

Exam Preparation

Ecology and Sustainable Development

Exam on 06.07.2020

Disclaimer

This document contains questions and answers for *Ecology and Sustainable Development 164.225* of the summer semester of 2020 and a list of commonly used acronyms. Please note, that due to the coronavirus this is a reduced questions-list compared to other semesters.

I cannot guarantee the correctness of any solution provided in this document.

1 Provide some examples:

Each correct entry is 1 point. Each wrong entry is minus 1 point. Maximum 10 points.

- Energy generated by fusion in the sun is emitted as: Radiation (50 % infrared (IR), 40 % visible, 10 % ultraviolet (UV)), Particles (solar wind).
- The two major scientific achievements after World War II leading to the Third Industrial revolution are: Invention of the transistor, Clarification of the structure of deoxyribonucleic acid (DNA).
- The advent of agriculture 10 000 years ago led to: Permanent human settlements, domestic animals, metal tools.
- The organelles in eukarotic cells are: Mitochondria, ribosomes, chloroplasts.
- The different layers of the atmosphere are called (bottom to top): Troposphere, Stratosphere, Mesosphere, Thermosphere.
- The very high dipole moment of the water molecule gives water special important properties: liquid at normal temperature, high solubility, high heat capacity (reduction of temperature extremes).
- In the hydrosphere carbon exists as: dissolved carbon dioxide, suspended carbonates, dead organic matter.
- Fertilizers typically provide the plant nutrients, the major ones being: nitrogen, phosphorus, potassium.
- Examples for present global ecological crisis are: Climate change, loss of biodiversity.

- Examples for past regional ecological crisis are: Exxon Valdez oil spill (Alaska), nuclear meltdown at Chernobyl.
- The most important radioactive elements released in the Chernobyl accident were: Caesium-137 ($^{137}_{55}\text{Cs}$), Strontium-90 (^{90}Sr), Iodine-131 (^{131}I).
- The major primary air pollutants are: Particulate Matter (PM) (PM_{10} , $\text{PM}_{2.5}$), Nitrogen dioxide (NO_2), Sulphur dioxide (SO_2), volatile organic compounds (VOCs)
- Major sources for SO_2 in ambient air of Europe: Power stations (coal, oil), transport using sulphur-containing fuel (esp. shipping).
- The main measures for the reduction of pollution of ambient air in Europe with PM were: industrial abatement measures (filters), reduced emissions for diesel passenger cars (Euro4, Euro5, Euro6 limits), improved road management, reduction of small scale heating and switch from coal to gas.
- Major inorganic contaminants of water: Nitrates and phosphates (human waste, manure, fertilizers), chemical waste (industrial), heavy metals including acid mine drainage (mostly accidents).
- Major organic contaminants of water: Various toxic organic compounds (insecticides, herbicides), detergents, various chemical compounds (personal hygiene, cosmetics), agro pharmaceuticals, human medicines, petroleum hydrocarbons including fuel.
- Drivers of increased resource (and energy) use: Population numbers, transition from agrarian to industrial regime (industrial 3 – 5× more resources per person).
- The most important modern fishing technologies leading to an over-exploitation of many fish stocks are: Radar detection of fish swarms, trawling (huge drag nets), purse seine (detect by sonar, up to 200 m deep net, catch whole swarm).
- First generation of bio-fuels (methanol/ethanol or diesel) are produced from: Cereals, sugar, plant oils.
- The main green house gases (GHGs) are: Water vapor (H_2O), carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O)?

2 Choose the correct item/figure:

Each correct choice is 1 point. Maximum 10 points.

- Our species, the homo sapiens, developed 20 000, 200 000 ✓, 1 million or 2 million years ago.
- Without the green house effect caused by water vapour in our atmosphere the average temperature on our earth would be 5 °C, 10 °C, 30 °C ✓ or 50 °C lower.

