

Resource

100 kg

Manufacturing

Electricity use: 100 kWh

Transport

100 km

Use phase

End-of-life

100 kg

A dense forest of tall, slender trees with green foliage, serving as the background for the slide.

Resource
TROPICAL HARDWOOD





Resource
WASTE WOOD



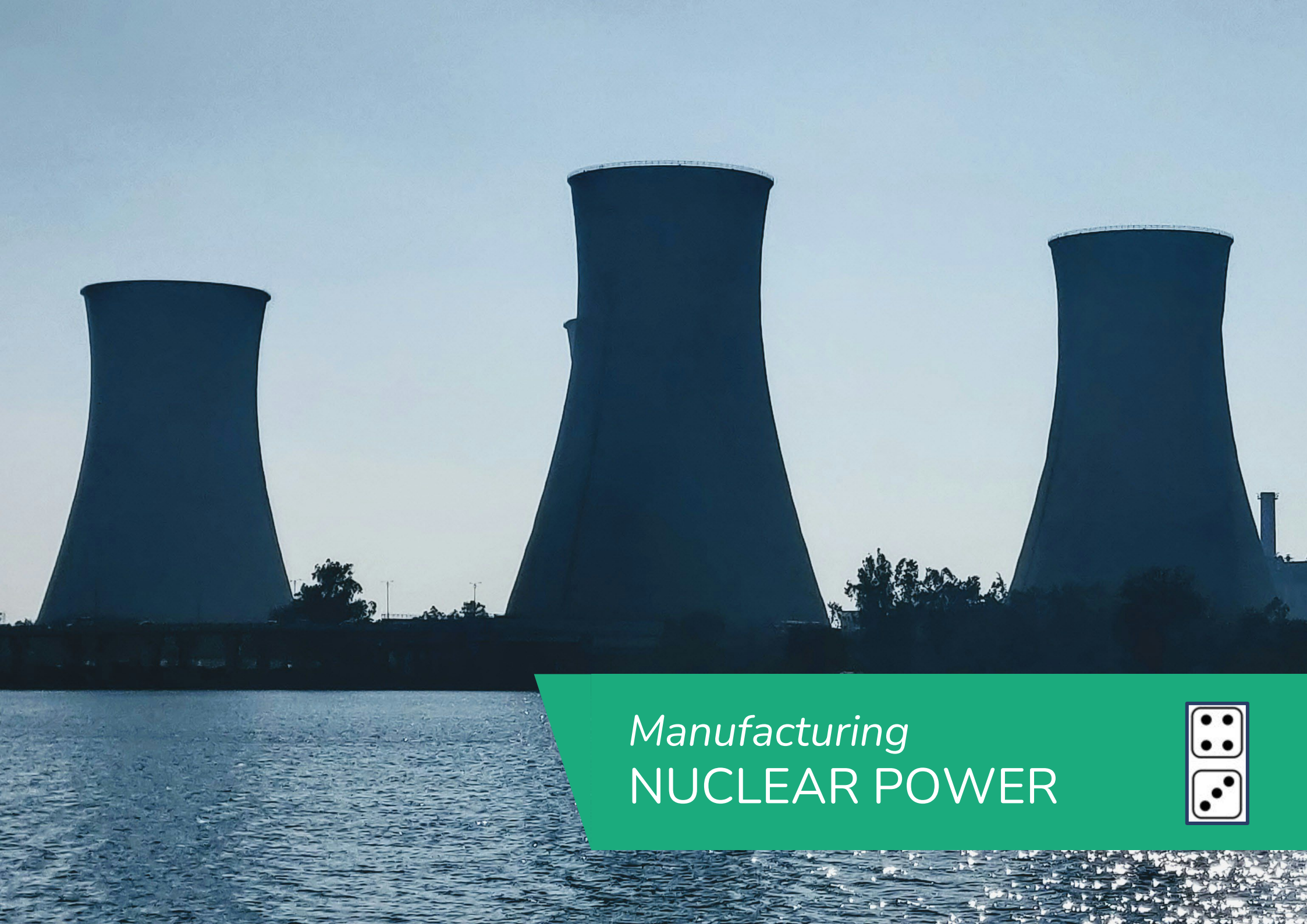
Resource
LOCAL OAK



A photograph of several wind turbines silhouetted against a sunset sky with hues of orange, pink, and purple. The turbines are arranged in a line, receding into the distance. The blades are in motion, creating a slight blur.

