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PRESS RELEASE

The ecological baggage of a white cotton T-shirt in Germany
What contributes to its eco assessment?

Frankfurt am Main, 4 December 2019

The new study *„The lifecycle of a T-shirt – an eco assessment"* by the Technical University Berlin describes the possible environmental impacts of the lifecycle of a white T-shirt – ranging from cotton cultivation and T-shirt manufacture to 44 x washing & drying and disposal. This study was mandated by the IKW (German cosmetic, toiletry, perfumery and detergent association) and high-lights this: Cotton production and T-shirt manufacture decisively determine most of the examined possible effects on the environment, e.g. land use, freshwater use, abiotic resource depletion potential as well as negative effects on waters and their organisms. The manufacture of the T-shirt and its use phase – i.e. washing & drying of the T-shirt – have a relevant influence on the global warming potential and the water depletion potential. In order to significantly reduce the environmental impacts of washing & drying in private households, the following applies: wash at low temperatures, precisely dose the detergent, load the washing machine to full capacity, and dry laundry outdoors.

On behalf of the IKW, the Technical University Berlin carried out the study *"The lifecycle of a T-shirt – an eco assessment"* which sums up the most important environmental impacts of a garment's lifecycle. The assumptions made for this study were as realistic as possible. For example, a standard commercial cotton T-shirt (white) was examined which was manufactured outside Europe, bought in Germany, worn, washed & dried 44 x, and finally disposed. Such a cotton T-shirt weighs about 150 g. The manufacture of the T-Shirt, the distribution and the textile care during its use phase as well as the disposal require quantities of resources (e.g. water) that exceed its weight many times over. Furthermore, substances are released during its lifecycle, e.g. greenhouse gases which correspond to 3.7 kg of carbon dioxide (CO_2). Here, it was assumed that consumers do not load their washing machines to capacity but only with 3.5 kg of laundry, dose 55 ml of liquid detergent per wash, and dry only every 10th load in a tumble dryer – the rest in fresh air.

Environmental impacts

Ecological assessments use the generic term "environmental impacts" to describe the effects of substances or processes on certain fields of the environment. This includes possible direct and indirect effects, which are caused, for example, by the manufacture of the T-shirt, washing machine or detergent. This study examined, inter alia, the following environmental impacts:

- Possible effects of the T-shirt's manufacture, use and disposal on global warming are referred to as *global warming potential*.

- The consumption of raw materials such as ores, metals or minerals, which are needed for the manufacture of the T-shirt, washing machine, detergent and tumble dryer and *for the providing of energy and water*, are summarised under the *abiotic resource depletion potential*.

- The possible impacts on the quality and function of soils (e.g. through changes in use or sealing and for the extraction and processing of raw materials) are described by the impact category *land use*.

- The *acidification potential* describes the impact of acidifying substances, which are released in the T-shirt's manufacture or textile care, on soils and waters.

- The measuring approach *water depletion potential* is the environmental impact of the consumption of water as a resource. Here, the use of freshwater (e.g. for cotton cultivation or washing during the use phase) is taken into account. However, the quantities of used freshwater that are returned into waters (e.g. after use in power plants as cooling water or to drive turbines or after purification in sewage treatment plants) are also included in the considerations.

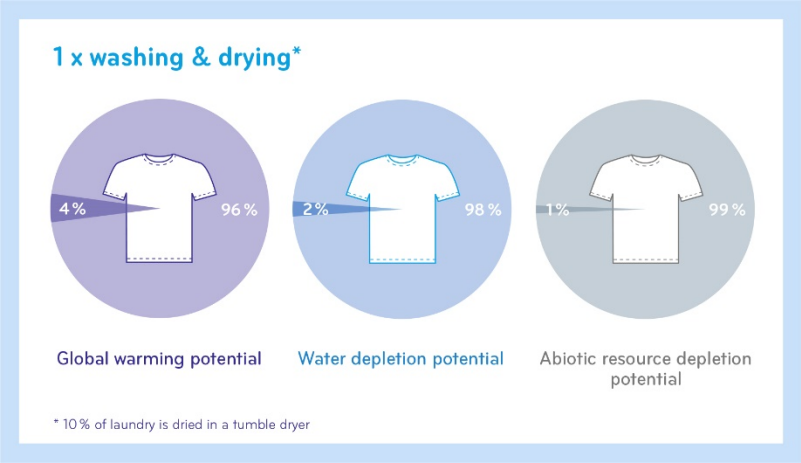
- The environmental impact *fresh-water aquatic ecotoxicity potential* is the term to describe the negative impacts that releases of substances can have on waters and their organisms.

