

## 12101 Kvantitativ bæredygtighed (Polyteknisk grundlag) S25

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How would you define the functional unit of a washing machine?

- ☒ **Washing of 10 kg clothes per week to an acceptable cleanliness for one year in Denmark**

Washing of 10 kg clothes per week to an acceptable cleanliness with the least energy consumption in Denmark

The energy consumption pr kg of clothes washed

The energy consumption for washing 10 kg of clothes at 40° C in Denmark

How do you interpret the I=PAT equation?

P and A represent the impact of producing services

- ☒ **I represent the total anthropogenic environmental impact as a function of population size, affluence, and technology**

T represent the time showing that environmental impact increase with time

I represent the environmental impact of Product A during its lifetime T

What is the typical CO<sub>2</sub> emission per energy unit produced from a coal fired power plant with no carbon capture?

5-20 g CO<sub>2</sub>e / kWh

20-100 g CO<sub>2</sub>e / kWh

100-400 g CO<sub>2</sub>e / kWh

- ☒ **400-1000 g CO<sub>2</sub>e / kWh**

You want to further interpret the impacts of the e-bike and what are the dominant contributions to its carbon footprint per km driven as well as to its health and biodiversity footprints. Open and use the carbon and health footprint solution file of various vehicles: "1210X QS carbon\_cost\_health\_absolute Car carbon footprint solutions\_S25a". As described in rows 94 to 111 of the carbon footprint tab, the electric bike weight 19 kg with a bike life span of 30000km, it has a Li-ion battery of an additional 4 kg with a battery lifespan of 15000 km. Its electricity consumption amounts to 0.007 kWh/km. The minutes of healthy life gained per km e-biked is estimated at 2/3rd of a conventional bike, that is 6.2 minutes gained per km driven with the e-bike.

Start by changing in the spreadsheet for the charging of the electric car and of the electric bike from the European electricity mix medium voltage **to the Danish electricity mix (market for electricity, low voltage)**. Identify the right process in ecoinvent and then select it first in the selected process and then in the carbon calculator.

Also complement for the e-bike the quantity of battery per e-bike-km in column F

Look at the results and interpret them to select the correct answer in the present and following question.

- ☒ **The amount of battery used in kg per e-biked-km amount to 2.67E-4**

The battery usage lifespans expressed in km driven over the battery lives is an important parameter that mostly modifies the use stage impacts, that is the electricity used per vehicle-km

Due to its electricity consumption, cycling on the electric bike leads to an overall net loss in human health, since health impacts of emissions associated with the bike manufacturing added to the health impacts of electricity are higher than the health gain associated to the physical exercise

For the carbon footprint of the e-bike, the battery production has a higher carbon footprint than the bicycle production due to its shorter lifespan

The transportation of the e-bike by cargo freight over 10000 km and by truck over 2000 km at the start of its life still plays a substantial role, with close to 20% of the e-bike carbon footprint per km

Let us now compare the carbon footprint of the e-bike against the petrol and the electric vehicle. Select the one correct answer.

- ☒ **For the electric car with Danish electricity mix, the use phase represents more than 50% but less than 65% of the carbon footprint**

Thanks to the high renewable fraction in the Danish electricity mix, the electric bike has a more than 40 times lower carbon footprint than a gasoline car

The electric car using coal electricity has a lower footprint than the gasoline car

The carbon footprint of an electric vehicle is dominated by methane emissions, since methane is a main contributor to electricity production in Denmark and in the car manufacturing.

The carbon footprint of use phase of the gasoline car is more than 5 times higher than the carbon footprint of the use phase of the electric car.

We had calculated in our morning coffee exercise that the life cycle carbon footprint of one cup of coffee in Europe amounts to 0.132 kgCO<sub>2</sub>e/cup. Let us assume that a European citizen drinks 4 cups of coffee per day and commutes to work 15 km per day (2 x 7.5km) either with an electric car or an e-bike. Calculate the cumulative carbon footprint of these two activities and select the correct answer for this question  
Select the one correct answer.

