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UNIVERSITÀ DEGLI STUDI DI NAPOLI PARTHENOPE

MASTER MEIM 2021-2022

Green Management

ENVIRONMENTAL IMPACT OF ENERGY SYSTEMS

A cura del prof. Simona Di Fraia

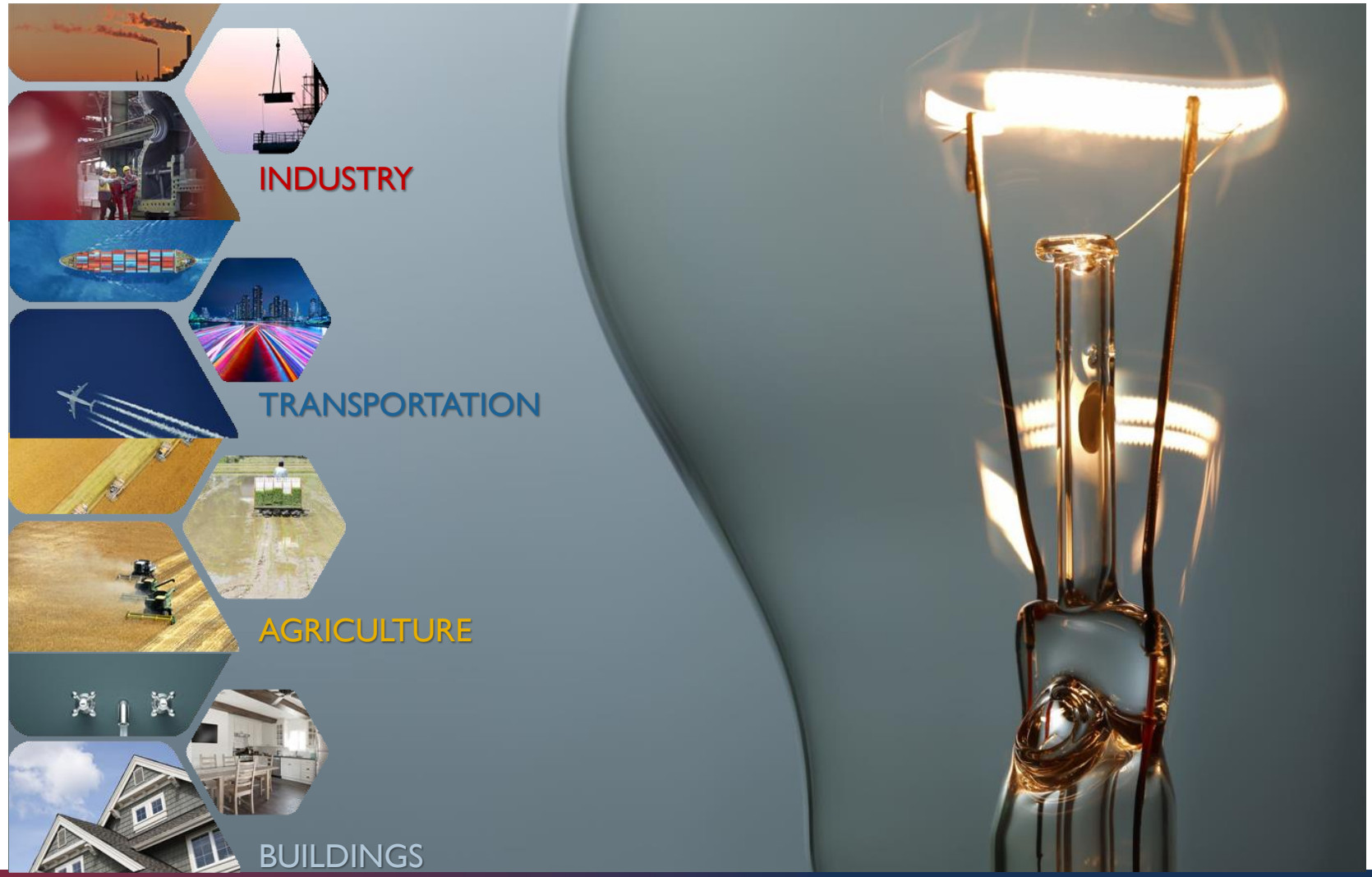
Ricercatrice del Dipartimento di Ingegneria dell'Università degli Studi di Napoli Parthenope

Why green management?

https://www.worldometers.info/

Adopted by all United Nations Member States in 2015 to achieve social, economic and environmental sustainability

Introduction



Introduction

Energy producing systems presently in use across the world can be classified into three main categories:

- fossil fuels
- nuclear power
- renewables

Introduction

Environmental pollution

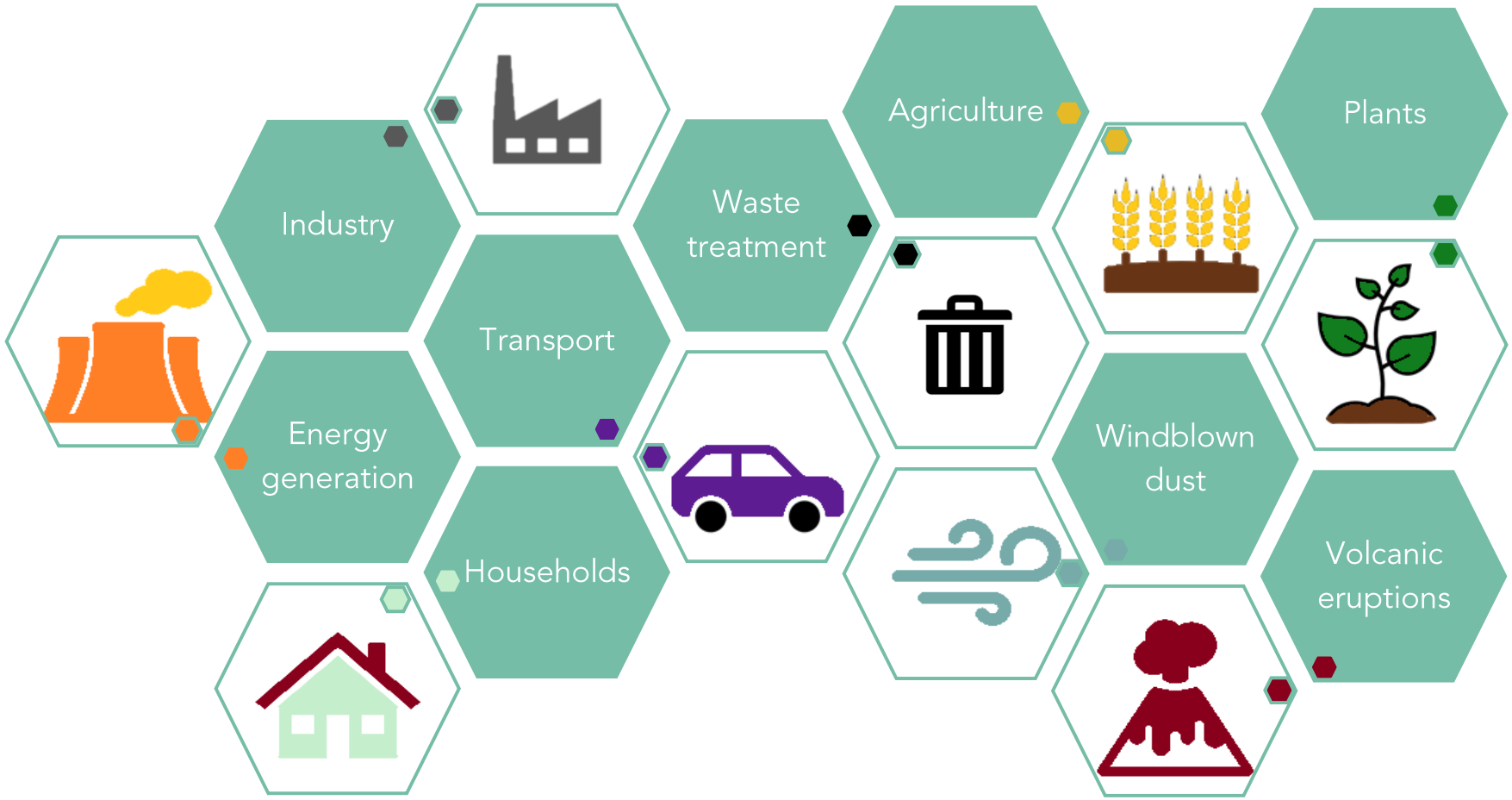
Energy and environment are closely related.

Environmental pollution is defined as the addition of any substance or any form of energy to the environment at a rate faster than it can be dispersed, diluted, decomposed, recycled, or stored in some harmless form.

Introduction

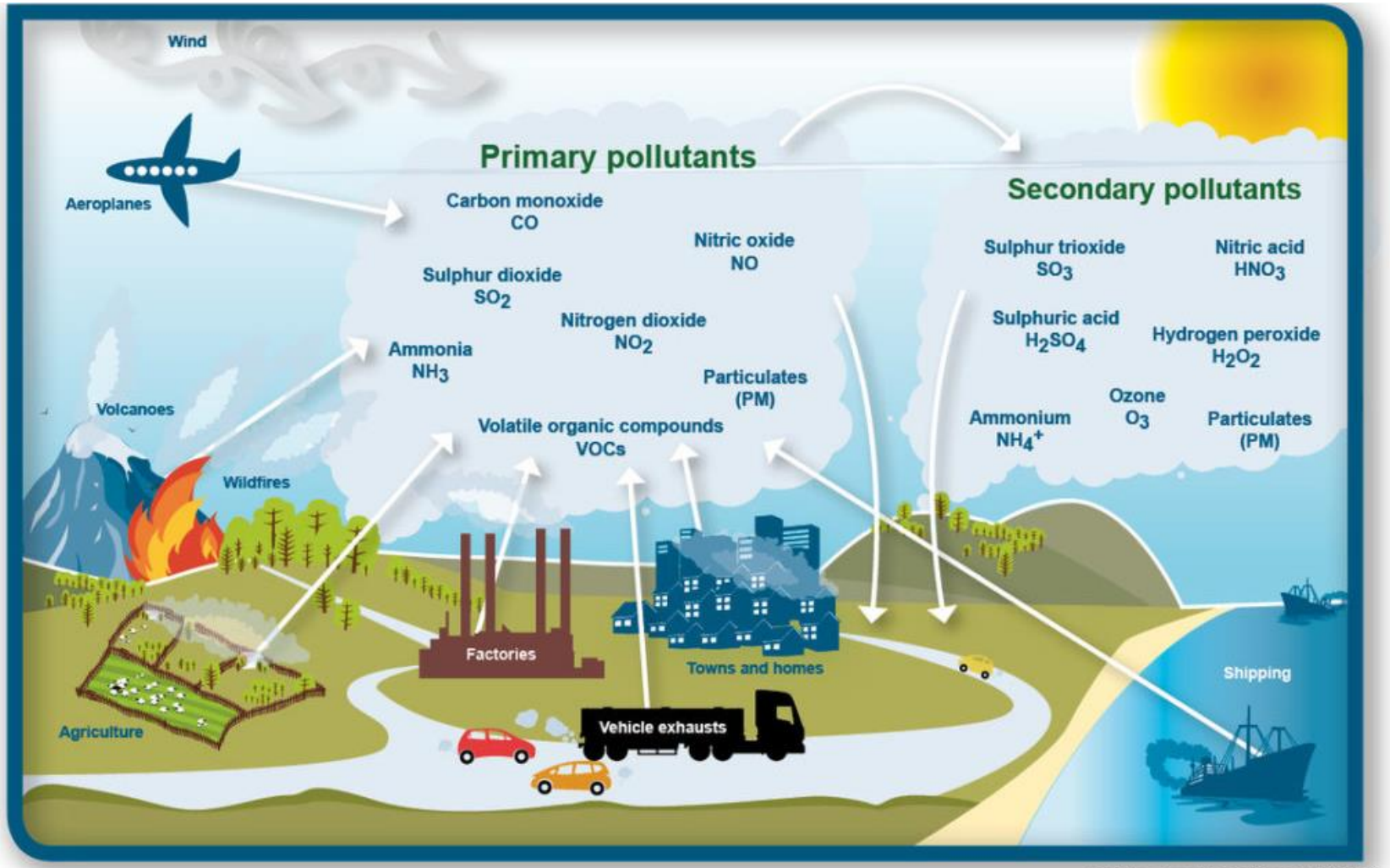
Air pollution

Contamination of indoor or outdoor environment by any chemical, physical or biological agent that modifies its natural characteristics.



Introduction

Air pollution



Introduction

Air pollution

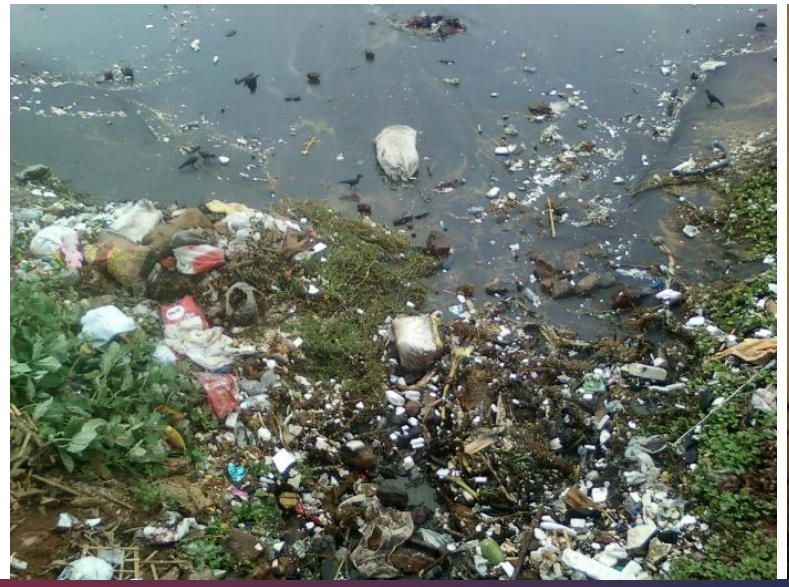
An air quality index (AQI) is used by government agencies to communicate to the public how polluted the air currently is or how polluted it is forecast to become.

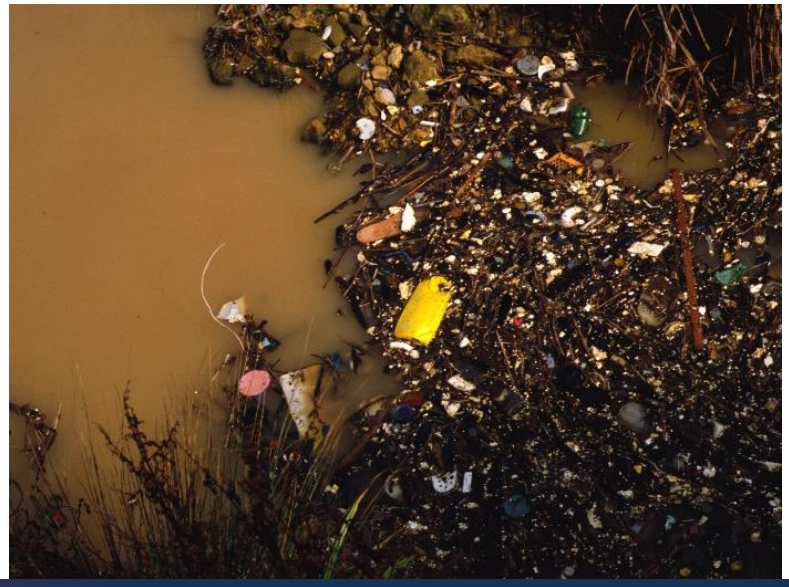
Website	Pollutants	Standard
https://waqi.info	PM 2.5, PM10 It provides information about weather conditions (temperature, pressure, humidity, rain, wind)	US EPA AQI standard
https://www.iqair.com/earth	PM 2.5, PM10 It provides information about wind	US EPA AQI standard
https://www.breezometer.com/	It shows the instantaneous main pollutants	Different standards

Introduction

Water pollution

Water pollution is the contamination of water sources by substances which make the water unusable for drinking, cooking, cleaning, swimming, and other activities.

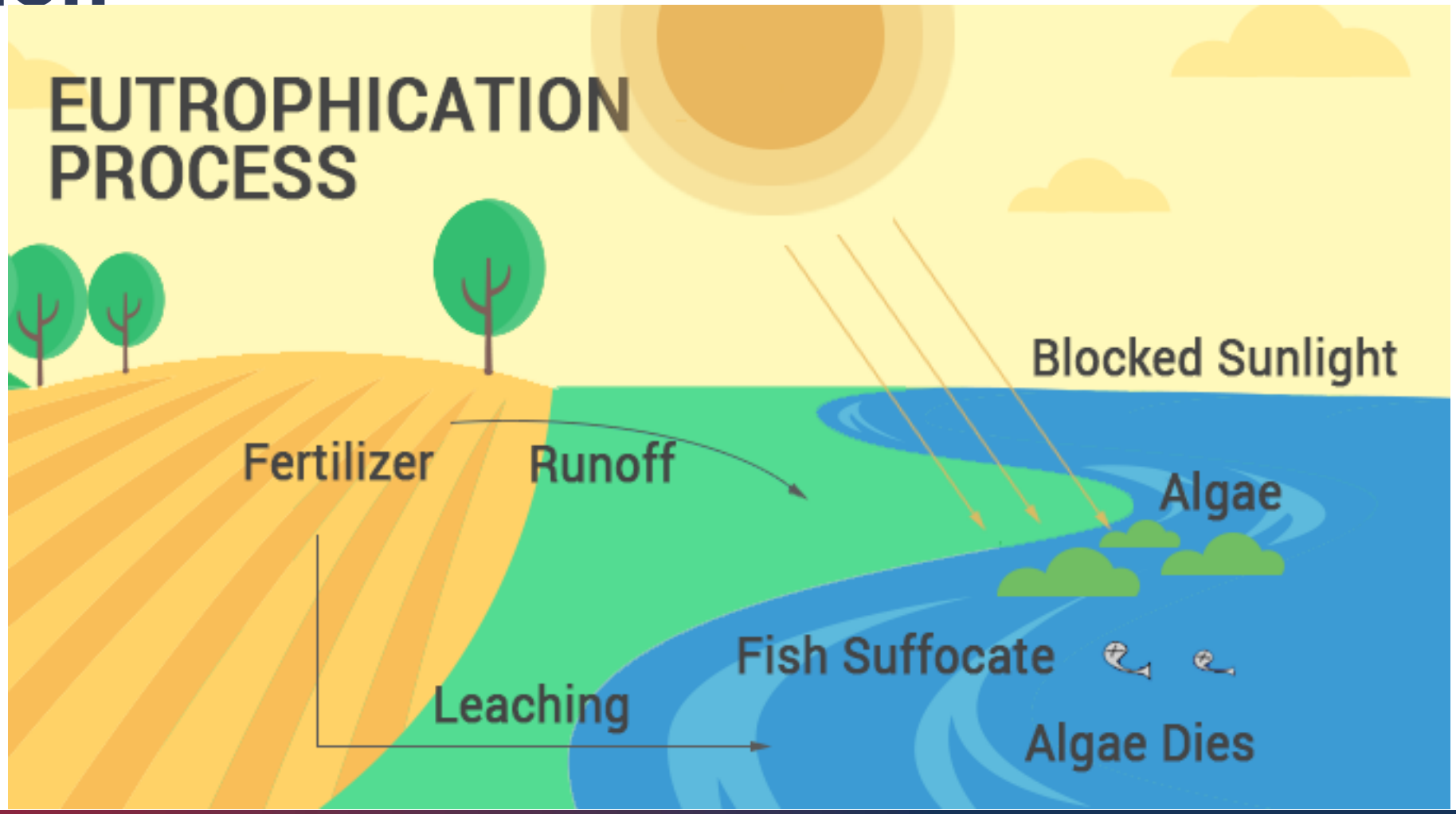




Pictures from:
https://connectforwater.org/tag/h2o-facts/
https://commons.wikimedia.org/wiki/File:Water_pollution_0025.jpg
https://commons.wikimedia.org/wiki/File:Water_pollution_due_to_domestic_garbage_at_RK_Beach_01.jpg
https://www.iaea.org/newscenter/news/science-and-partnerships-key-to-tackling-marine-plastic-pollution-iaea-at-un-ocean-conference

Introduction

Water pollution



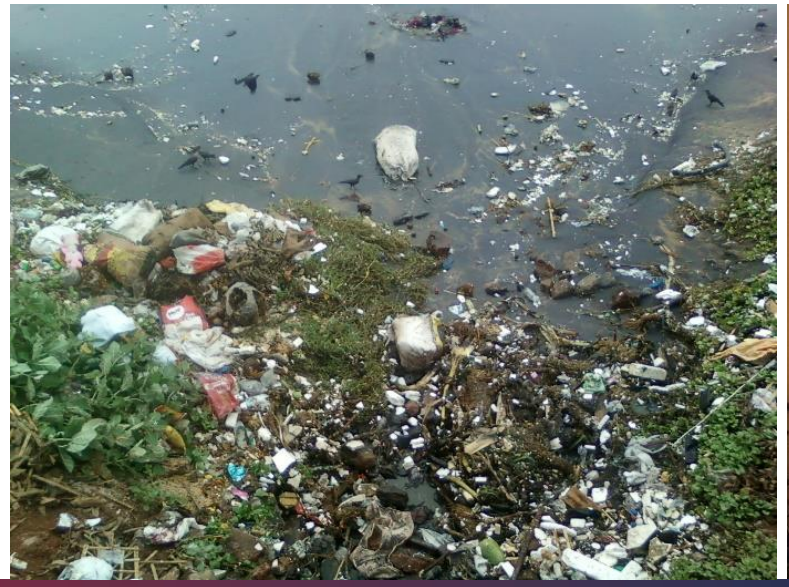
https://earthhow.com/eutrophication-causes-process-examples/

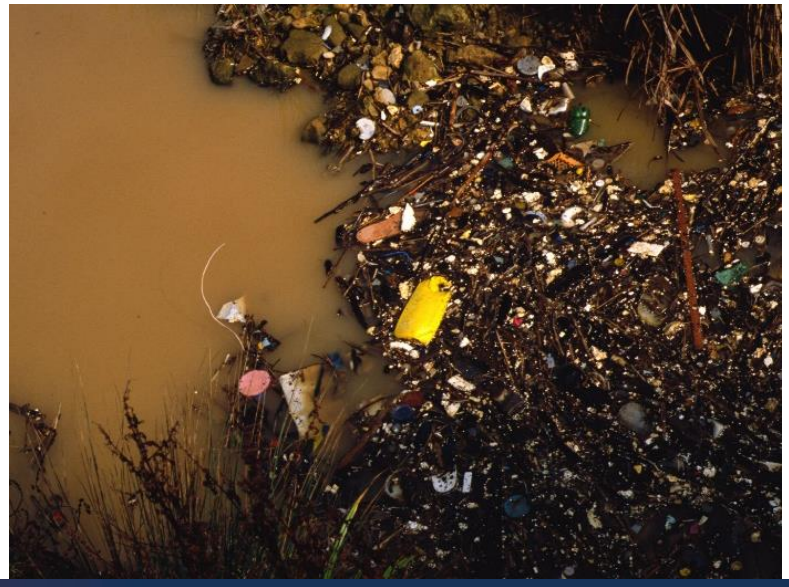
Introduction

Water pollution

In addition to agriculture, sources of water pollution include:

- industrial waste
- marine dumping
- solid wastes, wastewater, and sewage
- oil leaks and oil spills
- greenhouse gases.