In ecological assessments, it is not permitted to weigh different environmental impacts against each other.

When a T-shirt is newly purchased, it already has the "ecological baggage" of environmental impacts due to its manufacture and distribution. When it is subsequently used – and thus also washed & dried – this further adds to the T-shirt's "ecological baggage". The most important results of the eco assessment are described in the following 10 key messages:

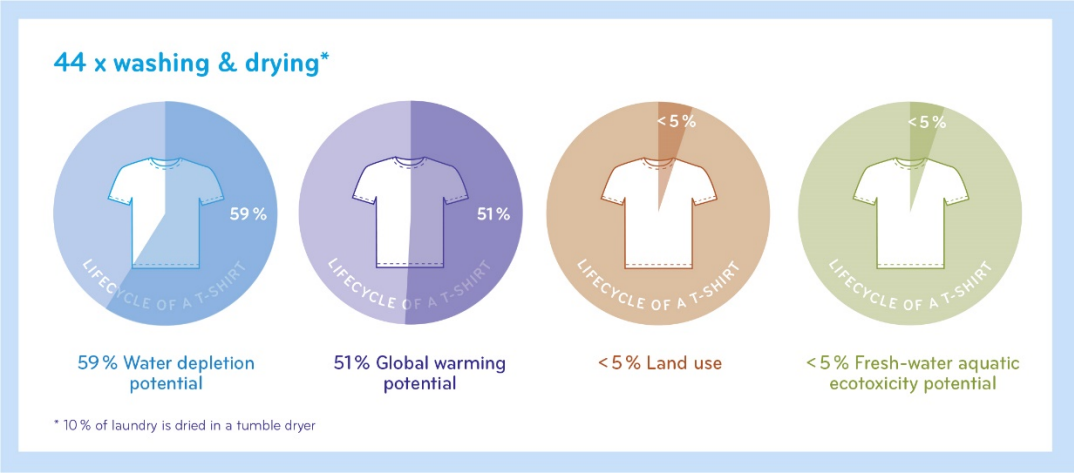
1. **The environmental impacts of a T-shirt's lifecycle are mainly determined by cotton cultivation and T-shirt manufacture.**

Referred to the entire lifecycle of a T-shirt which, hypothetically, is washed & dried only once, the manufacture and distribution of the T-shirt and its pre-products as well as its disposal contribute 96% to the *global warming potential*, 98% to the *water depletion potential*, and 99% to the *abiotic resource depletion potential*. 1 x washing & drying has a share of only 4.2% and 1%, respectively, in these three environmental impacts.



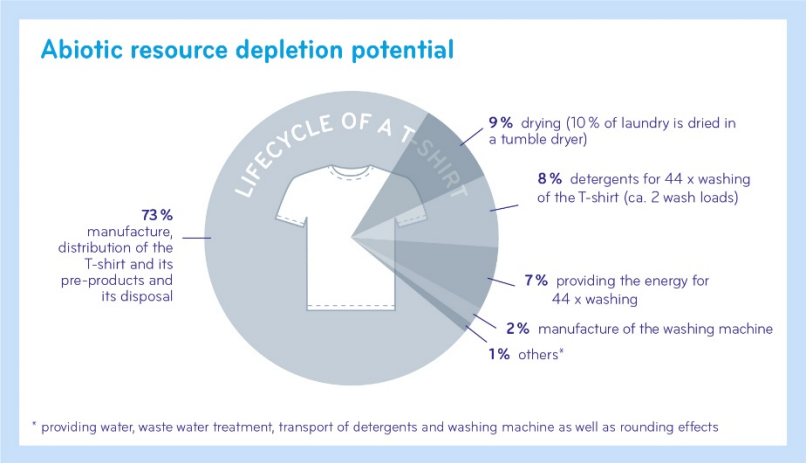
2. **44 x washing & drying of a T-shirt contributes roughly as much to the global warming potential as the T-shirt's manufacture, distribution and disposal.**