In all scenarios the coffee contributes to a much smaller footprint compared to the commuting

The carbon footprint of one cup of coffee is equivalent to approximately 7 km (+/-20%) by e-bike

- ☒ **According to this calculation, the health physical exercise benefits of driving the car are surprisingly higher in absolute value than the health impacts of the gasoline car emissions and manufacturing**

For both the e-bike and electric car commuting scenarios, the use phase is responsible for at least 30% of the ecosystem impacts

The carbon footprint scores are based on estimated damages on ecosystems, and are therefore highly uncertain compared to the human health impacts

Select the one correct answer for the cumulative carbon footprint of 4 cups of coffee per day and 15 km per day commute to work by an electric car running on a DK electricity mix.

It is lower than 0.25 kgCO<sub>2</sub>e/d

It is between 0.25 and 1 kgCO<sub>2</sub>e/d

- ☒ **It is between 1 and 2.5 kgCO<sub>2</sub>e/d**

It is between 2.5 and 5 kgCO<sub>2</sub>e/d

It is between 5 and 10 kgCO<sub>2</sub>e/d

How would you define common goods?

Users can exclude others from using that good and their use of this good does not affect the ability of others to use it.

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Users can exclude others from using that good and their use of this good affects the ability of others to use it.

- ☒ **Users cannot exclude others from using that good and their use of this good affects the ability of others to use it.**

Can you use a renewable resource indefinitely?

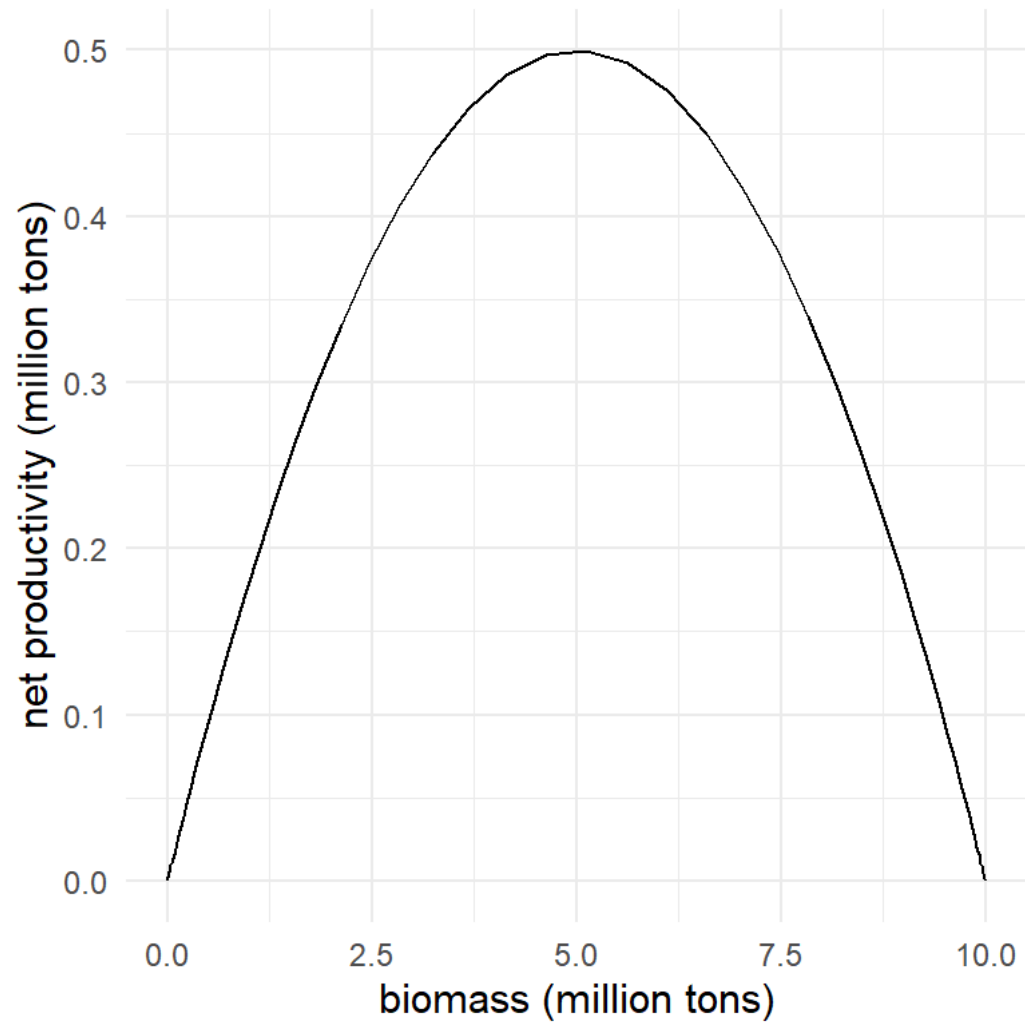
- ☒ **Yes, by ensuring that the extraction rate stays at or below its replenishing rate**

