MATERIALS AND CHEMICALS IN TEXTILES AND THEIR ENVIRONMENTAL IMPACTS

2019-11-13

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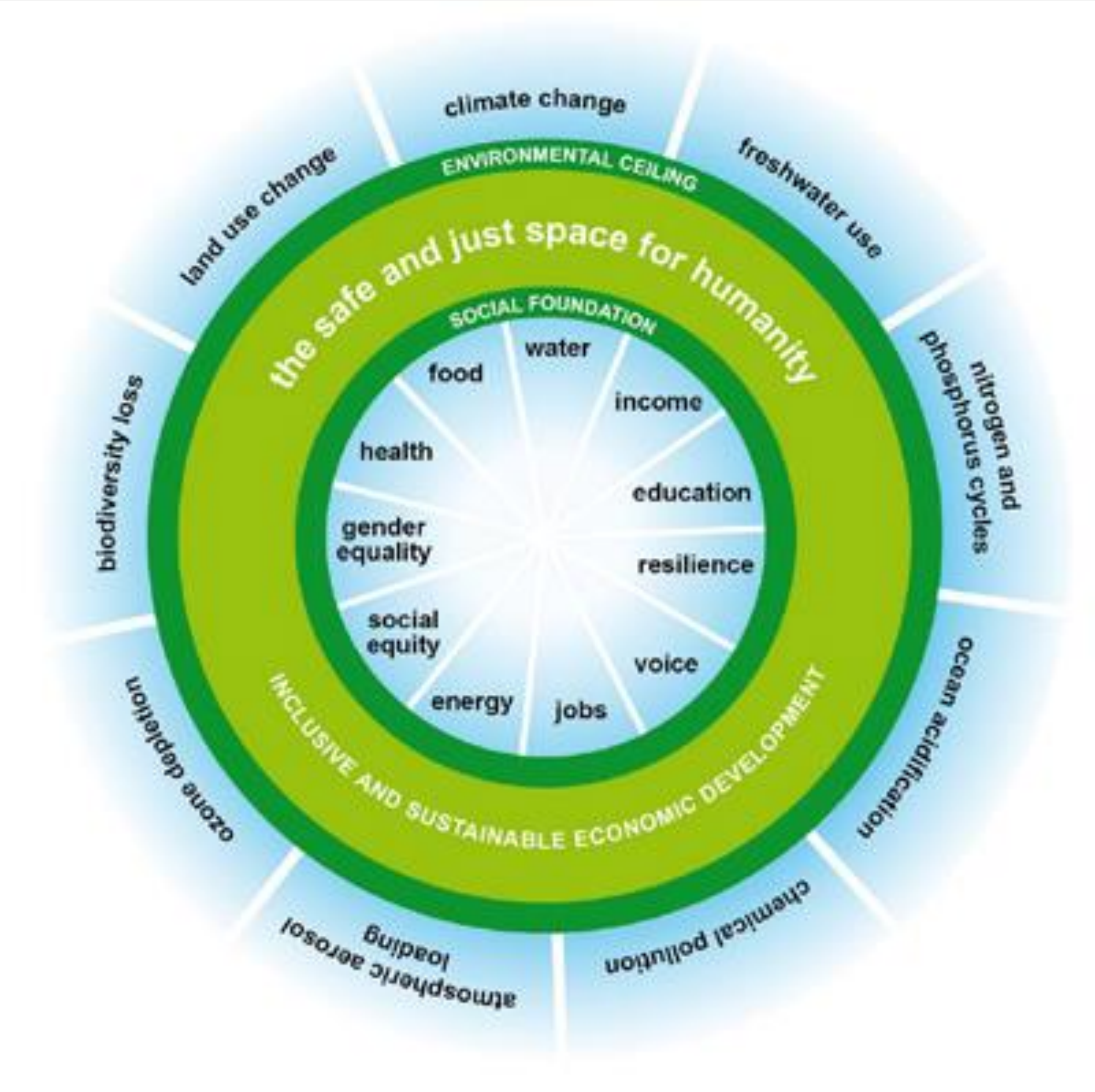
Participates in Produktdesign, Produktion & Teknik

Research Institutes of Sweden

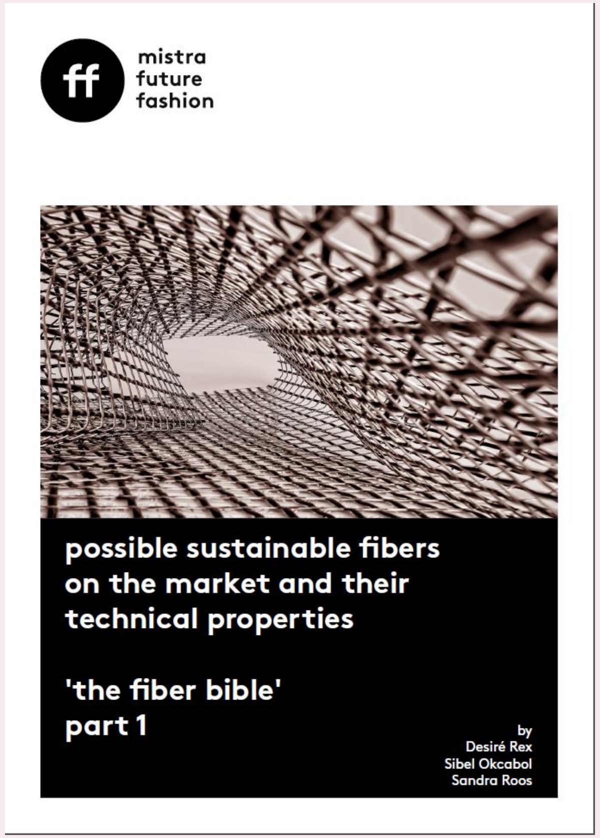
Material och Produktion

Can we live within the Doughnut?

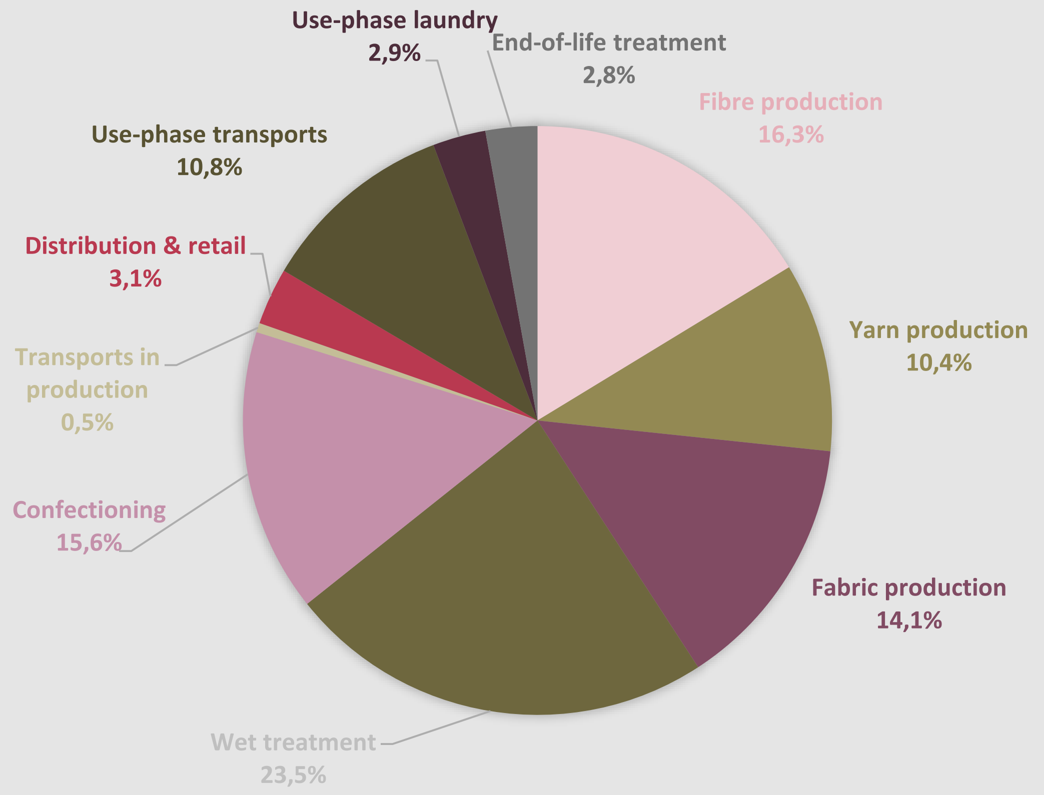


Raworth, K. (2012). A Safe and Just Space For Humanity: Can we live within the Doughnut? *Nature*, *461*, 1–26. doi:10.5822/978-1-61091-458-1

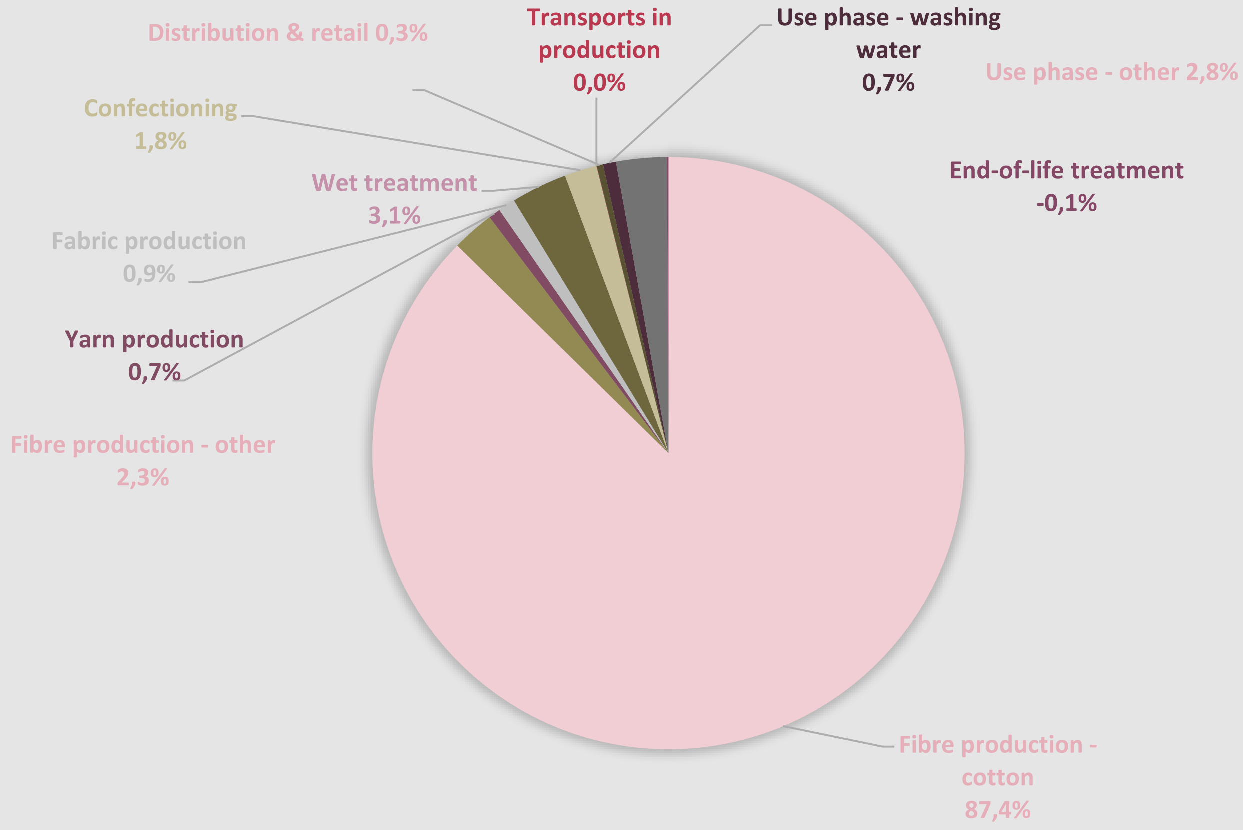
http://mistrafuturefashion.com/download-publications-on-sustainable-fashion/