Well over half (51%) of the *global warming potential* is attributable to 44 x washing & drying of the T-shirt during its average lifespan or duration of wearing, assuming that only every 10th time a tumble dryer is used. 49% of the *global warming potential* is determined by cotton production and the T-shirt's manufacture, distribution and disposal. 44 x washing & drying during the entire lifecycle contributes 59% to the *water depletion potential*. 44 x washing & drying contributes less than 5% each to the environmental categories *land use* and *fresh-water aquatic ecotoxicity potential* while the T-shirt's manufacture, distribution and disposal account for over 95%.



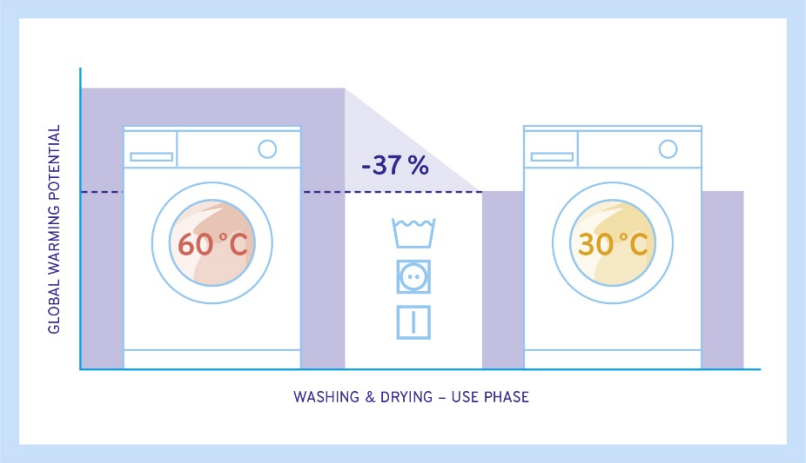
3. The consumption of raw materials such as ores, metals or minerals in the T-shirt's lifecycle is largely attributable to its manufacture.

Around 73% of the abiotic resource depletion potential respectively raw materials such as metals, ores and minerals contributes to the manufacture and distribution of the T-shirt and its pre-products and for its disposal; drying of the T-shirt accounts for 9%, assuming that it is mostly dried in fresh air and only every 10th time in a tumble dryer. In 44 x washing of the T-shirt, a maximum of 8% in the consumption of these raw materials falls to the share of detergent manufacture, Further 7% are required for providing the energy for the washing machine; the manufacture of the washing machine accounts for just under 2%.



4. Consumers can decisively reduce the environmental impacts during the use phase of the T-shirt by washing at low temperature.

Reducing the washing temperature from 60°C to 30°C leads to less energy consumption. This lowers the *global warming potential* during the use phase by ca. 37%.



In fact, the amount of water used by a washing machine in a particular wash programme (e.g. “cotton”) does not depend on the temperature. All the same, washing at lower temperature reduces the use of water. This is because water is also needed to provide electricity, e.g. to drive turbines and for the cooling of power plants. Consequently, the contribution of the use phase to *water depletion potential* is cut almost by half if laundry is washed at 30°C instead of 60°C.

