co Mosquito Control Commission from spraying DDT); *Torrey Canyon* oil tanker runs aground near Cornwall, UK; Churchman introduces the term *wicked problem*; European Community (replaces EEC).

1968

Publication of Paul Ehrlich's, ***Population Bomb***; Garrett Hardin introduces ***Tragedy of the Commons*** (follow-on essay in 1976, carrying capacity as an ethical concept, '*Lifeboat Ethics*'); Aureilio Puecpei founds the Club of Rome; Hong Kong flu leaves 1,000,000 dead; first UN Biosphere Conference in Paris (hosted by UNESCO); World Federation of Engineering Organizations (WFEO).

1969 Friends of the Earth; Pollution Probe, Toronto; Cuyahoga River, OH catches on fire again (leads to Clean Water Act, Great Lakes Water Quality Agreement, US EPA); Icelandic herring stock collapses; Canada's Pearson Commission on World Bank and international development (leads to IDRC); Neal Armstrong steps on the moon; first Boeing 747; Stonewall Inn patrons riot upon police raid - credited as catalyst for America's LGBT rights movement.

1970 International Development Research Center (Gov. of Canada); first Earth Day(s) (coins the term '*sustainable society*' – some 20 million people participate peacefully in US); 134 countries in the world.

1971 Greenpeace starts in Vancouver – replaces Don't Make a Wave Committee, 1970; International Institute of Economic Development (London, UK); Rene Dubos and Barbara Ward, ***Only One Earth***; Ralph Nader et al ***Action for Change*** (which launches more than 100 college campus Public Interest Research Groups); Pierre Wack, begins scenario planning at Royal Dutch Shell; OECD recommends 'polluter pay principle'; UN Conference on the Human Environment, Stockholm (114 countries participate, 109 recommendations including creation of UNEP); Klaus Schwab founds the World Economic Forum (WEF) in Geneva; Médecins Sans Frontières founded in France, receives Nobel Peace Prize 1999; International Institute for Environment and Development established (IIED, UK); first email; US abandons global gold standard (started in 1834 when Congress fixed the price at \$20.67 per ounce).



First handheld mobile phone demonstrated (Motorola).



1973

1974

1972 UNCHE held in Stockholm launches UN Environment Program (Maurice Strong chairs UNCHE and first Executive Director of UNEP); Club of Rome publishes **Limits to Growth**; BRAC (formerly Bangladesh Rural Advancement Committee); first 'blue marble' photograph of earth from Apollo 17; Goldsmith and Allen **Blueprint for Survival**; convention for protection of world cultural and natural heritage; Archie Cochrane publishes **Effectiveness and Efficiency: Random Reflections on Health Services, on the importance of using evidence to provide equitable health care**.

1973 OPEC oil crises; E.F. Schumacher publishes, **Small is Beautiful**; Ignacy Sachs founds the International Research Centre on Environment and Development (CIRED) in Paris; women in Himalayan villages begin the Chipko movement to protect trees from commercial logging; Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) adopted; MARPOL Convention (pollution from shipping).

1974 Rowland and Moilna publish on CFC and ozone (Nobel Laureates 1995) – data on CFCs from James Lovelock; Club of Rome, **Mankind at the Turning Point**; Worldwatch Institute (founded by Lester Brown with \$500,000 grant from Rockefeller Brothers Fund); Bucharest conference 'Science and Technology for Human Development'; TERI, Tata Energy Research Institute, established in Delhi by Dabari Seth; global population 4 billion.

1975 CITES comes into force; UN Habitat and Human Settlements Foundation; first UN conference on women and development, Mexico City; Worldwatch Institute (Lester Brown); MITS Altair PC kits.

1976 Eric Hoffer publishes, **The Ordeal of Change**; Body Shop founded by Anita Roddick; OECD releases Guidelines for Multinational Enterprises (voluntary standards for responsible business); UN Habitat I, Vancouver.

