

## SECTION 1 FACT CHECK MONOBLOC

The MONOBLOC is a stackable plastic seating furniture manufactured since the early 1970s. Together with designer Pierre Paulin, French engineer Henry Massonnet developed the plastic chair, which is now the most widely sold seating furniture in the world.

Although the Monobloc is reviled as a mostly white, ugly behemoth, it can be found in almost every garden, getaway, beach, park, and large events around the world. It has many practical qualities: it is stackable, very light, quite weather-resistant, washable with soapy water and, above all, cheap. Particularly detrimental to its image are its instability and the stain-attracting effect of its surface, which quickly make it look gray and unsightly. Broken Monobloc chairs litter the landscape and contribute significantly to global plastic litter.



The production of one piece (monobloc) in a single operation gave the chair its name, because the injection molding process can produce a chair from 2.5 kg of polypropylene granules PP worth 2.50 Euros in just 56 seconds. Up to 1,500 chairs are produced within 24 hours!

Advances in the chemical-technical processing of petroleum into plastics with weather-resistant and load-bearing properties, as well as efficient polymerization processes, are the basis for Monobloc production in such high quantities at a low price.

But in the future, not only the practical things in life will be connected with the plastic chair. Since the beginning of 2022, the Monobloc is even a movie star! Hauke Wendler from Hamburg is a documentary filmmaker, journalist and producer and has researched the history, distribution, use and disposal of the Monobloc in such detail that reports, podcasts and a cinema film have been produced. The film "Ein Plastikstuhl erobert die Welt" ("A plastic chair conquers the world") will be presented in the Kulturjournal of the NDR. Broadcast: Kulturjournal | 24.01.2022 | 22:45 Uhr (6 Min).



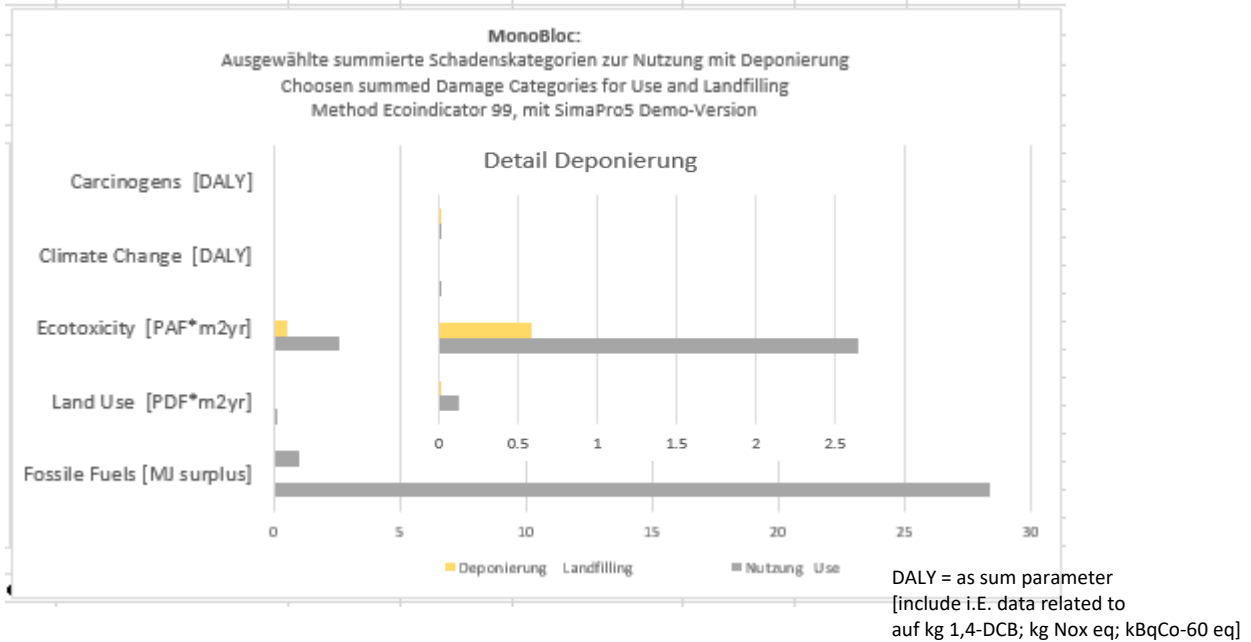
### TASKS:

1. Research the production process and distribution of the Monobloc.
2. What is polypropylene made of and how is the PP pellet made?
3. Find out the price and sales figures in US, Uganda and Vietnam.
4. Research and discuss its image in these three countries. Are there similarities and differences?

As sources use YouTube Videos, Wikipedia ....