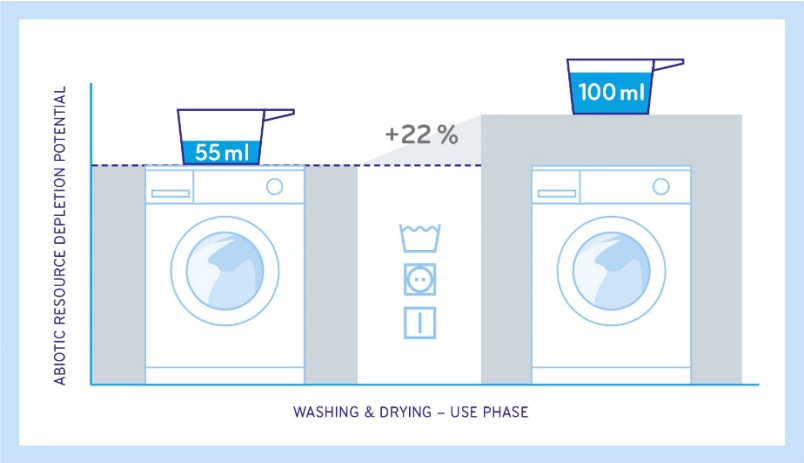
5. By loading the washing machine as full as possible, consumers can decisively reduce the T-shirt’s environmental impacts during its use phase.

If a washing machine, in which up to 7 kg of laundry can be washed, is used at full load and not at half load, this can reduce the *global warming potential* during the use phase by 45%.

The *water depletion potential*, too, is roughly cut by half during the use phase if the washing machine is loaded to full capacity.

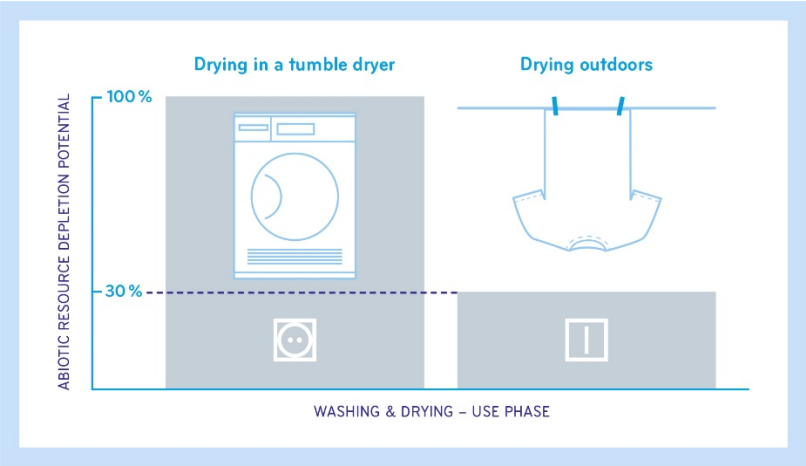
6. During the T-shirt's use phase, detergent dosing influences, in particular, the abiotic resource depletion potential.

If almost twice the amount of detergent (100 ml instead of 55 ml) is used per wash cycle, the *abiotic resource depletion potential* rises by 22% during the use phase. At the same time, the following environmental impacts increase: *acidification potential* by 19% and *global warming potential* by 6%.



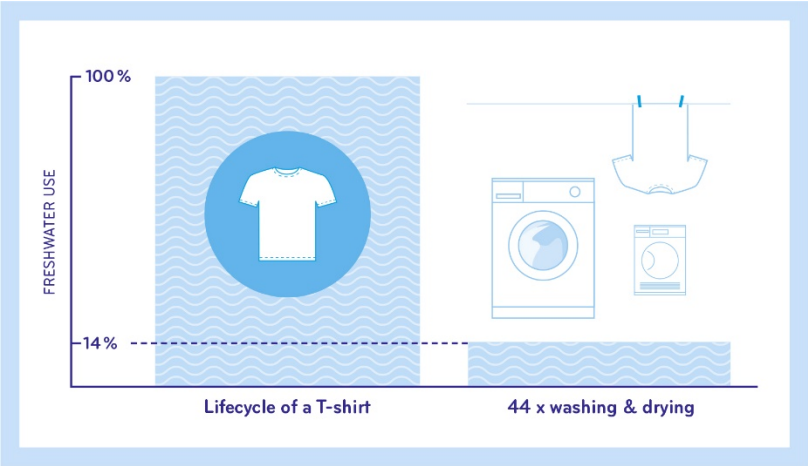
7. Drying outdoors significantly reduces the environmental impacts during the T-shirt's use phase.