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https://commons.wikimedia.org/wiki/File:Water_pollution_0025.jpg
https://commons.wikimedia.org/wiki/File:Water_pollution_due_to_domestic_garbage_at_RK_Beach_01.jpg
https://www.iaea.org/newscenter/news/science-and-partnerships-key-to-tackling-marine-plastic-pollution-iaea-at-un-ocean-conference

Introduction

Land pollution

Impacts on land are generally due to man-made causes and naturally occurring causes.

Anthropogenic soil pollution causes:

- accidental leaks of chemicals;
- foundry activities
- manufacturing processes
- mining activities
- construction activities
- agricultural activities
- transportation activities
- waste disposal.

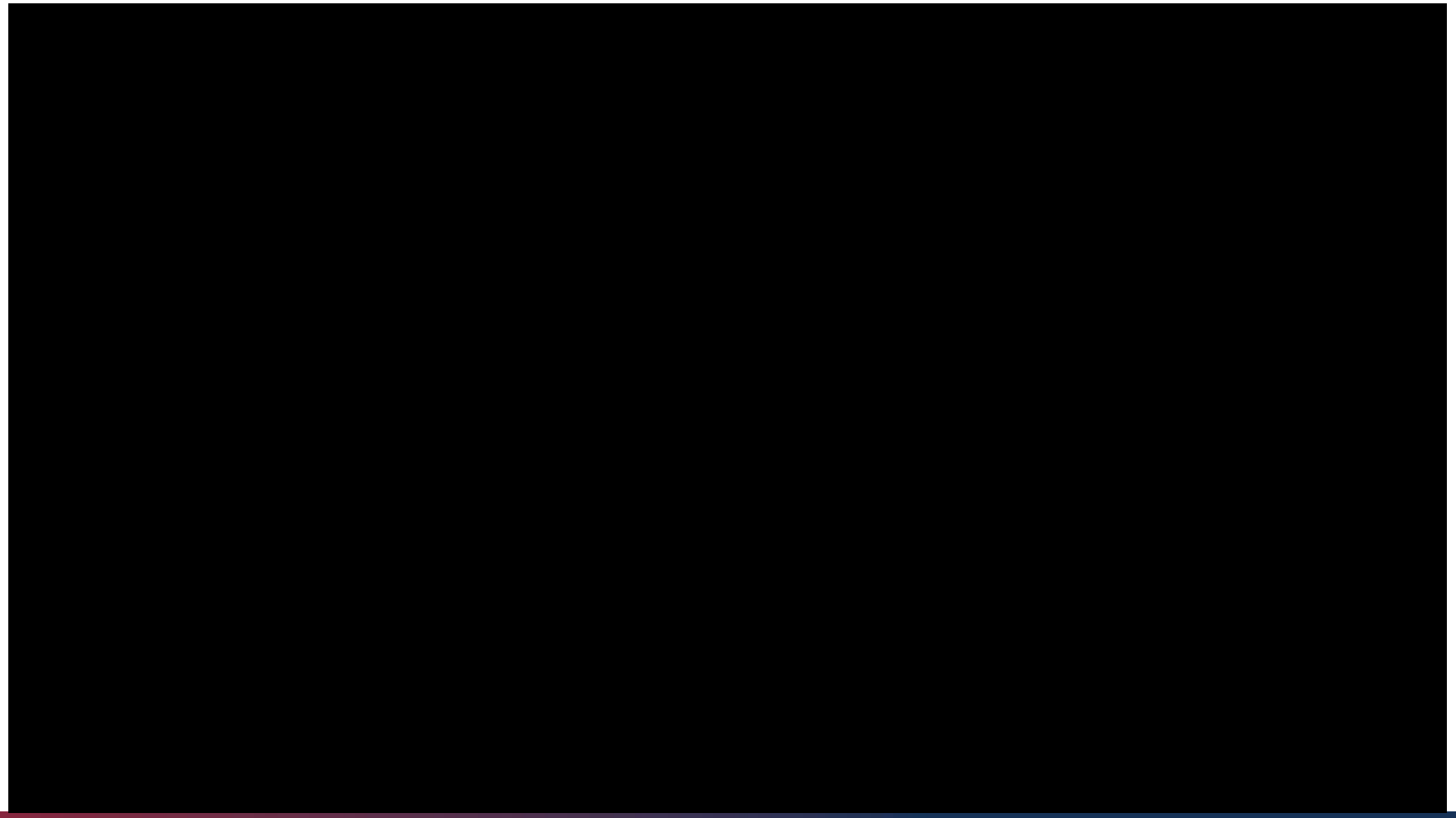
Pictures from:
https://safestart.com/news/first-line-defense-against-chemical-spills/
https://it.wikipedia.org/wiki/Fonderia#/media/File:Castingiron.jpg
https://commons.wikimedia.org/wiki/File:Togo_phosphates_mining.jpg
https://commons.wikimedia.org/wiki/File:2021-05-21-Construction-work-Benrodestrasse-foto3.jpg
https://commons.wikimedia.org/wiki/File:Agriculture_in_Vietnam_with_farmers.jpg
https://commons.wikimedia.org/wiki/File:Disposal_of_solid_waste_in_the_city_%286908383519%29.jpg

Introduction

Land pollution

Soil permeability influences land pollution.

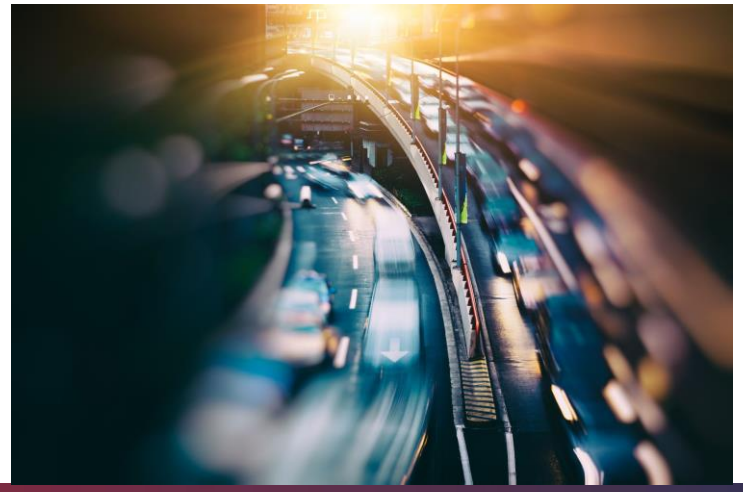
The greater the permeability, the greater the risks from land pollution.

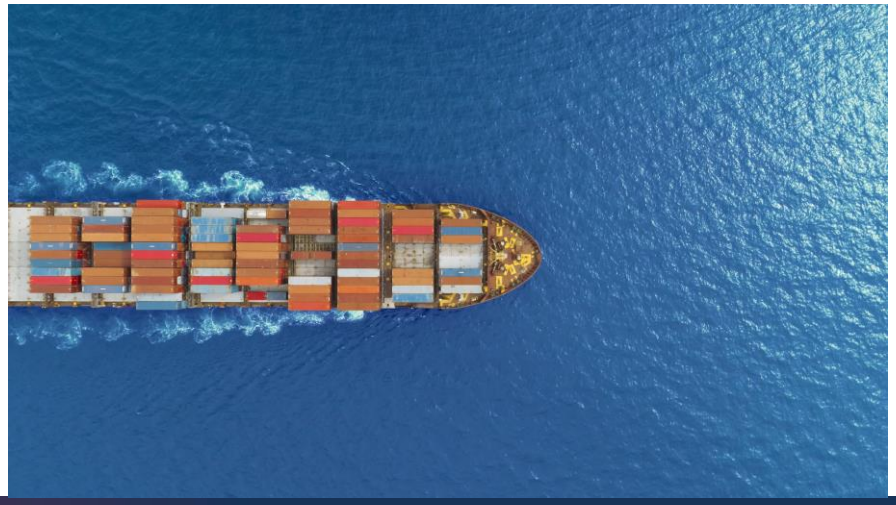


Introduction

Noise pollution

Noise pollution is caused by machines and engines pretty much associated with the industry, as well as the noise of transportation systems.

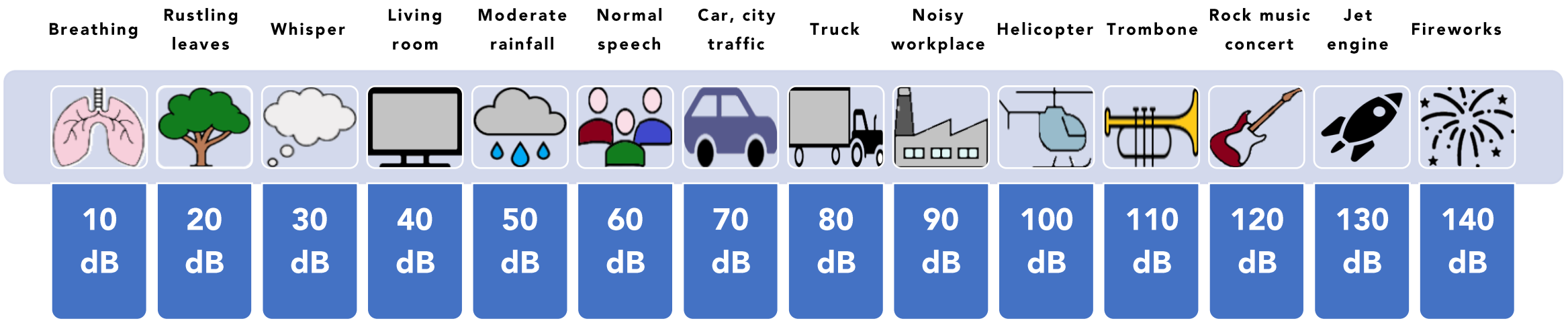




Introduction

Noise pollution

Sound is measured in decibels. The normal audible frequency range is approximately 20 Hz–20 kHz.



Introduction

Noise pollution

Health problems caused by exposure to loud noise.

Impacts on the health and well-being of wildlife (both on land and under water).

Introduction

Visual pollution

Many do not know about visual pollution and that is why it is becoming more frequent to have contact with it and its effects.

Due to the excessive amount of elements contained in these indoor or outdoor environments.

Light pollution is an example.

Introduction

Visual pollution

For human beings, it generates visual problems, distraction and psychological stress.

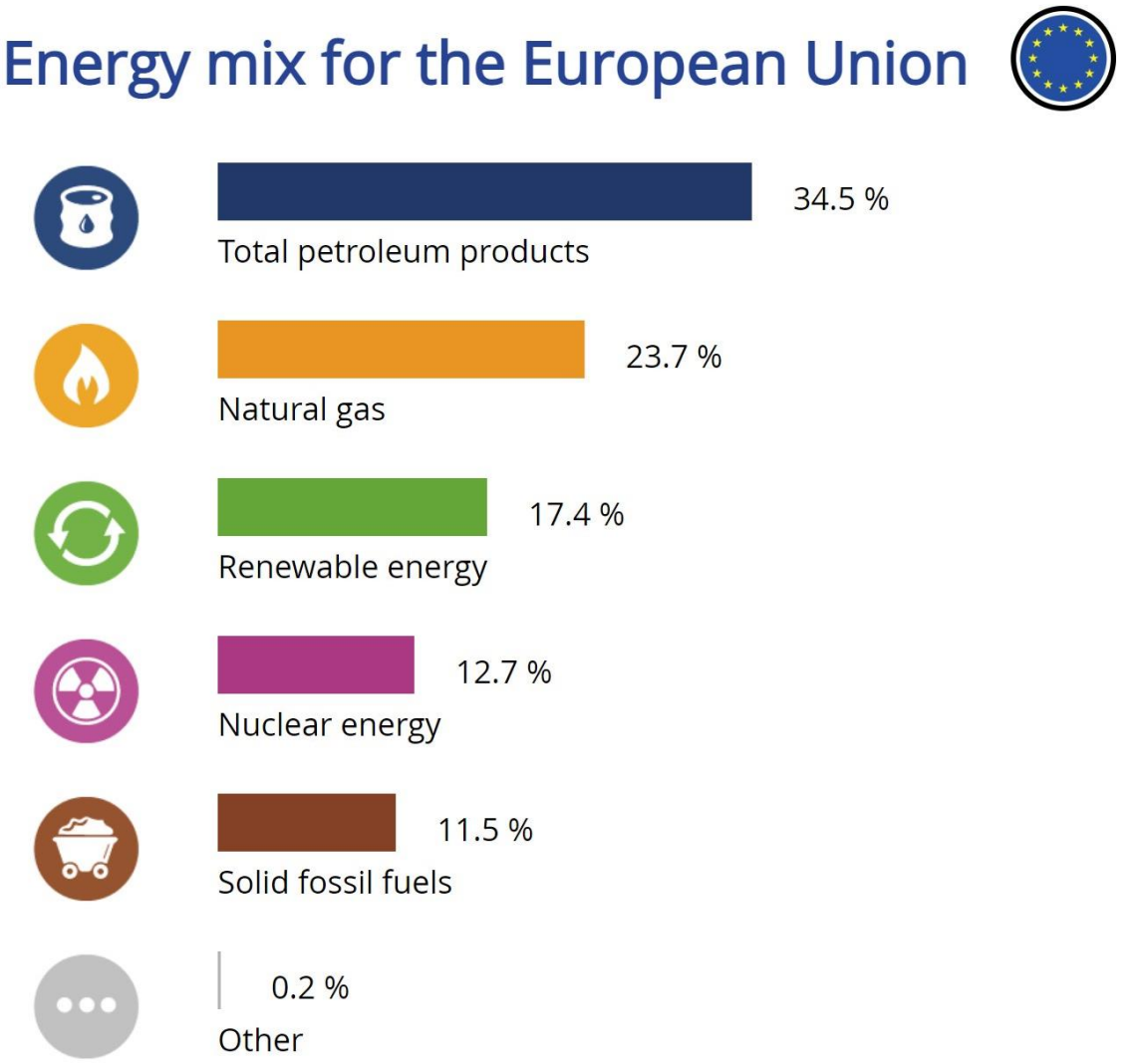
Fauna and flora can be affected with migration of species as consequence.

Introduction

Thermal pollution

Thermal pollution is the rise or fall in the temperature of a natural body of water caused by human influence.

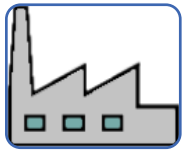
Fossil fuels



https://ec.europa.eu/eurostat/cache/infographs/energy/bloc-2a.html

Fossil fuels


Land


Air


Water


Noise

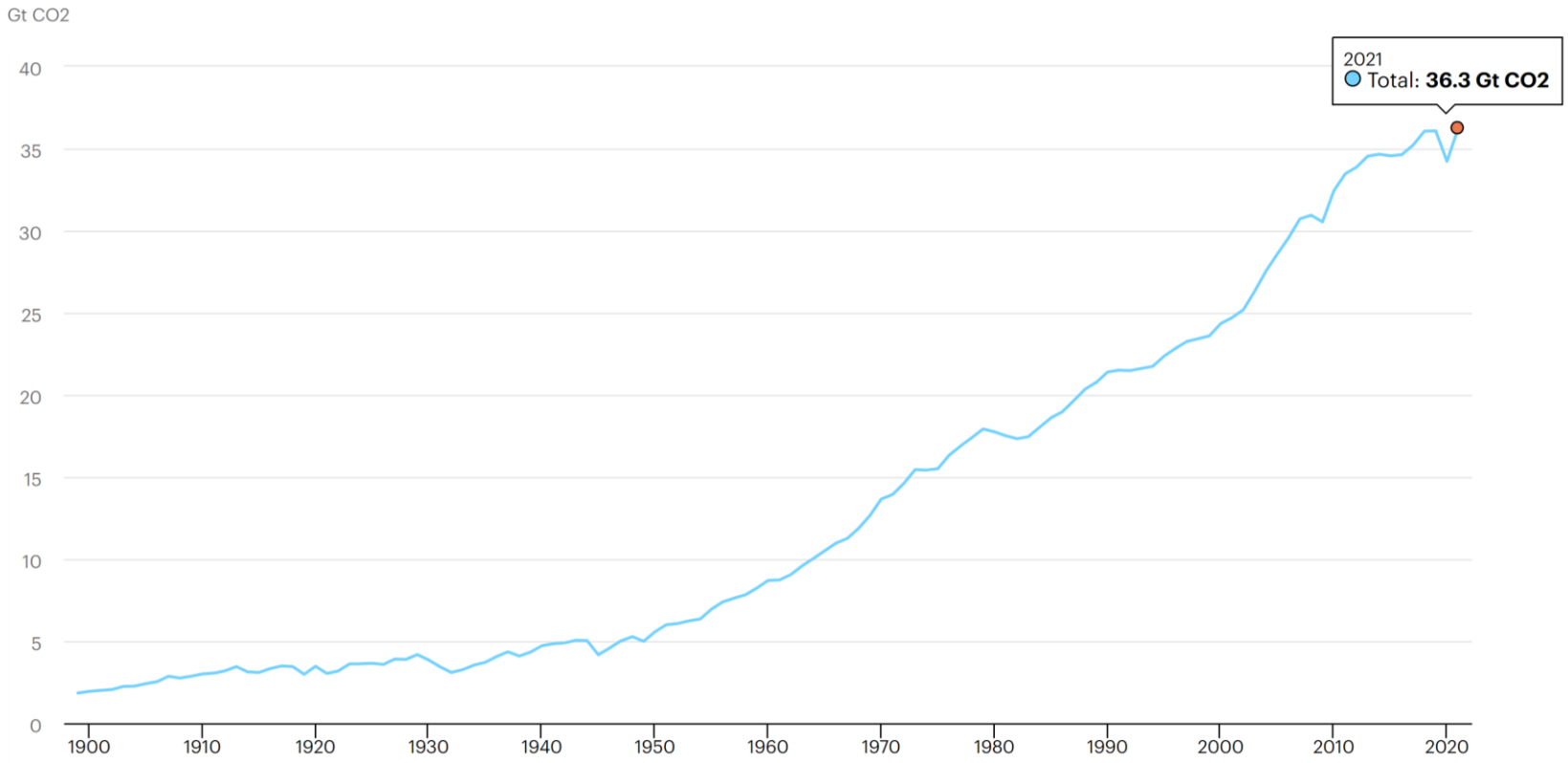

Visual

https://ec.europa.eu/eurostat/cache/infographs/energy/bloc-2a.html

Fossil fuels

Air pollution

CO_2 emissions from energy combustion and industrial processes, 1900-2021

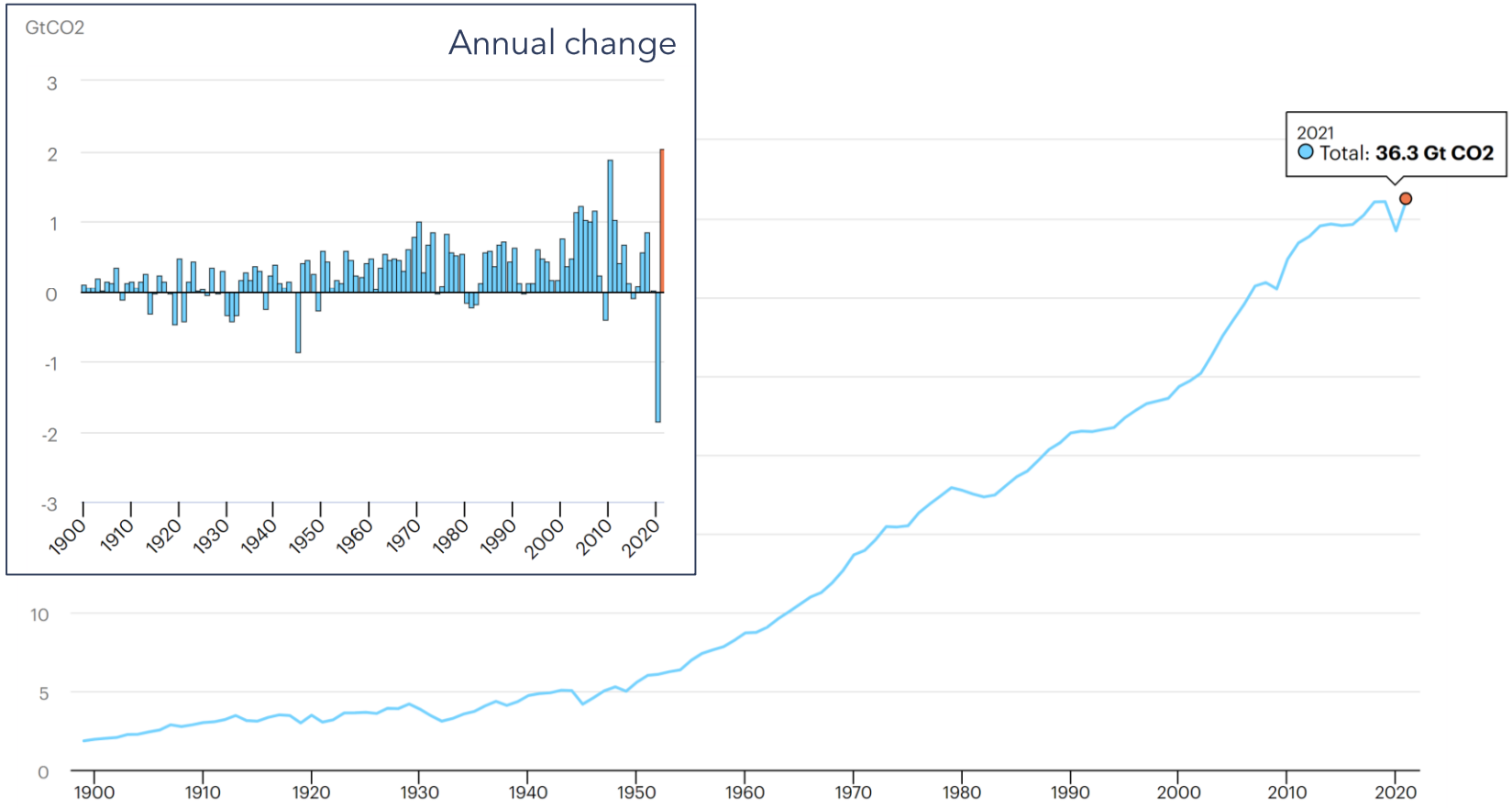


IEA, CO_2 emissions from energy combustion and industrial processes, 1900-2021, IEA, Paris https://www.iea.org/data-and-statistics/charts/co2-emissions-from-energy-combustion-and-industrial-processes-1900-2021

Fossil fuels

Air pollution

CO_2 emissions from energy combustion and industrial processes, 1900-2021



IEA, CO_2 emissions from energy combustion and industrial processes, 1900-2021, IEA, Paris https://www.iea.org/data-and-statistics/charts/co2-emissions-from-energy-combustion-and-industrial-processes-1900-2021

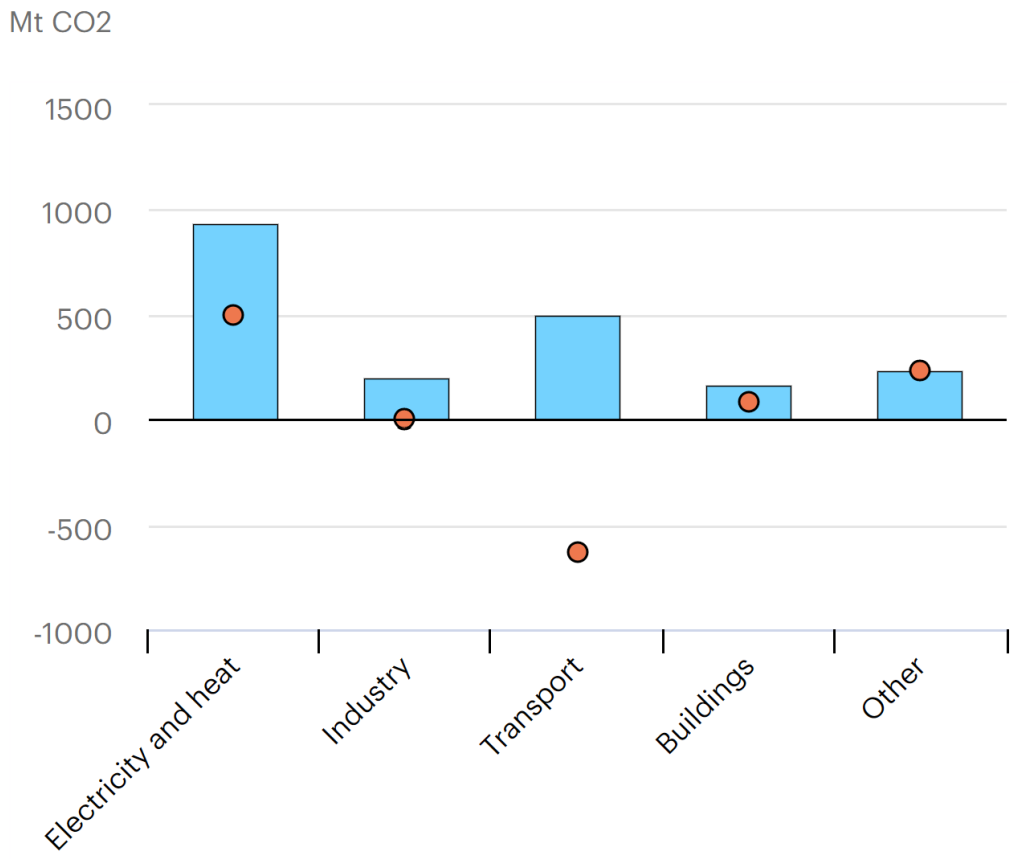
Fossil fuels

Air pollution

Annual change in CO_2 emissions by sector, 2021

A 6% increase from 2020 pushed emissions to 36.3 Gt, in line with the jump in global economic output of 5.9%.