- In the respiration process **energy is produced ✓**, energy is consumed or no energy change of the system is taking place.
- Nitrates contain the chemical group $-\text{NO}$, $-\text{NO}_2$, **$-\text{NO}_3$ ✓** or $-\text{NH}_4$.
- Roughly 1 %, **10 % ✓**, 50 % or 75 % of the European urban population suffer from exposure to concentrations of the air pollutants PM, NO_x and ozone above immission limit values.
- The area needed for the production of 1 kg of vegetable is 0.1 m^2 , **1 m^2 ✓**, 5 m^2 or 10 m^2 .
- According to the Intergovernmental Panel on Climate Change (IPCC) the temperature increase caused by GHGs between 1850 and now is ca. **1°C ✓**, 2°C , 4°C or 6°C .
- The largest source sector for the emission of green house gases in the European Union (EU) is transport, agriculture, **energy production ✓** or industrial processes.
- Life expectancy in Africa is about 5 %, 10 %, **25 % ✓** or 50 % lower than in Europe.
- The costs for energy imports of the EU are roughly 1 million, 100 million, **1 billion ✓** or 10 billion EUR per day.
- Our solar system has 6, 7, **8 ✓** or 9 planets.
- In the Anthropocene during the last 100 years the consumption of energy and natural resources has increased by a factor of 5, 10, **15 ✓** or 25.
- The tropical rain forest grows in a climate which has stable lower temperatures, dry summers, **high and stable seasonal precipitation ✓** or little winter precipitation.
- The Gulf Stream is largely driven by: the magnetic field of the earth, the composition of the atmosphere, the amount of precipitation, **the global thermohaline circulation ✓** or the trade winds.
- The EU Maximum Residue Limit (MRL) for pesticides in ground and drinking water is 1 ng/L , 10 ng/L , **100 ng/L ✓** or 1000 ng/L .
- The air pollutant which has been reduced the most in the last decades is NO_x , non-methane volatile organic compounds (NMVOCs), **SO_2/SO_3 ✓** or PM.
- 10 %, 30 %, **50 % ✓** or 75 % of the global known conventional oil reserves have already been consumed.
- The concentration of CO_2 in the air has reached a value of ca. 200 ppm, **400 ppm ✓**, 600 ppm or 800 ppm.
- The EU emission trading system covers about 100, 1000, **10 000 ✓** or 100 000 installations.

- The (material) living standard in the EU (measured as Gross Domestic Product based on Purchasing Power Parity (PPP GDP) per capita) is about 10 %, 25 % higher or 10 %, **35 % lower ✓** than in the USA.
- The appearance of homo sapiens lead to the extinction of cyanobacteria, dynosaurus rex, **homo neanderthalis ✓** and the moa birds.
- The first major European colony “New Spain” was founded after conquest of the Inca Empire, the Eastern Seaboard of North America, **the Aztec Empire ✓** or the Philippines.
- Unpolluted rain water in respect to its pH-value is neutral, **slightly acidic ✓**, slightly basic or strongly acidic.
- The Gulf Stream influences the climate of the west coast of North America, the eastern coast of South America, south east Asia or **Western Europe ✓**.
- The primary productivity is the highest in the corn belts of the USA, the high intensity agricultural areas of Europe, the North Atlantic or **the equatorial zones of our planet ✓**.
- The emission standard for small vehicles Euro6 applicable since 2018 reduces emissions of NO_x for diesel cars by 10 %, 25 %, **70 % ✓** or 100 % compared to Euro4 (introduced 2005).
- Agriculture accounts for 30 %, 50 %, **70 % ✓** or 80 % of the global consumption of freshwater.
- The share of oil in global total energy production in 2018 was 12 %, 24 %, **33 % ✓** or 45 %
- The annual per capita CO₂-emissions of the United States of America (USA) are about 3 t, 7 t, **15 t ✓** or 25 t (2015).
- Till 2050 the population of Africa will grow from 1.2 billion to 1.5 billion, **2 billion ✓**, 3 billion or 4 billion.
- The lithosphere consists mainly of iron oxides, metallic nickel, **silicates ✓** or carbon-hydrates.
- The large amounts of water on our earth most likely originates from bombardment by asteroids, impact of comets, **outgassing of crystalline water from minerals of the mantle ✓** or reactions in our atmosphere.
- The influential book “Limits to Growth” published 1972 demands to stop economic growth, to limit the increase of the global population, **to decouple economic activity from resource use and environmental pollution ✓** or to reduce the global amount of money in circulation.
- According to International Monetary Fund (IMF) 2018 reports the Gross Domestic Product (GDP) of all EU member states together is ca. 8000 billion EUR, **15 000 billion EUR ✓**, 25 000 billion EUR or 40 000 billion EUR.
- In its trade relations with China the EU during the last decade had a stable balance, an increase of the surplus or **an increase of the deficit ✓**.