No, renewable resources disappear eventually

Yes, by ensuring that the extraction rate exceeds its replenishing rate

No, the extraction rate must be so small to do so that extraction patterns are not economically viable

Take a look at the figure below displaying information about the net productivity of a fish stock in relation to its biomass. What is the Maximum Sustainable Yield for this stock?



☒ 0.5 million tons

5 million tons

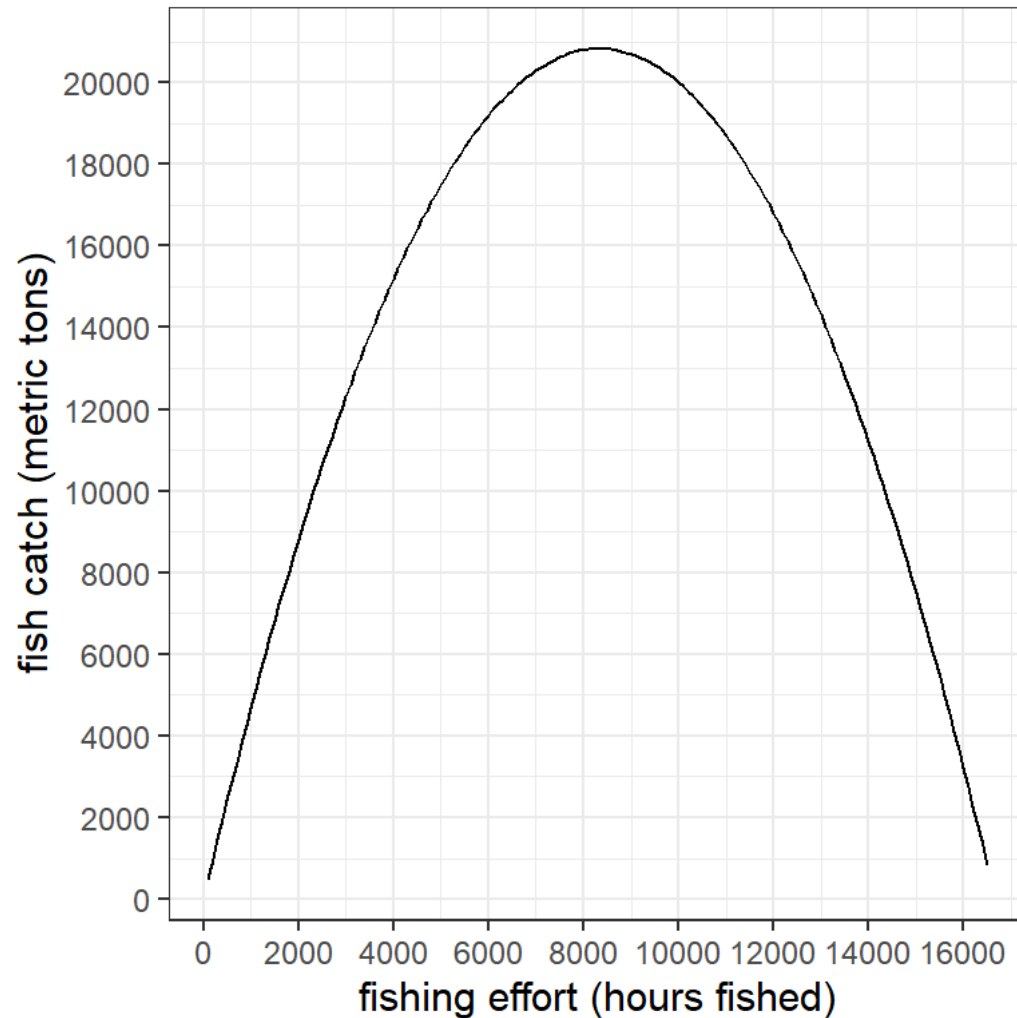
0

2.5 million tons

Take a look at the figure below displaying information we have obtained about how much fish can be caught annually (in tons) in relation to the fishing effort it took to catch it (cumulative number of hours spent fishing annually).