The biggest increase in CO2 emissions by sector in 2021 took place in electricity and heat production, where they jumped by more than 900 Mt.



IEA, Annual change in CO_2 emissions by sector, 2021, IEA, Paris https://www.iea.org/data-and-statistics/charts/annual-change-in-co2-emissions-by-sector-2021

Fossil fuels

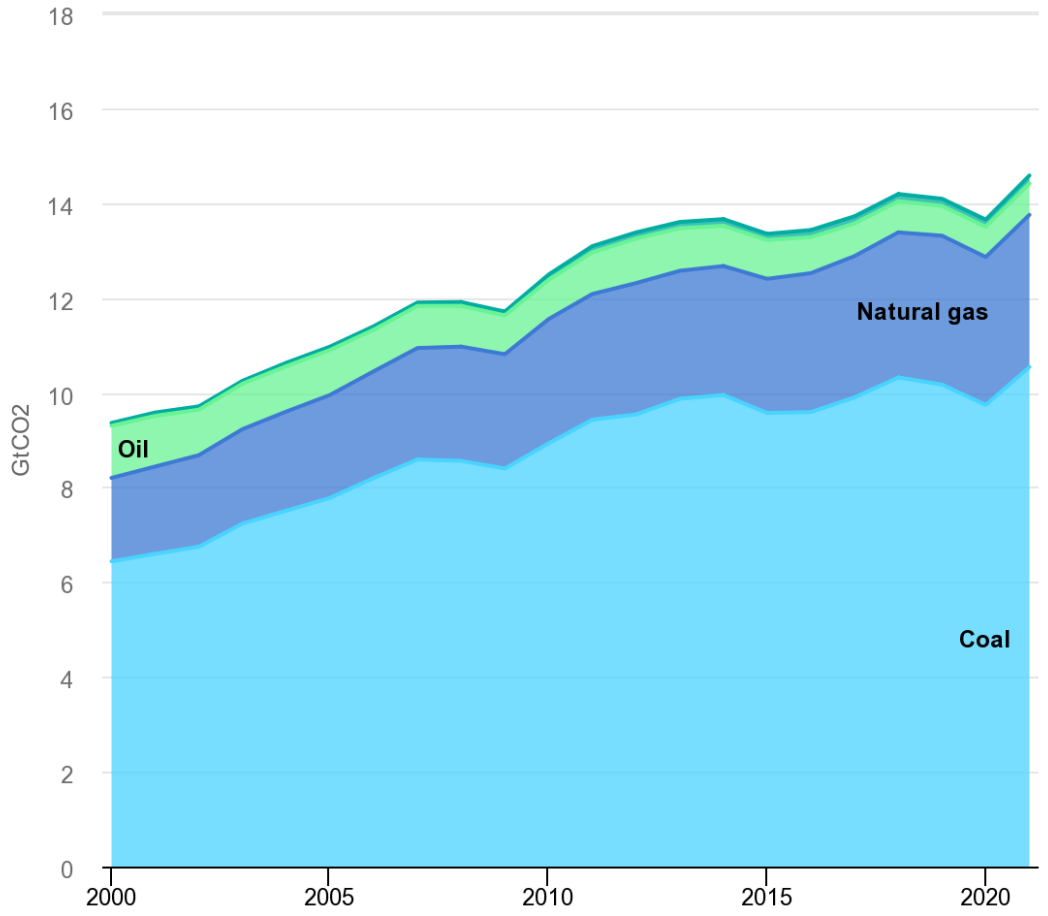
Air pollution

CO_2 emissions from electricity and heat production by fuel, 2000-2021

Despite the rebound in coal use, renewable energy sources and nuclear power provided a higher share of global electricity generation than coal in 2021.

Without increasing output from renewables and nuclear power, the rise in global CO_2 emissions in 2021 would have been 220 Mt higher.

IEA, Annual change in CO_2 emissions by sector, 2021, IEA, Paris https://www.iea.org/data-and-statistics/charts/annual-change-in-co2-emissions-by-sector-2021



Fossil fuels

Air pollution

Targets for reducing greenhouse gas emissions

Key targets for 2020

- 20% cut in greenhouse gas emissions (from 1990 levels)
- 20% of EU energy from renewables (more than double the 2010 level of 9.8%, with a 10% share of renewables in the transport sector)
- 20% improvement in energy efficiency

Key targets for 2030

- At least 40% cuts in greenhouse gas emissions (from 1990 levels)
- At least 32% share for renewable energy
- At least 32.5% improvement in energy efficiency

By 2050

- The EU aims to be climate-neutral by 2050 – an economy with net-zero greenhouse gas emissions. This objective is at the heart of the European Green Deal and in line with the EU's commitment to global climate action under the Paris Agreement.

https://e.ceuropa.eu/clima/eu-action/climate-strategies-targets_en

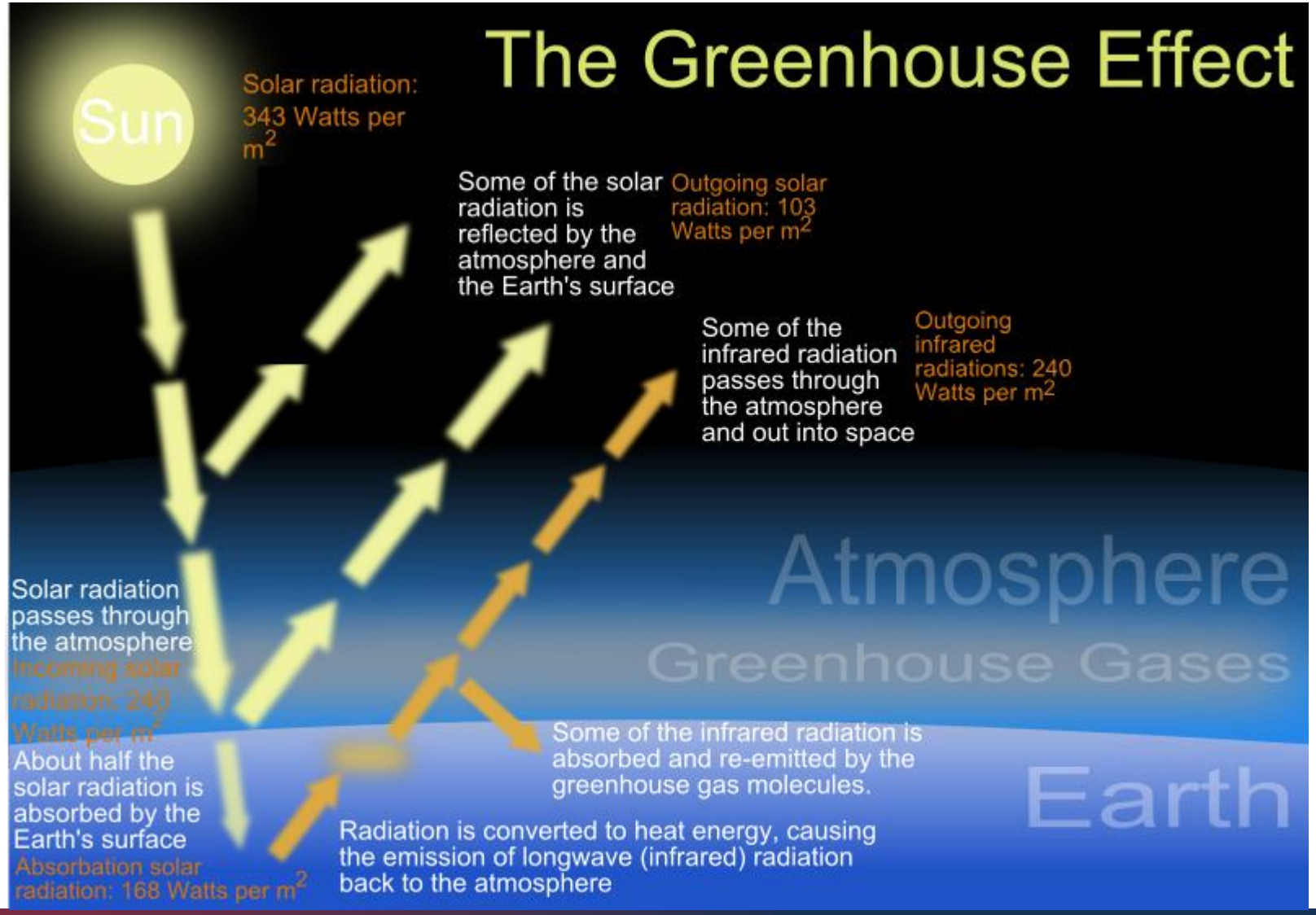
Fossil fuels

Air pollution

Greenhouse effect

The greenhouse effect helps trap heat from the sun.

People's activities are increasing the amount of heat-trapping greenhouse gases in the atmosphere, causing the earth to warm up.



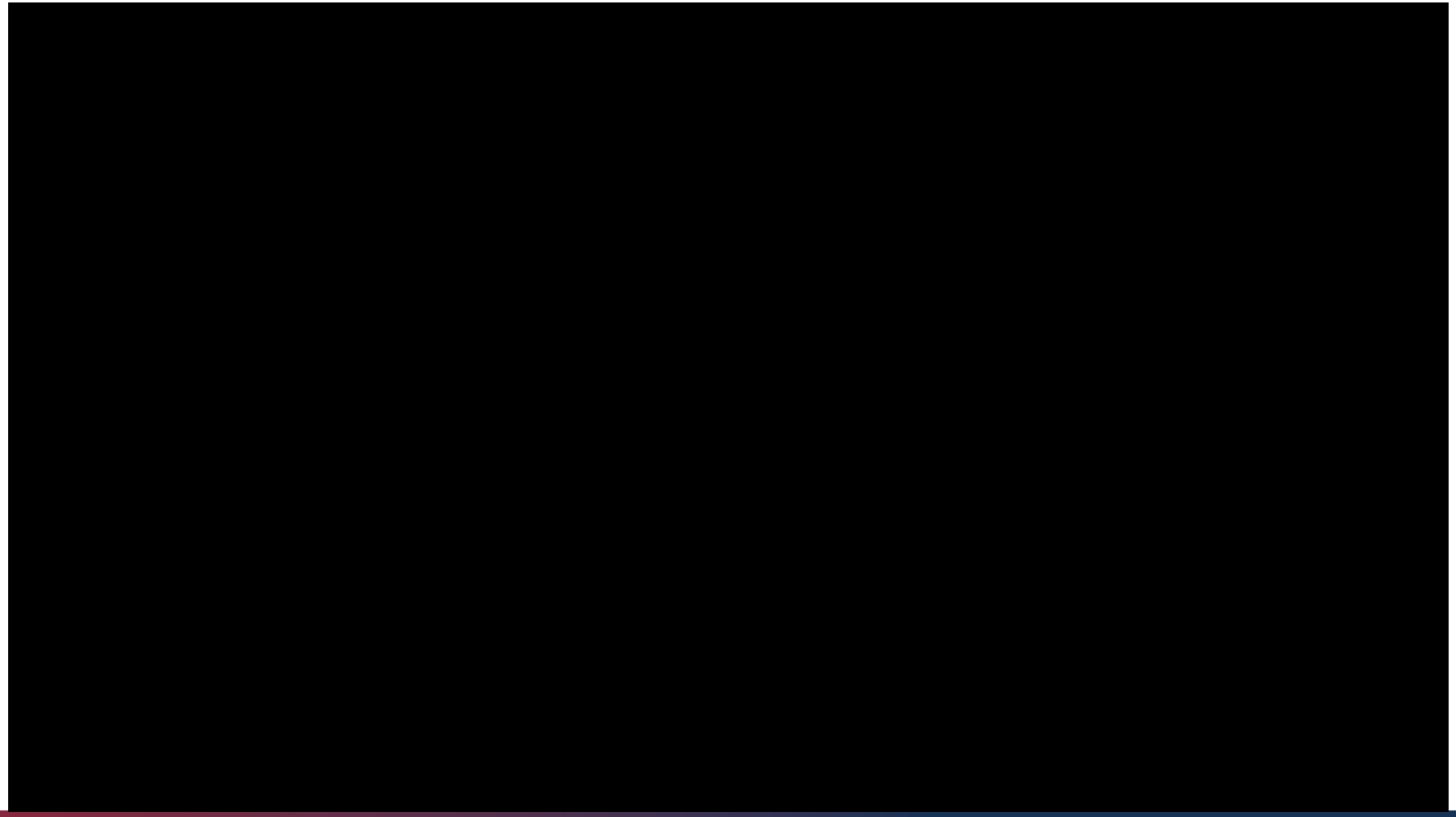
https://commons.wikimedia.org/wiki/File:The_green_house_effect.svg

Fossil fuels

Air pollution

Greenhouse effect

https://youtu.be/VYMjSule0Bw

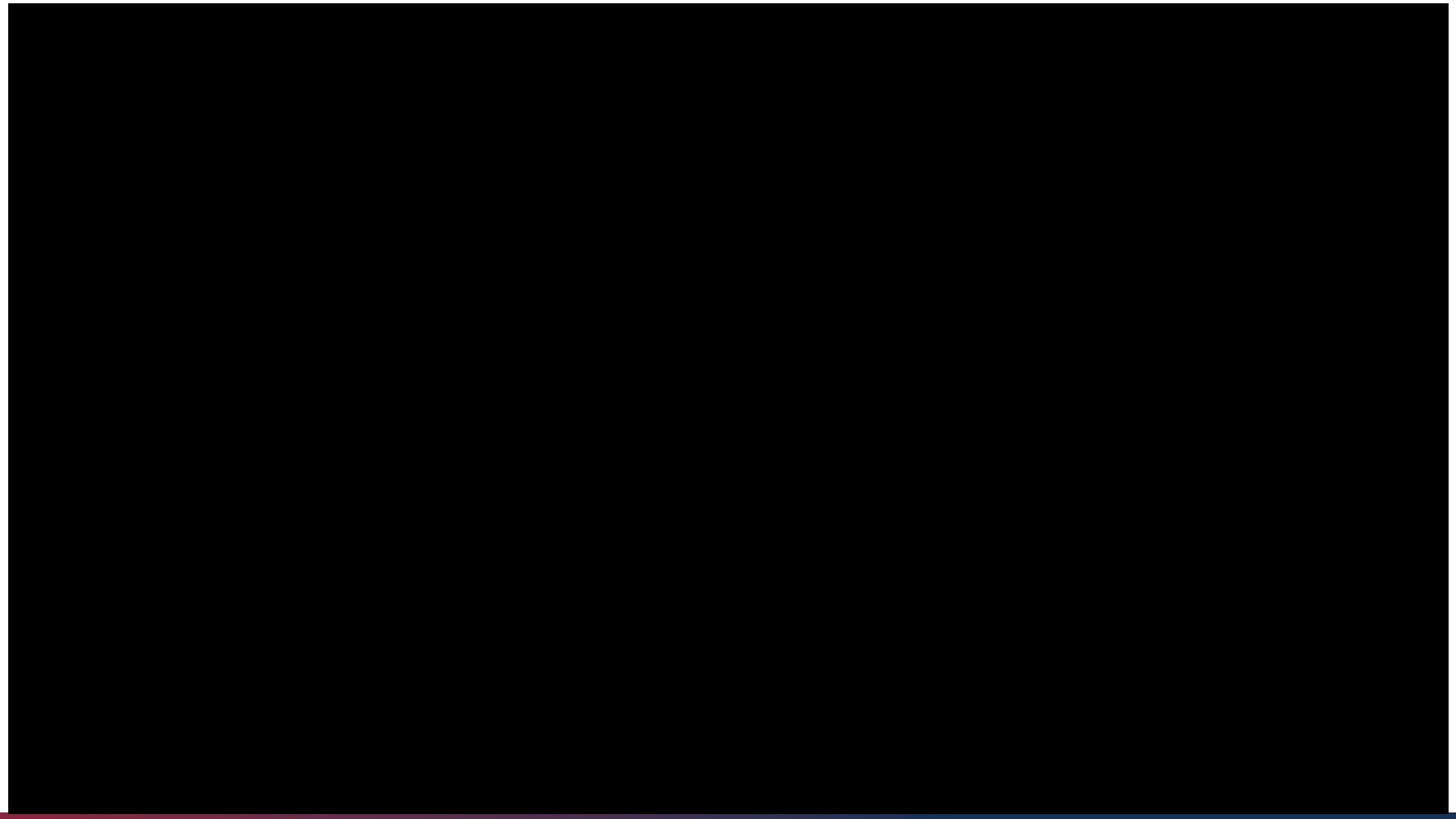


Fossil fuels

Air pollution

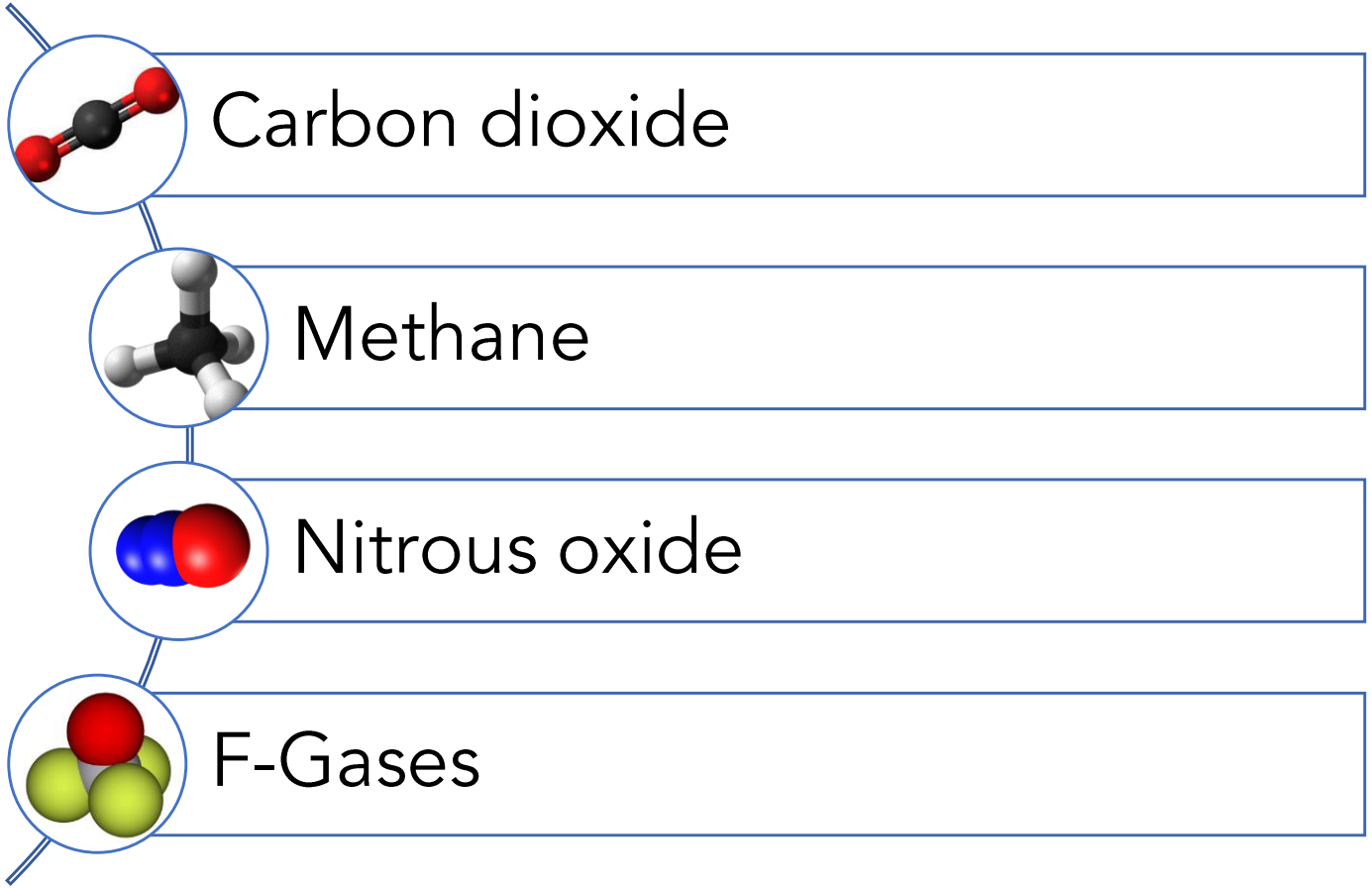
Greenhouse effect:
the carbon cycle

https://youtu.be/lWEvBLlUa2E



Fossil fuels

Key greenhouse gases

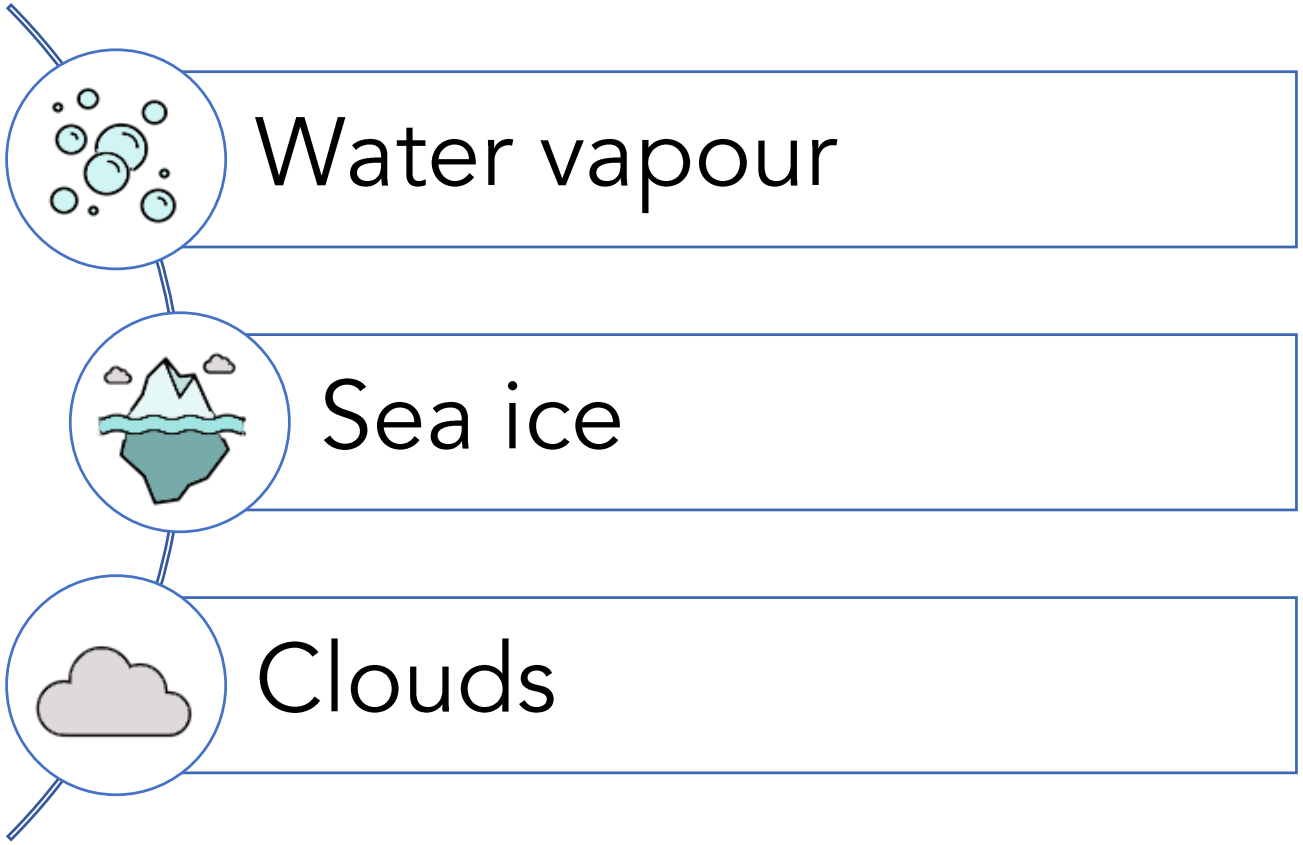


Pictures from: https://commons.wikimedia.org/wiki/File:Carbon_dioxide_3D_ball.png
https://freesvg.org/methane-molecule-3d
https://commons.wikimedia.org/wiki/File:Nitrous_oxide-3D-vdW.png
https://commons.wikimedia.org/wiki/File:Vanadium%28V%29-oxytrifluoride-3D-vdW.png