- 1977 Green Belt Movement starts in Kenya (Wangari Muta Maathai, founder, is awarded Nobel Peace Prize in 2004); Sullivan Principles created to help US companies apply pressure to South Africa to end apartheid; protests in the Philippines lead to the World Bank's withdrawal of support for four dams on the Chico River; Commodore PET.
- 1978 Lester Brown's *The Twenty Ninth Day* published; World Bank's first World Development Report (WDR), *Prospects for Growth and Alleviation of Poverty*; UN Habitat established (replaces UN HHSF, 1975); China reforms (opens) its economy; year in which Genuine Progress Indicator peaked globally – declining ever since (on average, GPI does not increase beyond a GDP/capita ~ \$7000/year); Manuel Castells *City, Class and Power* published; Amoco Cadiz oil spill off Britany coast.
- 1979 Three Mile Island nuclear accident; James Lovelock's, *The Gaia Hypothesis*; Ralf Dahrendorf *Life Chances*; Greenpeace International, Amsterdam; introduction of China's one child policy; NTT Japan launches first cellular network.
- 1980 World Conservation Strategy (IUCN); *Our Common Crises* (Willy Brandt, chair); first GMO patent issued (a bacterium that digests crude oil – US Supreme Court rules to permit patenting of life forms); The Global 2000 Report to the President commissioned by Jimmy Carter released; Mount St. Helens erupts.
- 1981 *Bermuda's Delicate Balance* (an applied systems approach to people and the environment); start of *Ashoka: Innovators for the Public* by Bill Drayton.



1987

- 1982 World Resources Institute (Gus Speth starts with a \$15 million grant from MacArthur Foundation); UN General Assembly approve World Charter of Nature; ***Our Common Security*** (Olof Palme, chair); Internet protocol (TCP/IP) introduced as standard protocol on the ARPNET; Latin America debt crises; North Carolina PCB protests, which are largely attributed as the start of environmental justice movement.
- 1983 Grameen Bank established, Bangladesh; World Commission on Environment and Development (WCED) created; H.T. Odum introduces systems ecology (flow of materials); Kitchener first city in Canada to launch Blue Box recycling program (>80 per cent participation); Development Alternatives, India.
- 1984 Bhopal chemical leak (5,000 dead, 500,000 injured); Jane Jacobs, ***Cities and the Wealth of Nations***; first Worldwatch ***State of the World***; Debt-for-nature swap endorsed by Thomas Lovejoy, WWF – first transaction between Conservation International and Bolivia (1987); Third World Network established.
- 1985 Metropolis city association (HQ Montreal); Antarctica ozone hole discovered; 'Responsible Care', Canadian Chemical Producers; France sinks Greenpeace Rainbow Warrior in New Zealand.
- 1986 Chernobyl nuclear accident.

Montreal Protocol for ozone protection; ***Our Common Future*** (the Brundtland Report); atmospheric CO₂ concentration exceeds 350 ppm; ISO (quality management) 9000 series; global population 5 billion; Conservation International founded.

‘Earth Summit’ in Rio de Janeiro (Agenda 21) – Convention on Biological Diversity signed, comes into force 1993; Business Council for Sustainable Development (becomes WBCSD in 1995); William Rees introduces ecological footprint.

1992

- 1988 Intergovernmental Panel on Climate Change (IPPC) created; Chico Mendez, assassinated in Brazil; Canada’s National Roundtable on Environment and Economy (closed 31 March 2013); Piper Alpha oil production platform, North Sea, explodes – killing 167; Canada-US Free Trade agreement (first of many bilateral trade agreements); E.O. Wilson, *Biodiversity* published.
- 1989 Stockholm Environment Institute (SEI); Exxon Valdez oil tanker runs aground; ‘*Endangered Earth*’, Time magazine’s ‘*Planet of the Year*’; Berlin Wall falls; Gallopoulos and Frosch popularize the term *industrial ecology* in special issue of Scientific American, ‘*Managing Planet Earth*’; The Natural Step introduced by Karl-Henrik Robèrt; Basel Convention (controlling shipping of hazardous waste); extinction of golden toad, Costa Rica; Tianamen Square.
- 1990 International Institute of Sustainable Development (IISD), Winnipeg; ICLEI (HQ in Toronto); Canada’s Green Plan for a Healthy Environment (with \$3 billion over five years funding); McDonald’s restaurant opens Pushkin Square, Moscow (eventually becomes chain’s busiest – est. 40,000 patrons/day – closes 2014, re-opens several months later); ‘dolphin safe’ labelling for tuna introduced; East and West Germany reunited; Nelson Mandela freed from prison; 166 countries worldwide.
- 1991 Global Environment Facility, Washington DC; Canadian cod fishery collapses; Environment Canada’s *State of Canada’s Environment; Environmentally Sustainable Economic Development - Building on Brundtland*, edited by Robert Goodland, Herman Daly, Salah El Serafy, Bernd von Droste; Wuppertal Institute, Germany; ‘Acid Rain Treaty’ signed between Canada and US; India reforms (opens) its economy; Soviet Union collapses; World Wide Web introduced.