- According to United Nations Environment Programme (UNEP) 10 million, 200 million, **800 million ✓** or more than 1 billion people are without access to safe drinking water.
- Which of the following sea regions has the highest oxygen content in the waters: Mediterranean Sea, the Pacific near the equator, the Indian Ocean or **the North Atlantic ✓**? *From Graphic in Eco&SD Part 1 p. 66, not sure*
- The annual per capita CO₂-emissions of the EU are about 3 t, **7 t ✓**, 15 t or 25 t (2015).
- The number of internet users has increased during the last 20 years by a factor of 10, 50, **100 ✓** or 1000.
- The mass of the earth is responsible for the magnetic field, the ocean currents, composition of the atmosphere or **the gravitational field ✓**.
- The National Emission Ceiling Directive (EU 2016/2284) (NEC) applies to the EU Member States and limits the immission concentration of air pollutants, limits the emission of the green house gas CO₂, **limits the emission of several air pollutants like NO_x and SO₂ ✓**, or defines minimal expenditure for environmental protection measures.
- Globally only 6 %, **12 % ✓**, 20 % or 30 % of land surface is usable for agriculture.
- The annual CO₂-emissions of the EU are about **10 % ✓**, 20 %, 30 % or 50 % of the total global emissions (2015).
- Under the optimal stabilisation scenario (IPCC RCP 2.6 scenario) total annual CO₂ emissions have to decrease by 10 %, 25 %, **50 % ✓** or 100 %.
- Asia has ca. 30 %, 40 %, 50 % or **60 % ✓** of the world population. *estimate from pie chart*
- The World Trade Organization (WTO) treaty of 1995 created essentially a borderless world for goods and money – covering 60 %, 80 %, **95 % ✓** or 100 % of the global production and financial services.
- According to UNEP 50 million, 100 million, 400 million or **700 million ✓** people are undernourished (World Bank 2018).
- Wind energy in the EU: Share in electricity production 2017 is 3 %, 8 %, **12 % ✓** or 20 %.
- Our galaxy, the “Milky Way” contains about 200–400 thousand, million, **billion ✓** or trillion stars.
- The percentage of the human genome identical with the genes of chimpanzees is 90 %, **99 % ✓**, 99.9 % or 99.99 %.
- The temperate deciduous forest grows in a climate which has extremely cold winters, dry summers, **stable seasonal precipitation ✓** or high winter precipitation.

- The ratio of nitrogen to oxygen in our atmosphere is 1:4, 1:1, 2:1 or **4:1 ✓**.
- PM, NO_x, SO₂ or **ozone ✓** is the air pollutant which affects the largest number of European urban inhabitants with concentrations above immission limit values.
- The Global Atmosphere Watch (GAW) network of the World Meteorological Organization (WMO) serves mainly to control industrial emissions in the region, **monitor background concentrations of air pollutants ✓**, provide warnings from extreme weather situations or to observe changes in intercontinental air streams. *guess from wikipedia*
- The share of genetically modified (GM) soy within the global soy harvest is 20 %, 40 %, 60 % or **80 % ✓**.
- The share of renewable (hydro, biomass, geothermal, wind and sun) in global total energy production in 2018 was 6 %, **12 % ✓**, 25 % or 40 %.
- The largest sector for the emission of GHGs in the EU is transport, agriculture, **energy production ✓** or industrial processes.
- According to UNEP 100 million, 600 million, 1 billion or **2.5 billion ✓** people are without proper sanitation services.

3 Select the correct component:

Each correct choice is 1 point. Each wrong choice is minus 1 point. Max 10 points.

- The Gulf Stream influences the climate along the East coast of South America, **the West coast of Europe ✓**, the seashores of Japan or the East coast of North America.
- The Haber-Bosch process has the following characteristics:
 - ✓ It uses nitrogen from air as a raw material.
 - ✓ It is an exothermic reaction producing energy.
 - ✓ It operates at very high temperatures.
 - ✗ It uses hydrogen from water.
 - ✓ It is the main chemical process to produce ammonium for chemical fertilizers.
- Major sources for the elevated concentrations of PM in the ambient air of Europe are **small scale heating ✓**, airplanes, **road traffic ✓**, railroads, **regional transport of air pollutants ✓**, fertilization in agriculture.
- The major sources for the GHG CH₄ are **agriculture ✓**, burning of fossil fuel, **gas and oil exploration ✓**, application of fertilizers, biomass burning.
- Major macromolecules in living species are **proteins ✓**, water, sodium chloride, chlorophyll, glucose and **carbohydrates ✓**.