Fossil fuels

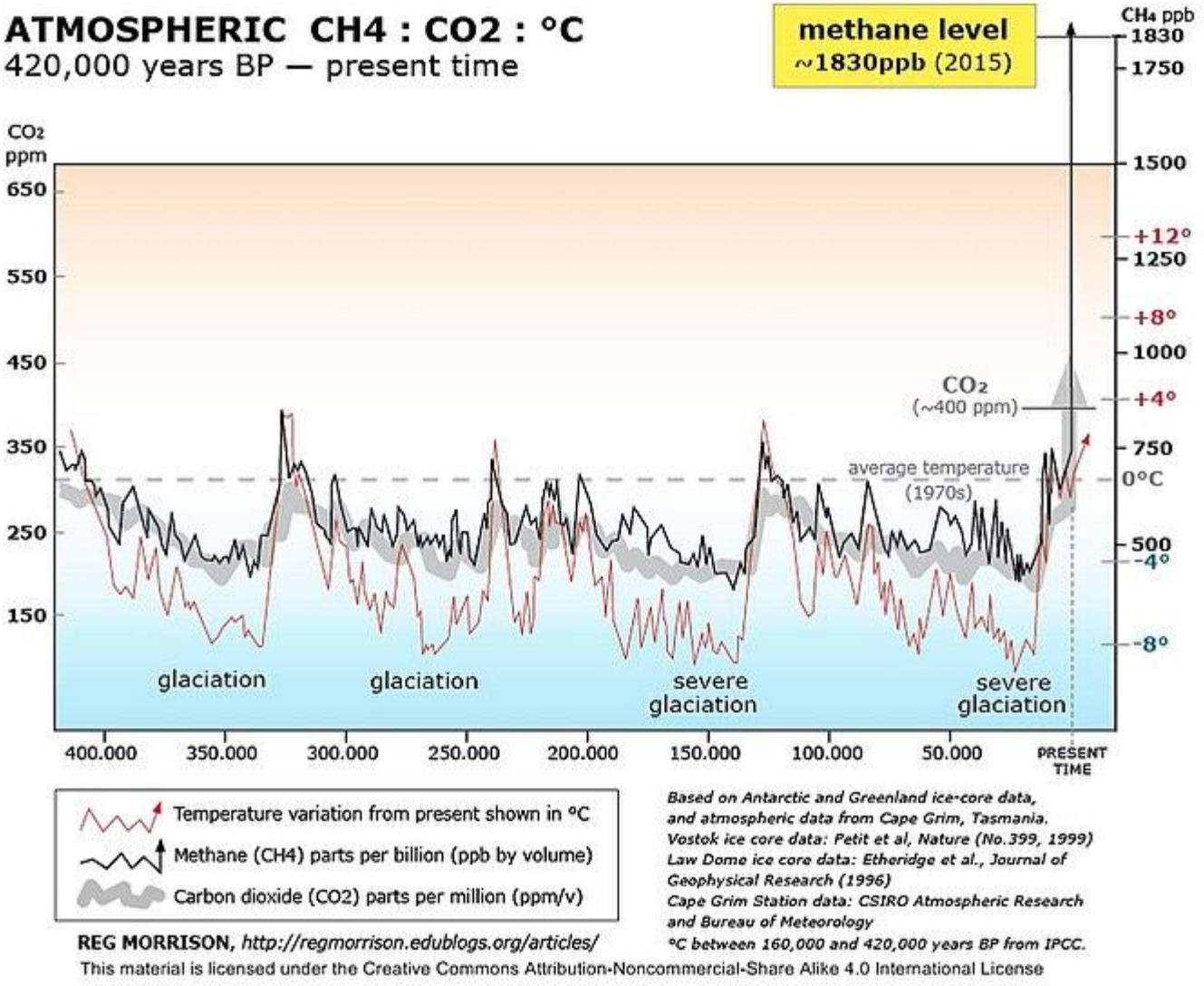
Climate feedback

https://climatekids.nasa.gov/time-machine/



Fossil fuels

Climate feedback

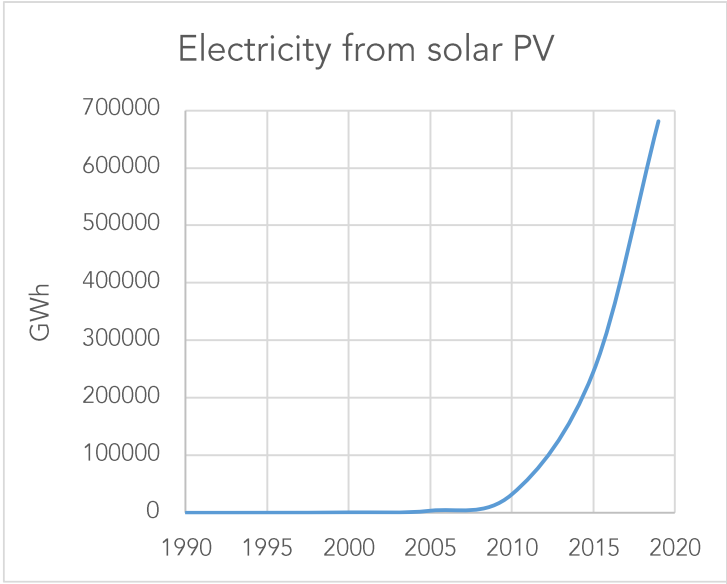


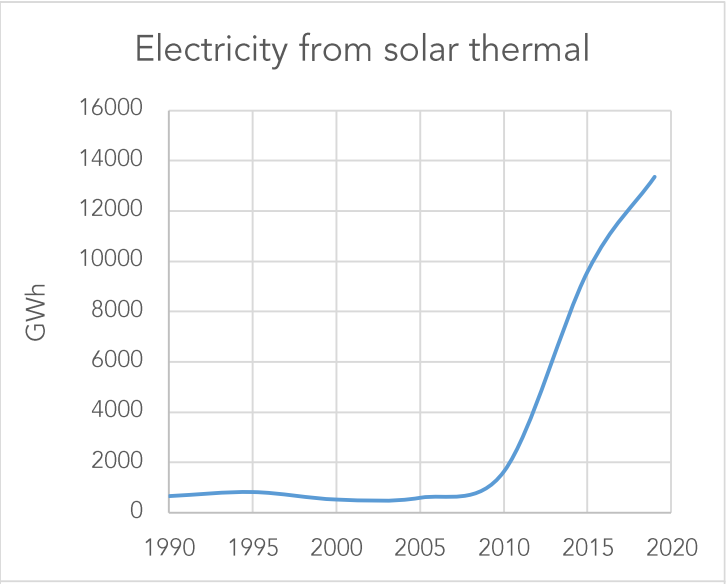
Picture from: https://commons.wikimedia.org/wiki/File:Graph_CO2_CH4_and_Temperature_Graph_in_English_15_June_2015_by_Reg_Morrison.jpg

Renewables

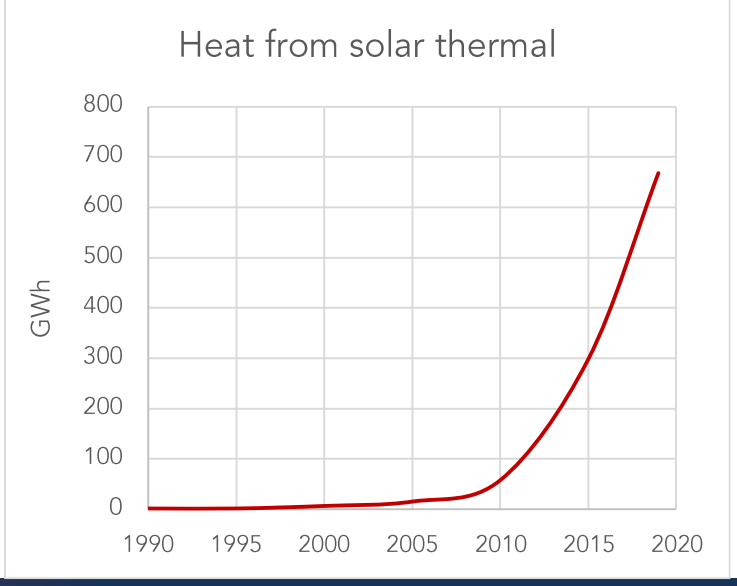
Solar energy

Solar energy is attracting more and more to reduce the environmental impact of energy generation.





https://www.iea.org/fuels-and-technologies/renewables

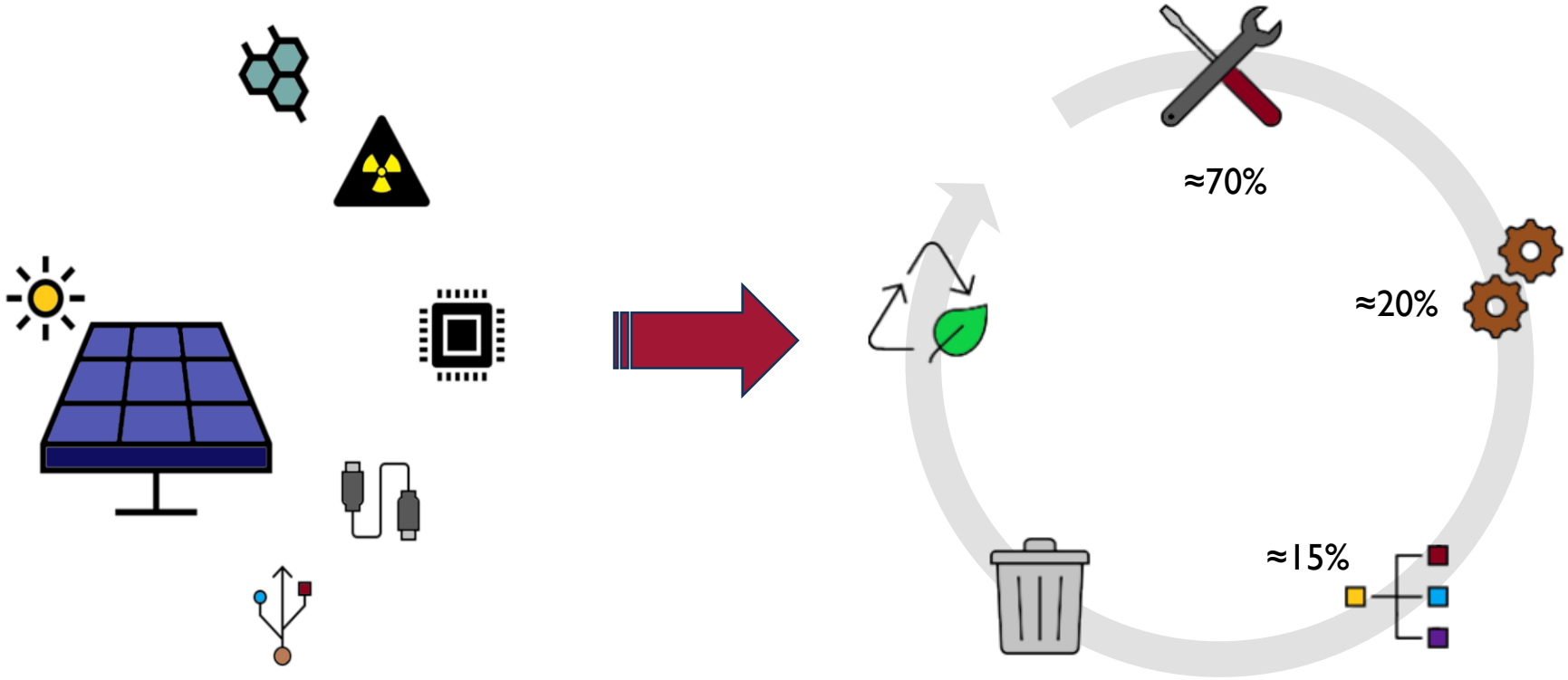


Renewables

Solar energy

PV setup consists of several parts, i.e. cells, electrical and mechanical components.

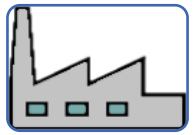
The fabrication of different components of the PV system involves the use of different chemicals and hazardous material.



Renewables

Solar energy


Land


Air


Hazardous materials


Water


Noise


Visual

Renewables

Solar energy

Solar power systems have a very high energy land-use intensity compared to other energy technologies.

The construction phase usually contributes to the major environmental impact on the land and habitat.

Shortening the distance between the rows of PV modules or installing the modules in occupied spaces can lower land use and raise land efficiency.

Land use can be also reduced by employing floating PV or hybrid systems.

https://commons.wikimedia.org/wiki/File:At_work_on_the_solar_array._%289474823276%29.jpg
https://commons.wikimedia.org/wiki/File:Solar-Car-Park-PV-Structures.jpg
https://commons.wikimedia.org/wiki/File:Floating_PV_system_Far_Niente_Winery_California_2018.jpg

Renewables

Solar energy

Manufacturing is responsible for the largest share of emissions.

Eventual cut of plants to avert shading effects reduces sequestration rate of CO_2 by vegetation.

Albedo effect.

PV impact may be reduced by improving the performance, increasing lifespan, increasing irradiance, using renewable energy mixes and thin-film or cadmium selenide quantum dot PVs.

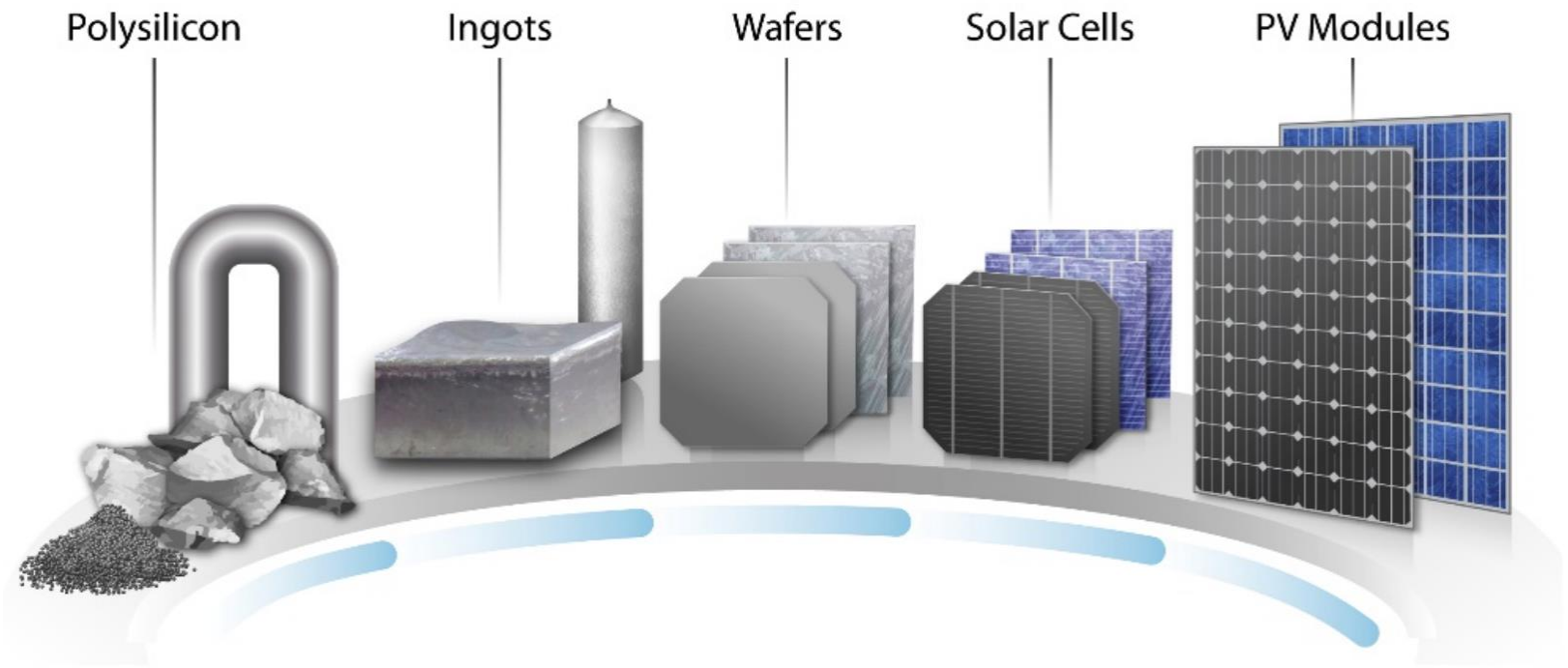
Renewables

Solar energy

PV cells' manufacturing requires the use of:

- several raw materials, i.e. silicon, cadmium, tellurium, copper, selenium, and gallium;
- numerous chemicals and solvents.

Thus, recycling of PV waste and disposed PV modules is crucial.



Picture from: Woodhouse, Michael. Brittany Smith, Ashwin Ramdas, and Robert Margolis. 2019. Crystalline Silicon Photovoltaic Module Manufacturing Costs and Sustainable Pricing: 1H 2018 Benchmark and Cost Reduction Roadmap. Golden, CO: National Renewable Energy Laboratory. https://www.nrel.gov/docs/fy19osti/72134.pdf

Renewables

Solar energy

Manufacturing and recycling processes are characterized by a significant water consumption (higher than during operation).

Water consumption is critical mainly for countries exposed by severe water shortage.

However, compared to other conventional and renewable energy type of technologies PV would be the best option for conserving water supply.

Picture from: https://commons.wikimedia.org/wiki/File:Matrice_nettoyage.jpg

Renewables

Solar energy

Noise impact may be relevant during the construction phase, whereas it is insignificant during operation.

One novel design is the use of PV systems as noise barriers.

Picture from:
https://commons.wikimedia.org/wiki/File:Autobahn_L%C3%A4rmschutzwall_T%C3%B6ging_am_Inn.JPG

Renewables

Solar energy

Visual impact depends on the area of installation.

The negative impact can be minimized by:

- mounting PV panels on the rooftop and building facades
- placing the PV facilities in regions far away from residential areas such as desert regions.