**SECTION 2 DATA SET MONOBLOC - End-of-Life „LANDFILLING“**

A life cycle analysis is to be carried out using the example of the consumer product "Monobloc". The method used for this purpose is a life cycle assessment which can be carried out with the aid of the freely available DEMO version of the LCA database tool "SimaPro5". In addition to the production and use of the plastic chair, three end-of-life scenarios are considered: Landfilling, incineration and recycling of the PP.



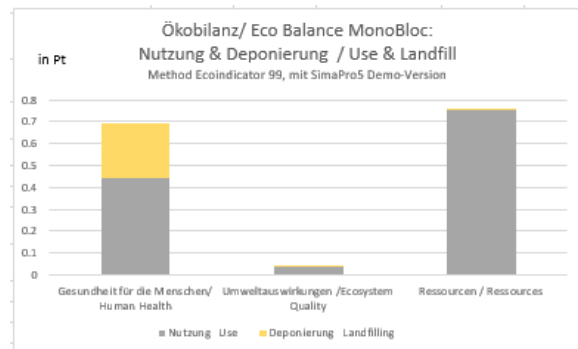
The production of the monobloc consisting of polypropylene is at the expense of fossil and energy resources. The composition of the energy mix used in the process has a significant impact on the life cycle assessment.

Schadenskategorie / Damage Categories	Einheit / Unit	Summe / Sum	Nutzung / Use	Deponierung / Landfilling
Carcinogens	DALY	7.05E-06	0.0000017	0.00000535
Resp. Organics	DALY	1.32E-08	1.31E-08	1.3E-10
Resp. Inorganic	DALY	6.26E-06	6.22E-06	3.24E-08
Climate Change	DALY	1.82E-06	1.78E-06	4.29E-08
Radiation	DALY	1.39E-08	1.38E-08	7.15E-11
Ozone Layer	DALY	3.39E-10	3.33E-10	6.44E-12
Ecotoxicity	PAF*m2yr	3.22	2.64	0.584
Acidification/Eutrophicatio	PDF*m2yr	0.122	0.121	0.00104
Land Use	PDF*m2yr	0.135	0.131	0.00456
Minerals	MJ surplus	0.123	0.123	0.000447
Fossile Fuels	MJ surplus	28.5	28.4	0.0747

Health and the environment are significantly affected. Above all, the carcinogenic potential should be mentioned.

If the chair is landfilled after its use, the resources it contains remain unused. However, fossil-based plastics in particular have a high energy density, which would be better put to secondary use (e.g. incineration) or else recycled.

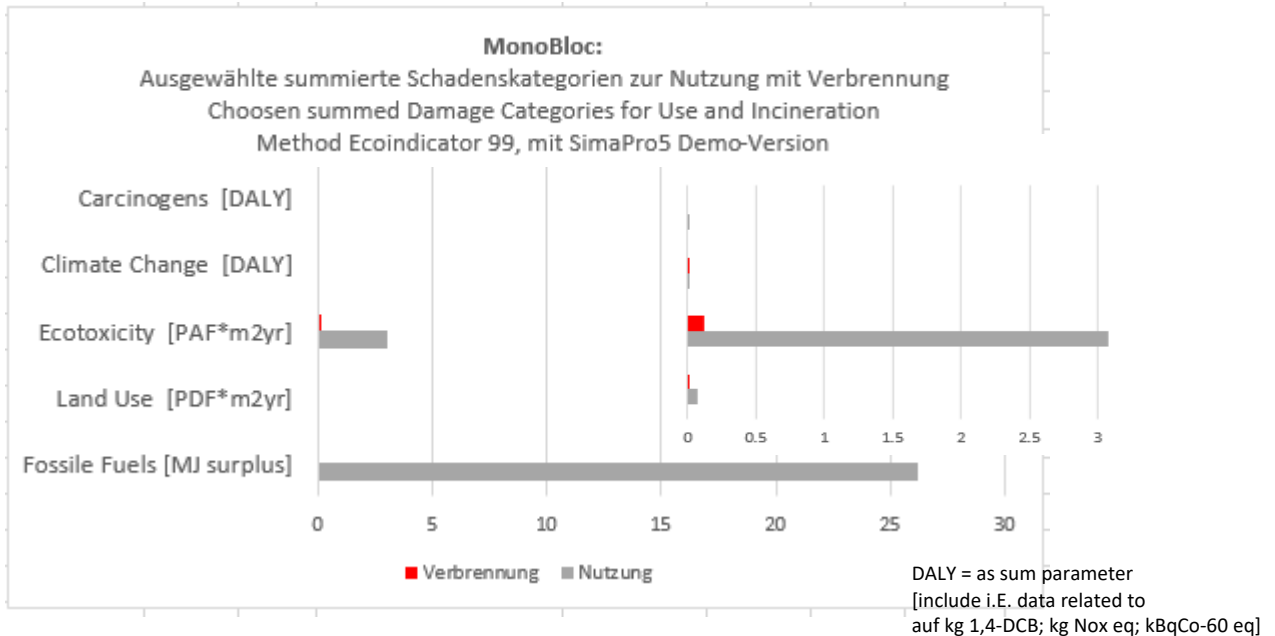
Schadenskategorie / Damage Categories	Einheit / Unit	Nutzung / Use	Deponierung / Landfilling	Summe / Sum in Pt
Gesundheit für die Menschen / Human Health	Pt	0.444	0.248	0.692
Umweltauswirkungen / Ecosystem Quality	Pt	0.0361	0.00447	0.0405
Ressourcen / Resources	Pt	0.756	0.00199	0.758
Summe / Sum	Pt	1.24	0.254	1.49