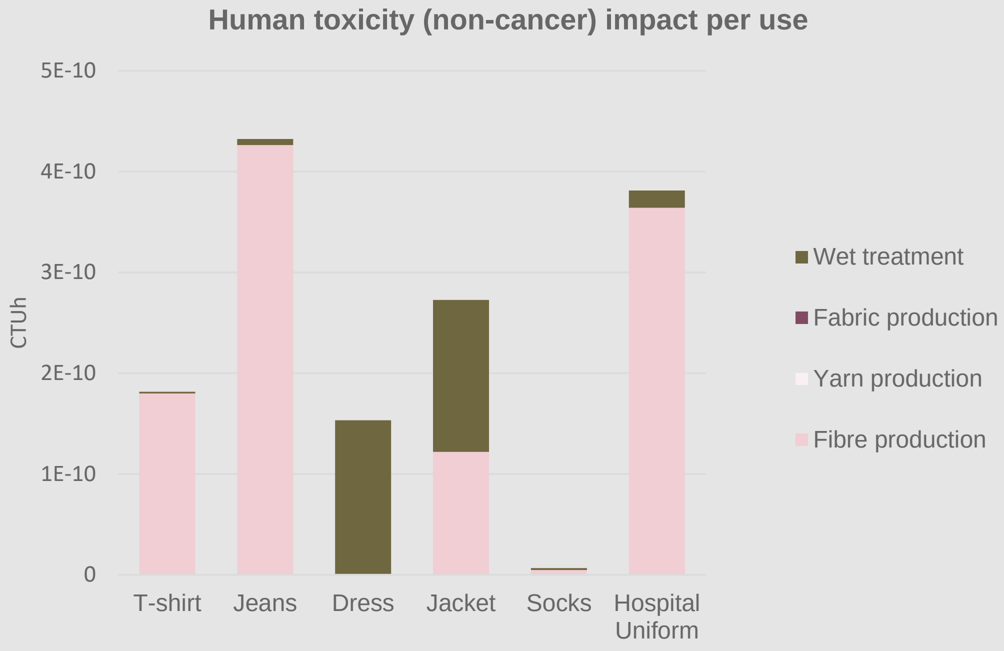
Climate impact

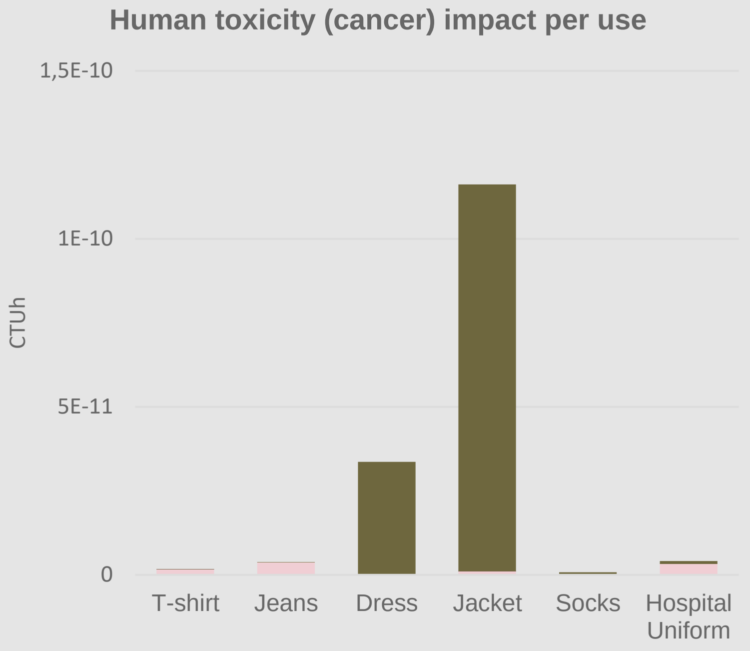


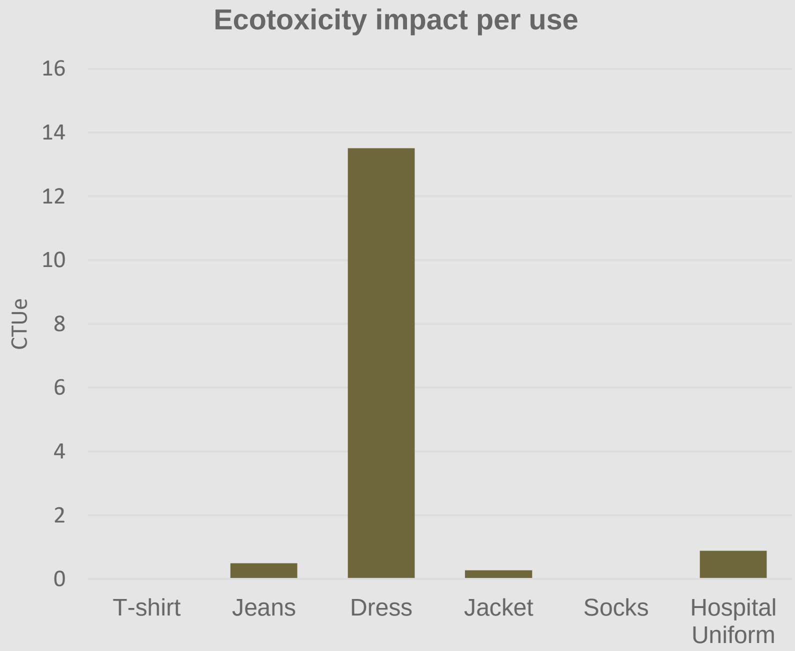
Water scarcity impact



Sandin et al. (2019a)

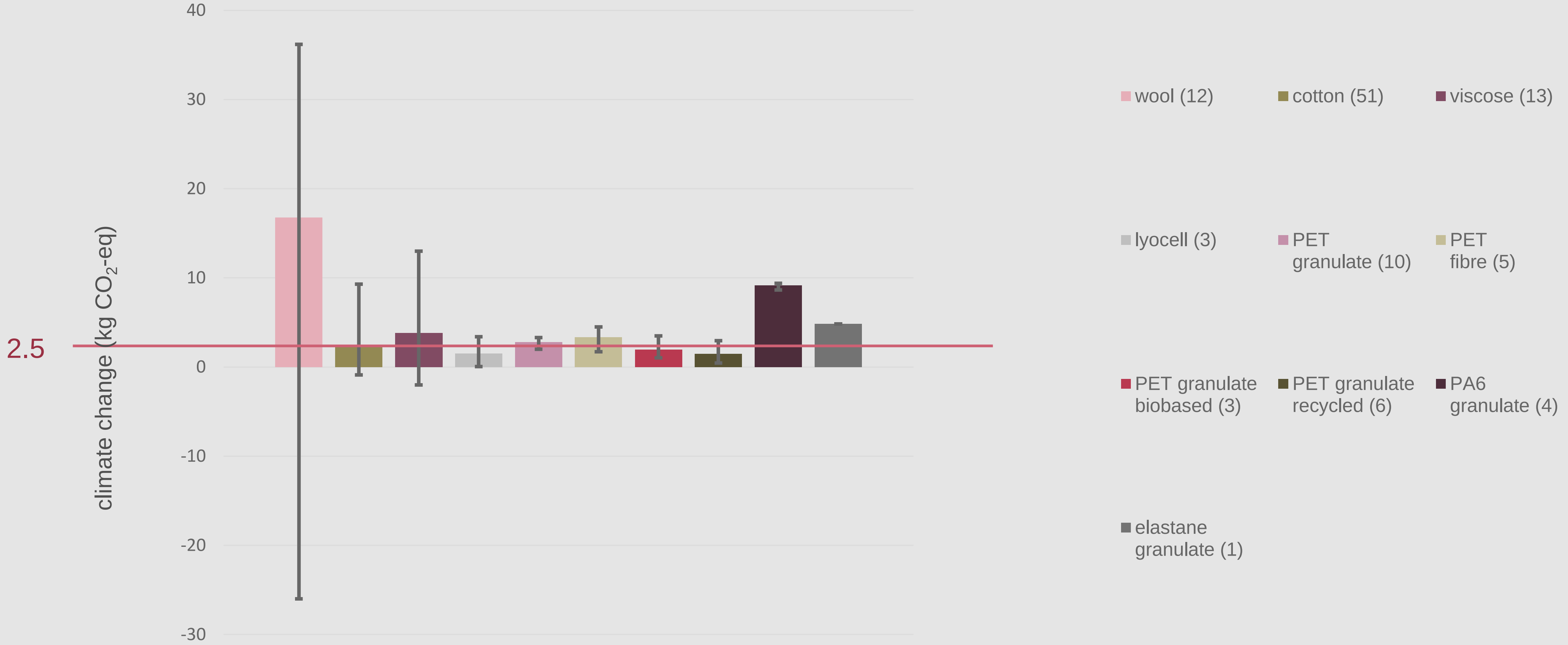






Sandin et al. (2019a)