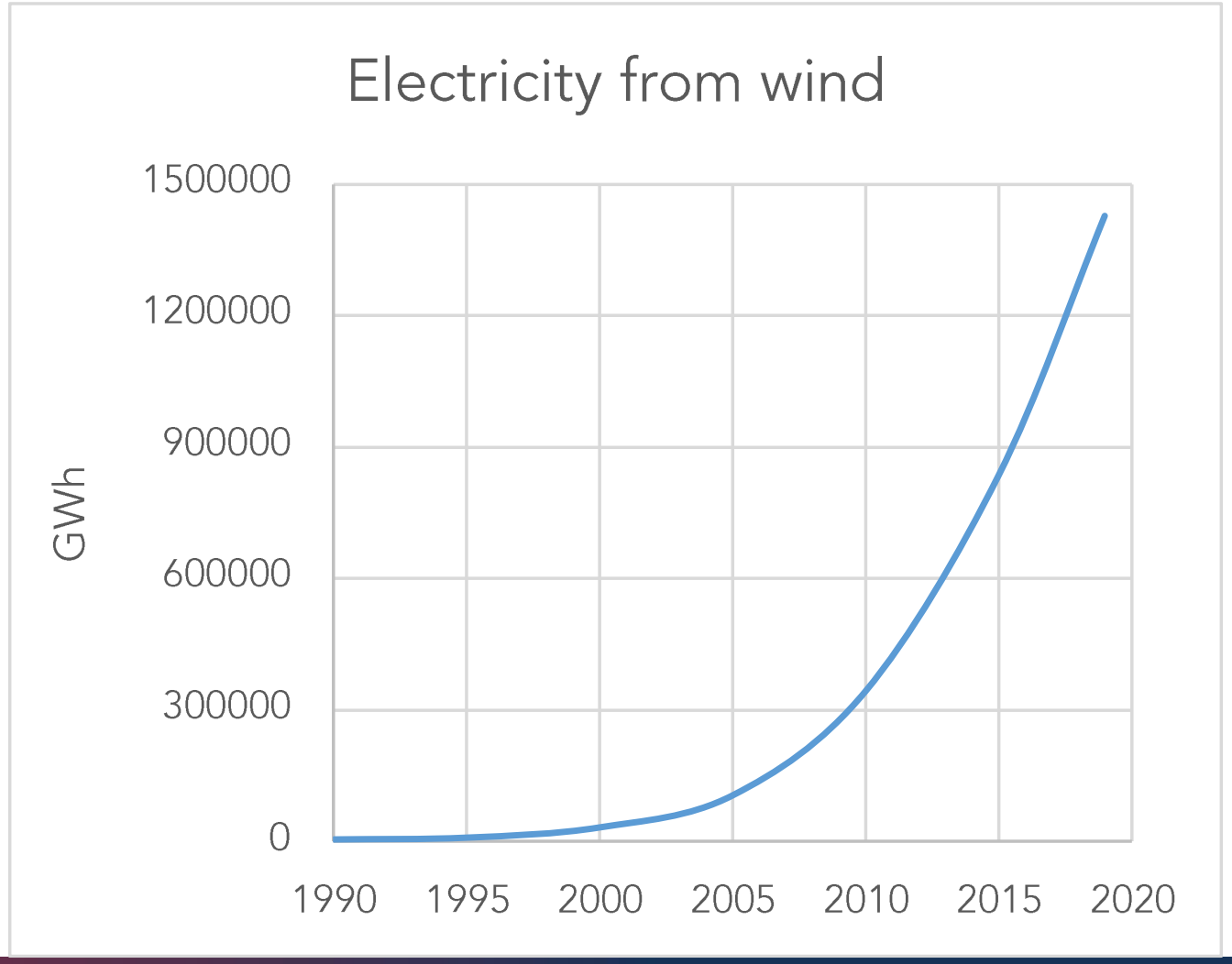
Picture from:
https://commons.wikimedia.org/wiki/File:BAPV_solar-facade.JPG
https://www.pv-magazine.com/2021/11/03/pv-system-design-for-low-cost-hot-water-production/
https://commons.wikimedia.org/wiki/File:PikiWiki_Israel_75640_pv_site.jpg

Renewables

Wind energy

Throughout the history of the progress of wind power, there has been a clear correlation between the oil price and the demand for wind energy.

https://www.iea.org/fuels-and-technologies/renewables

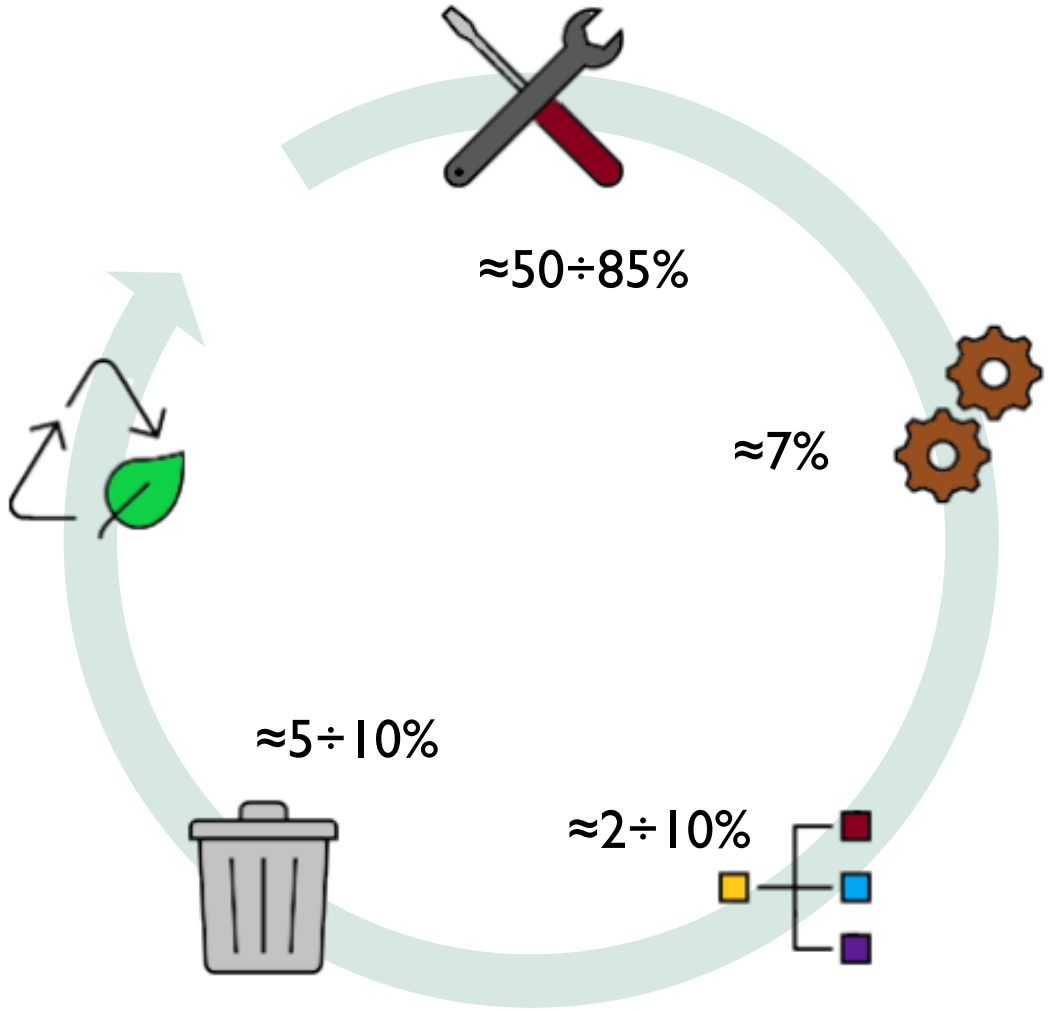


Renewables

Wind energy

Conventional wind turbines are generally considered "zero-emission" during operation.

However, there are environmental hazards associated with their manufacturing and disposal processes.



Data from:
Gkantou, M., Rebelo, C., & Baniotopoulos, C. (2020). Life cycle assessment of tall onshore hybrid steel wind turbine towers. Energies, 13(15), 3950.
Arvesen, A., & Hertwich, E. G. (2012). Assessing the life cycle environmental impacts of wind power: A review of present knowledge and research needs. Renewable and sustainable energy reviews, 16(8), 5994-6006.

Renewables

Wind energy


Noise impact


Visual impact


Fauna


Climatic conditions


Land use

Renewables

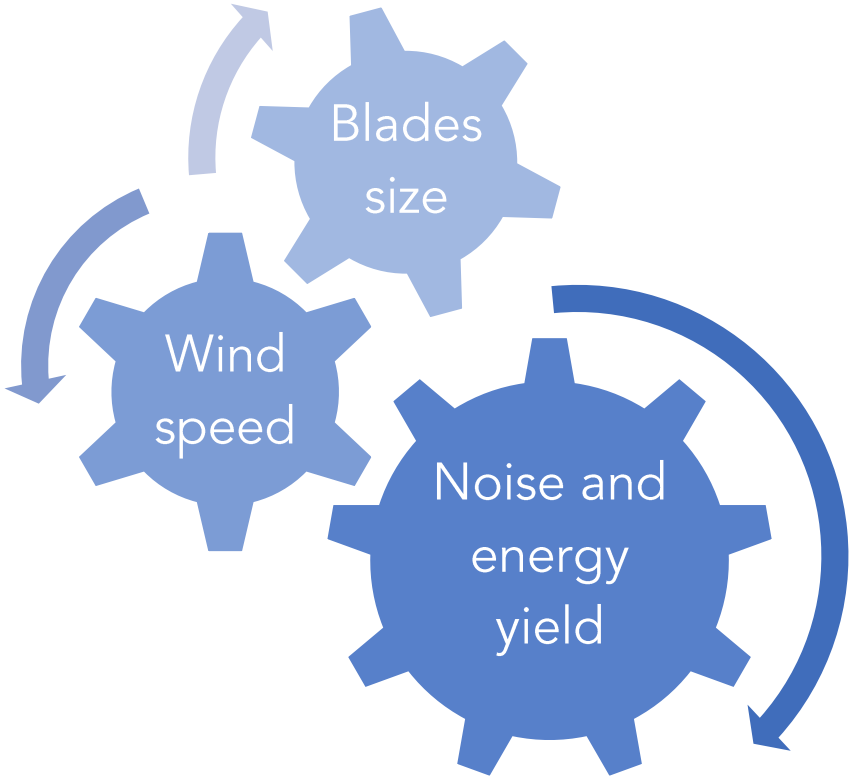
Wind energy

Mechanical noise

- It is caused by rotating machinery.
- It is affected by normal wear and tear, poor component designs, or lack of preventative maintenance.
- It can be alleviated by incorporating sound insulation.
- Actually it has virtually disappeared in the newer designed rotors.

Aerodynamic noise

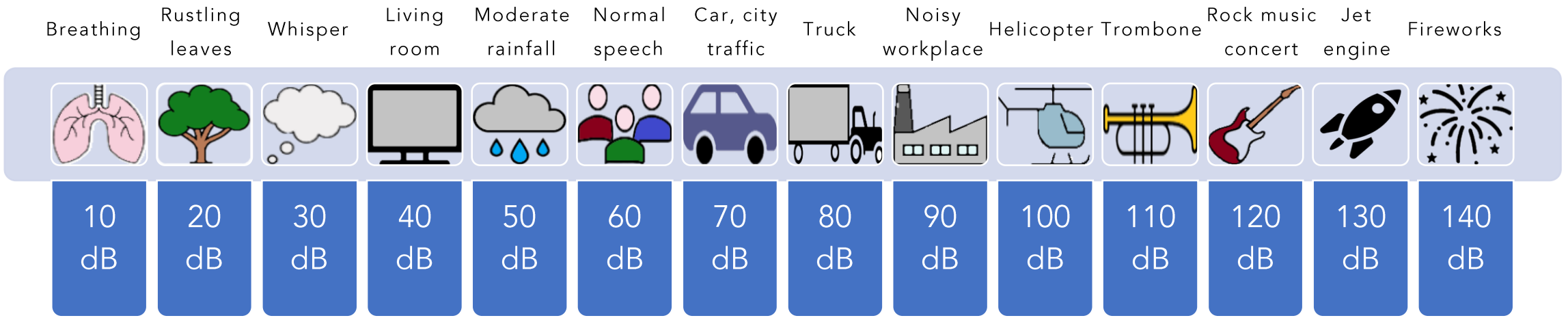
- It is the swishing sound emitted as the blades pass the tower.
- It can create headaches, hearing loss, and sleep disorders. It may even hamper the vestibular system.
- The intensity is higher near the base of the wind turbine.
- For blade noise, lower blade tip speed results in lower noise levels.



Renewables

Wind energy

Wind farms are always located where the wind speed is higher than average, and the background noise of the wind tends to cover any sounds that might be produced by operating wind turbines.

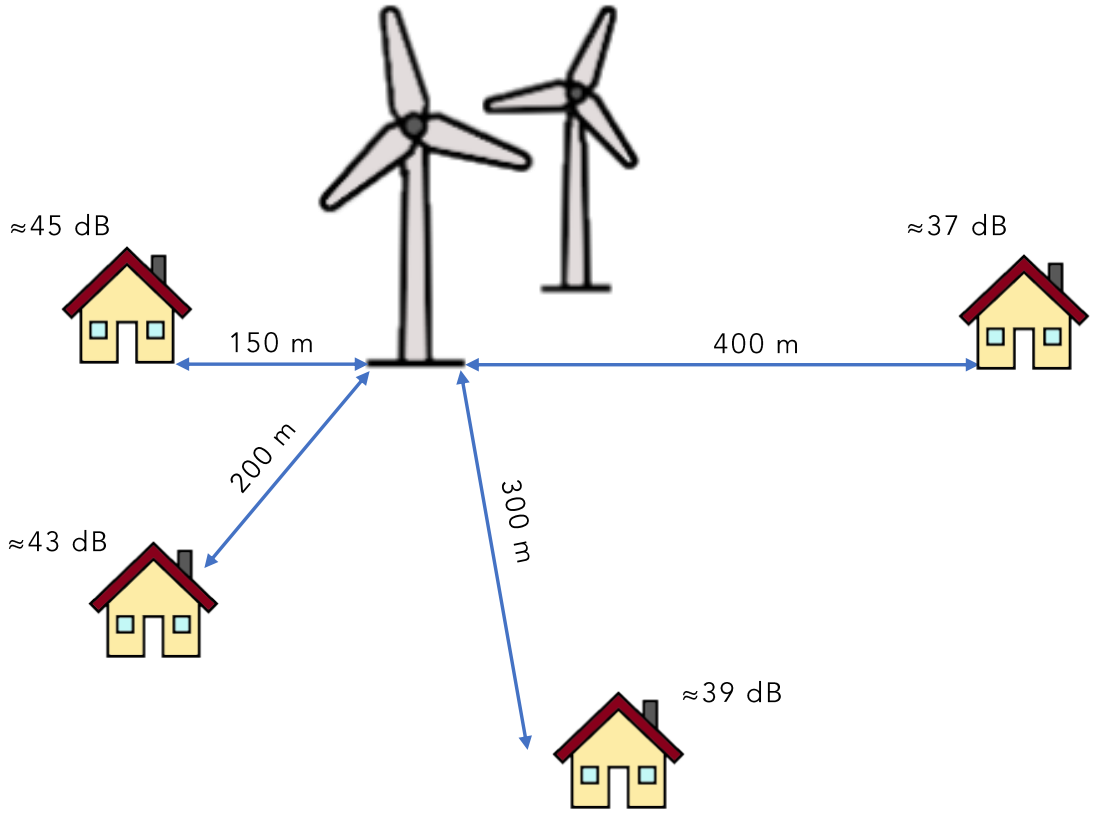


Renewables

Wind energy

Noise pollution decreases as the distance from the turbine decreases.

It is affected by background noise and wind velocity.

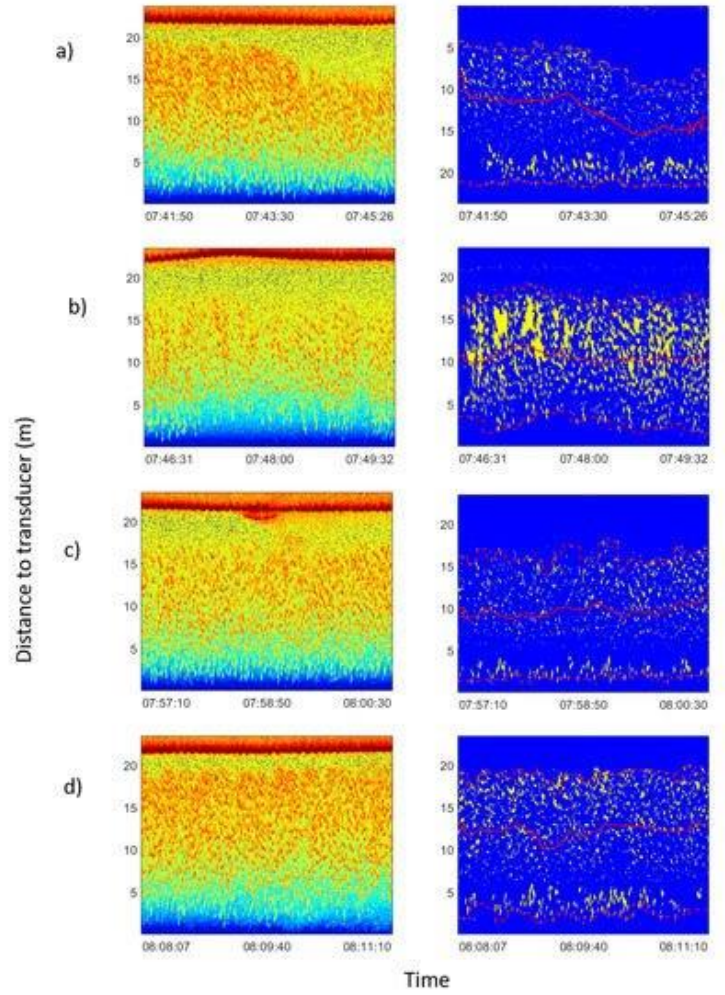


Renewables

Wind energy

Noise can be reduced by using:

- upwind turbines;
- variable-speed turbines;
- direct-drive machines, with no gearbox or high-speed mechanical components;
- prediction models and software tools to predict emissions.



Pictures from: https://commons.wikimedia.org/wiki/File:Gearbox_,_Rotor_Shaft_and_Disk_Brake_Assembly_for_Turbine_No_11_-_geograph.org.uk_-_785216.jpg

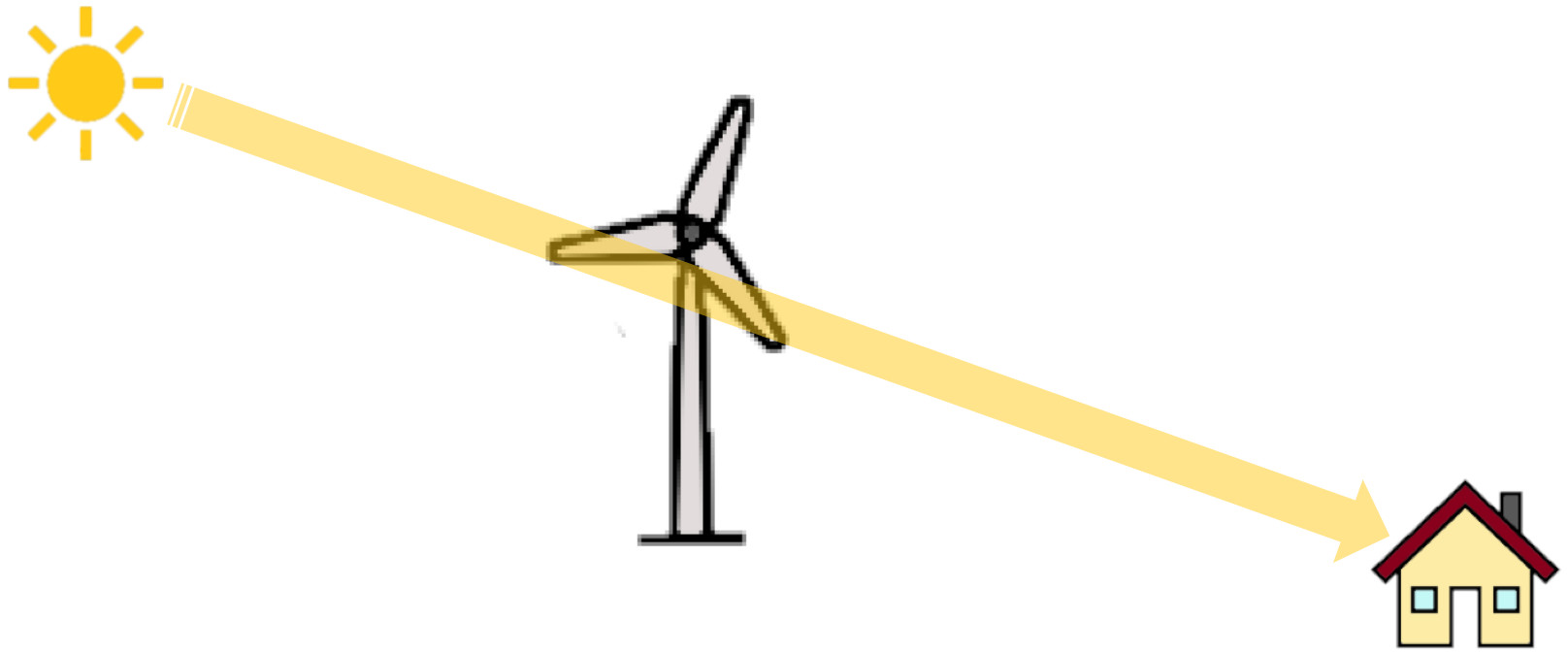
Puig-Pons, V., Soliveres, E., Pérez-Arjona, I., Espinosa, V., Poveda-Martínez, P., Ramis-Soriano, J., ... & Santaella, E. (2021). Monitoring of caged bluefin tuna reactions to ship and offshore wind farm operational noises. *Sensors*, *21*(21), 6998.

Renewables

Wind energy

Visual effects vary with:

- color contrast
- size
- distance from the home
- flashing shadows.



Renewables

Wind energy

Birds can be injured or killed when they collide with the blades of a wind turbine.

Moreover, lights near the wind farm attract nearby birds which increases the chance of collision

Picture from:
https://commons.wikimedia.org/wiki/File:Kraniche,_Windr%C3%A4der.jpg

Renewables

Wind energy

Birds can be injured or killed when they collide with the blades of a wind turbine.

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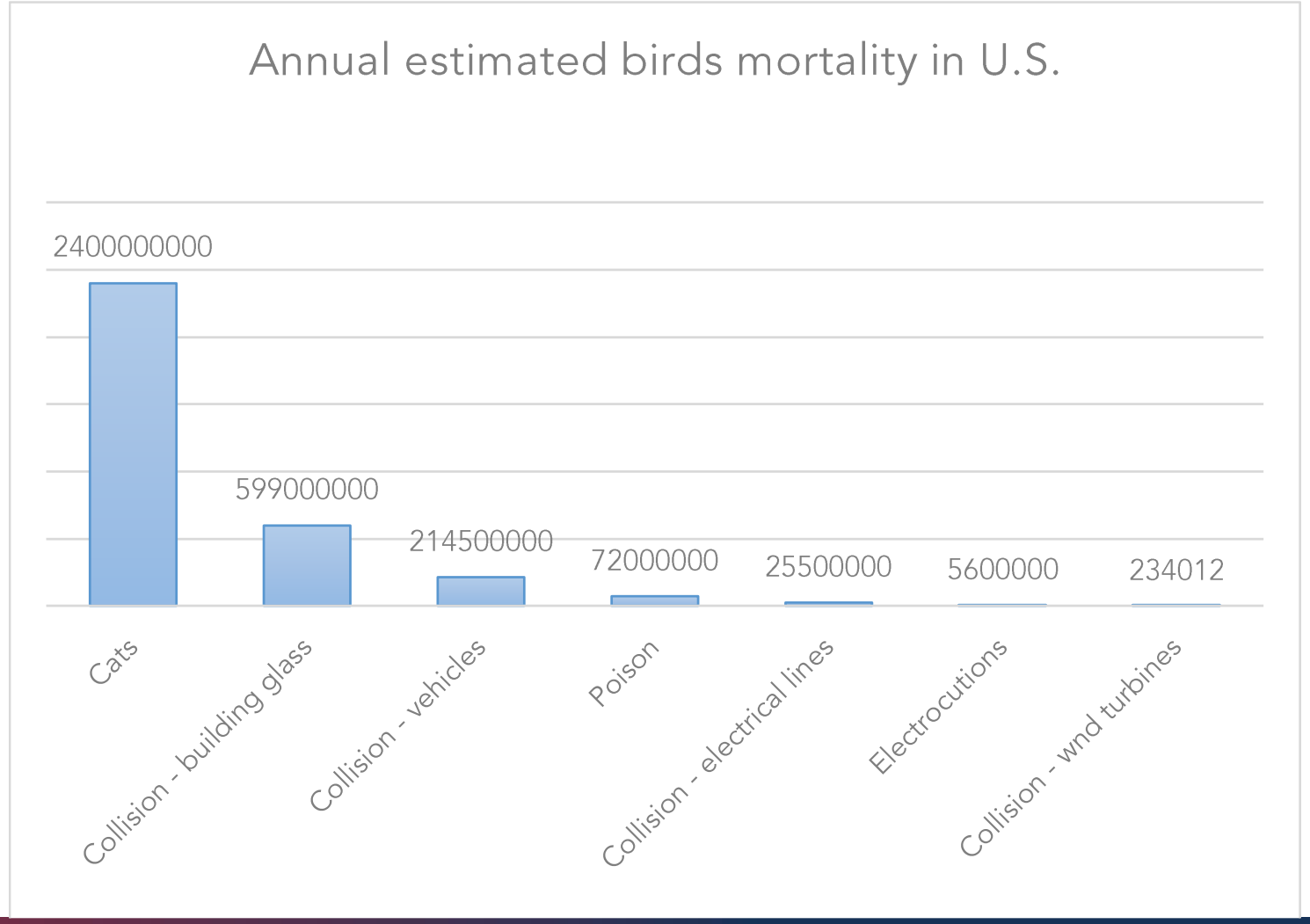


Renewables

Wind energy

The impact on the natural ecosystems is a significant issue.