1 Pt (Eco Point) stands for 1/1,000th of the annual environmental impact (Environmental Load) of an average European citizen.

**SECTION 2 DATA SET MONOBLOC - End-of-Life „INCINERATION“**

A life cycle analysis is to be carried out using the example of the consumer product "Monobloc". The method used for this purpose is a life cycle assessment which can be carried out with the aid of the freely available DEMO version of the LCA database tool "SimaPro5". In addition to the production and use of the plastic chair, three end-of-life scenarios are considered: landfilling, **incineration** and recycling of the PP.



The production of the monobloc consisting of polypropylene is at the expense of fossil and energy resources. The composition of the energy mix used in the process has a significant impact on the life cycle assessment.

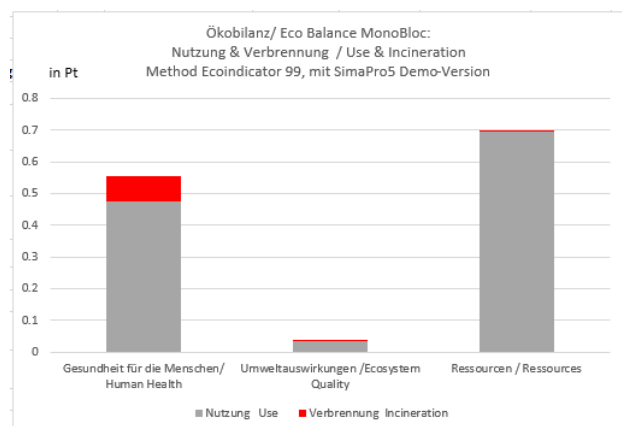
Schadenskategorie Damage Categories	Einheit Unit	Summe Sum	Nutzung Use	Verbrennung Incineration
Carcinogens	DALY	2.5E-06	0.00000218	0.00000322
Resp. Organics	DALY	1.1E-08	1.08E-08	2.29E-10
Resp. Inorganic	DALY	6.6E-06	0.00000652	0.00000011
Climate Change	DALY	3E-06	0.00000167	0.00000133
Radiation	DALY	1.2E-08	1.16E-08	1.31E-10
Ozone Layer	DALY	2E-10	1.99E-10	3.83E-12
Ecotoxicity	PAF*m2yr	3.19	3.07	0.125
Acidification/Eutrophication	PDF*m2yr	0.122	0.116	0.00586
Land Use	PDF*m2yr	0.0703	0.0698	0.000508
Minerals	MJ surplus	0.117	0.116	0.00181
Fossile Fuels	MJ surplus	26.2	26.2	0.0536

Health and the environment are significantly affected. Above all, the carcinogenic potential should be mentioned.

Fossil-based plastics in particular have a high energy density. If the chair is thermally recycled after use, the resources it contains can be channeled, for example, into electricity generation or district heating.