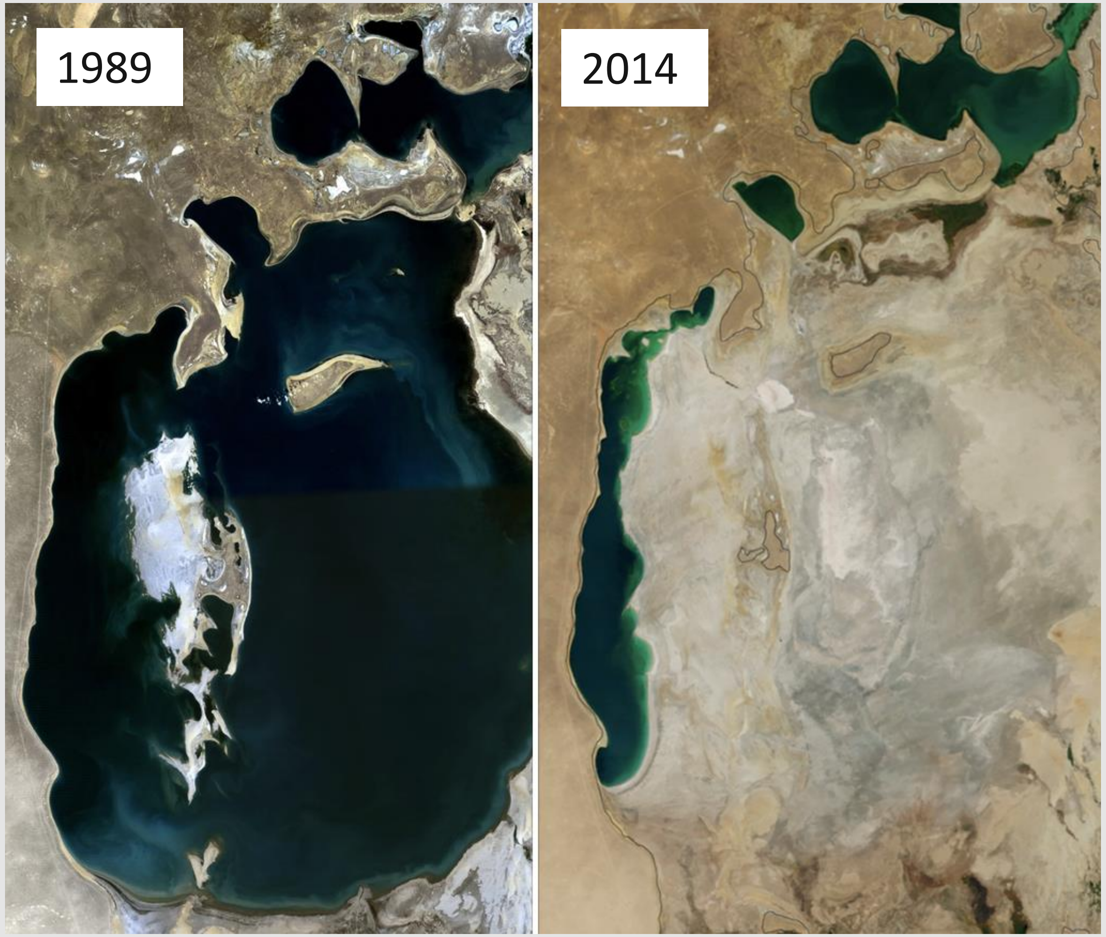
Conclusion from scientific facts: There are no ”sustainable” or ”unsustainable” fibres! It is the suppliers that differ!



Rex et al. (2019)
Sandin et al. (2019b)

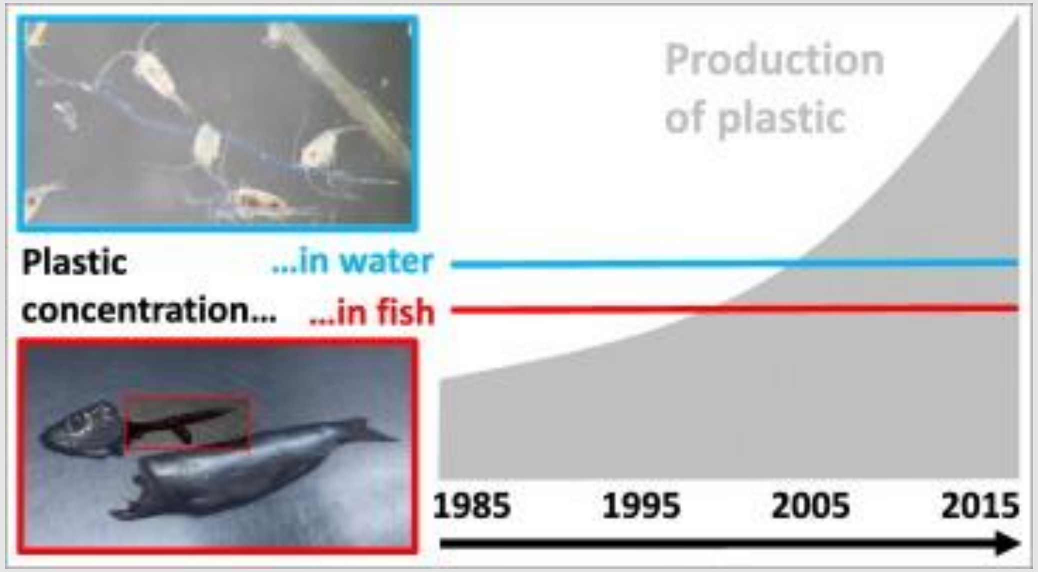
The Aral sea disaster…

But, the sea's depth increased from 30 meters in 2003 to 42 meters in 2008.



The Kok-Aral Dam was built in 2005

Beer et al. No increase in marine microplastic concentration over the last three decades – A case study from the Baltic Sea, 2018



- **First** long term study (more are needed)
- Microplastics have been present in the Baltic environment and the digestive tracts of fishes **for decades**, the levels have **not changed** in this period.
- Microplastic pollution **may be more closely correlated to specific human activities in a region than to global plastic production and utilization as such**.

vision for 2030

best technique

too much water

bad chemicals

too much energy

2030, 45 pieces / year

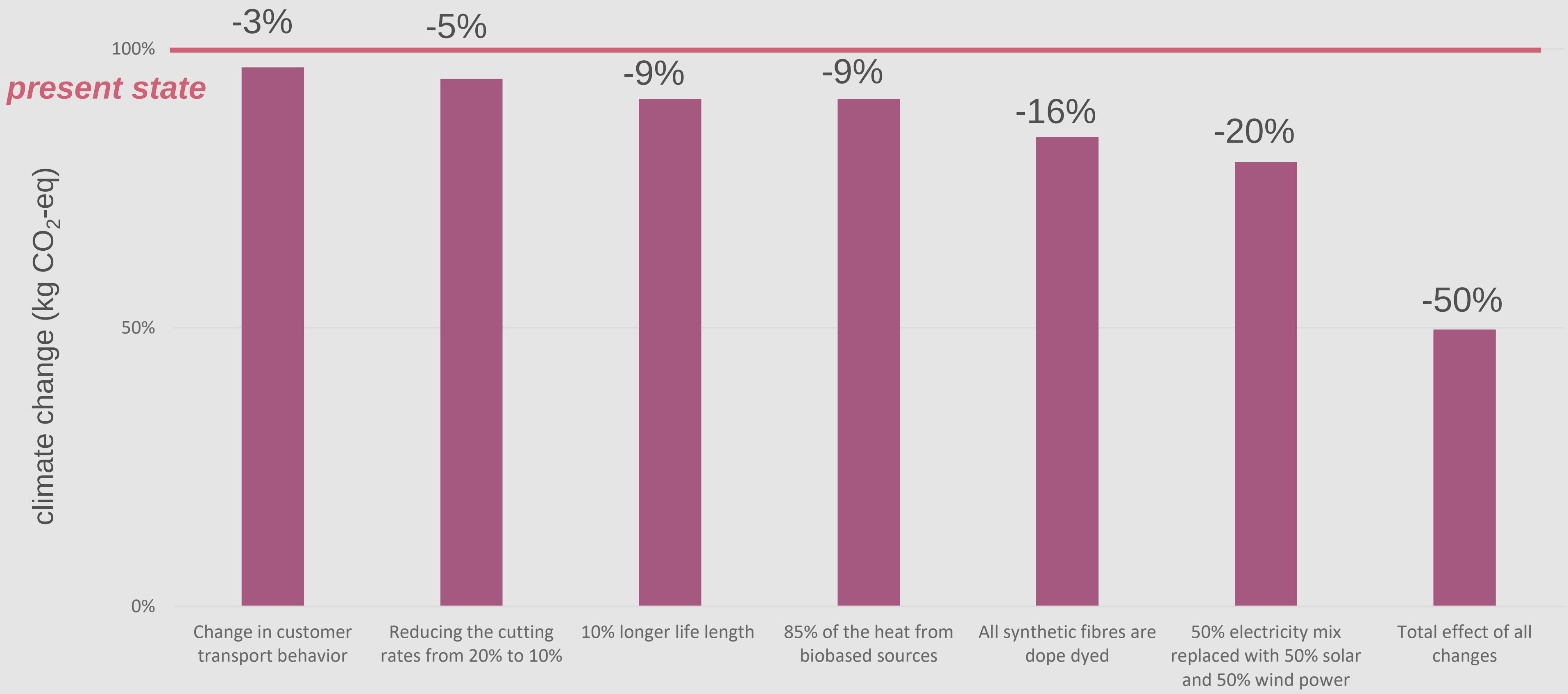
today, 50 pieces /year

Roos et al. (2019)

“what is measured is improved”

potential to reduce environmental impact

climate reduction



water use

blue water withdrawal as % of mean monthly river flow

Roos et al. (2019)

”The big problem for the climate is carbon dioxide emissions and combustion of fossil fuel.”

Christian Azar, professor vid Fysisk resursteori/Rymd- geo- och miljövetenskap på Chalmers, hjälper oss att reda ut frågetecknen.

– Det stora problemet för klimatet är koldioxidutsläppen och förbränning av fossila bränslen. Men metan är inte oviktigt. Både koldioxid och metan absorberar värmestrålning från jordytan.

När metan bryts ner i atmosfären bildas växthusgaserna troposfäriskt ozon och stratosfärisk vattenånga. På kort sikt, mindre än ett år efter utsläpp, har metan 120 gånger starkare uppvärmande effekt på jordens klimat än ett motsvarande utsläpp av koldioxid. På hundra års sikt bidrar ett utsläpp av metan cirka trettio gånger mer till växthuseffekten än ett lika stort utsläpp av koldioxid.