First cloning of a mammal
(Dolly the sheep).

1996

- 1993 Robert Putnam's ***Making Democracy Work***; founding of the European Union (replaces EC); Forest Stewardship Council (FSC) founding assembly held in Toronto; Union of Concerned Scientists issues *Warning to Humanity* (reiterated in 2017); Francis Fukuyama ***The End of History*** published; first text message; International Year of the World's Indigenous People ; first UN High Commissioner for Human Rights appointed.
- 1994 John Elkington coins the term triple bottom line; Interface (a carpet company) founded by Ray Anderson; CEOs of seven largest tobacco companies state under oath before US House Subcommittee that they believe nicotine is not addictive; NAFTA enacted January 1; China's Agenda 21; Amazon.com founded, first book sold 1995.
- 1995 World Trade Organization launched (replaces GATT which commenced 1948); Francis Fukuyama, ***Trust***; first Conference of the Parties (COP1) UNFCCC, Berlin; Graedel and Allenby, ***Industrial Ecology***; Fourth World Conference on Women in Beijing; Ken Saro-Wiwa hanged in Nigeria; first transaction on eBay (broken laser pointer sold for \$14.83); 1995 to 2018 > half of all concrete ever produced (50 billion tonnes).
- 1996 First commercial harvest of genetically modified crop; ISO 14000 series (environmental management); Habitat II, Istanbul; Ismael Serageldin (World Bank), ***Sustainability and the Wealth of Nations***.
- 1997 Kyoto Protocol adopted 11 December; launch of Journal of Industrial Ecology; Global Reporting Initiative (GRI – sustainability guidelines released in 2000); Costanza et al publish ***The value of the world's ecosystem services and natural capital***; Janine Benyus ***Biomimicry***; WRI, ***Resource Flows: The Material Basis of Industrial Economies***; forest fires burn more than 5 million Ha.



1999

1998 Hunter and Amory Lovins with Ernst von Weizsäcker publish **Factor Four** (call to double wealth while halving resource consumption); Google launched; WBCSD-WRI GHG protocol; UN Habitat and World Bank sign MOU to establish Cities Alliance; European Union blocks imports of GMOs; Multilateral Agreement on Investment (MAI).

Amartya Sen, **Development as Freedom**; Donella Meadows, **Twelve leverage points** (system intervention); Dow Jones Sustainability Indexes; Seattle anti-globalization protests; global population 6 billion; Euro introduced; colonialism officially ends when Portugal transfers Macau to China.

2000 Hernando de Soto, **The Mystery of Capitalism**; Paul Crutzen (Nobel Laureate) with others popularizes the term *Anthropocene* (the geologic epoch 'Age of Man' to replace the Holocene); UN Millennium Development Goals; Carbon Disclosure Project; Jantzi Social Index (securities, Canada); Yale's Environmental Sustainability Index (becomes Environmental Performance Index, 2006); per capita GDP ~ \$6,500, global total ~\$41 trillion (total wealth \$117 trillion); average life expectancy ~78 years; 187 countries; mineral extraction alone displaces ~57 billion tonnes per year of sediments, exceeding the natural rate of riverborne sediment transport ~three-fold; ~55 per cent of global ice-free land intensively used by humans, wild area down to 25 per cent - was ~50 per cent wild in 1700; Urban population 2.95 billion.