- Phosphorous occurs as an important element in carbonate rocks, coal, **inorganic phosphates and sediments** ✓, the fertilizer urea, **animal excretions** ✓, crude oil, acid rain, **detergents** ✓.
- The United Nations (UN) Agenda for Sustainable Development 2015 sets goals and indicators for **poverty** ✓, pensions for older people, **gender equality** ✓, **clean energy** ✓, migration from poor to rich countries, **clean water and sanitation** ✓, redistribution of wealth from upper to lower income levels, or number of billionaires in this world.
- The primary air pollutants forming the secondary pollutant ozone are **NO_x** ✓, SO₂, CFCs, **VOCs** ✓, benz-a-pyrene, dioxin, DDT.
- Which of the following structural elements are present in prokaryotic cells: **cell wall** ✓, mitochondria, **cytoplasm** ✓, **ribosomes** ✓, a membrane-bound nucleus encapsulating the DNA.
- The core of earth contains mainly the metals aluminium, **iron** ✓, copper, **nickel** ✓, cobalt and magnesium.
- Chemical characteristics of persistent organic pollutants (POPs) are high water solubility, **high lipid solubility** ✓, **ability for bioaccumulation** ✓, low molecular weight, **ability to pass through biological membranes** ✓, short lifetime in the atmosphere, present only near emission sources.
- The main implementation measures of the EU Climate and Energy Policy are increasing the imports of natural gas, **setting up of an Emission Trading System (ETS)** ✓, large scale exploration of shale gas in Europe, **establishing an aggregate reduction target for the non-ETS sector** ✓, outsourcing of energy intensive industry to emerging economies, **implementing a European Strategic Energy Technology Plan (SET)** ✓, replacing coal-fired power plants by nuclear power plants, reduction of the electricity consumption by 50 % till 2030. *Could not find SET in presentation, but it exists.*
- European seafarers who had a major impact on the colonization of the rest of the regions of our world by European nations were Julius Cesar, **Christoforo Colombo** ✓, Antoine Lavoisier, **Vasco da Gama** ✓, Gallileo Gallilei, David Livingstone, Raffaello Santi, **Fernão de Magalhães** ✓, George Washington, **James Cook** ✓.
- In terms of their production volume the three most important food products are beef, soy beans, **wheat** ✓, milk, **rice** ✓, potatoes or **maize** ✓.
- The main technical measures foreseen in the EU to reduce its green house gas emissions by 40 % till 2030 are reduction of primary energy use, substitution of coal and oil for heating with gas gained in the EU territory with the fracking technology, **reduction of the CO₂ emissions of power plants by installing carbon capture and storage (CCS) technology** ✓, importing more gas from Russia, outsourcing the energy intensive production of steel and cement to countries outside the EU, **increase the production of renewable energy** ✓, substitute 50 % of the gasoline and diesel used in road traffic by biofuels.

- Which of the following structural elements are present in prokaryotic *and* eukaryotic cells: **cell wall** ✓, mitochondria, **cytoplasm** ✓, **ribosomes** ✓, a membrane-bound nucleus encapsulating the DNA.
- The second atmosphere of our earth consisted mainly of argon, **carbon dioxide** ✓, **ammonia** (NH₃) ✓, nitrogen (N₂), hydrogen, oxygen and helium.
- Major air pollutants are: agrochemicals, chlorophyll, nitrogen, **ozone** (O₃) ✓, ammonium phosphate, **nitrogen dioxide** (NO₂) ✓, **sulphur dioxide** (SO₂) ✓, tributyl tin, water vapour.
- Major results of the Paris Climate Agreement are **to limit global warming to 2 °C** ✓, to set criteria for immigration of “climate refugees” into the EU, to establish a quota for burden sharing in reduction efforts between industrialized and developing countries, to enhance deforestation in the tropical regions, to reduce the water consumption in dry regions, **to implement national action plans for mitigation** ✓, to reduce global transport of goods and to replace nuclear energy by wind and solar energy. *Missing something?*
- Which of the following structural elements are present only in eukaryotic cells: cell wall, **mitochondria** ✓, cytoplasm, ribosomes, **a membrane-bound nucleus encapsulating the DNA** ✓.
- The most important chemical substances in relation to pollution of the environment are nitrogen, rubber, **fertilizers** ✓, **detergents** ✓, wood, paper, iron ores, natural gas, coal, limestone minerals, cement products.
- Policy Acts of the EU, which had a major impact on the development of the environmental and sustainability policies, are the publication of the book “The Silent Spring”, foundation of the club of Rome, the commissioning of the Brundlandt Report, **the Single European Act of 1997 (Amsterdam)** ✓, the founding of Greenpeace, **the Gothenburg European Council Decision establishing EU Sustainable Development Policy in 2001** ✓, the fall of the Berlin Wall, the founding of UNEP, **the Climate and Energy Package (a series of Directives to combat climate change)** ✓.
- Which of the following features apply for Rosetta: carried people to the moon, launched by National Aeronautics and Space Administration (NASA), **launched by European Space Agency (ESA)** ✓, first analysis of material from Mars, **detection of precursors of life on a comet** ✓, first pictures of the back-side of the moon.