Consumers can greatly influence the environmental impacts in the drying of the T-shirt. The manufacture of the tumble dryer and providing energy and water contributes directly and indirectly to the *abiotic resource depletion potential*. Referred to the use phase, *abiotic resource depletion potential* in private households, where the T-shirt is washed 44 x and dried every time exclusively in a tumble dryer, is thus around three times higher than in private households where the T-shirt is washed 44 x but dried exclusively outdoors. The *global warming potential* and the *water depletion potential* are more than twice as high.



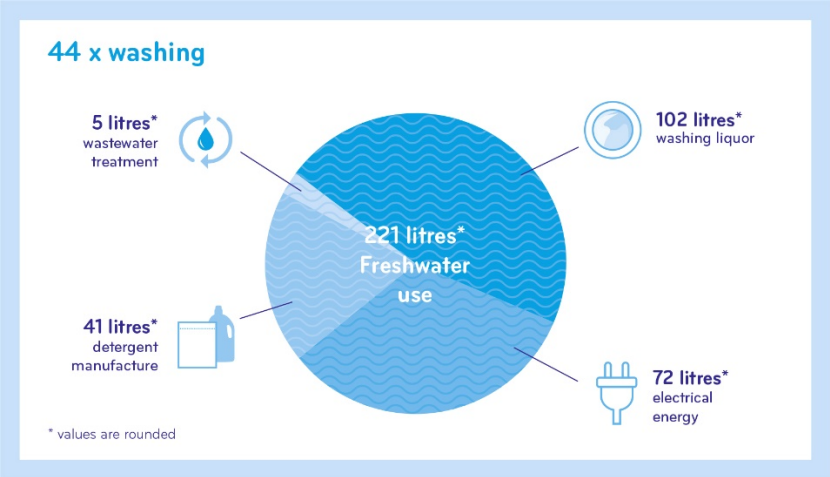
8. **Throughout the T-shirt's lifecycle, freshwater use is dominated by the manufacture of pre-products for the T-shirt. 44 x washing & drying of the T-shirt has a share of 13% in freshwater use.**

In total, 1,670 litres of freshwater are used for the entire lifecycle of a T-shirt that is washed & dried 44 x. Out of this total, the manufacture of the T-shirt's pre-products (e.g. cotton) requires 1,370 litres, which accounts for 82% of freshwater use throughout the entire lifecycle. 55 litres of freshwater (3%) are used for the actual manufacture of the T-shirt. 221 litres (13%) of freshwater are needed for the washing process. 17 litres (1%) are necessary for drying, assuming that only every 10th time the tumble dryer is used. As regards freshwater use, shares of freshwater also go into the providing of electrical energy for the washing process and drying in a tumble dryer, e.g. for cooling in power plants and driving turbines.



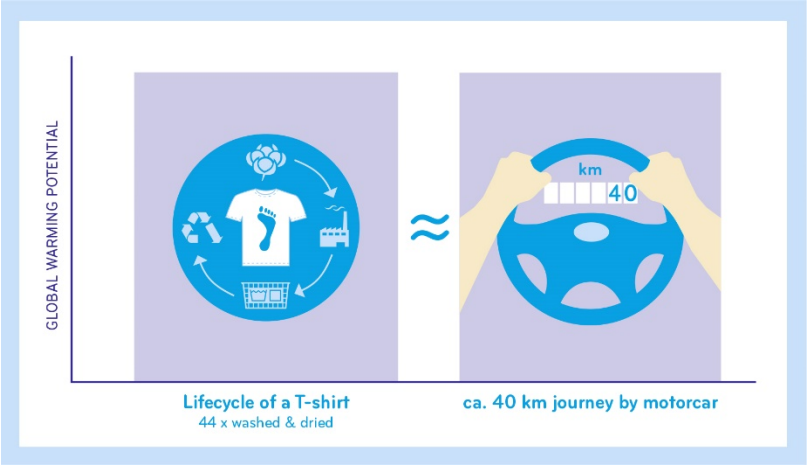
9. **For washing the T-shirt 44 x, a total of 221 litres of freshwater are used – out of this total, less than half (102 litres) for the washing liquor and just under a third (72 litres) for providing electrical energy.**