In addition, you know that you will catch by accident about 1 dolphin per 1000 hours of fishing. The population of dolphins exposed to this accidental mortalities cannot sustain more than 10 deaths caused by fishing per year.

You have the choice to decide how much fishing effort should take place this year: which of the following four options will be a sustainable fishing effort?



10320 hours

9600 hours

☒ **8000 hours**

9000 hours

Are disposal costs or residual value normally included in the life cycle costs?

☒ **Yes**

No

Which of these activities are normally **NOT** part of the goal and scope of LCC:

Determine the purpose of LCC analysis

Define the scope of the system

Select the appropriate model

☒ **Consider the volatility of costs and cost-influencing parameters**

Using the excel sheet "12101 - Life cycle costing\_exam" try to change the numbers of electricity use and the costs of 1 kWh. First let the electricity use be 0.26 kWh/km as in the Carbon footprint excel. If the cost of one kWh reaches 0.75 €/kWh how will the price pr vehicle - km be compared to gasoline car or leasing the e-vehicle?

The price will still be lower than for the gasoline car

☒ **The price will be higher than for the gasoline car**

It will still be lower (at app. 91%) of the price of a leased car v-km

It will be the same as for the leased car

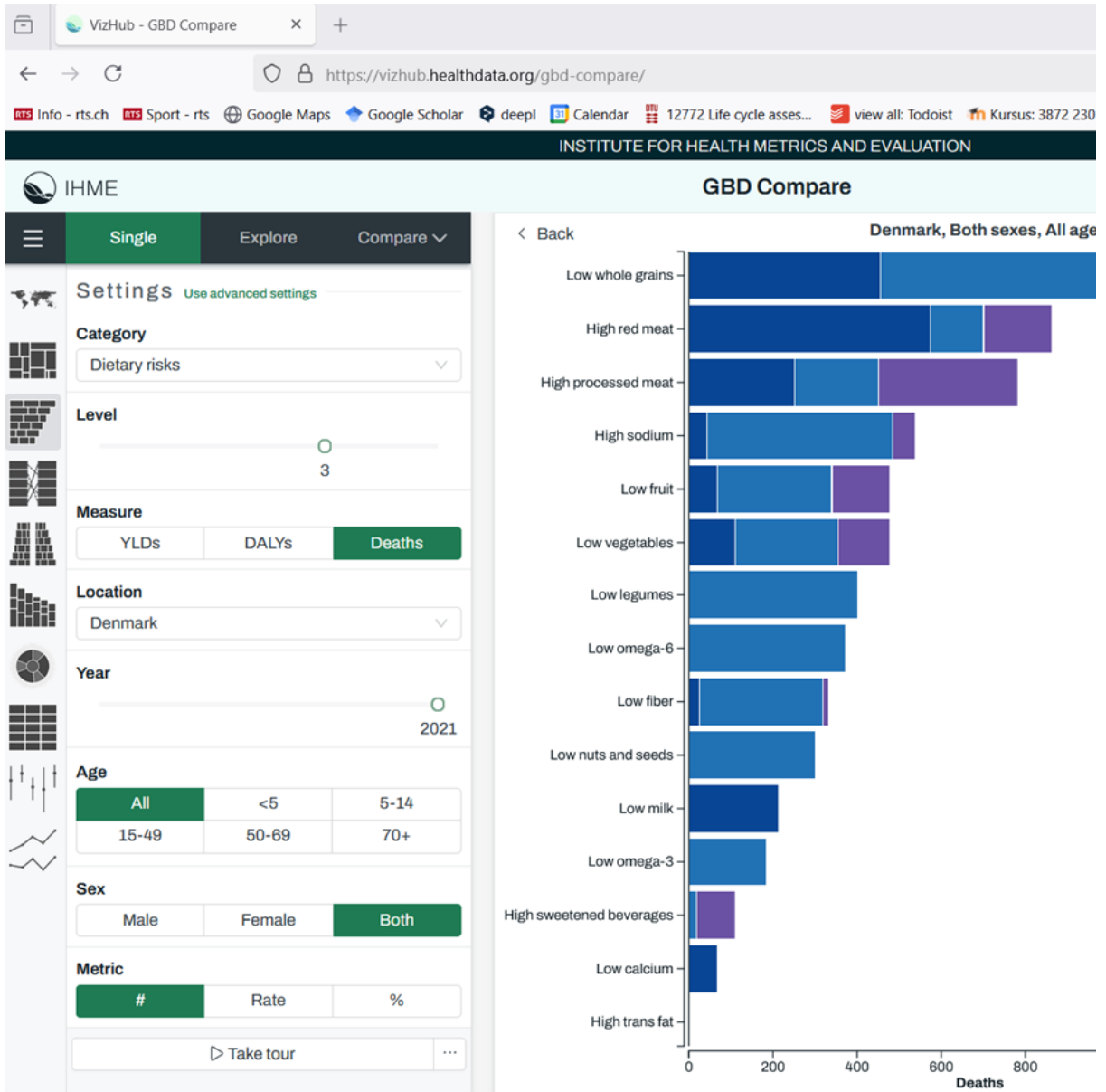
Now change the price back to 0.2 €/kWh but this time change the vehicle life span of the electric vehicle to 150000 km. How does the price of 1 v-km change?