4 Complete the following sentences:

Each correct entry is 1 point. Maximum 10 points.

- The “Golden Age” of Europe following the Middle Ages is called the ... **Renaissance**....
- Justus von Liebig developed in the 19th century the first ... **chemical fertilizer**... providing the key to solve one of the biggest problems of that time.

- Animals, plants and fungi have ... *eukaryotic*... cells.
- The core of our earth consists mainly of ... *iron and nickel*....
- Organic compounds are produced from CO₂ by autotroph organisms through the process of ... *photosynthesis*....
- A significant fraction of Europe's population suffers from summer smog, whose main chemical compound is ... *ozone*....
- A new technology to exploit gas reserves in deep rock formations by hydraulic cracking of the rock layers is called ... *(hydraulic) fracking*....
- A widely-used measure of eutrophication is the determination algal and cyanobacterial biomass from the ... *chlorophyll*... concentration.
- The ... *NEC*... requires all Member States to report information annually concerning emissions and projections for four main air pollutants.
- The first human made object to orbit our planet was called ... *Sputnik 1 (Спутник 1)*....
- The scientist who developed the fundamental laws for chemical reactions was ... *Antoine Lavoisier*....
- The building stones of proteins are ... *amino acids*....
- Chloroplasts produce ... *glucose (C₆H₁₂O₆) and oxygen (O₂)*... from carbon dioxide and water.
- In the top surface zone of the ocean the primary production of biomass by ... *phytoplankton*... takes place.
- In respect to the energy balance respiration is an ... *exothermic*... reaction.
- Photosynthesis takes place in cell organelles called ... *chloroplasts*....
- In the absence of oxygen decay of animal and plant matter causes a break down of the carbon compounds to ... *methane*....
- A main activity of the ... *IPCC*... is publishing scientific assessments of global warming.
- An ... *eutrophic*... lake is a lake with high primary productivity, the result of an excessive nutrient content.
- The Comprehensive Global Earth Observation System established in co-operation of EU, USA, Japan, etc. has the acronym ... *Global Earth Observation System of Systems (GEOSS)*....
- Our universe began ca. 14 billion years ago through the ... *"Big Bang"*....
- The key invention leading to the First Industrial Revolution was the ... *steam engine*....
- The catalyst for producing glucose from carbon dioxide and water in chloroplasts of plant cells is called ... *chlorophyll*....

- The major driving force for atmospheric circulation is ... *solar heating*....
- ... *Fossil fuel combustion*... has caused a massive increase of the NO_x flux into the atmosphere contributing to the increased acidity of precipitation.
- The persistent pesticide ... *DDT*... is the most effective mean to combat the spreading of malaria.
- An ... *oligotrophic*... lake is a lake with low primary productivity, the result of low nutrient content.
- The ... *UN Convention on the Law of the Sea*... treaty deals with aspects of overfishing and grants coastal states exclusive fishing rights for a 200 mile zone.
- Changes in the Earth's orbit around the sun, known as the ... *Milankovitch* ... cycles, are believed to be the main reason for the large oscillations in the CO_2 concentrations of the atmosphere.
- The first landing of people on the moon was achieved with a NASA mission called ... *Apollo 11*....
- The particles emitted by the sun are called ... *solar wind*....
- The foundations of our governance system were developed in ... *ancient Rome (500 BC till 500 AD)*....
- The key invention of the 20th century providing the basis for our modern information and communication society is the ... *transistor*....
- A structure inside an eukaryotic cell performing a specific function is called ... *an organelle*....
- Photosynthesis can be described by the summary reaction: ... $6 \text{CO}_2 + 6 \text{H}_2\text{O} + h\nu \longrightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{O}_2$
- The conservation of biological diversity has become a global concern and is addressed in the ... *Convention on Biological Diversity*..., which is an international treaty of 1992 (Rio).
- Agricultural ... *manure*... can lead to bacterial contamination of ground or surface waters.
- The function establishing the relation between the per capita GDP of a country and the per capita primary energy consumption is called the ... *Kutznets*... curve.
- Detergents are the major source for the element ... *nitrogen*... in waste water leading to eutrophication.
- Air quality is measured as ... *immission concentration*... ($\mu\text{g}/\text{m}^3$)
- The compass was invented in the Middle Ages in ... *China*....
- Proteins are formed by chains of ... *amino acids*....