2001 China joins WTO; Enron scandal; Human Genome Project publishes working draft; start of the **Acumen Fund** by Jacqueline Novogratz; Stockholm Convention on Persistent Organic Pollutants.



9/11 terrorist attacks.

2001



Facebook launched.

2004

- 2002 Global Reporting Initiative; Hindu-Muslim violence in Gujarat leaves more than 1,000 dead; terrorist bombing in Bali; Chechen rebels take hostages in Moscow theatre, 116 dead; international Fairtrade certification mark launched – worldwide use, except US; ~ 1 billion Internet connections; Braungart and McDonough, ***Cradle to Cradle: Remaking the Way We Make Things***; about 500 million PCs in use worldwide.
- 2003 World Bank's WDR, ***Sustainable Development in a Dynamic World***; US and Britain launch war against Iraq; European heat waves (70,000 dead); first Skype connection; SARS traced to a doctor from Guangdong staying at a hotel in Hong Kong in February – by June almost 8,500 people in 30 countries contracted SARS.
- 2004 HIV/AIDS pandemic peaks (started approx. 1960 in Congo Basin, traversing through Kinshasa, 30,000,000 dead); China surpasses US as world's largest generator of solid waste; terrorist attacks in Spain, 200 dead; Chechen terrorists take 1,200 school children hostage, 340 dead; ASCE, Sustainable Engineering Practice, with WFEO – followed by ***The Vision for Civil Engineering*** in 2025 (2006); Wangari Maathai awarded Nobel Peace Prize.
- 2005 Royal Academy of Engineering publishes, ***Engineering for Sustainable Development: Guiding Principles***; Hurricane Katrina; C40 cities association begins (London); Millennium Ecosystem Assessment; Walmart adopts global sustainability strategy; Ellen Johnson-Sirleaf becomes Africa's first female head of state (Liberia); London hit by terrorist attacks, 52 dead, more than 700 wounded; Jared Diamond, ***Collapse***; first video posted on YouTube.

2006

Nicholas Stern Review (makes economic case for climate action); Danish newspaper challenges Muslim taboos in publishing cartoons; Iraq sees severe civil strife between Sunnis and Shiites; bombing in Mumbai commuter train kills more than 200; Porter and Kramer (HBR), *Strategy & Society: The link between competitive advantage and corporate social responsibility*; first tweet, “just setting up my twttr”.

2007

Al Gore's *An Inconvenient Truth* wins Academy Award (IPCC and Gore share Nobel Peace Prize); iPhone unveiled; Tesco, a UK grocer, pledges CO₂ labelling for all products (discontinued 2012).

2009

ISO 31000 (risk management) series; G20 Pittsburgh Summit – leaders call for phasing out fossil fuel subsidies; Copenhagen climate negotiations (COP 15) fails to reach agreement (cities play key role); Elinor Ostrom receives Nobel Prize in Economics for her work on governance of the commons; China overtakes US as world's largest GHG emitter; first year more items connected to the Internet than people living (launches 'Internet of things' – number of connected devices doubles every ~five years); Sustainability Consortium founded; concept of 'planetary boundaries' introduced in journal *Nature*.

2010

Deepwater Horizon oil spill, Gulf of Mexico; Nagoya Protocol (Convention on Biological Diversity) and Cartagena Protocol (Biosafety); more than 400 die in massive Pakistani flooding; G8 pledges to double aid to Africa to \$50 billion/year, cancel debt, and open trade; WBCSD Vision 2050.

2011

Arab Spring starts in Tunisia; world population exceeds seven billion; Japan earthquake and tsunami – Fukushima nuclear plant damaged; COP17 climate negotiations in Durban yield mixed results (framework for future agreement beyond Kyoto); Osama bin Laden killed; South Sudan declares independence (Africa's 54th country, UN's 193rd member); Norway hit by terrorist attacks; Occupy Movement

2008

Some global food prices increase 43 per cent; US financial markets tumble (global recession begins, \$20 trillion+ global wealth lost); world passes 50 per cent urban mark; 1 billion PCs in use worldwide.

2011



starts in New York City; western black rhino hunted to extinction.