Noise during construction process hampers the breeding process.

Off-shore WTs can also harm marine bird lives.

Pictures from:
https://commons.wikimedia.org/wiki/File:Demoiselle_cranes_flying_past_wind_turbines,_Gujarat.jpg
https://commons.wikimedia.org/wiki/File:Alpha_Ventus_Windmills.JPG

Renewables

Wind energy

Effects on:

- the kinetic energy of local winds;
- direction of the high-speed wind near the ground and consequently on local moisture evaporation.

Renewables

Wind energy

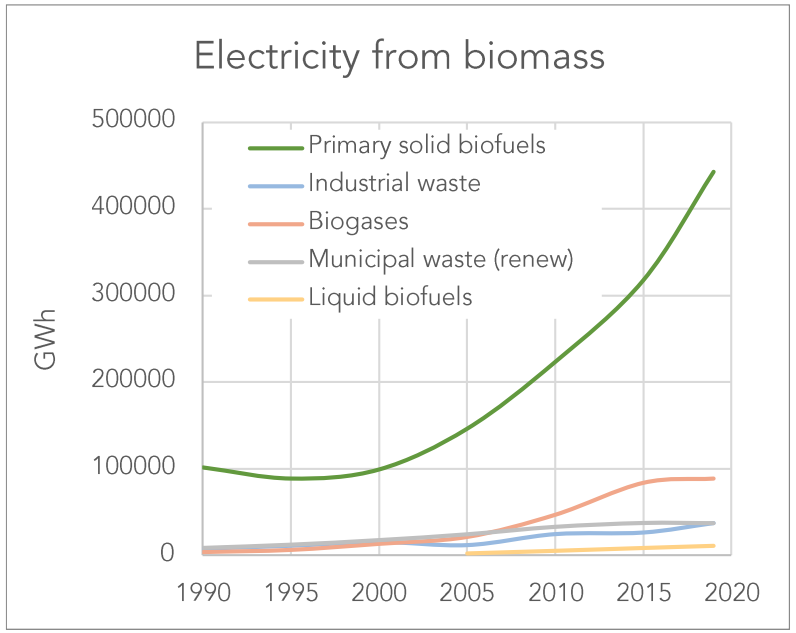
Development of wind energy farms causes soil erosion and deforestation.

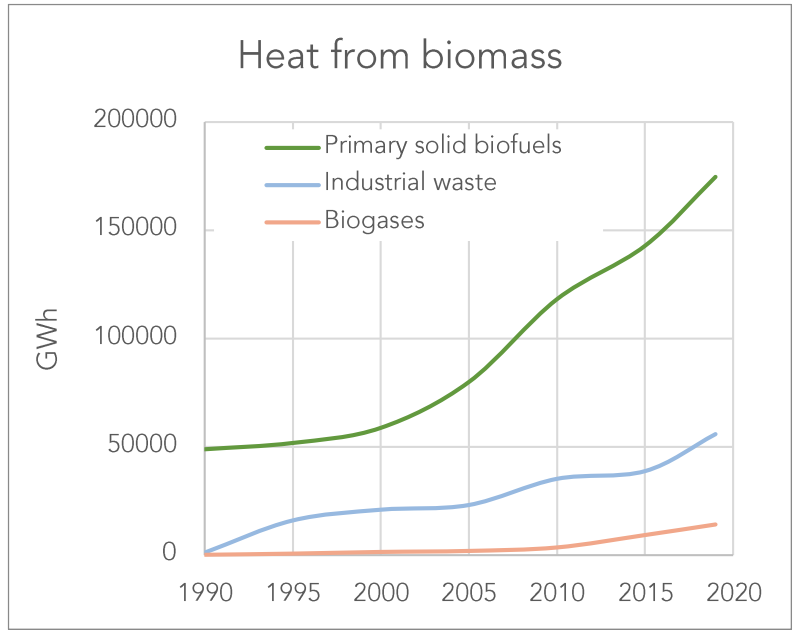
Several activities, such as the excavation of foundations, roads, and projected lands during the construction of the wind energy farm, affect the local biological system.

Renewables

Bioenergy

Biomass is one of the oldest sources of energy.





https://www.iea.org/fuels-and-technologies/renewables

Renewables

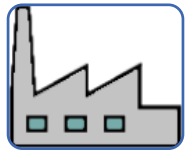
Bioenergy

Biomass is one of the oldest sources of energy.

Land

Water

Fauna and flora



Air

Renewables

Bioenergy

In case of dedicated biomass:

- eventual deforestation;
- high soil erosion rate;
- competition with food production.

To mitigate the adverse effects:

- use of marginal lands;
- waste, residues, aquatic biomass.

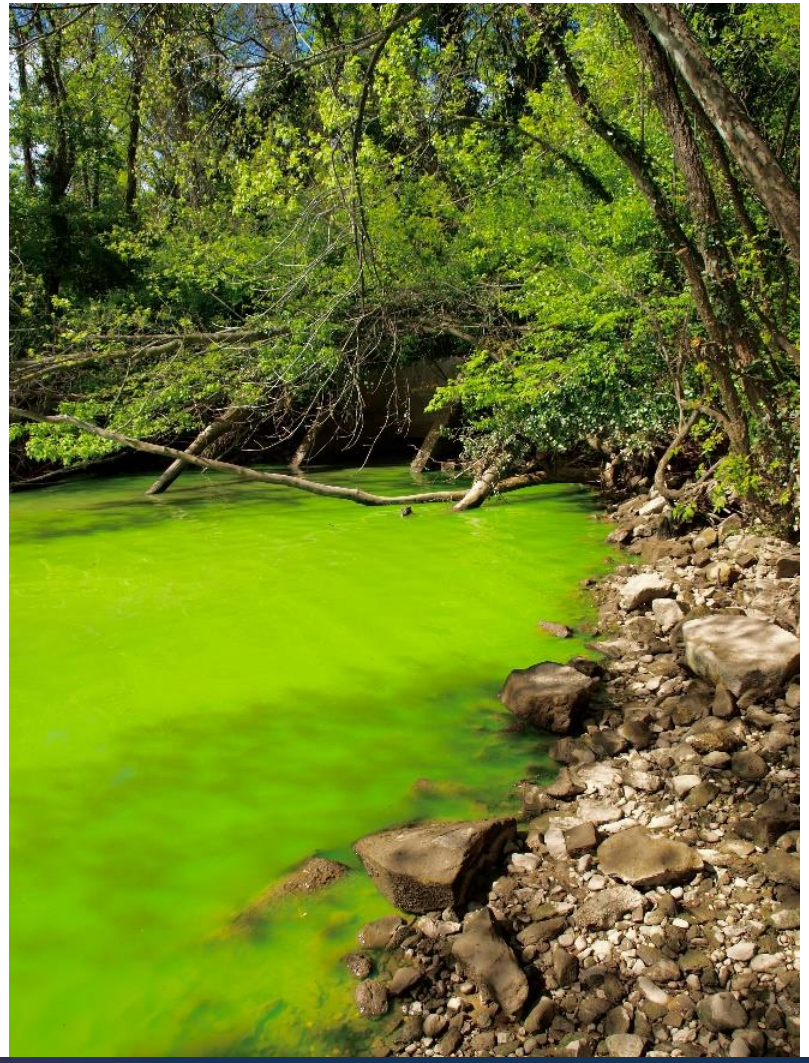
Pictures from:
https://www.publicdomainpictures.net/it/view-image.php?image=296121&picture=la-deforestazione
https://pxhere.com/en/photo/1107629

Renewables

Bioenergy

Water requirements are comparable to other electricity plants: approximately 75 ÷ 200 l per MWh of energy.

Risk of eutrophication.



Pictures from: https://commons.wikimedia.org/wiki/File:Potomac_green_water.JPG

Renewables

Bioenergy

Problems for wildlife due to the destruction of habitats and nutrients or food resources.

The impact on biodiversity depends on:

- the initial land use condition;
- the type of bioenergy production system;
- the landscape configuration.

Pictures from:
https://zestip.com/role-of-ipr-in-bio-diversity/

Renewables

Bioenergy

The most common pollutant emissions are:

- carbon monoxide;
- sulfur dioxide;
- nitrogen oxide.

In some instances, the biomass burned can emit more pollution than fossil fuels.

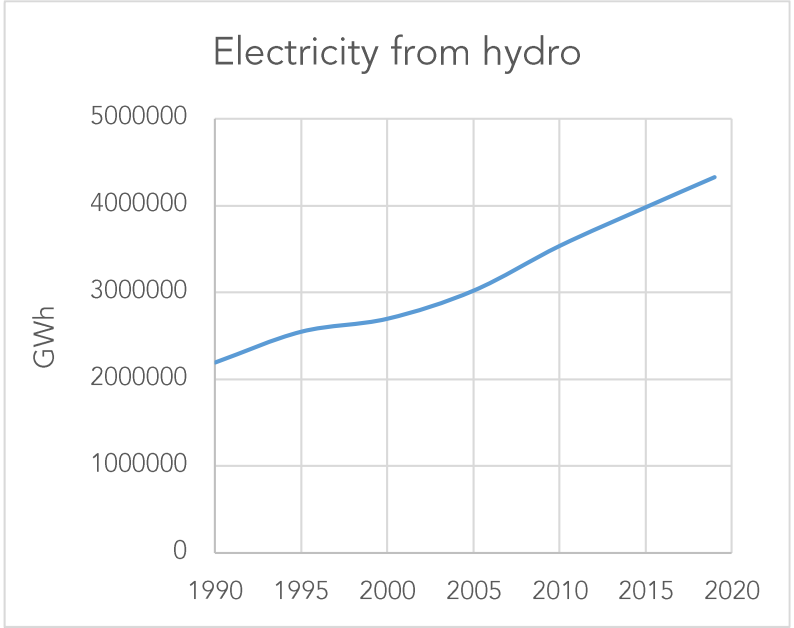
Pictures from:
https://zestip.com/role-of-ipr-in-bio-diversity/

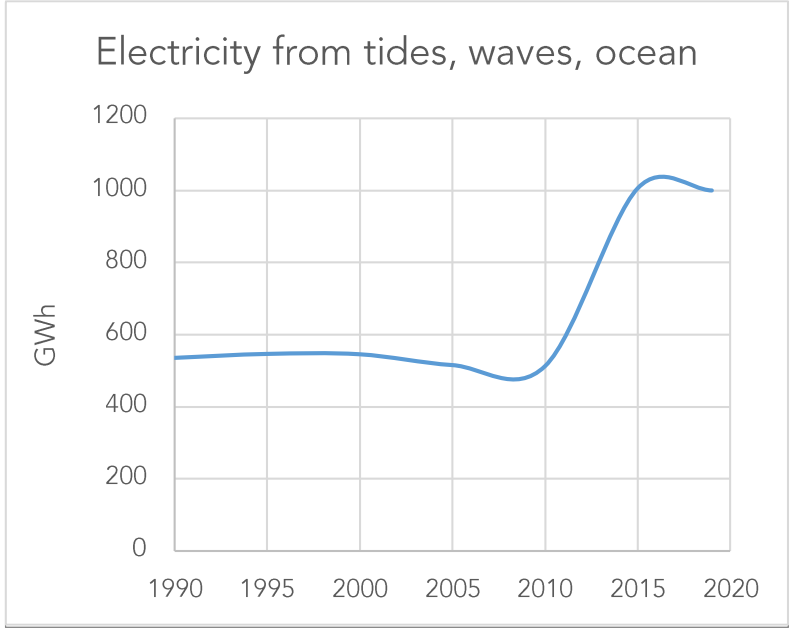
Renewables

Water based

Hydropower provides the largest power generation globally compared to other renewable technologies.

Although still at the research and development stage and not yet commercially available, tides, waves and currents can be used to produce electricity.





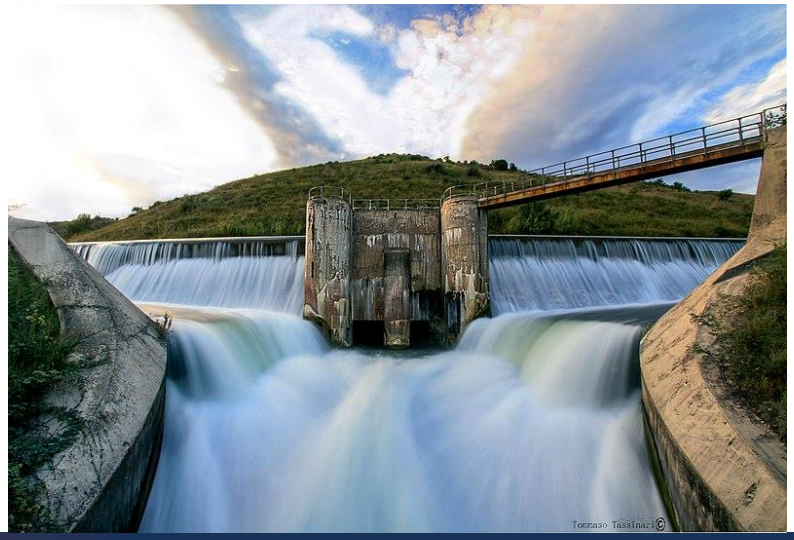
https://www.iea.org/fuels-and-technologies/renewables

Renewables

Water based

Land usage is influenced by geographical conditions.

It can cause destruction of cultivable lands, archeological sites, wildlife habitats, and forests.



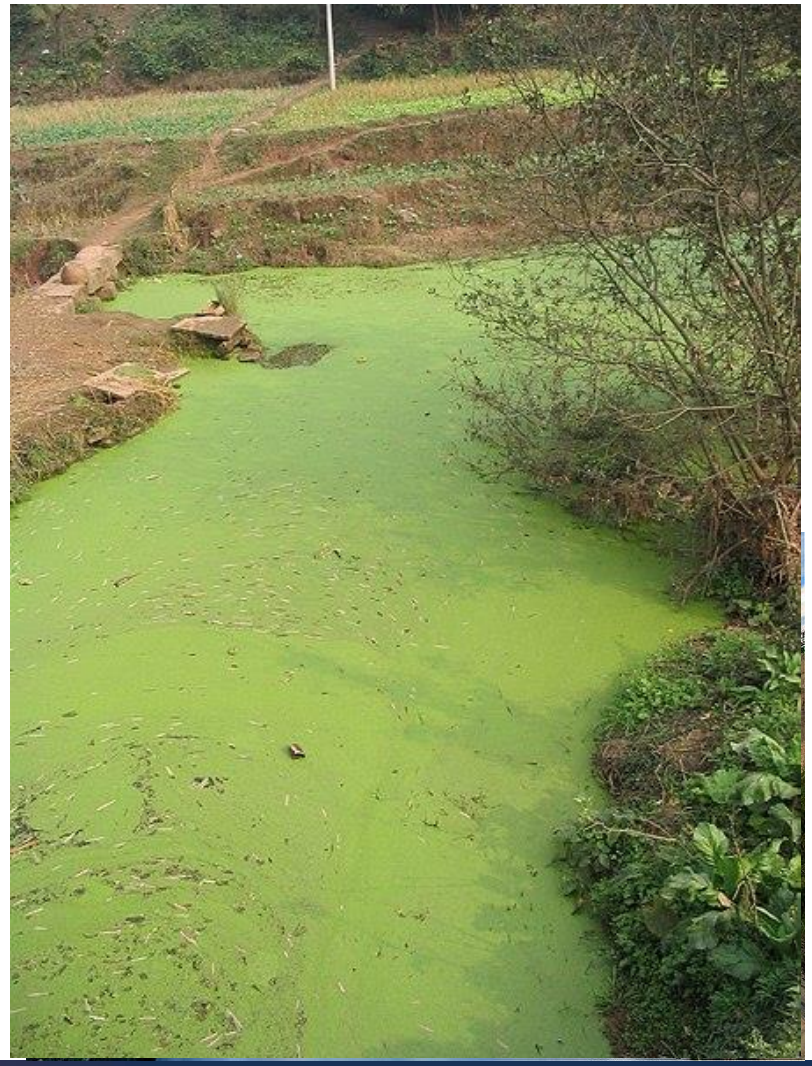
Pictures from:
https://commons.wikimedia.org/wiki/File:Presa_de_El_Atazar_-_01.jpg
https://commons.wikimedia.org/wiki/File:Dam_sel.jpg
https://commons.wikimedia.org/wiki/File:Diga_comelico_2.jpg
https://commons.wikimedia.org/wiki/File:Diga_di_Alanno_2016.jpg

Renewables

Water based

Stagnant nature of reservoir water may cause:

- eutrophication
- an increase in water evaporation rate
- decrease of the oxygen level.



Pictures from:
https://commons.wikimedia.org/wiki/File:River_algae_Sichuan.jpg
https://it.wikipedia.org/wiki/File:Diga_Furore.jpg
https://commons.wikimedia.org/wiki/File:Diga_del_truzzo.jpg

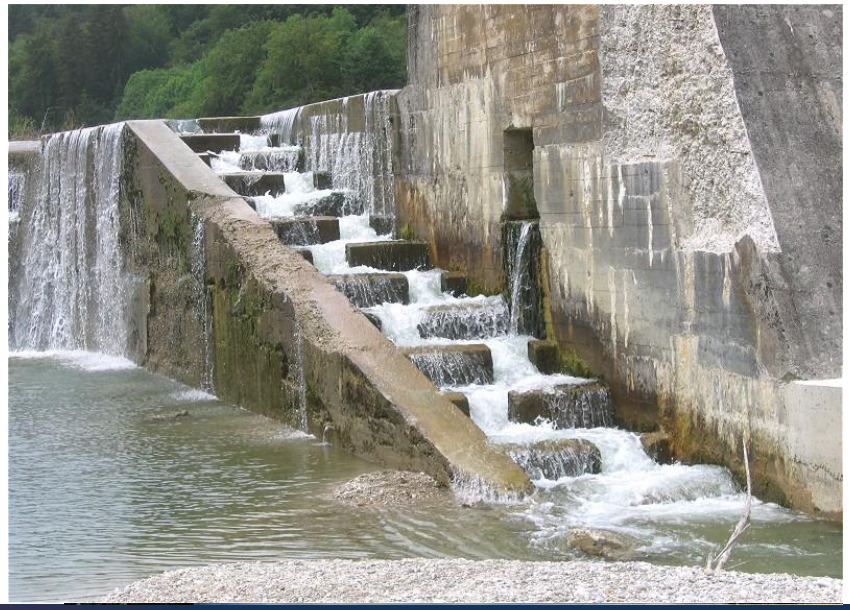
Renewables

Hydropower

Barriers or dams of hydro power plants affect:

- the migration process of fish
- the temperature and flow of water
- the chemical properties of the water.

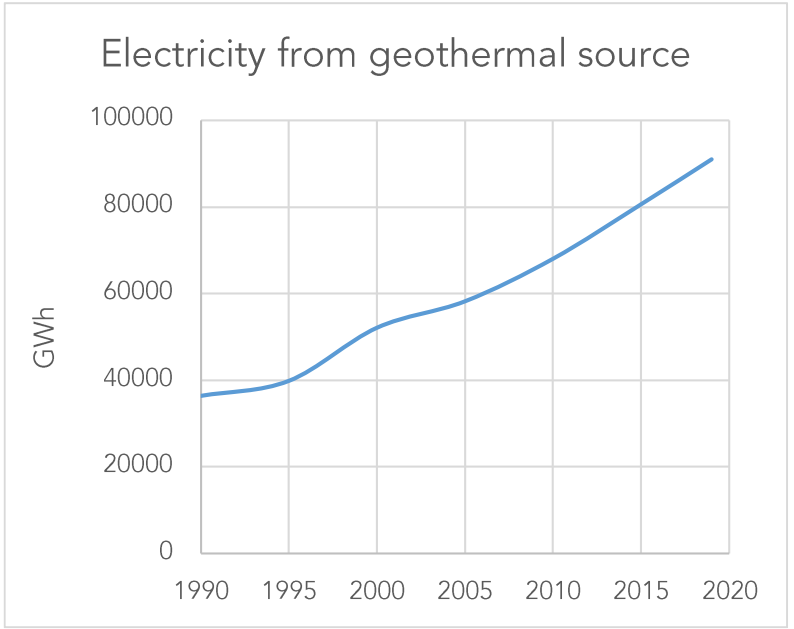
Consequently most indigenous plants and animals will experience negative impacts.

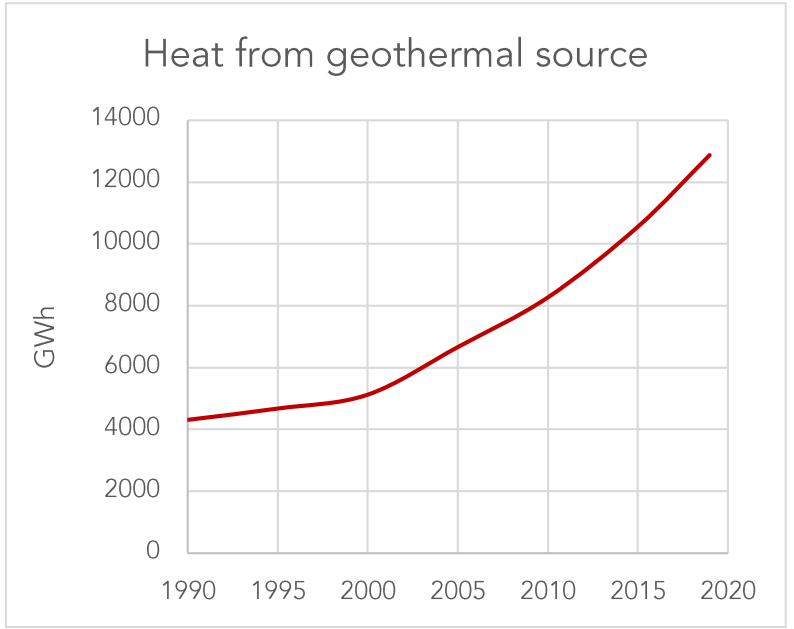


Pictures from:
https://commons.wikimedia.org/wiki/File:John_Day_Dam_fish_ladder.jpg
https://it.wikipedia.org/wiki/Passaggio_per_pesci#/media/File:Fischtreppe_Isar_bei_Pullach.jpg

Renewables

Geothermal source



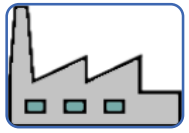


https://www.iea.org/fuels-and-technologies/renewables

Renewables

Geothermal source

Water



Air

Land

Noise

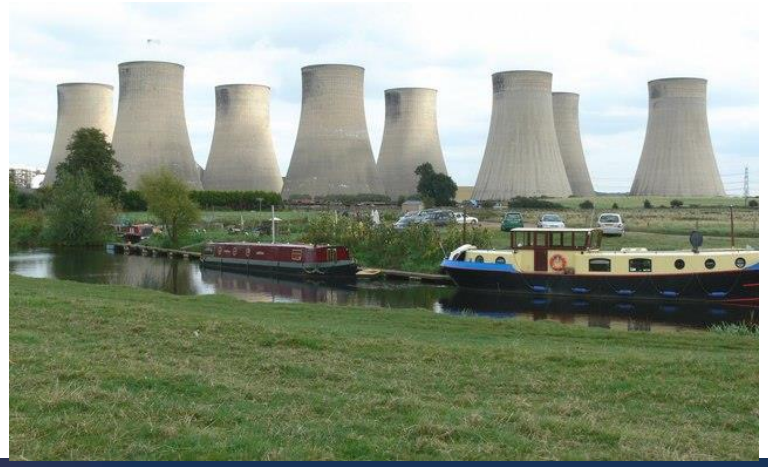
Visual

Renewables

Geothermal source

Water is impact is related to:

- withdrawal of large quantities of geothermal fluid
- drilling wells activities
- discharge of heat
- groundwater level change and pollution.