- The core of our planet consist of iron and nickel and provides for the ... *magnetic field*... of our earth.
- The tremendous ... *heat capacity*... of the oceans moderates the planet's climate, and its absorption of gases affects the composition of the atmosphere.
- The Haber-Bosch-Process produces NH_3 according to this reaction: ... *$\text{N}_2 + 3 \text{H}_2 \longrightarrow 2 \text{NH}_3$*
- POPs typically contain the element ... *Chlorine (Cl)*....
- The air pollutant ... *ozone (O_3)*... is formed from VOCs and NO_x in the presence of UV radiation.
- The Boreal region has huge carbon stocks which could emit ... *methane* ... under conditions of strong global warming leading to a non-linear acceleration of temperature rise.
- CCS stands for ... *carbon capture and storage*....
- The powerful mirror telescope orbiting our earth to explore the galactic evolution of our universe was called ... *Hubble Space*... Telescope.
- The Aurora is caused by charged particles emitted by ... *the sun*....
- Protein production is directed by the nucleic acids deoxyribonucleic acid (DNA) and ... *ribonucleic acid (RNA)*....
- The zone of the ocean till about 150 m deep and rich in fish is called the ... *pycnoclyne zone*....
- The steady winds flowing from east to west near the surface of the earth in the Northern Atlantic Ocean are called ... *trade winds (easterlies)*....
- NO and NO_2 in the atmosphere react with hydrocarbons to form ... *tropospheric ozone O_3* ... which is a major component of summer smog.
- Nearly one fifth of the land in the EU is protected under the Habitats Directive and the Birds Directive and is commonly known as ... *Natura 2000*... areas.
- UNFCCC stands for ... *United Nations Framework Convention on Climate Change*....
- The EU legislation from 2000 requiring integrated impact-based river basin management based on an ecosystem approach is called ... *the Water Framework Directive*....
- The ... *Keeling's*... curve shows the increase of atmospheric concentrations of CO_2 which roughly matches the amount of fossil fuels burned per year.
- The newly established EU earth observation system to monitor global change is called ... *Copernicus*....

Acronyms

CCS carbon capture and storage. 7, 11

DDT dichlorodiphenyltrichloroethane. 7, 10

DNA deoxyribonucleic acid. 1, 7, 8, 11

ESA European Space Agency. 8

ETS Emission Trading System. 7

EU European Union. 3–9, 11

GAW Global Atmosphere Watch. 6

GDP Gross Domestic Product. 4, 10

GEOS Global Earth Observation System of Systems. 9

GHG green house gas. 2, 3, 6

GM genetically modified. 6

IMF International Monetary Fund. 4

IPCC Intergovernmental Panel on Climate Change. 3, 5, 9

IR infrared. 1

MRL Maximum Residue Limit. 3

NASA National Aeronautics and Space Administration. 8, 10

NEC National Emission Ceiling Directive (EU 2016/2284). 5, 9

NM VOC non-methane volatile organic compound. 3

PM Particulate Matter. 2, 3, 6

POP persistent organic pollutant. 7, 11

PPP GDP Gross Domestic Product based on Purchasing Power Parity. 4

RCP Representative Concentration Pathway. 5

RNA ribonucleic acid. 11

SET European Strategic Energy Technology Plan. 7

UN United Nations. 7, 10

UNEP United Nations Environment Programme. 5, 6, 8

UNFCCC United Nations Framework Convention on Climate Change. 11

USA United States of America. 4, 9

UV ultraviolet. 1, 11

VOC volatile organic compound. 2, 7, 11

WMO World Meteorological Organization. 6

WTO World Trade Organization. 5