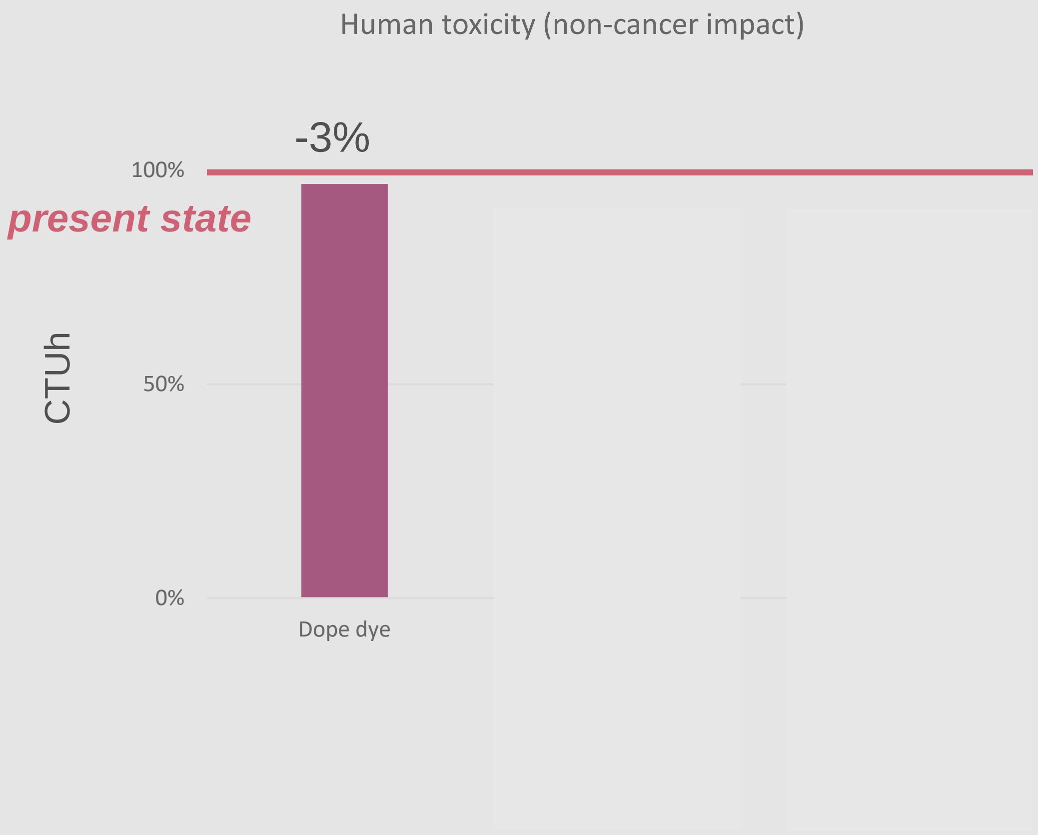
”

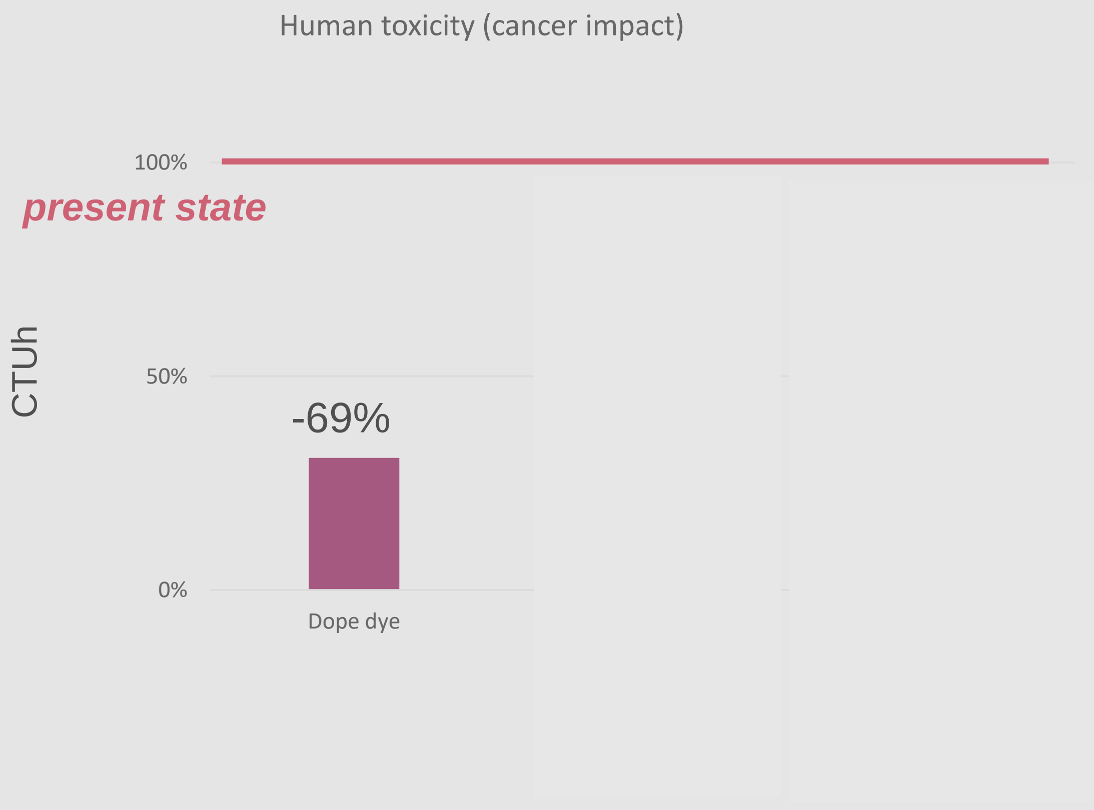
Metanhalten i atmos-

lerade uts
forskning
Eftersom
är så stor
delen av m

Göteborgs-Posten 10 November 2019

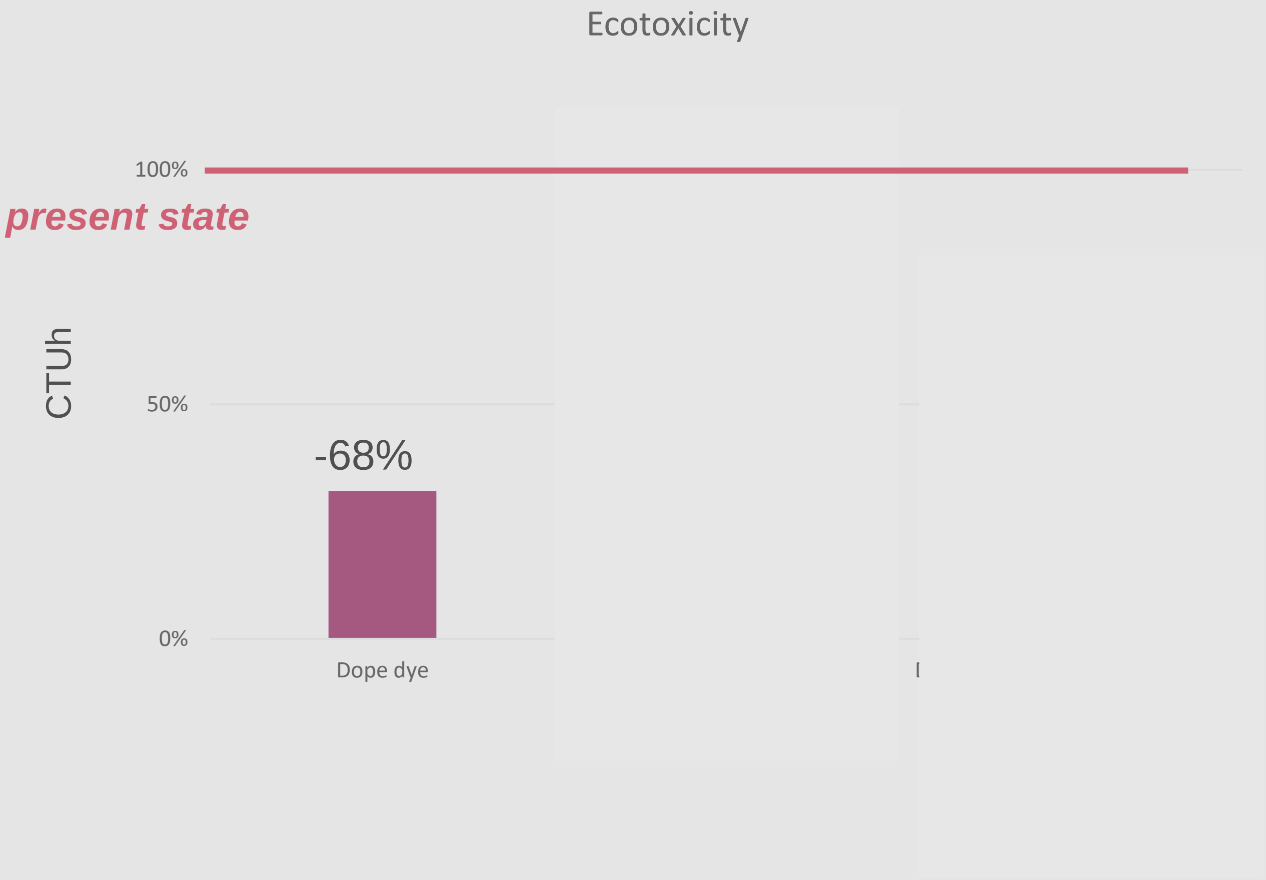
reduce the toxicity by half via spin dye and replacement of 50% of the conventional cotton





Roos et al. (2019)

reduce the toxicity by half via spin dye and replacement of 50% of the conventional cotton



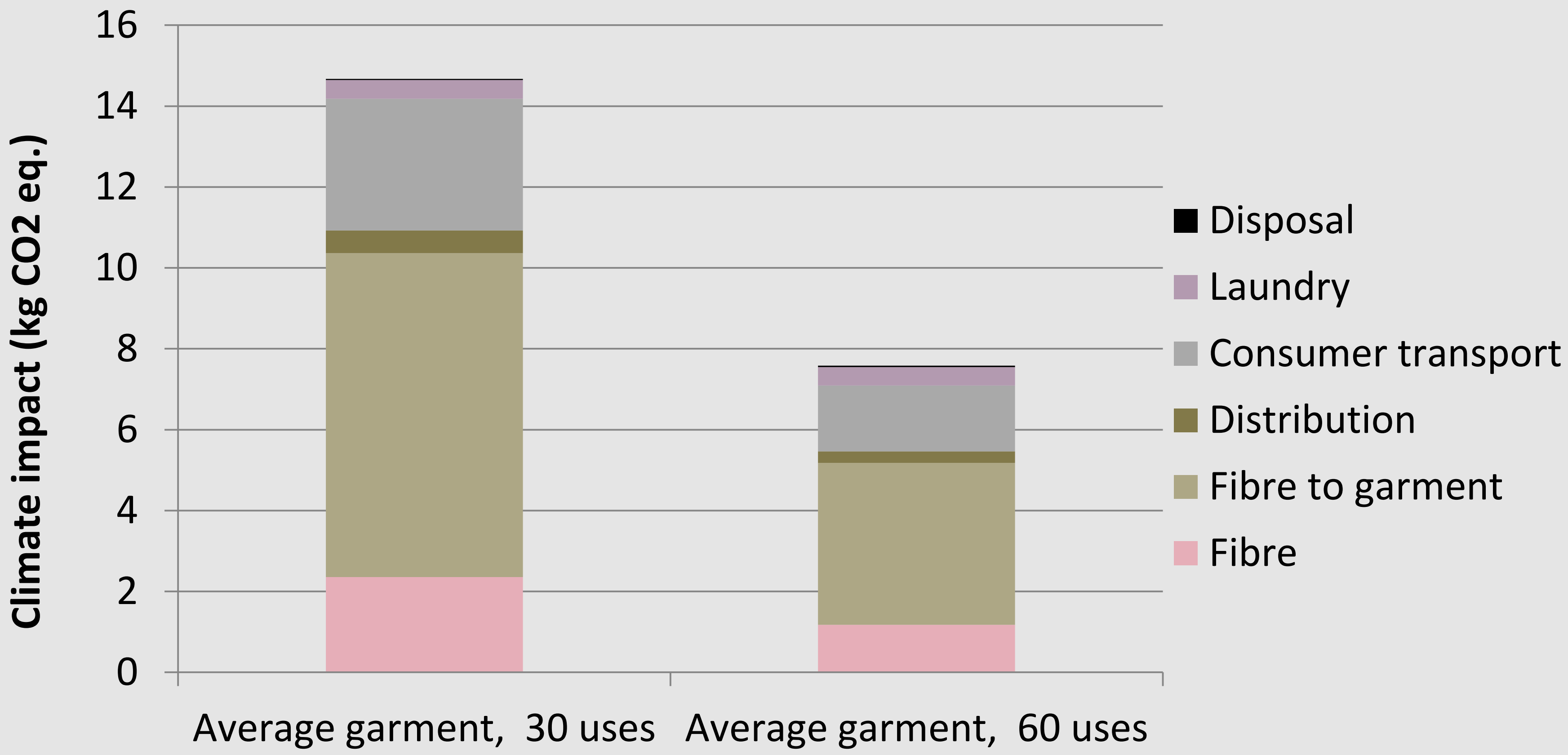
Roos et al. (2019)