2012 Rio+20 strives (unsuccessfully) for an agreement to 'greening' the world's economies; Russia joins WTO; in Pakistan 14-year-old Malala Yousafzai shot in the head; 'Lonesome George', last known specimen of the Pinta island tortoise, dies.

2013

World Federation of Engineering Organizations (WFEO) Model Code of Practice for Sustainable Development and Environmental Stewardship; May 9th daily average atmospheric CO₂ 400.03 ppm at Mauna Loa, HI (Ralph Keeling continuously measuring CO₂ concentrations since 1958 – first time concentration exceeds 400); clothing factory collapses in Bangladesh killing at least 900; Edward Snowden admits to leaking classified US intelligence; Saudi Arabia declines seat on UN Security Council; Nelson Mandela dies at age 95; average foreign currency exchange reaches \$5.3 trillion per day.

Launch of SDGs; terrorist attack in Paris; COP21 Paris climate agreement; average concentration of CO₂ exceeds 400 ppm (value likely to be exceeded for rest of century); Steffen et al update Rockstrom et al (2009) planetary boundaries; globally annual fossil fuel subsidies exceed \$500 billion (IEA); Alibaba Group's IPO of \$25 billion largest in history; 'Laudato si' authored by Pope Francis 'on care of our common home'.

2015

2014 Malala Yousafzai awarded Nobel Peace Prize; The New Economy report launched by Nick Stern and President Calderon; WWF Living Planet report launched (states that between 1970-2014 half of all wildlife lost); ISO 37120 (sustainable development communities); global wealth \$262 trillion – 94.5 per cent of wealth held by 20 per cent of adults, \$798,000 and above places you in wealthiest 1 per cent.

2016 Habitat III (Quito); SDGs take effect (goals to 2030); UK votes 52 per cent to leave the EU; Donald Trump elected US President.

2017 The director of US National Intelligence reports that Russia influenced 2016 presidential election; the US withdraws from the Paris climate agreement; record northern hemisphere hurricane season – 17 named storms; atmospheric CO₂ - 408.8 ppm (June); global solid waste generation 2.01 billion tonnes; world energy supply is 15,046 Mtoe.



Last male northern white rhinoceros dies (species extinct).

2018

2018 Wildfires in Greece (87 dead) and California (88 dead); Jamal Khashoggi murdered in Saudi consulate in Istanbul; IPCC releases Special Report on Global Warming of 1.5°C; atmospheric CO₂ - 410.8 ppm (June); global solid waste generation 2.13 billion tonnes; world energy supply 15,798 Mtoe; Greta Thunberg begins demonstrating outside Swedish parliament in August; GHG emissions increase 2.7% to 48.9 GtCO₂e.

2019 President Trump impeached; UK Prime Minister May resigns over Brexit, replaced by Boris Johnson; Hong Kong protests; China lands on the dark side of the moon; Facebook fined \$5Bn by US FTC for mishandling user's privacy; Ethiopian Airlines Flight 302 crashes (second Boeing 737 Max); Greta Thunberg TIME person of the year; COVID-19 pandemic begins in Wuhan, China; China's first aircraft carrier, Shandong, enters service; US founds US Space Force; global solid waste generation 2.2 billion tonnes; world energy supply 16,430 Mtoe; atmospheric CO₂ - 409.9 ppm.

2020 Australian wildfires continue – 47 million acres burned; widespread lockdowns for COVID-19; DJIA suffers worst single-day point drop ever (12.93%); Black Lives Matter protests widespread (George Floyd killed); invasive Asian hornet spotted in WA state; wildfires in CA and WA states; President Trump tests positive for COVID-19; Joe Biden wins presidential election in US; COVID-19 mRNA vaccine begins roll-out in Dec.; UN progress report - none of the 2020 SDGs achieved; Colombia joins the OECD; Jeff Bezo's personal wealth exceeds \$200 Bn; more than 80 million COVID-19 cases, at least 2 million deaths; global economy's circularity 8.6%; global GHG emissions - 50 GtCO₂e; global solid waste generation 2.25 billion tonnes; global average atmospheric CO₂ 412.5 ppm, CH₄ 1891.9 ppb (increased 14.7 ppb).