Manufacturing WIND ELECTRICITY





Manufacturing
NUCLEAR POWER





Manufacturing
ELECTRICITY FROM NATURAL GAS





Transport
TRAIN





Transport
TRUCK





Transport
SHIP



Use phase
BUILDING MATERIAL





Use phase
EXHIBITION MATERIAL

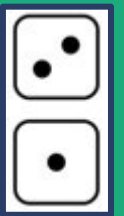




Use phase
SHELTER MATERIAL



End-of-life
INCINERATION





End-of-life
RECYCLING





End-of-life
LANDFILL



TROPICAL HARDWOOD

36

Climate Change



Ecotoxicity



Human toxicity



Mineral resources



Particulate matter



Water use



TROPICAL HARDWOOD

Cultivation of the wood including chemical weed control, fertilizer and machines for harvesting, including transport per ship to Europe.

Climate Change

Fuel and the production and maintenance of the container ship

Ecotoxicity

Fuel and the production and maintenance of the container ship

Human toxicity

Transport of tractor and trailer, diesel burned in agricultural machinery

Mineral resources

Fuel and the production and maintenance of the container ship

Particulate matter

Fuel and the production and maintenance of the container ship

Water use

Fuel and the production and maintenance of the container ship

WASTE WOOD

0

Climate Change

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

Ecotoxicity

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

Human toxicity

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

Mineral resources

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

Particulate matter

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

Water use

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

WASTE WOOD

Wood originating from end-of-life products that have been used already and have no economic value left.

Climate Change

It is assumed to come burden free

Ecotoxicity

It is assumed to come burden free

Human toxicity

It is assumed to come burden free

Mineral resources

It is assumed to come burden free

Particulate matter

It is assumed to come burden free

Water use

It is assumed to come burden free

LOCAL OAK

30

Climate Change



Ecotoxicity



Human toxicity



Mineral resources



Particulate matter



Water use



LOCAL OAK

Planting, including seedling production and all process related to forest management (site preparation, planting, tending, young growth tending, clearing, thinning) and harvesting operations. It also covers the maintenance and construction of forest roads.

Climate Change

Clefting, skidding and sawing

Ecotoxicity

Skidding and gravel for natural road

Human toxicity

Gravel for natural road, clefting and skidding

Mineral resources

Gravel for natural road, clefting and skidding

Particulate matter

Clefting and skidding

Water use

Sawing and gravel for natural road

Climate Change

Ecotoxicity

Human toxicity

Mineral resources

Particulate matter

Water use

WIND ELECTRICITY

32



WIND ELECTRICITY

It includes operation and maintenance (lubricating oil) expenditures as well as infrastructure inputs.

Climate Change

Fixed parts and moving parts

Ecotoxicity

Fixed parts and moving parts

Human toxicity

Fixed parts and moving parts

Mineral resources

Fixed parts and moving parts

Particulate matter

Fixed parts and moving parts

Water use

Fixed parts and moving parts

NUCLEAR POWER

33

Climate Change



Ecotoxicity



Human toxicity



Mineral resources



Particulate matter



Water use



NUCLEAR POWER

Includes fuel elements, chemicals, diesel requirements as well as the relevant transport requirements and water use for cooling.

Climate Change

Nuclear fuel element and power plant

Ecotoxicity

Nuclear fuel element and power plant

Human toxicity

Nuclear fuel element

Mineral resources

Nuclear fuel element

Particulate matter

Nuclear fuel element and power plant

Water use

Water

ELECTRICITY FROM NATURAL GAS

39

Climate Change



Ecotoxicity



Human toxicity



Mineral resources



Particulate matter



Water use



ELECTRICITY FROM NATURAL GAS

All operation and maintenance activities and materials of the power plants.

Climate Change

Carbon dioxide and natural gas

Ecotoxicity

Natural gas

Human toxicity

Natural gas

Mineral resources

Natural gas

Particulate matter

Natural gas and nitrogen oxides

Water use

Water

TRAIN

34

Climate Change



Ecotoxicity



Human toxicity



Mineral resources



Particulate matter



Water use



TRAIN

The production and the maintenance of the locomotive and the goods wagon, the construction of the railway track and the energy use and operation emission of a freight train using diesel and electricity.