Garment ecodesign checklist

Action	Climate	Water	Chemicals
1. Increase life span (resulting in increased number of uses)	impact/ number of uses	impact/ number of uses	impact/ number of uses
2. Better production technology	LESS ENERGY	LESS WATER USE	WASTE WATER TREATMENT
3. Better energy sources	LESS FOSSIL FUEL	-	less toxicity
4. Better chemicals selection and reduction of chemicals' use	LESS CLIMATE IMPACT	LESS POLLUTED WATER	LESS TOXICITY
5. Better materials	-	LESS WATER USE	less toxicity
6. Minimizing microfiber shedding	-	less polluted water	less toxicity
7. Optimize transport and packaging	less fossil fuel	-	less toxicity

LARGE IMPACT / small impact

Optimise the life span!



Climate impact expressed as kg CO_2 equivalents and calculated for a hypothetical average garment of 0.5 kg.

A doubled life length, from 30 uses of the garment (left) to 60 uses of the garment (right), decreases the climate impact by 48% - from 14.7 to 7.6 kg CO_2-eq.

Modified from Roos et al. (2015).

1. Increase the life span!

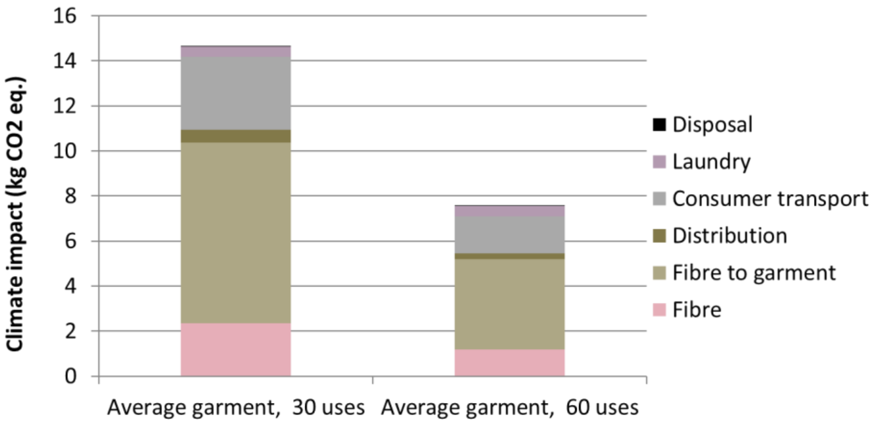
Actions:

A. Analyze which factor(s) decides the life span:

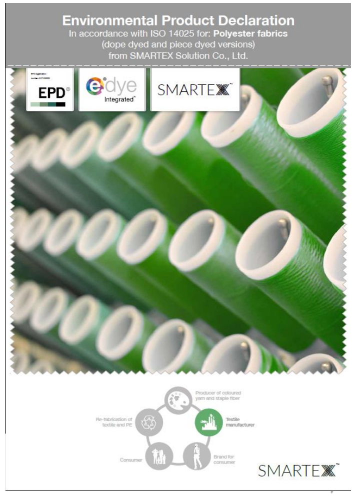
- Do you know how many times does the average customer use the garment?
- Do you analyze causes of returns? (both unused garments and claims made after use)

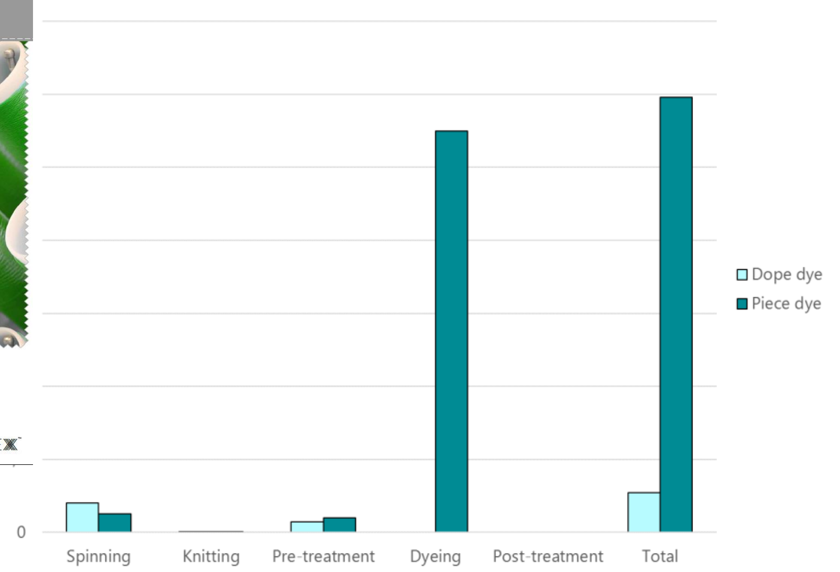
B. Improve by:

- Define who the intended user is and how many times the garment is expected to be used and include in the design brief.
- Make the design more timeless/classic in collaboration with dedicated customers.
- Guarantee the life length (minimum 10 years?) of your garments.
- Construct the garments to reduce the seam slippage.
- Use fibers with good durability (this may also have a positive impact on micro plastics release).
- Use dyestuff with good durability.
  - Optimal color for gussets, collars and other sensitive parts (shade/dyestuff)
- Select better options for parts that are likely to be worn out first:
  - Prints with lower technical performance than the rest of the garment.
  - Zippers
  - Reflecting tapes
  - Children's trousers (knee)
  - For shoes, sewn soles instead of glued will improve technical life span.
- Provide spare buttons and other trims (often simpler if trims are standardized/carry over)
- Offer mending services for customers
- Take back and resell garments second-hand



2. Better production technology





Actions:

A. Improve efficiency:
- Reduce cutting rates
- Reduce rework in the production facilities

B. Cleaner production:
- Use solution dye/dope dye technology to remove the dyeing step completely.
- Automated dosing systems for less exposure to chemicals for the workers.
- Waste water treatment plant (WWTP) with mechanical, chemical and biological treatment.

C. Select suppliers that:
- Have environmentally certification or declaration schemes for production facilities
- Keep their waste water treatment plant (WWTP) turned on (also after audits…)
- Offer transparency regarding:
- Sub-suppliers' environmental performance
- Energy use and sources
- Social sustainability and labor conditions

3. Better energy sources

Actions:

A. Drive change at your suppliers' facilities to more sustainable energy sources:

- Solar panels or wind turbine installation
- Use of bio fuels
- Electric trucks at warehouses

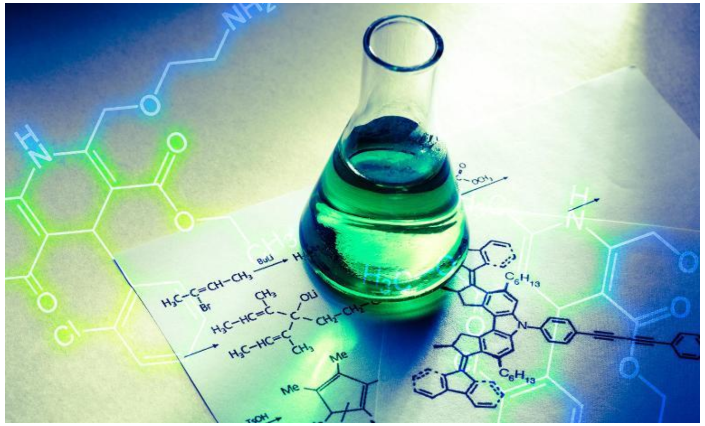
B. Select suppliers that are already using better energy sources:

- E.g. at Laos, high amount of water power, or the Nordic region (Table 2).

Global warming potential for different electricity sources (g CO2-eq./kWh*)		Global warming potential for state grid electricity in different countries (g CO2-eq./kWh*)	
Coal power plant	1,057	China	1,140
Oil power plant	916	Korea	638
Natural gas power plant	600	Laos	211
Wind power plant	14	Lithuania	195
Solar panel	84	Sweden	11

*gram carbon dioxide equivalents per kWh

4. Better chemicals selection and reduction of chemicals' use



Actions:

A. Phase out (unless essential use):
- Persistent organic pollutants (POP)
- Durable Water Repellent treatment – use fluorine/silicon free unless PPE[1] applies
- Antibacterial treatment
- Transport fungicides – keep dry and cool instead

B. Improve by:
- Use dry processes instead of wet processes (e.g. solution dye/dope dye)
- Reduce rework
- Automated dosing systems
- Are there any unnecessary effect chemicals in the garments? (softeners, "easy care" etc.)

C. Select suppliers that:
- Offer safety data sheets
- Offer transparency about what chemicals they use
- Have a good chemicals management work in place

[1]Personal Protective Equipment Regulation (EU) 2016/425.