To wash 44 x a T-shirt that weighs ca. 150 g, roughly as much water is needed for the washing liquor as for two wash loads with about 3.5 kg of laundry each, i.e. ca. 102 litres of freshwater. Add to this just under 72 litres of freshwater for providing electrical energy, e.g. for cooling in power plants and driving turbines. Around 41 litres of freshwater are used to manufacture the detergent for two wash loads (110 ml). Additionally, waste water treatment requires nearly 5 litres for two of these wash loads.



10. A calculation independent of the TU Berlin study shows that a journey of almost 40 km in an average motorcar has the same global warming potential as the entire lifecycle of a T-shirt.

The *global warming potential* of a T-shirt – from manufacture to 44 x washing & drying and disposal – is equivalent to 3.7 kg of carbon dioxide (CO_2). A 40 km journey in an average, petrol-driven motorcar has roughly the same *global warming potential.* This comparison was carried out independently of the TU Berlin study; it only serves to illustrate and categorise the result for *global warming potential*. The starting point for this comparison is an assumed carbon dioxide emission of an average motorcar of 95 g of carbon dioxide[1] per kilometre driven.



<u>Tips for environmentally sound laundry care:</u>

1) The right care contributes to preserving the T-shirt's value so that it can ideally be washed and worn more than 44 x. For this purpose, the care instructions in labels should be observed and textiles should be washed & dried accordingly.

2) The T-shirt should be washed preferably at low temperatures to avoid unnecessary energy use. For the hygiene of the washing machine, a bleach-containing heavy duty detergent in solid form (powder, granule, tab) should be used for washing at 60°C at least once a month. Only solid heavy duty detergents contain bleaching agents.

3) If the washing machine is loaded as full as possible, it works particularly economically. "Loaded as full as possible" means the following for a washing machine with a 7 kg loading capacity:
   - With a cotton programme – 7 kg of dry laundry.
   - With an easy-care programme – a maximum of 4 kg of dry laundry.
   - With a wool programme – a maximum of 1.5 kg of dry laundry.

   If different items of laundry are combined with each other, they should be washed with the programme and detergent type for the most sensitive laundry item.

[1] Regulations (EC) No 443/2009 and (EC) No 510/2011 to reduce CO_2 emissions of passenger cars and light-duty vehicles – applicable in the European Union – lay down that from 2020 in the EU newly registered vehicles may emit on average only 95 g of CO_2/km.

4) Follow the dosing instructions on detergent packs. The amount of detergent needed depends on the degree of soiling, load of the washing machine and water hardness.
   - Avoid over- and underdosing of the detergent.
   - Choose the right detergent for each type of laundry (heavy duty detergent, colour or easy-care or wool detergent).
   - Information about the water hardness range can be obtained from water suppliers or landlords.

5) Laundry should preferably be dried outdoors. If this is not possible due to weather conditions, drying in an unheated, well-ventilated room is recommended. Good ventilation is important to avoid mould formation.

What is behind it?

An eco-balance is also called a lifecycle assessment (LCA). An eco-balance describes the environmental impacts of a product, process or service across its entire lifecycle. The lifecycle of a product can be characterised, for example, by individual stages or lifecycle phases: manufacture and distribution of the pre-products (e.g. cotton, yarns), manufacture and distribution of the main product (e.g. T-shirt), use phase of the main product (e.g. washing & drying the T-shirt), disposal of the main product (e.g. thermal, material or mechanical recycling of the T-shirt and accompanying substances).