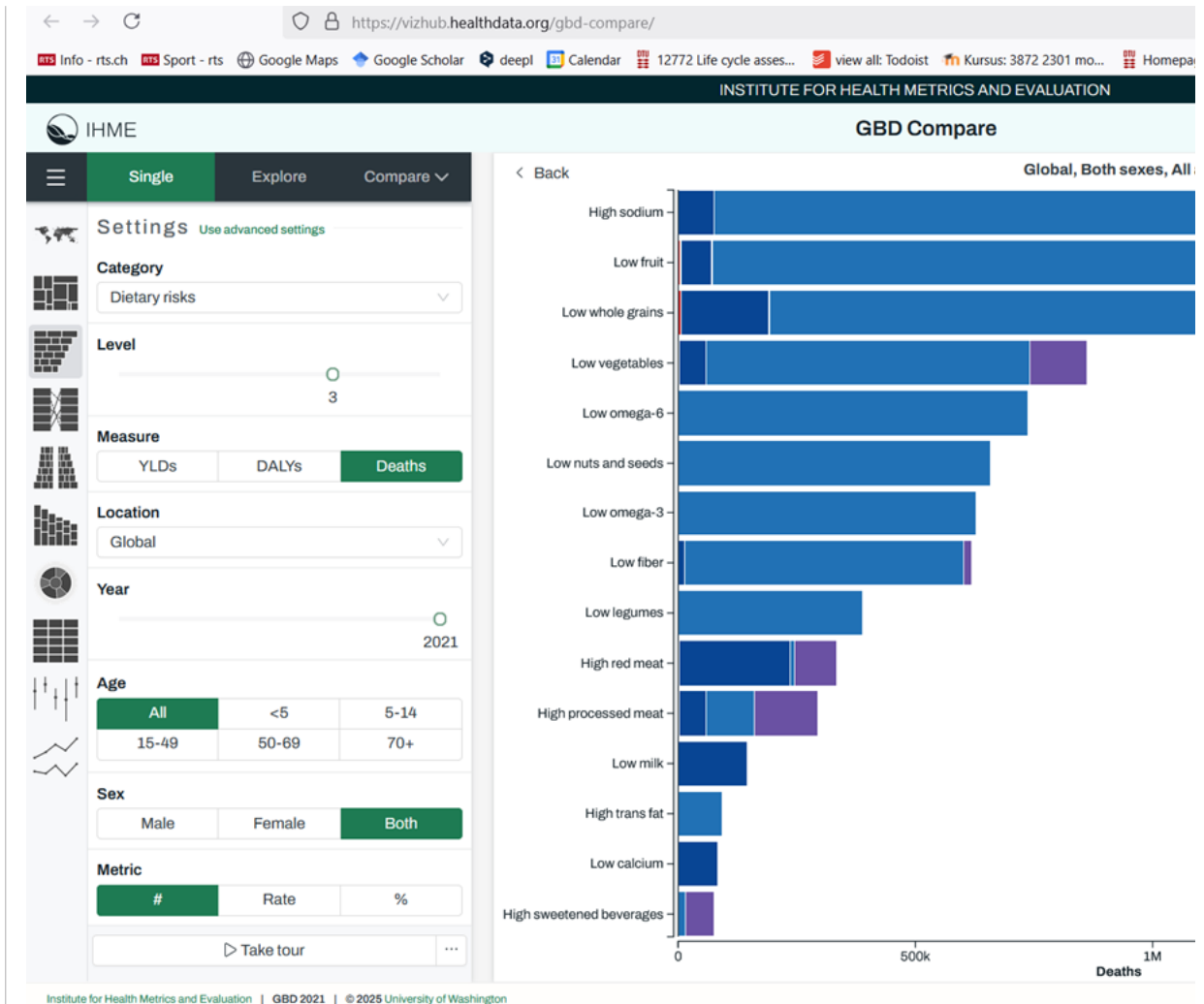
☒ **It becomes approximately 130% of the original price**