Climate Change

Electricity use and railway track

Ecotoxicity

Railway track and goods wagon

Human toxicity

Electricity use and railway track

Mineral resources

Railway track and goods wagon

Particulate matter

Railway track, nitrogen oxides and electricity use

Water use

Electricity use and railway track

Climate Change

Ecotoxicity

Human toxicity

Mineral resources

Particulate matter

Water use

TRUCK
41



TRUCK

The infrastructure of the truck and road network, the materials and efforts needed for maintenance of these, and the fuel consumed in the vehicle for the journey.

Climate Change

Carbon dioxide and diesel

Ecotoxicity

Brake wear emissions and truck

Human toxicity

Truck and brake wear emissions

Mineral resources

Truck and diesel

Particulate matter

Diesel, nitrogen oxides and road

Water use

Truck, diesel and road

SHIP
28

Climate Change



Ecotoxicity



Human toxicity



Mineral resources



Particulate matter



Water use



SHIP

The operation of an average container ship (eg consumption of fuel, airborne gaseous emissions, particulate emissions, heavy metal emissions) and links to the production and maintenance of one ship and the construction of one port.

Climate Change

Carbon dioxide

Ecotoxicity

Container ship

Human toxicity

Container ship and heavy fuel oil

Mineral resources

Container ship and heavy fuel oil

Particulate matter

Sulphur dioxide and nitrogen oxides

Water use

Container ship and heavy fuel oil

INCINERATION

31

Climate Change



Ecotoxicity



Human toxicity



Mineral resources



Particulate matter



Water use



INCINERATION

Waste being treated and waste-specific emissions from the incineration process and auxiliary material consumption for flue gas cleaning are released to the environment.

Climate Change

Facility, dinitrogen monoxide and required heat

Ecotoxicity

Facility

Human toxicity

Bottom ash and residues

Mineral resources

Facility

Particulate matter

Nitrogen oxides

Water use

Water

RECYCLING

26

Climate Change



Ecotoxicity



Human toxicity



Mineral resources



Particulate matter



Water use



RECYCLING

The use of a stationary electric chopper which is powered by a motor of 37 kW and additionally a 5 kW-motor for the feeding of the wood.

Climate Change

Electricity use

Ecotoxicity

Chipping unit and electricity use

Human toxicity

Electricity use

Mineral resources

Chipping unit and electricity use

Particulate matter

Electricity use

Water use

Electricity use

LANDFILL

31

Climate Change



Ecotoxicity



Human toxicity



Mineral resources



Particulate matter



Water use



LANDFILL

Wood being landfilled and waste-specific emissions from the landfill are released to the environment (air due to landfill gas, water due to landfill leachate, and subsequent into groundwater).

Climate Change

Methane emissions

Ecotoxicity

Gravel, diesel for construction and leachate

Human toxicity

Zinc to ground (water)

Mineral resources

Diesel for construction, leachate and gravel

Particulate matter

Diesel for construction and gravel

Water use

Leachate and gravel

TROPICAL HARDWOOD

36

Climate Change



Ecotoxicity



Human toxicity



Mineral resources



Particulate matter



Water use



LOCAL OAK

30

Climate Change



Ecotoxicity



Human toxicity



Mineral resources



Particulate matter



Water use



Climate Change

Ecotoxicity

Human toxicity

Mineral resources

Particulate matter

Water use

WIND ELECTRICITY

32

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

NUCLEAR POWER

33

Climate Change



Ecotoxicity



Human toxicity



Mineral resources



Particulate matter



Water use



ELECTRICITY FROM NATURAL GAS

39

Climate Change



Ecotoxicity



Human toxicity



Mineral resources



Particulate matter



Water use



TRAIN

34

Climate Change

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

Ecotoxicity

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

Human toxicity

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

Mineral resources

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

Particulate matter

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

Water use

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

TRUCK

41

Climate Change

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

Ecotoxicity

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

Human toxicity

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

Mineral resources

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

Particulate matter

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

Water use

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

SHIP
28

Climate Change



Ecotoxicity



Human toxicity



Mineral resources



Particulate matter



Water use



INCINERATION

31

Climate Change



Ecotoxicity



Human toxicity



Mineral resources



Particulate matter



Water use



RECYCLING

26

Climate Change



Ecotoxicity



Human toxicity



Mineral resources



Particulate matter



Water use



LANDFILL

31

Climate Change



Ecotoxicity



Human toxicity



Mineral resources



Particulate matter



Water use



Specific:

Carbon dioxide

Methane

Nitrous oxide

Categories:

Chlorofluorocarbons

Hydrochlorofluoro-carbons

Hydrofluorocarbons

Chlorocarbons and
hydrochlorocarbons

Bromocarbons, hydrobromocarbons
and Halons

Fully Fluorinated Species

Halogenated alcohols and ethers

CLIMATE CHANGE

An emission of a greenhouse gas (kg) will lead to an increased atmospheric concentration of greenhouse gases (ppb) which, in turn, will increase the radiative forcing capacity (W/m^2), leading to an increase in the global mean temperature. Increased temperature ultimately results in damage to human health and ecosystems.

This is either including or excluding emissions from biogenic (from biomass) carbon sources. Emissions from non-biogenic (from fossil sources) carbon are always taken into account.



18,500 substances

Some examples:

Ethylbenzene

Styrene

Toluene

Phenol

Isopropyl Phenyl Carbamate

Bromoxynil

Chlorobenzilate

Dimethoate

2,6-Dinitrotoluene

2,4,6-Trichloroaniline

Acetonitrile

Hexachlorocyclopentadiene

Tetraethyl lead

ECOTOXICITY

The characterization factor of human toxicity and ecotoxicity accounts for the environmental persistence (fate), accumulation in the human food chain (exposure), and toxicity (effect) of a chemical. A cause-effect pathway, from emission to the environment, via fate and exposure, to affected species and disease incidences, leading finally to damage to ecosystems and human health.



18,500 substances

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Acetonitrile

Hexachlorocyclopentadiene

Tetraethyl lead

HUMAN TOXICITY

The characterization factor of human toxicity and ecotoxicity accounts for the environmental persistence (fate), accumulation in the human food chain (exposure), and toxicity (effect) of a chemical. A cause-effect pathway, from emission to the environment, via fate and exposure, to affected species and disease incidences, leading finally to damage to ecosystems and human health.



Some examples:

Aluminium

Arsenic

Cesium

Clay

Copper

Feldspar

Gypsum

Iron

Lithium

Magnesium

Nickel

Phosphorus

Silver

Titanium

Uranium

Zinc

MINERAL RESOURCES

The primary extraction of a mineral resource will lead to an overall decrease in ore grade, meaning the concentration of that resource in ores worldwide, which in turn will increase the ore produced per kilogram of mineral resource extracted. This, when combined with the expected future extraction of that mineral resource, leads to an average surplus ore potential which is the midpoint indicator for this impact category. An increase in surplus ore potential will then lead to a surplus cost potential. These two indicators follow the principle that mining sites with higher grades or with lower costs.



Specific:

NH_3

NO_x

SO_2

$\text{PM}_{2.5}$

NO

NO_2

NO_3

SO

SO_x

SO_3

PARTICULATE MATTER

Air pollution that causes primary and secondary aerosols in the atmosphere can have a substantial negative impact on human health, ranging from respiratory symptoms to hospital admissions and death. An emission of NO_x , NH_3 , SO_2 or primary $\text{PM}_{2.5}$ is followed by atmospheric fate and chemistry in the air; NO_x , NH_3 , and SO_2 are transformed in air to secondary aerosols. Subsequently, $\text{PM}_{2.5}$ can be inhaled by the human population, leading to increased number of mortality cases in humans, and final damage to human health. No thresholds for $\text{PM}_{2.5}$ effects were assumed in the effect calculations.



Specific: Water

WATER USE

All water-related impacts used here are based on water consumption. Water consumption is the use of water in such a way that the water is evaporated, incorporated into products, transferred to other watersheds or disposed into the sea. Water that has been consumed is thus not available anymore in the watershed of origin for humans nor for ecosystems.