Pictures from:
https://commons.wikimedia.org/wiki/File:Rig_drilling_known_locally_as_Borewell_for_Water_well_drilling_in_operation_in_India.jpg
https://commons.wikimedia.org/wiki/File:Eight_cooling_towers_-_geograph.org.uk_-_556733.jpg
https://commons.wikimedia.org/wiki/File:Geothermal_steam_rich_rock_gorges.jpg

Renewables

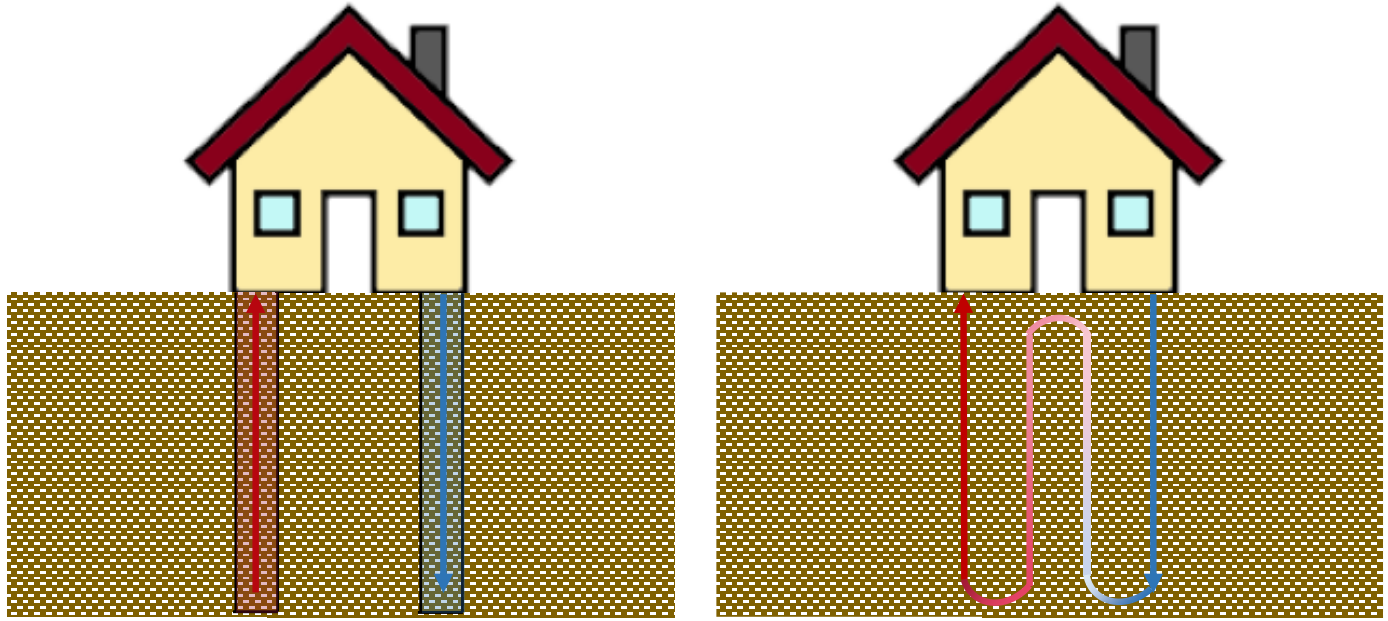
Geothermal source

Air emissions are affected by the plant configuration.

Carbon dioxide is the main greenhouse gas emission from geothermal power plants.

Emissions of H_2S can significantly vary according to individual fields.

Geothermal gases may contain ammonia, mercury in trace amounts, boron vapour and hydrocarbons such as methane.



Open loop

Closed loop

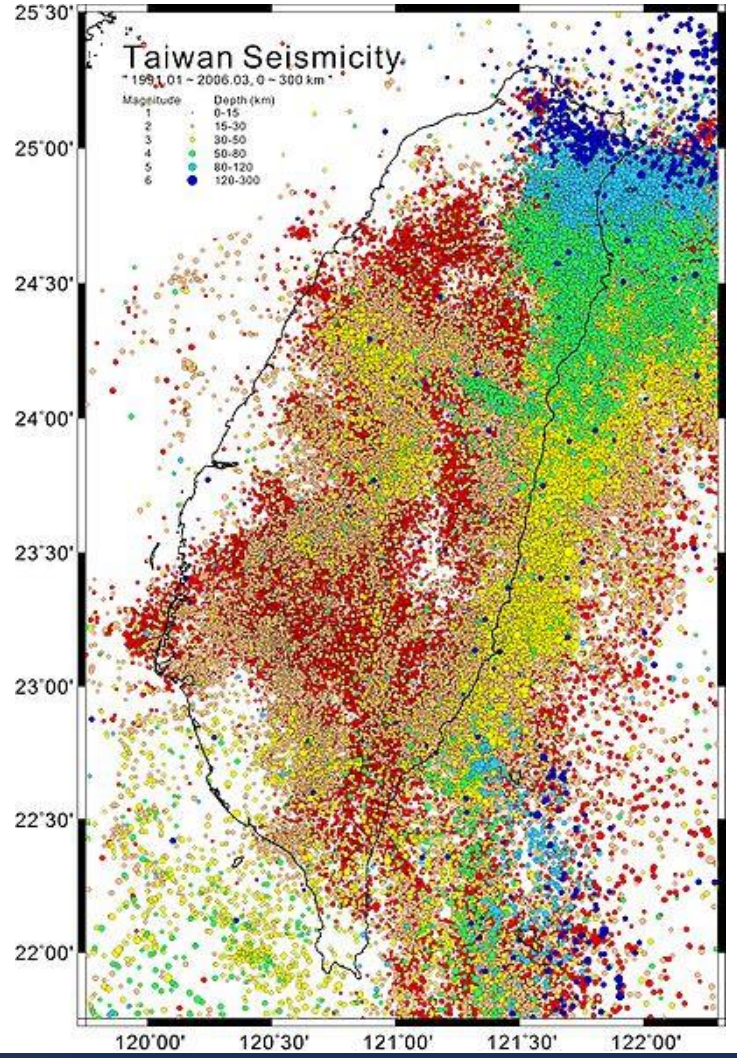
Renewables

Geothermal source

Land occupation depends on the properties of the geothermal source, the plant layout and capacity, the type of cooling system, the locations of wells, pipelines, the substation and auxiliary building.

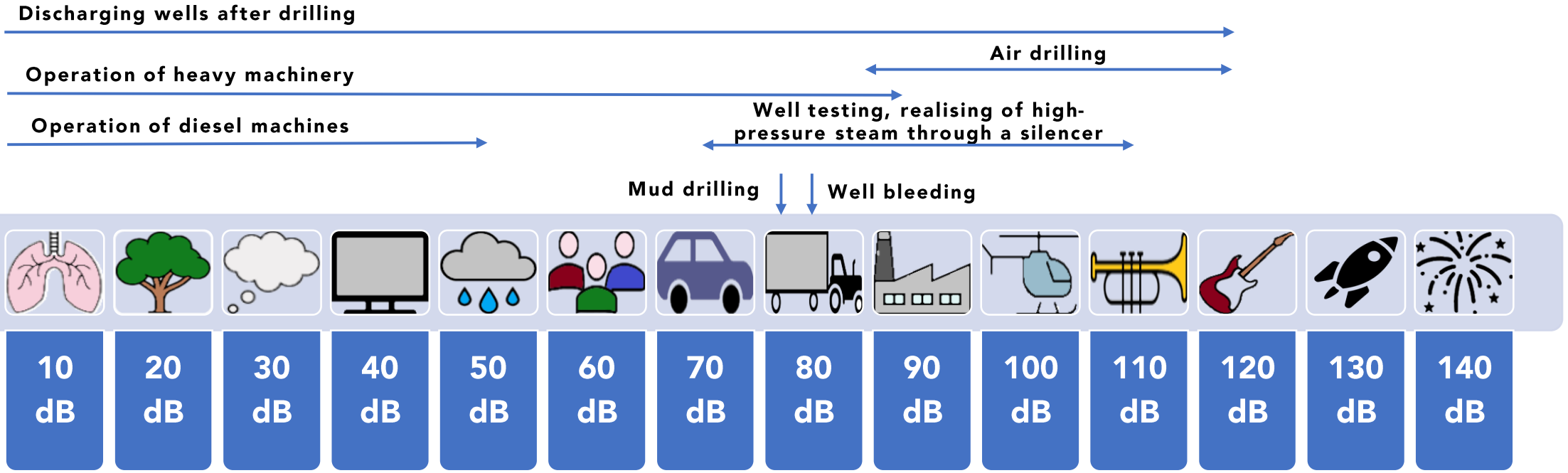
Other effects on ground are:
- subsidence
- induced seismicity.

Pictures from:
https://commons.wikimedia.org/wiki/File:The_Hellishei%C3%B0i_Geothermal_Power_Plant,_2018,_Iceland.jpg
https://commons.wikimedia.org/wiki/File:Vale_Seccolo_Geothermal_Power_Plant.jpg
https://commons.wikimedia.org/wiki/File:Taiwan_seismicity.jpg



Renewables

Geothermal source



Data from:
Bošnjaković, M., Stojkov, M., & Jurjević, M. (2019). Environmental impact of geothermal power plants. *Tehnički vjesnik, 26*(5), 1515-1522.

Renewables

Geothermal source

Visual impact is significant during construction of the plant.

The impact is high when geothermal source is located close to naturalistic attractions.

Pictures from:
https://commons.wikimedia.org/wiki/File:Rig_drilling_known_locally_as_Borewell_for_Water_well_drilling_in_operation_in_India.jpg
https://commons.wikimedia.org/wiki/File:Krafla_geothermal_power_station_wiki.jpg
https://commons.wikimedia.org/wiki/File:Hellisheidi_Geothermal_Power_Plant.png

MEIM | MASTER IN ENTREPRENEURSHIP INNOVATION MANAGEMENT IN COLLABORATION WITH MIT SLOAN

UNIVERSITÀ DEGLI STUDI DI NAPOLI PARTHENOPE

Assessment

Assessment

Tools

- Environmental Impact Assessment
- Lifecycle Assessment
- Ecological and Carbon Footprint
- …

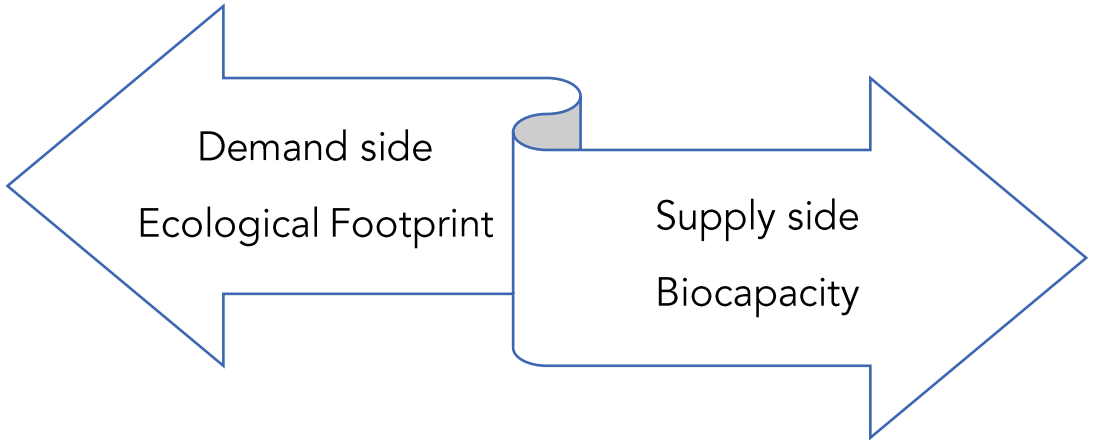
Assessment

Ecological and Carbon Footprint

The Ecological Footprint measures how much nature we have and how much nature we use.

It is measured in “global hectares” (gha).

It can be assessed at various scales—for individuals, regions, countries, and humanity as a whole.



Demand for	Availability of biologically productive land and sea area, including
plant-based food and fiber products	forest lands
livestock and fish products	grazing lands
timber and other forest products	cropland
space for urban infrastructure	fishing grounds
forest to absorb its carbon dioxide emissions from fossil fuels.	built-up land.

https://ec.europa.eu/environment/eia/index_en.htm

Assessment

Ecological and Carbon Footprint

Demand side

Ecological Footprint

Supply side

Biocapacity

It depends on how much we use and how efficiently this is being produced

It depends on the available productive area, its productivity, and the population that shares this biocapacity.

https://ec.europa.eu/environment/eia/index_en.htm

Assessment

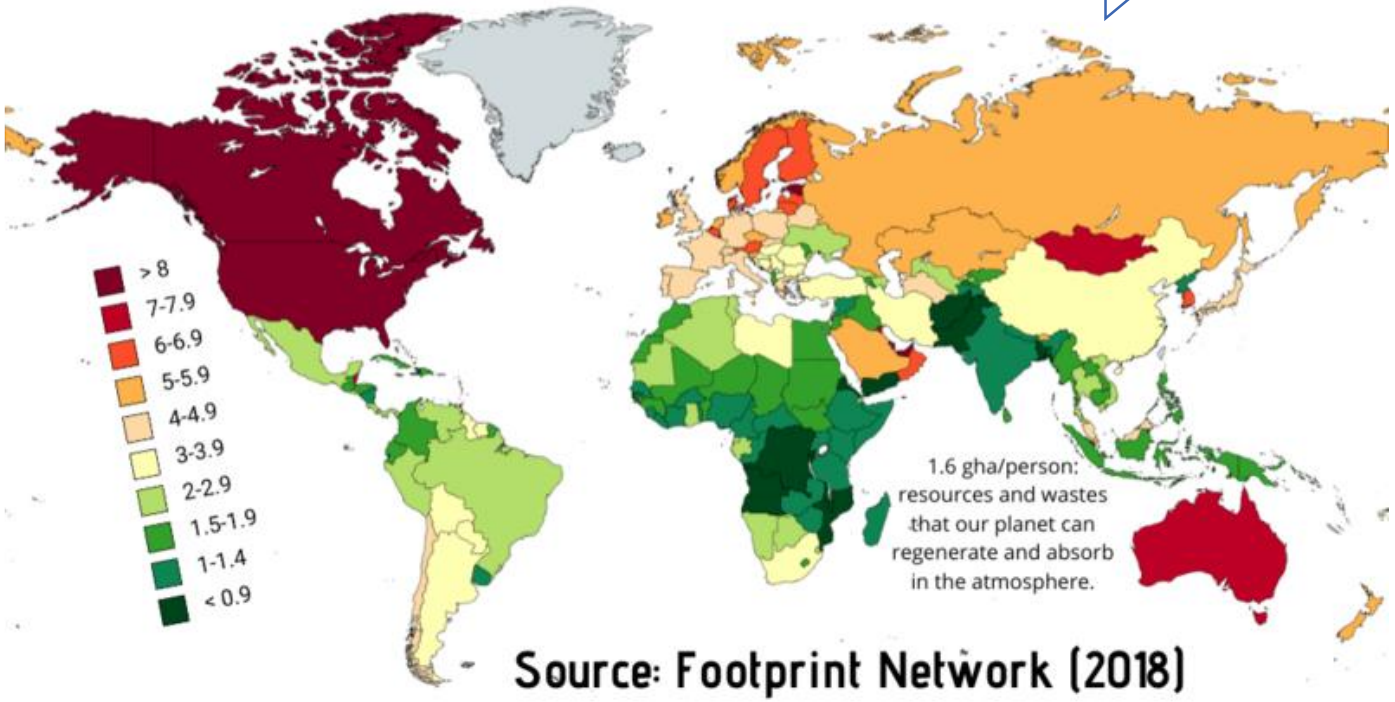
Demand side
Ecological Footprint

Supply side
Biocapacity

Ecological and Carbon Footprint

Ecological deficit
Ecological Footprint > Biocapacity

Ecological reserve
Ecological Footprint < Biocapacity



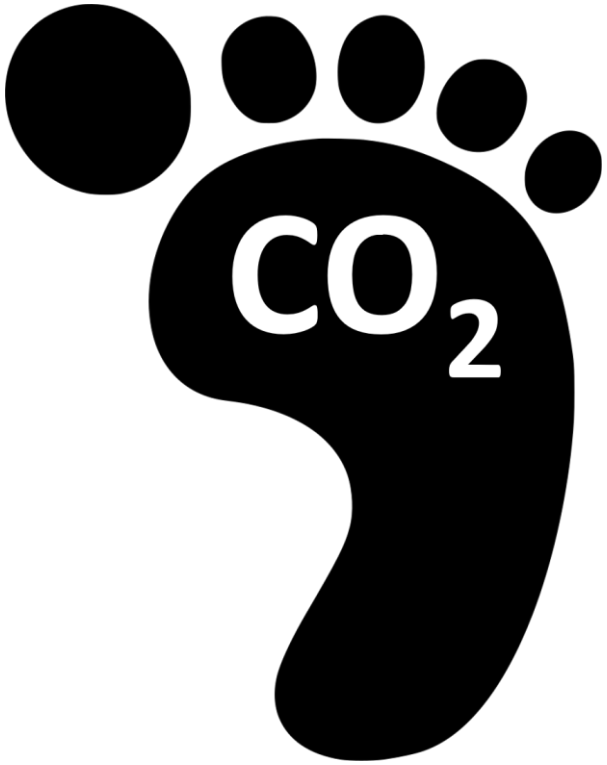
Assessment

Ecological and Carbon Footprint

A carbon footprint is the total greenhouse gas emissions caused by an individual, event, organization, service, place or product, expressed as carbon dioxide equivalent (CO_{2e}).

A carbon dioxide equivalent is a metric measure used to compare the emissions from various greenhouse gases on the basis of their global-warming potential (GWP), by converting amounts of other gases to the equivalent amount of carbon dioxide with the same global warming potential.

Global warming potential (GWP) is the heat absorbed by any greenhouse gas in the atmosphere, as a multiple of the heat that would be absorbed by the same mass of carbon dioxide.



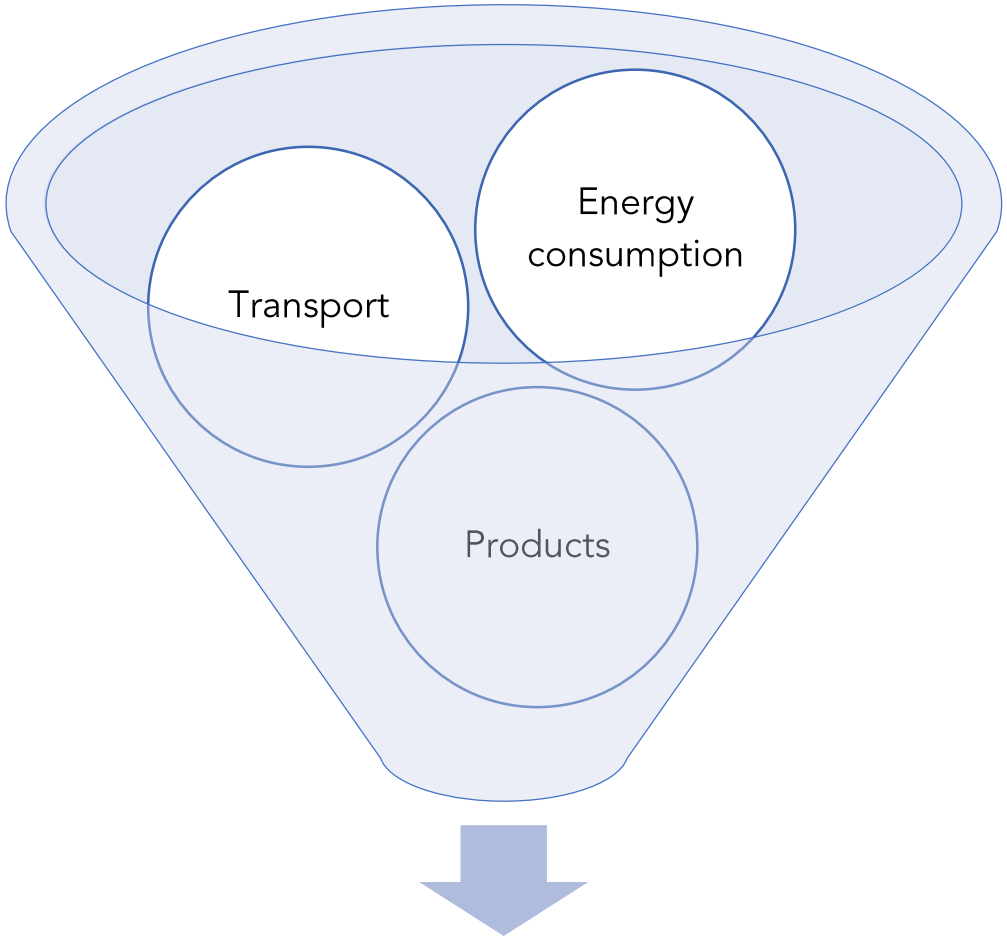
Assessment

Ecological and Carbon Footprint

Energy consumption:
- Electricity (https://quantoconsumo.luce-gas.it/)
- Heat (https://luce-gas.it/guida/consumo/gas)

Transport:
- Own transportation
- Public transport
- Flights

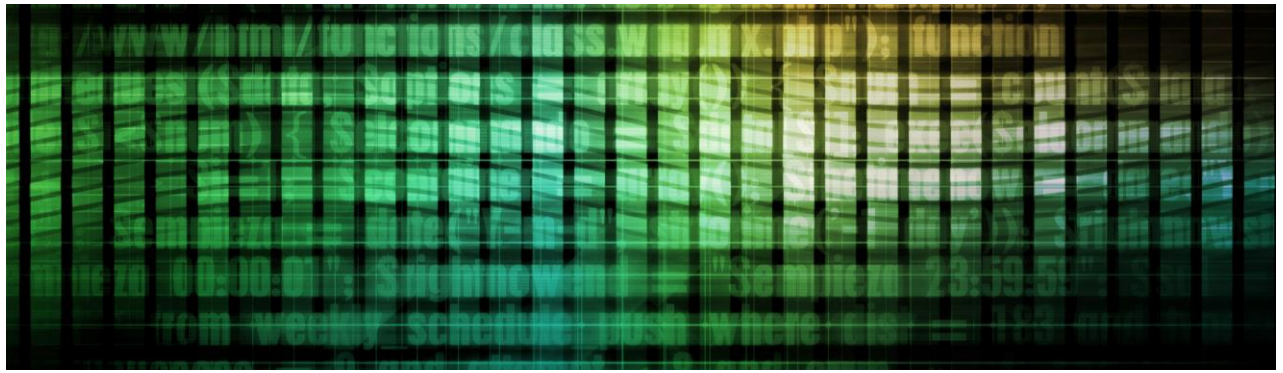
Products:
- Food
- Clothes, textiles and shoes
- Paper based products
- Hobbies
- Furniture
- Hotels, restaurants…
- Education
- …