5. Better materials

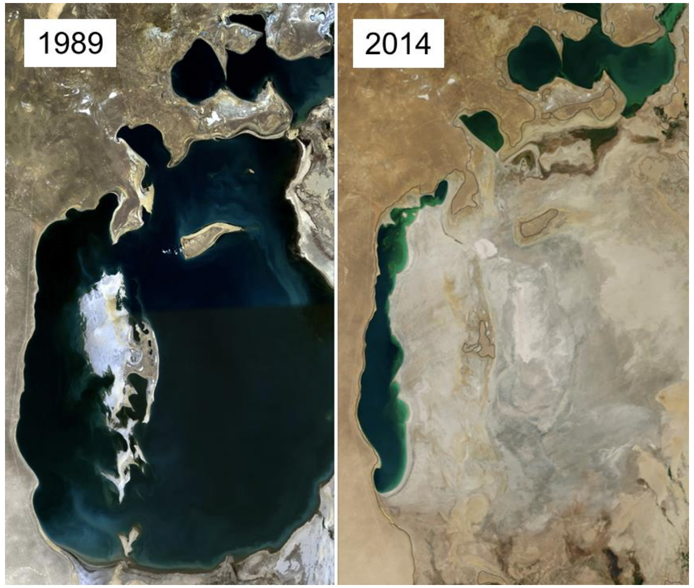
Actions:

A. Replace conventional cotton:
- Can you use e.g. 50/50 forest fiber and cotton fiber?
- Can you use polyester instead of cotton?

B. Select sustainable fibers:
- Set the fibers' life-cycle performance at center stage – including their fit-for-purpose and effects on subsequent production, user behavior and end-of-life options.
- Avoid GMO cotton
- Use fibers with good durability
- Use fibers that can be solution/dope dyed
- Watch out for green-wash! The claim of being "green" must be accompanied by some explanation of in what way, and in case of claims to be "better" – how much better?

C. Avoid unnecessary materials:
- Are there any unnecessary functions in the garments?

D. Standardize trims, attachments, hang tags etc.:
- Increase control for "high risk" materials
- Simplify exchange of buttons etc. in the use phase.



6. Avoid microplastics

Actions:

A. Reduce microplastics generation in the production of the garment:
- Are there any unnecessary brushing operations?
- Use laser or ultrasound cutting if possible.

B. Reduce the amount of microplastics shed from the garment:
- Use materials/constructions that shed less upon mechanical stress during use

C. Reduce the amount of microplastics being carried by the garment:
- Ensure good air quality in the facilities.
- Remove dust from synthetic fibers with dry methods such as vacuum cleaning.

7. Optimise transport and packaging

Actions:

A. Reduce air freight:

- Can there be a total ban of air freight in the company?

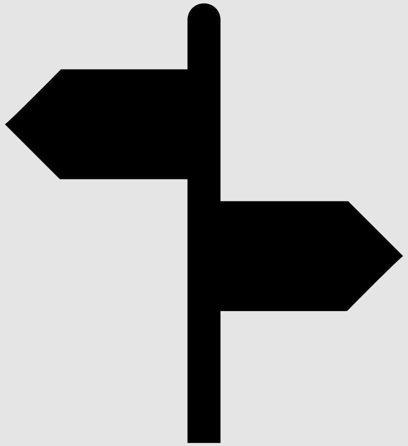
B. Reduce anti-mold agents (fungicides):

- Pack and store in dry conditions
- Keep dry and cool
- Unpack as soon as goods arrive (humidity, temperature and time drives mold growth)

C. Optimize packaging materials:

- Make sure the packaging does its work and protects the goods
- Reduce the size of the packaging and the amount of packaging material
- Do not use hazardous chemicals (for instance prints)

Recommendations for how to do it



organization

- membership the most important element

business models

- sustainable business models needs promotion for scaling and mainstreaming
- new tools for transparency, traceability, compliance etc.

policy instruments

- multi-stakeholder initiatives
- cross-national legislation

common challenge and solution

- cross-organization and cross-national responsibility

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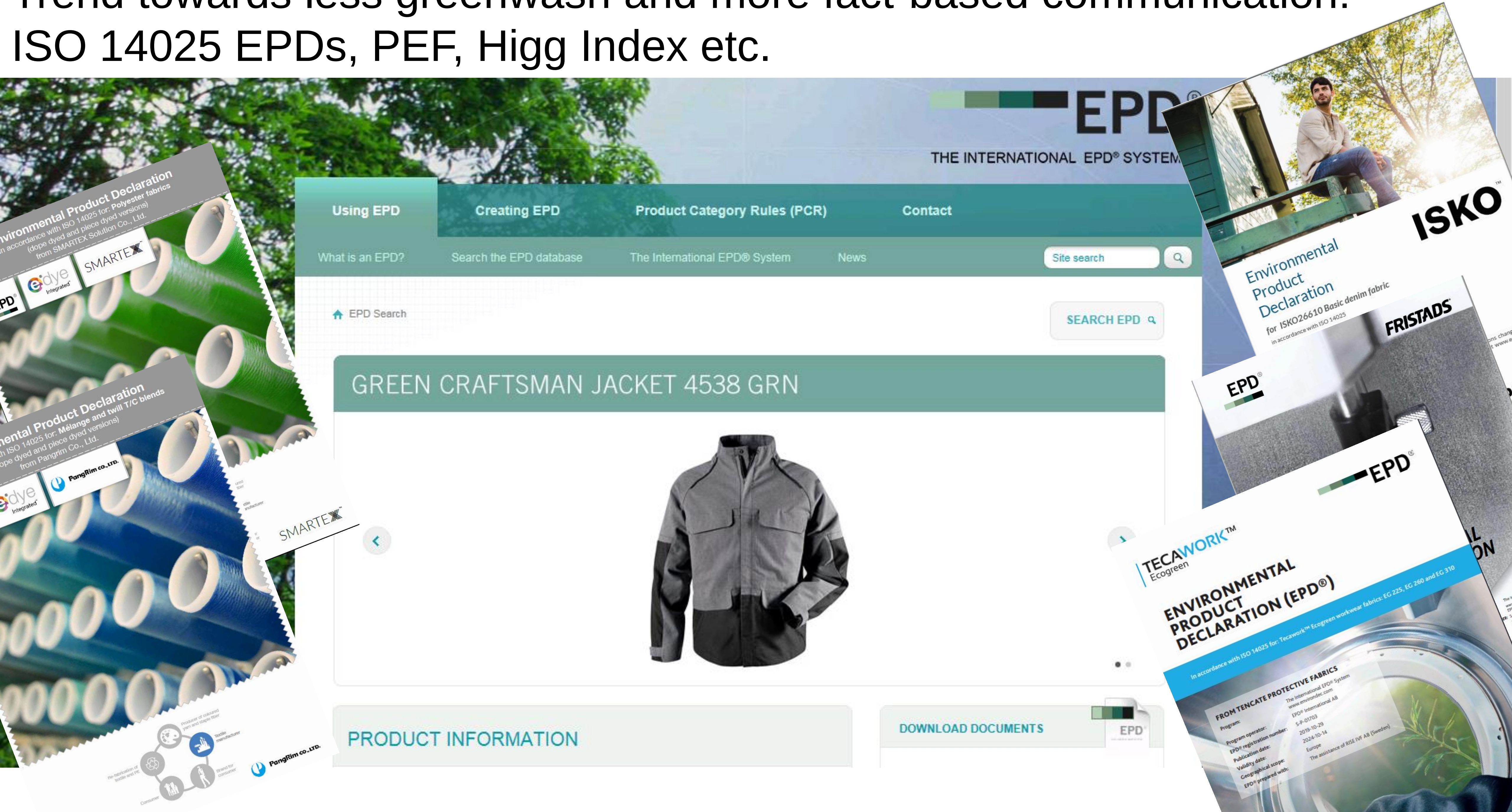
Reitan Andersen, K. & Pedersen, E. R. G. (2018). Lokal produktion i en global tidsalder. Geografisk Orientering.
Reitan Andersen, K. (2017) Stabilizing Sustainability in the Textile and Fashion Industry. Doctoral Thesis. Copenhagen Business School.
Sendlhofer, T.(2019) Organising Corporate Social Responsibility: The Case of Employee Involvement at Small and Medium-Sized Enterprises. Doctoral Thesis. Stockholm School of Economics.

Trend towards less greenwash and more fact-based communication: ISO 14025 EPDs, PEF, Higg Index etc.



Questions?

Global Warming Potential

the case, it must have occurred several centuries ago, as leprosy became increasingly scarce in the British Isles after the 17th century (3). It is also conceivable that humans may have been infected through contact with red squirrels bearing *M. leprae*, as these animals were prized for their fur and meat in former times (30). Our findings show that further surveys of animal reservoirs of leprosy bacilli are warranted, because zoonotic infection from such reservoirs may contribute to the inexplicably stubborn plateau in the incidence of the human leprosy epidemic despite effective and widespread treatment with multidrug therapy (1).

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ACKNOWLEDGMENTS

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SUPPLEMENTARY MATERIALS

www.sciencemag.org/content/354/6313/744/suppl/DC1
Materials and Methods
Figs. S1 to S5
Tables S1 to S14
References (31–51)

21 June 2016; accepted 27 September 2016
10.1126/science.aah3783

ARCTIC SEA ICE

Observed Arctic sea-ice loss directly follows anthropogenic CO_2 emission

Dirk Notz[1*] and Julienne Stroeve[2,3]

Arctic sea ice is retreating rapidly, raising prospects of a future ice-free Arctic Ocean during summer. Because climate-model simulations of the sea-ice loss differ substantially, we used a robust linear relationship between monthly-mean September sea-ice area and cumulative carbon dioxide (CO_2) emissions to infer the future evolution of Arctic summer sea ice directly from the observational record. The observed linear relationship implies a sustained loss of 3 ± 0.3 square meters of September sea-ice area per metric ton of CO_2 emission. On the basis of this sensitivity, Arctic sea ice will be lost throughout September for an additional 1000 gigatons of CO_2 emissions. Most models show a lower sensitivity, which is possibly linked to an underestimation of the modeled increase in incoming longwave radiation and of the modeled transient climate response.