It becomes the same as the gasoline car

It remains lower than the gasoline car

Looking at these dietary risks from the Global burden of disease visualization tool taken from (<https://vizhub.healthdata.org/gbd-compare/>) please choose the correct answer below.





None of the dietary risks exceed 1000 death per year for the Danish population

- ☒ **Under consumption of fruit is among the two highest dietary risk factors at global level, but it is not in Denmark**

The risks associated with low consumption of legumes are mostly associated with diabetes and kidney disease

According to the GBD, the main impact of a low consumption of calcium is osteoporosis

The sum of all dietary risk is higher than 8000 death per year for the Danish population

### Health question - Select the one correct answer

If a hotdog leads to 36 minutes of life lost, it is mostly because of the transfat (TFA) contained in the hotdog

- ☒ **Body lotion and cream containing hydroquinone can lead to more than 50 minutes of life lost per person per day**

For a moderate Parkinson disease, its disability weights are still smaller than 0.2

For the impacts of climate change of heat and cold, it is the continents that most induce the climate change (i.e. North America and Europe), that are affected the most and have the maximum minutes lost per person due to the high heat waves observed in Europe and North America

Per km biked or run, the minutes or hours of health gained are higher for biking than for running

Taxation (e.g., a carbon or a biodiversity tax) is a kind of economic intervention to encourage sustainability transitions. What is the purpose of taxation in such a context?

- ☒ **it helps to internalize in the price of goods and services their impact on communities and the planet**

it punishes bad practices

it helps pay for adaptation to climate change

it redistributes wealth



Which of the following are **NOT** earth system processes in the planetary boundaries framework of absolute sustainability?

☒ **Depletion of fossil resources**

Land-system change

Biogeochemical flows

Stratospheric ozone depletion

Ocean acidification

Which of the following is a measure of eco-efficiency?

GDP/person

Person/GDP

☒ **kg CO<sub>2</sub>-eq/km**

km/h

USD/kWh

Earth overshoot day is the day of the year where...?

The highest global average temperature of the atmosphere is registered

the highest global average temperature of the oceanic surface waters is registered

the highest ecological footprint accumulated across all countries is registered

☒ **the accumulated ecological footprint across all countries exceeds the total productive area of the planet**

the highest emission of greenhouse gases is registered (measured in CO<sub>2</sub>-equivalents)

Bocken has a simplified model of circular economy, focusing on three main resource flow strategies: slowing, narrowing and closing. Narrowing refers to what area of the Circular Economy Scanner?

Rethink and reconfigure business models (orange area)

☒ **Restore, reduce and avoid impacts (green area)**

Recirculate parts & products (blue area)

Recirculate materials (grey area)

What does sustainability transition mean?

☒ **interventions so that acceptable outcomes on the three dimensions of sustainability are sustained and unacceptable conditions are changed towards more sustainable outcomes**

utopic scenario where the planet is moved away from planetary boundaries

a revolutionary approach to change the way societies work

a democratic approach to change the way societies work

Which of the following stakeholders are usually **NOT** present in a linear value chain?

Materials Providers

Logistic Providers

Component Manufacturers

☒ **Value Recovery companies**

Which of the following statements are correct?

- ☒ **The interpretation of the assessment involves an evaluation of the completeness (how well is the system covered).**

MDCA methods can be used for making a fully objective choice

The interpretation must always include a quantitative uncertainty assessment of the parameters in order to be able to run a monte carlo simulation

There are seldomly trade-offs between indicators and or sustainability dimensions