2022

2021 Rioters attack US Capitol; The Ever Given container ship obstructs Suez Canal for six days; US rejoins Paris Agreement; COVID-19 global death toll exceeds 5.4 million, 4.6 Bn people vaccinated with 9.2 Bn doses (72% in high- and upper-income countries, 0.9% in low-income countries); Shell oil company is mandated by Netherlands court to align its emissions with Paris Agreement; G7 agrees to 15% minimum corporate tax; heatwave in North America, floods in Europe; leaded petrol phased out globally; El Salvador becomes first country to accept bitcoin as official currency; WHO endorses first malaria vaccine; Russia creates a cloud of space debris following anti-satellite weapons test; global GHG emissions - 53 GtCO_{2e} (CO₂ increased 4.9% over 2020), solid waste generation - 2.32 billion tonnes, economy's circularity - 8.4% (est.), average atmospheric CO₂ - 415.6 ppm, CH₄ - 1908 ppb.

2022 World population exceeds 8 billion; lifting of many COVID-19 restrictions, global deaths surpass 6.5 million; inflation surges, many central banks raise interest rates; James Webb Space Telescope captures new images of the universe; Russia invades Ukraine; floods submerge a third of Pakistan; Europe faces heatwaves and worse drought in 500 years (at least 53,000 deaths); UN study states 'there is no credible pathway to 1.5°C'; coal burning an all-time high; COP27 agreement to establish a fund for climate loss and damage; US supports low-carbon transition with \$369 billion in support; new government in Australia increases emissions reduction targets from 26% to 43% by 2030; climate protests include soup thrown on Van Gogh's Sunflowers and deflating tires on at least 600 SUVs across nine countries in one night; scientists argue planetary boundary of chemical pollution (novel entities) crossed (adding to loss of genetic diversity, climate change, land-system change, and phosphorous and nitrogen flows); toxic air, soil and water kill more than 9 million per year;

COP15 (biodiversity) includes target to protect 30% of land and oceans by 2030 (similar targets made a decade ago were missed); US Supreme Court overturns Roe v. Wade; Japan's Shinzo Abe assassinated; Queen Elizabeth II dies at age 96; Luiz da Silva elected President of Brazil; Elon Musk buys Twitter; protests erupt in Iran after death of Mahsa Amini; two coup d'états in Burkina Faso; WHO declares monkey pox outbreak; Congress removes President Castillo in Peru; 53 migrants found dead in a trailer in San Antonio, TX; cryptocurrency FTZ loses \$18 billion; National Ignition Facility achieves fusion ignition; global GHG emissions - 55 GtCO₂e, solid waste generation 2.4 Gt, economy's circularity - 8.2% (est), average atmospheric CO₂ - 416 ppm, CH₄ - 1909 ppb.

2023 India's population exceeds China's; OpenAI launches GPT-4; fighting across Sudan; Russia's invasion of Ukraine continues (Wagner Group stages armed conflict with Russian military); Greece and Canadian wildfires; July hottest month on record, oceans reach a record high temperature of 20.96°C; Indian spacecraft lands on the moon; world's oldest built wooden structure (476,000 ybp) found in Zambia; Israel-Hamas war; COP28 consensus to "transition away" from fossil fuels; GHG emissions - 56 GtCO₂e, solid waste generation 2.5 Gt, economy's circularity 8.1% (est), average CO₂ 419.2 ppm, CH₄ 1919 ppm.

2025 101 cities expected to have populations over five million (~907 million total; up from 691 million in 2006).

2042 Human population likely nine billion (6.3bn urban); atmospheric CO₂ ~ 488 ppm.

2050 122 cities expected to have populations over five million (~1.4bn; 181 cities with populations over five million expected by 2100 – total population ~ 2.8 billion).

Estimates of key sustainability indicators

Global peak population (10.5 billion 2086)

Peak GHG emissions (61 Gt, 2043)

Peak solid waste (3.6 Gt, 2070)

Source: Hoornweg, D. (2015), A Cities Approach to Sustainability, University of Toronto. Updated 2024.

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