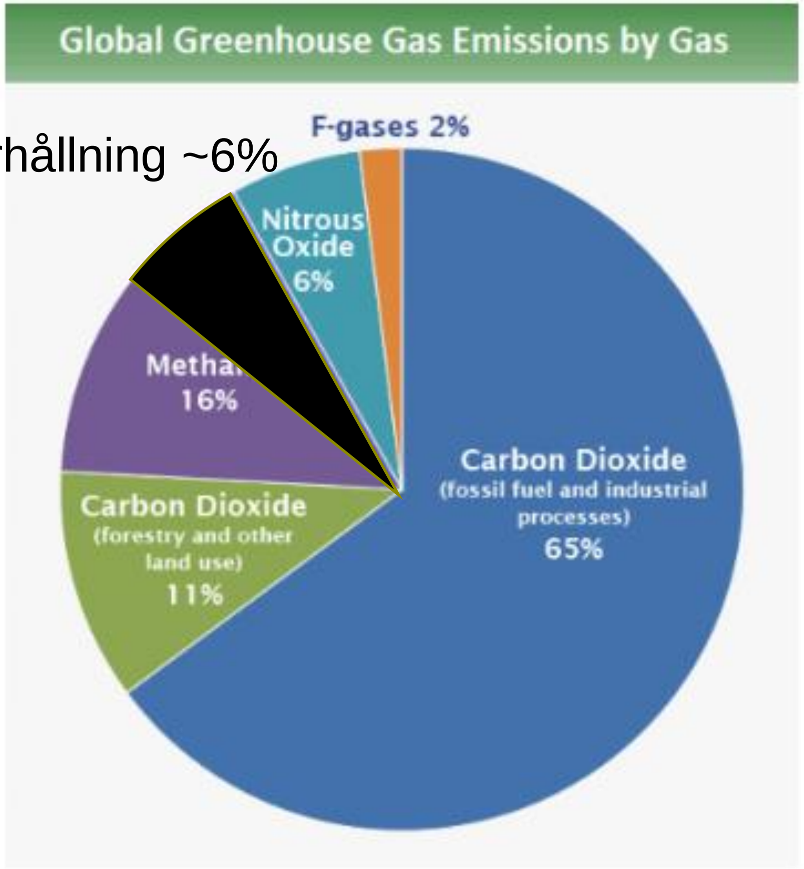
The ongoing rapid loss of Arctic sea ice has far-reaching consequences for climate, ecology, and human activities alike. These include amplified warming of the Arctic (1), possible linkages of sea-ice loss to mid-latitude weather patterns (2), changing habitat for flora and fauna (3), and changing prospects for human activities in the high north (3). To understand and manage these consequences and their possible future manifestation, we need to understand the sensitivity of Arctic sea-ice evolution to changes in the prevailing climate conditions. However, assessing this sensitivity has been challenging. For example, climate-model simulations differ widely in their timing of the loss of Arctic sea ice for a given trajectory of anthropogenic CO_2 emissions: Although in the most recent Climate Model Intercomparison Project 5 (CMIP5) (4), some models project a near ice-free Arctic during the summer minimum already toward the beginning of this century, other models keep a substantial amount of ice well into the next century even for an external forcing based on largely undamped anthropogenic CO_2 emissions as described by the Representative Concentration Pathway scenario RCP8.5 (4, 5).

To robustly estimate the sensitivity of Arctic sea ice to changes in the external forcing, we identify and examine a fundamental relationship in which the CMIP5 models agree with the observational record: During the transition to a seasonally ice-free Arctic Ocean, the 30-year running mean of monthly mean September Arctic sea-ice area is almost linearly related to cumulative anthropogenic CO_2 emissions (Fig. 1). In the model simulations, the linear relationship holds until the 30-year running mean, which we analyze to reduce internal variability, samples more and more years of a seasonally ice-free Arctic Ocean, at which point the relationship levels off toward zero. For the first few decades of the simulations, a few models simulate a near-constant sea-ice cover despite slightly rising cumulative CO_2 emissions. This suggests that in these all-forcing simulations, greenhouse-gas emissions were initially not the dominant driver of sea-ice evolution. This notion is confirmed by the CMIP5 1% CO_2 simulations, where the initial near-constant sea-ice cover does not occur (fig. S3A). With rising greenhouse-gas emissions, the impact of CO_2 becomes dominating also in all all-forcing simulations, as evidenced by the robust linear trend that holds in all simulations throughout the transition period to seasonally ice-free conditions. We define this transition period as starting when the 30-year mean September Arctic sea-ice area in a particular simulation decreases for the first time to an area that is 10% or more below the simulation's minimum sea-ice cover during the period 1850 to 1900, and

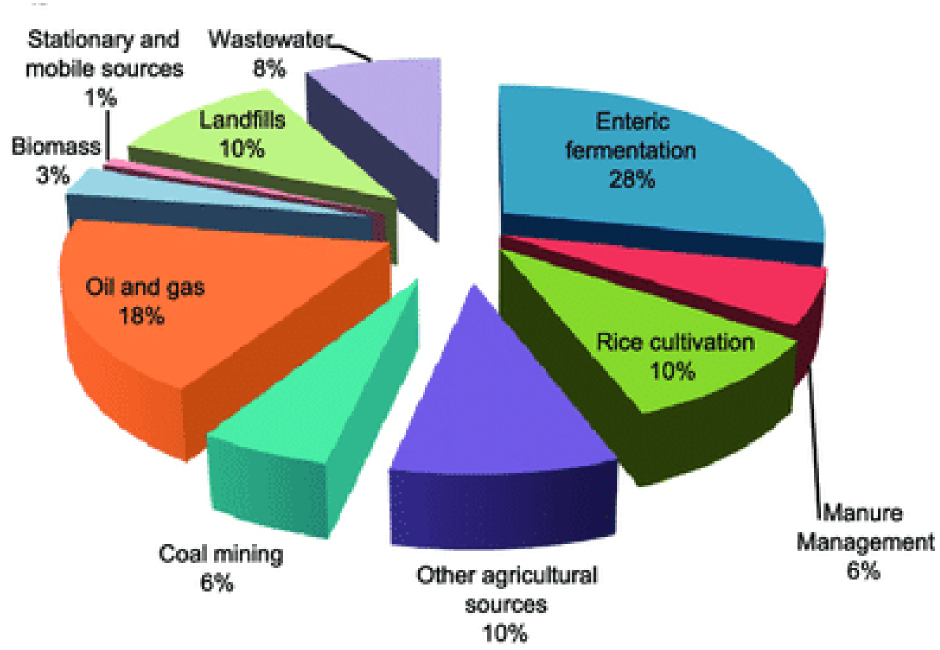
[1]Max Planck Institute for Meteorology, Hamburg, Germany. [2]National Snow and Ice Data Center, Boulder, CO, USA. [3]University College, London, UK.
*Corresponding author. Email: dirk.notz@mpimet.mpg.de

Intergovernmental Panel of Climate Change (IPCC)

Djurhållning ~6%



- 76% från CO_2. Domineras av förbränning av fossilt bränsle.
- 6% från N_2O. Från jordbruk samt förbränning av fossilt bränsle.
- 2% från fluorgaser.
- 16% från metan:



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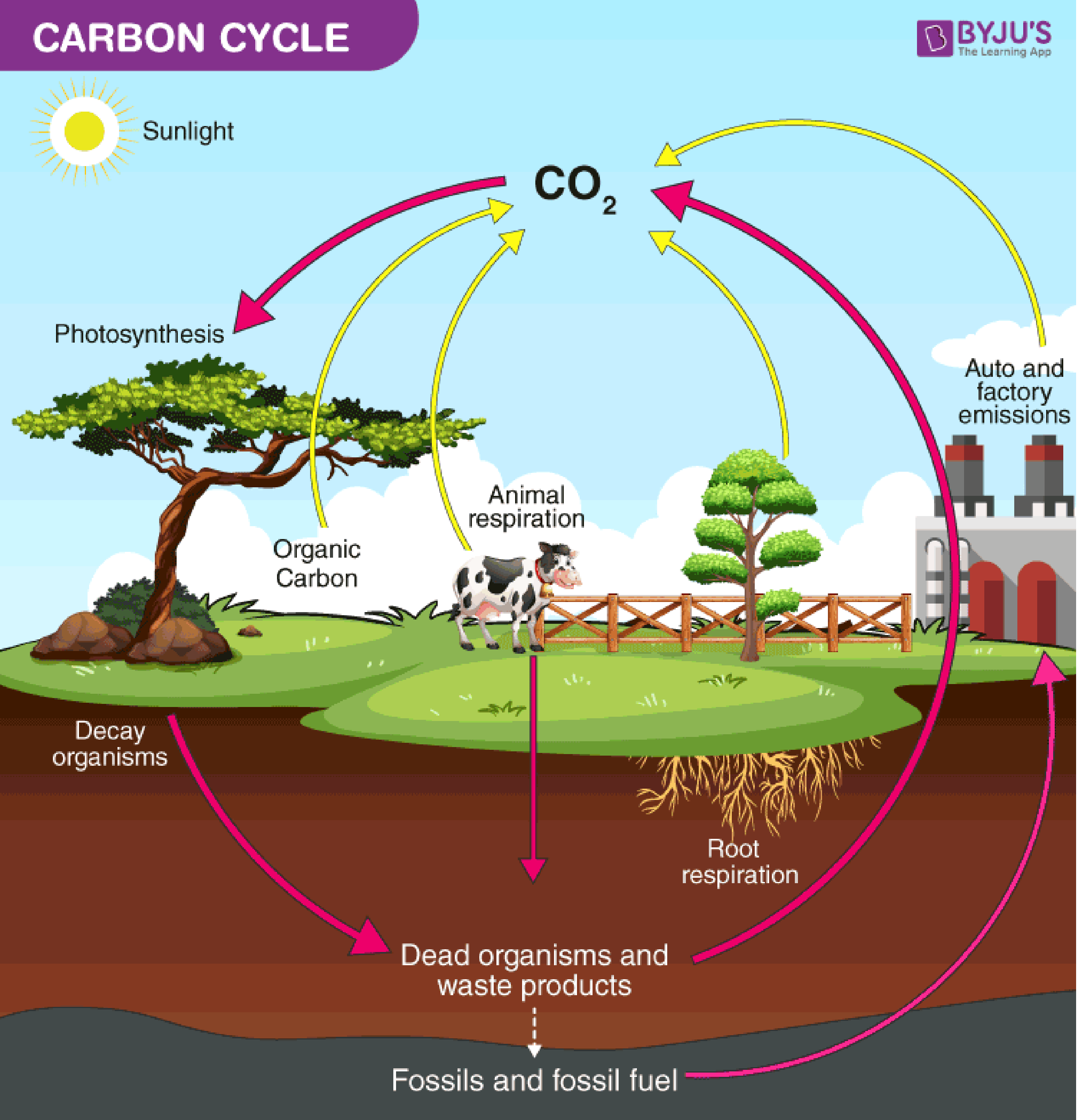
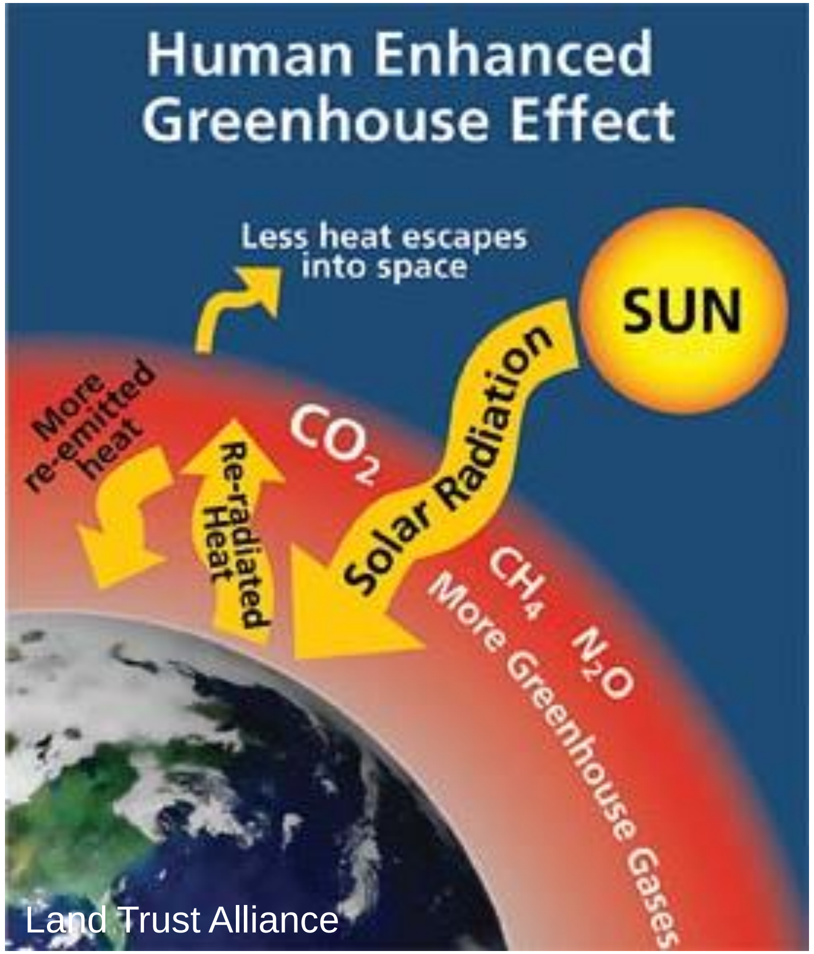
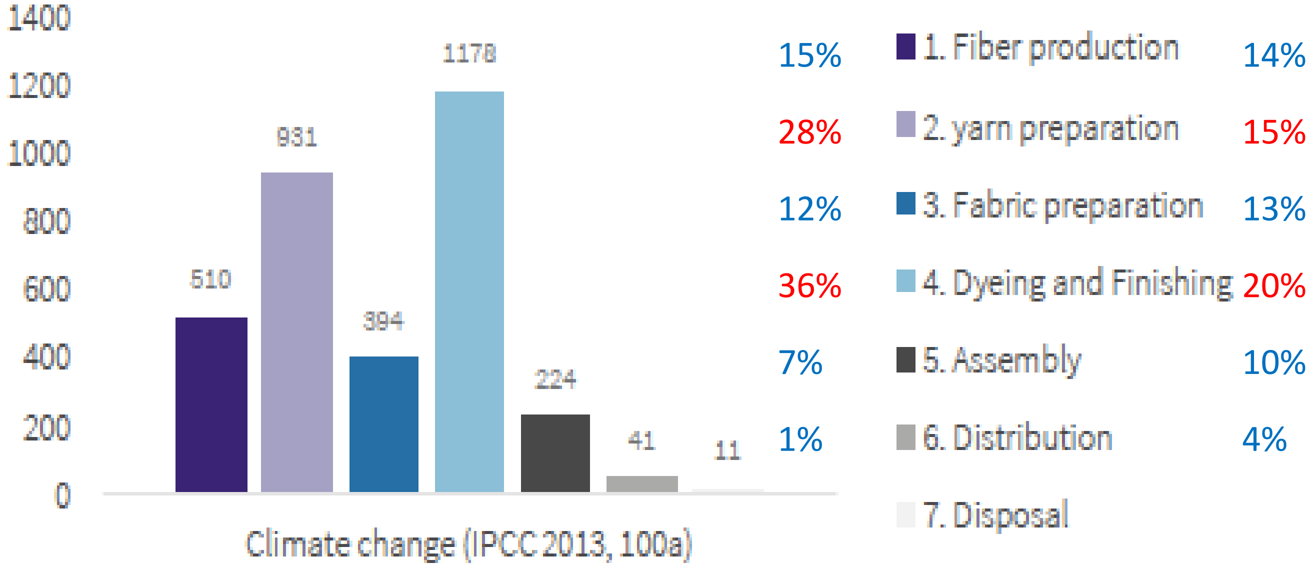