A lifecycle analysis can be used to identify product-related environmental impacts, assign them to the lifecycle phases and derive recommendations for action. In this study, the environmental impacts at each stage of the lifecycle refer to a white cotton T-shirt which is washed 44 x, each time in a washing machine with a total load of 3.5 kg, with 55 ml of an average liquid detergent and at an average washing temperature of 43.3°C. Washing the T-shirt 44 x corresponds to roughly two washing machine loads. Drying was assumed to be done in a tumble dryer in only 10% of cases; in all other cases, drying was outdoors.

The white cotton T-shirt is the so-called **functional unit** for the eco-balance to which the environmental impact calculations refer.

Environmental impacts describe the effects of a process (e.g. manufacture of a T-shirt) on the environment. The eco-balance of a standard commercial cotton T-shirt (white) included, inter alia, the examination of the following environmental impacts:

- ***Global warming potential:*** The relative contribution of a substance or process to the greenhouse gas effect.

- ***Abiotic resource depletion potential such as metals, ores, minerals,*** *stones, gravel etc: Use of non-fossil and non-renewable resources* ("elementary resource consumption").

- ***Land use:*** For example, in consequence of agricultural activities or caused by the utilisation and sealing of soil in the production and processing of raw materials (e.g. in order to obtain raw materials, plants are cultivated on agricultural areas or mineral oil is produced).

- ***Acidification potential:*** This is due to the emissions of acid-forming substances. Both terrestrial and aquatic ecosystems can be damaged by acidification.

- ***Danger of over-fertilisation*** ("terrestrial eutrophication potential"): Release of nutrients that can lead to an over-fertilisation of soils (terrestrial ecosystems) and adjacent waters (aquatic ecosystems).

- ***Water depletion potential*** ("Potential water scarcity"*):* This takes into account, inter alia, the use of freshwater for the respective processes in the lifecycle but also the proportionate backflows of used freshwater quantities in water catchment areas, e.g. after passing through power plants (cooling water, driving turbines) or after successful purification in waste water treatment plants. Thus, the environmental impact *Water depletion potential* is to measure water scarcity.

- ***Fresh-water aquatic ecotoxicity potential:*** Entry or release of substances that can have a harmful effect on freshwater organisms.

The environmental impacts of the T-shirt were appraised on the basis of a lifecycle model which was developed especially for this purpose and depicts the entire lifecycle of a white cotton T-shirt used in Germany, i.e. ranging from the use of material or energy resources for the T-shirt's manufacture along global production routes to its use (textile care), recycling and disposal in Germany. The specific environmental impacts of the T-shirt were determined using the eco-balance software GaBi 8.7, 2018. This software system includes pre-set standard parameters e.g. for upstream and downstream process chains (such as cotton production, fibre production, transport) of raw material and input production, taking into account the geographical reference. Further parameters were obtained in literature searches and expert discussions and incorporated in the model.

The eco assessment (lifecycle assessment) of a standard commercial cotton T-shirt (white) was completed in 2019 and followed the international LCA standards ISO 14040 and ISO 14044.

The press release and the complete study report of TU Berlin in German language *("Ökobilanzielle Bewertung des Lebensweges eines handelsüblichen weißen Baumwolle T-Shirts in Deutschland")* can be accessed at this web address:
https://www.ikw.org/ikw-english/home-care-topics/detail/the-lifecycle-of-a-t-shirt-an-eco-assessment-670/

Reprint free-of-charge – A specimen copy is requested

The Homecare Competence Partner within the association IKW is responsible for this information. The IKW was established in 1968 and is based in Frankfurt am Main. It represents at national and European levels the interests of more than 430 companies from the beauty and homecare sectors. The industry realises sales in excess of 18 billion euros. The IKW member companies have ca. 50,000 staff and account for more than 95% of sales in Germany.