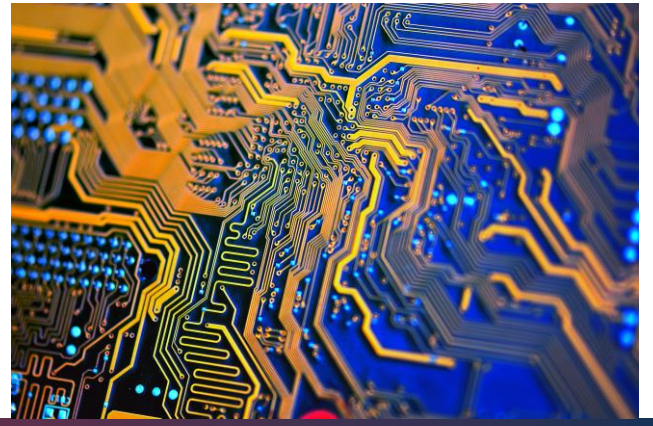


Assessment

Ecological and Carbon Footprint

- https://www.footprintcalculator.org/home/en
- https://www.carbonfootprint.com/calculator.aspx
- https://www.watercalculator.org/



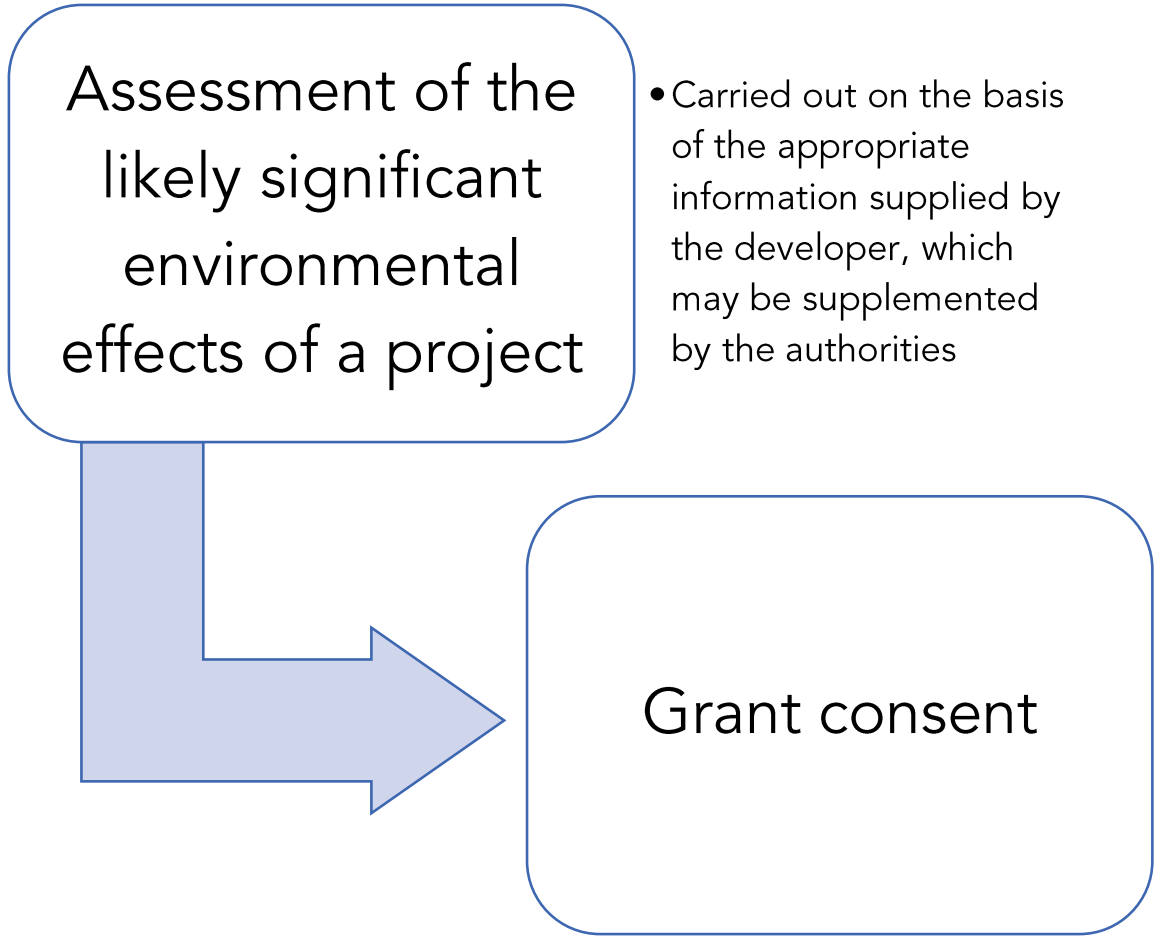


Assessment

Environmental Impact Assessment

The effects of a project on the environment should be assessed in order to take account of concerns:

- to protect human health
- to contribute by means of a better environment to the quality of life
- to ensure maintenance of the diversity of species
- to maintain the reproductive capacity of the ecosystem as a basic resource for life.



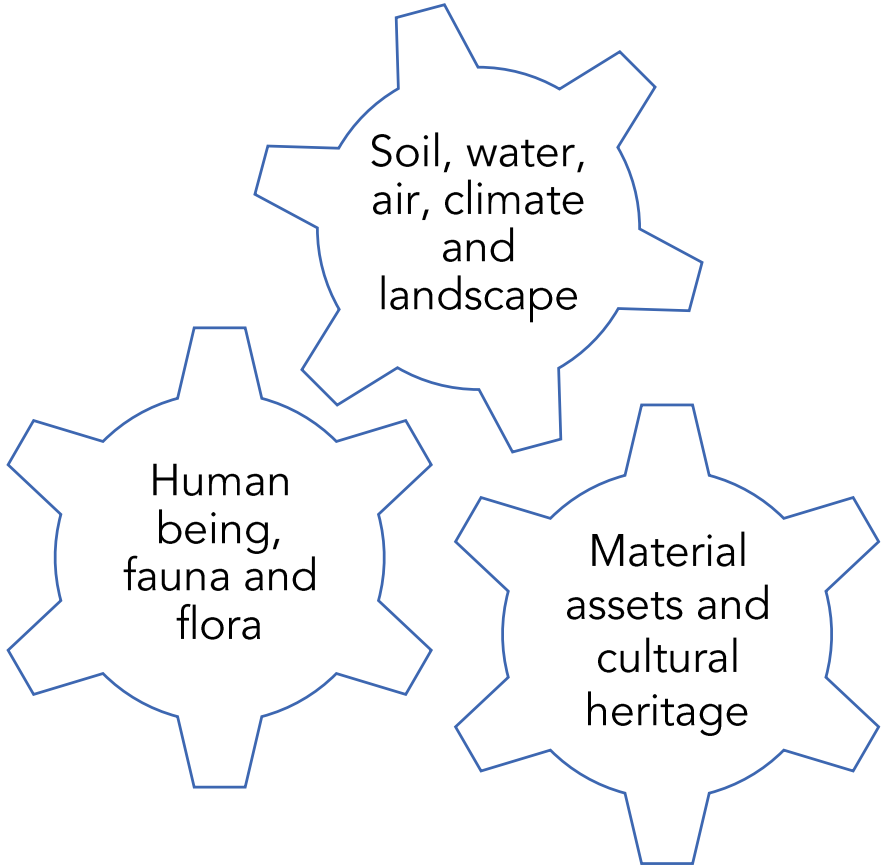
https://ec.europa.eu/environment/eia/index_en.htm

Assessment

Environmental Impact Assessment – For which projects (some examples)

- Crude-oil refineries and installations for the gasification and liquefaction of 500 tonnes or more of coal or bituminous shale per day
- Thermal power stations and other combustion installations with a heat output of 300 MW or more
- Nuclear power stations and other nuclear reactors including the dismantling or decommissioning of such power stations or reactors
- Installations for the reprocessing of irradiated nuclear fuel
- Groundwater abstraction or artificial groundwater recharge schemes where the annual volume of water abstracted or recharged is equivalent to or exceeds 10 million cubic metres.
- Extraction of petroleum and natural gas for commercial purposes where the amount extracted exceeds 500 tonnes/day in the case of petroleum and 500 000 cubic metres/day in the case of gas.
- Dams and other installations designed for the holding back or permanent storage of water, where a new or additional amount of water held back or stored exceeds 10 million cubic metres.
- Pipelines with a diameter of more than 800 mm and a length of more than 40 km: for the transport of gas, oil, chemicals; for the transport of carbon dioxide (CO_2) streams for the purposes of geological storage, including associated booster stations.
- Construction of overhead electrical power lines with a voltage of 220 kV or more and a length of more than 15 km.
- Installations for storage of petroleum, petrochemical, or chemical products with a capacity of 200 ktonnes or more.

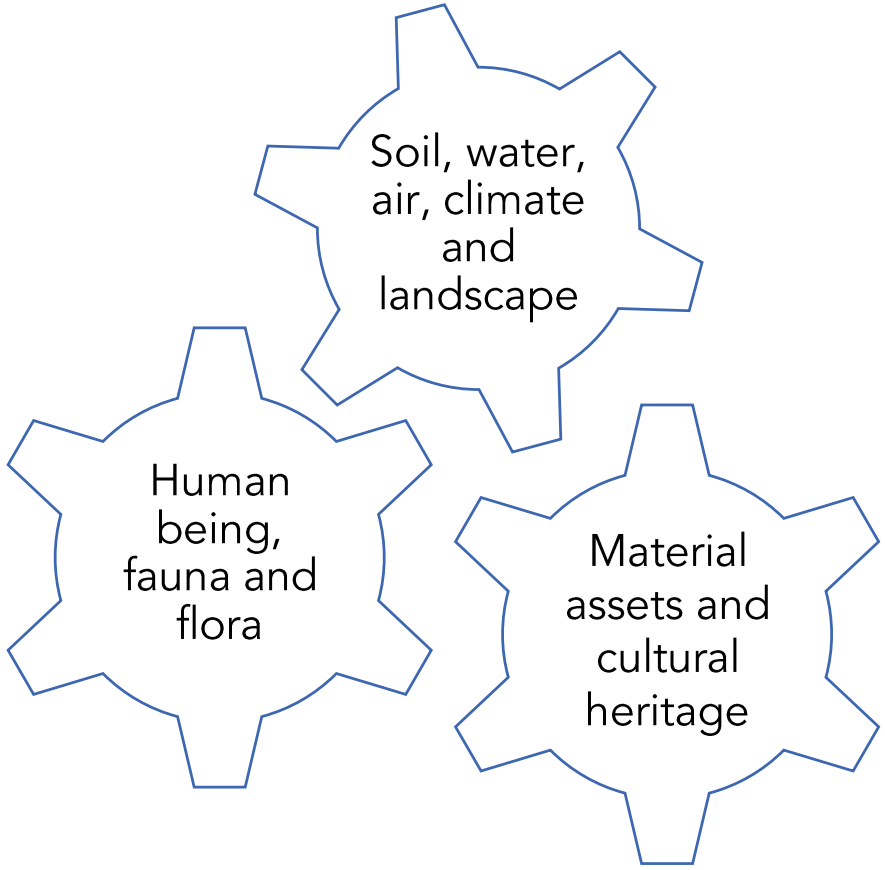
https://ec.europa.eu/environment/eia/index_en.htm



Assessment

Environmental Impact Assessment – For which projects (some examples)

- Construction of lines for long-distance railway traffic and of airports with a basic runway length of 2 100 m or more, construction of motorways and express roads, construction of a new road of four or more lanes.
- Construction of lines for long-distance railway traffic and of airports with a basic runway length of 2 100 m or more, construction of motorways and express roads, construction of a new road of four or more lanes
- Waste and waste wastewater treatment plants (see specific conditions)
- Industrial plants for the production of pulp from timber or similar fibrous materials, paper and board with a production capacity exceeding 200 tonnes per day



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Assessment

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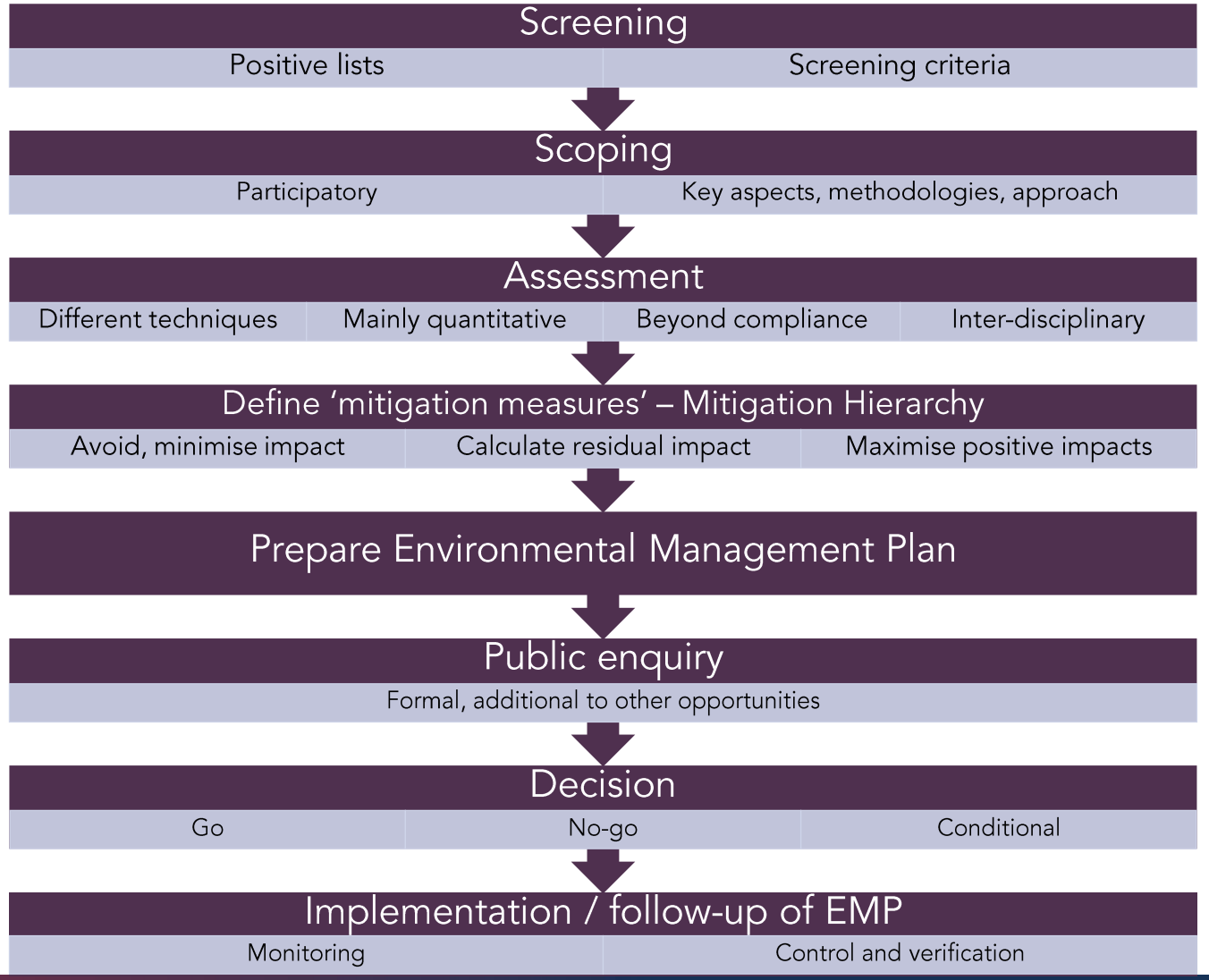
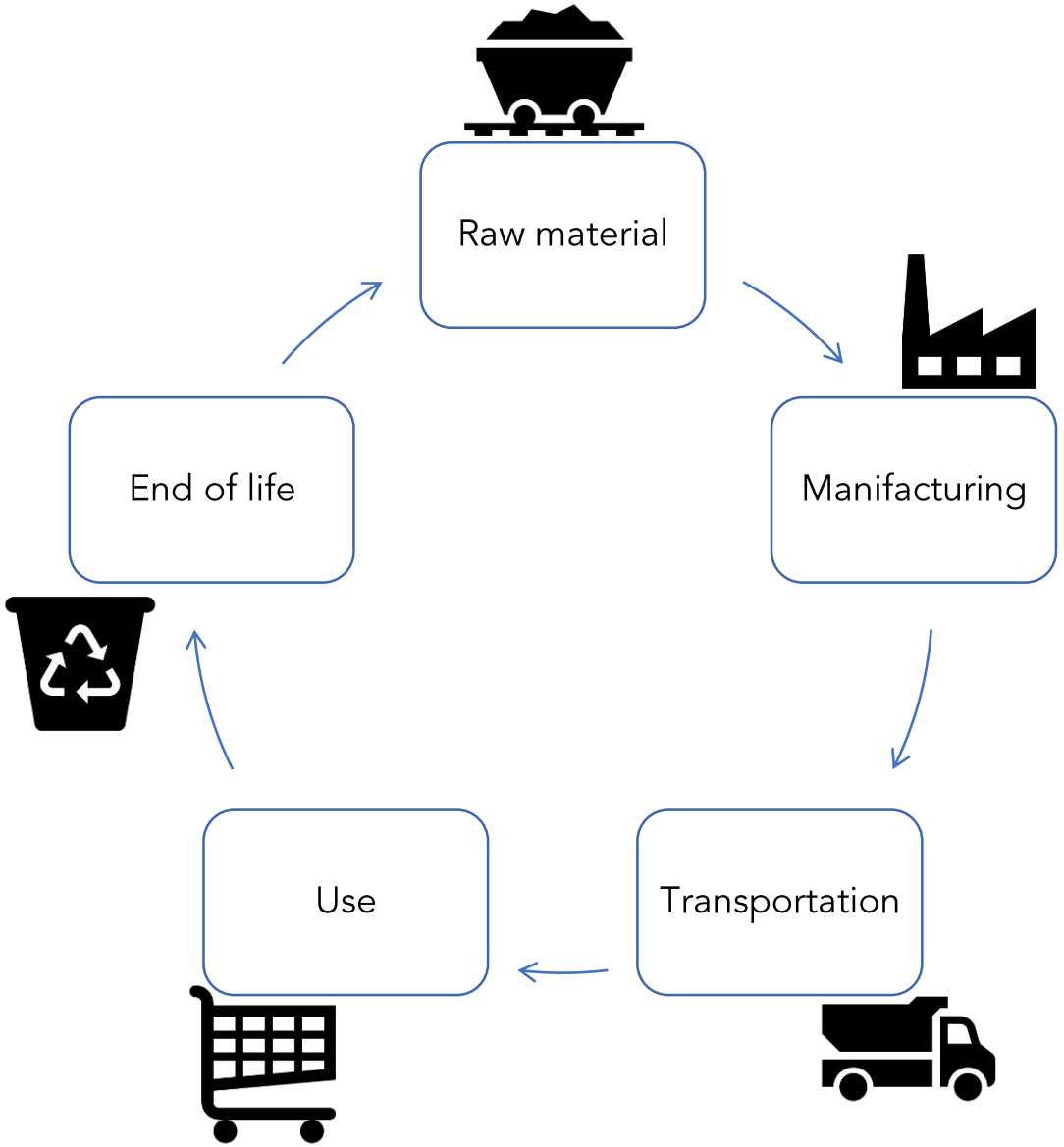


https://ec.europa.eu/environment/eia/index_en.htm

Assessment

Life Cycle Assessment

Defined as compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle.



https://ec.europa.eu/environment/eia/index_en.htm

Assessment

Life Cycle Assessment

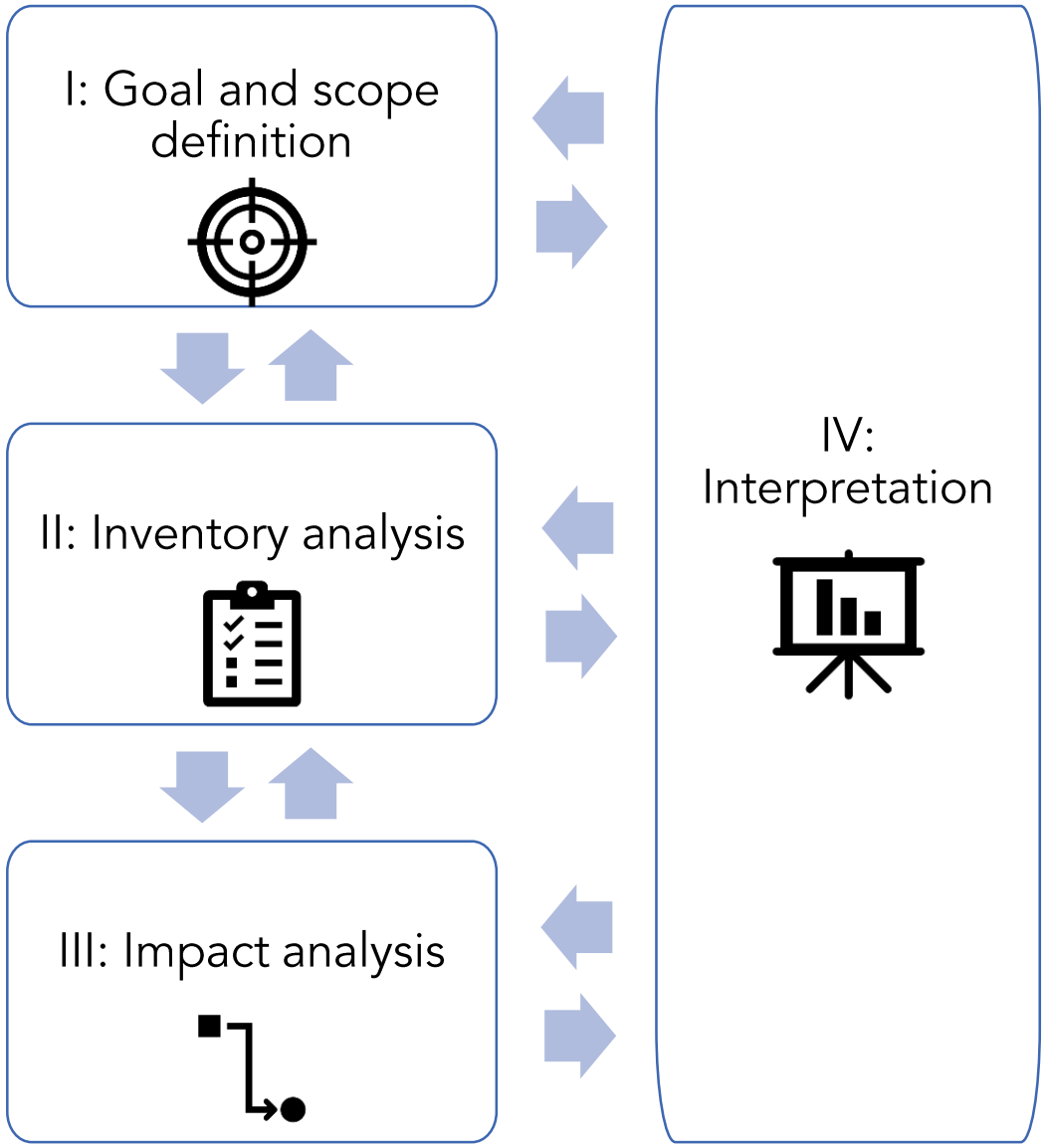
I: definition of the aims of the study, methodological choices (including the functional unit), system boundaries, allocation procedures, impact categories, models used.

II: data collection and calculation procedure for the quantification of inputs and outputs of the studied system.

III: results are associated to environmental impact categories and indicators (classification of the emissions into impact categories).

IV: interpretation of results obtained in the previous steps, in accordance to the stated goal and scope, including completeness, sensitivity and consistency checks, evaluation of uncertainty and accuracy.

https://eplca.jrc.ec.europa.eu/lifecycleassessment.html



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Grazie per averci seguito