CARBON CYCLE
BYJU'S
The Learning App
Sunlight
CO_2
Photosynthesis
Auto and factory emissions
Animal respiration
Organic Carbon
Decay organisms
Root respiration
Dead organisms and waste products
Fossils and fossil fuel

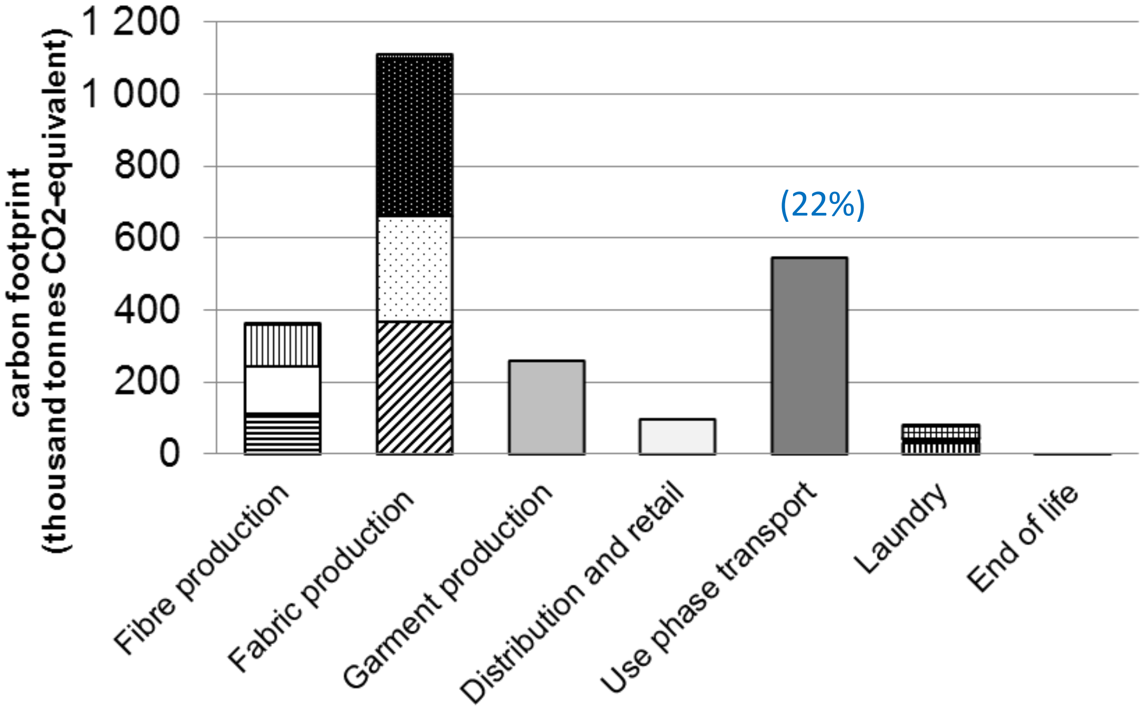

Human Enhanced Greenhouse Effect
Less heat escapes into space
SUN
More re-emitted heat
Re-radiated Heat
CO_2
Solar Radiation
CH_4
N_2O
More Greenhouse Gases
Land Trust Alliance

Sweden 2018: collapsing glaciers, forest fires, drought and emergency slaughter

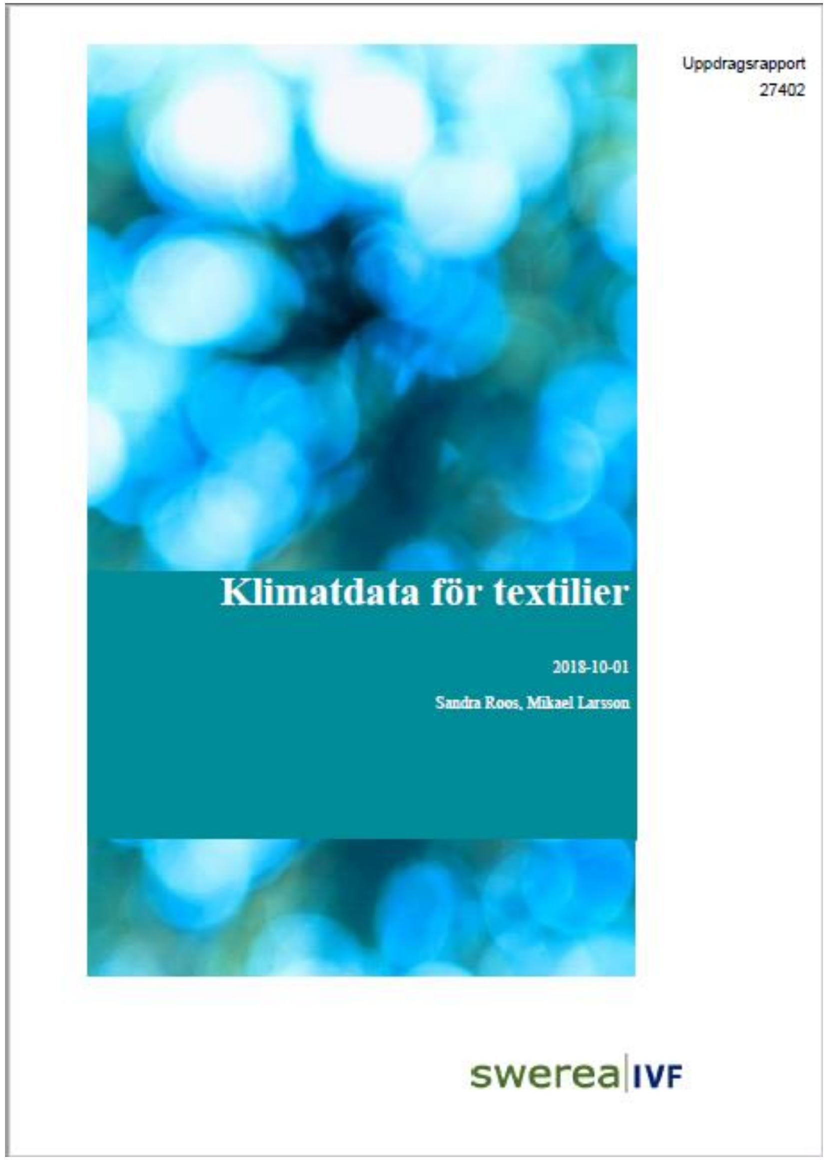
RI.
SE

Yarn making and wet treatment the production climate hotspots #1 and #2 in two independent studies





Greenhouse Gases from Textiles - In Sweden


Uppdragsrapport
27402

Klimatdata för textilier

2018-10-01

Sandra Roos, Mikael Larsson

swerea|IVF

Utsläppen från svensk textilkonsumtion ökar

Publicerad 30 okt 2018 kl 22.39


Klädbytardag på Brygghuset i Stockholm.
Foto: MIKAEL SJÖBERG

Klimatutsläppen från svensk textilkonsumtion har ökat med 27 procent – under sju år.

Det visar en studie genomförd av Naturvårdsverket.

– Alla behöver fundera på hur mycket nya kläder man egentligen behöver köpa, säger Karin Lexén, generalsekreterare på Naturskyddsföreningen.