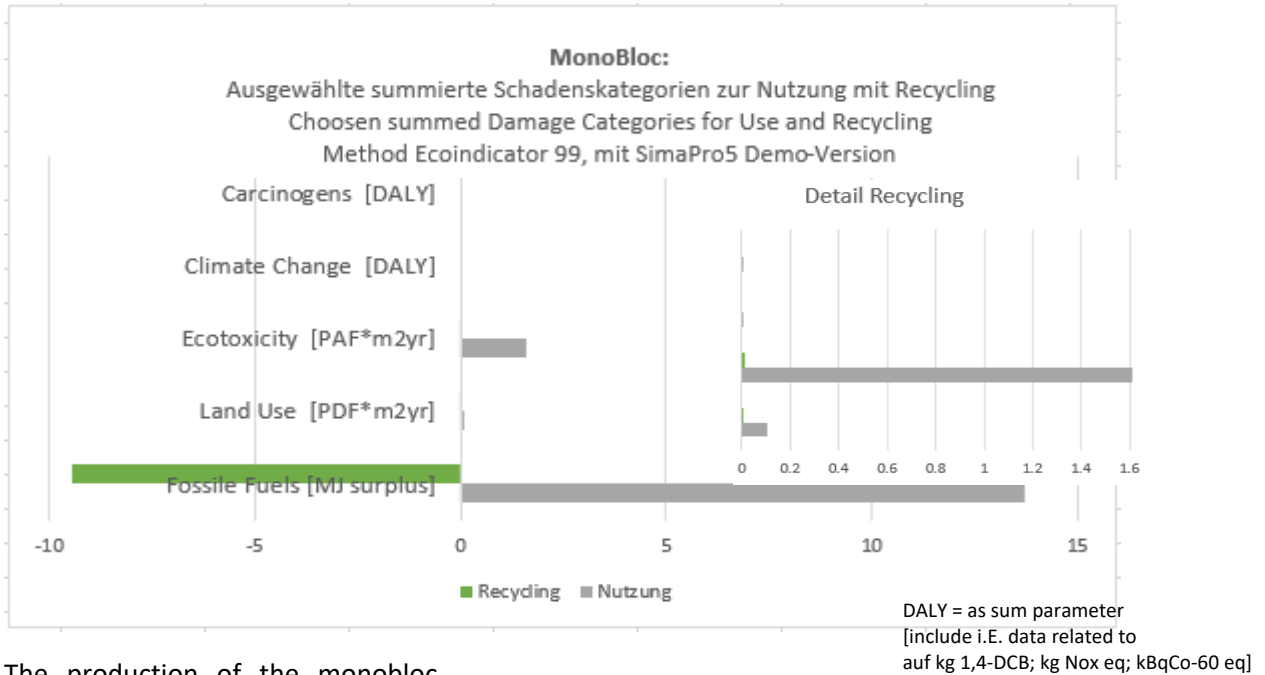
Schadenskategorie Damage Categories	Einheit Unit	Nutzung Use	Verbrennung Incineration	Summe Sum
Gesundheit für die Menschen/ Human Health	Pt	0.474	0.0805	0.555
Umweltauswirkungen /Ecosystem Quality	Pt	0.0344	0.00132	0.0357
Ressourcen / Ressources	Pt	0.697	0.00132	0.698
Summe / Sum	Pt	1.21	0.0833	1.29

1 Pt (Eco Point) stands for 1/1,000th of the annual environmental impact (Environmental Load) of an average European citizen.



**SECTION 2 DATA SET MONOBLOC - End-of-Life „RECYCLING“**

A life cycle analysis is to be carried out using the example of the consumer product "Monobloc". The method used for this purpose is a life cycle assessment which can be carried out with the aid of the freely available DEMO version of the LCA database tool "SimaPro5". In addition to the production and use of the plastic chair, three end-of-life scenarios are considered: landfilling, **incineration** and recycling of the PP.



The production of the monobloc consisting of polypropylene is at the expense of fossil and energy resources. The composition of the energy mix used in the process has a significant impact on the life cycle assessment.

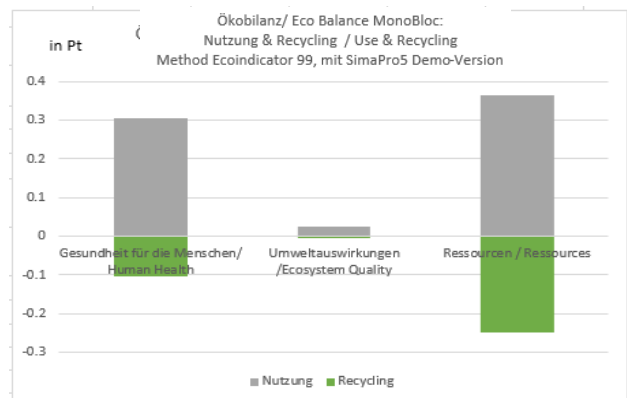
Health and the environment are significantly affected. Above all, the carcinogenic potential should be mentioned.

If the chair is recycled after use, the material and energy resources it contains are returned to a secondary material cycle. Less polypropylene has to be re-synthesized.

Schadenskategorie Damage Categories	Einheit Unit	Summe Sum	Nutzung Use	Recycling
Carcinogens	DALY	1.2E-06	1.18E-06	4.94E-09
Resp. Organics	DALY	4.3E-09	7.29E-09	-3.02E-09
Resp. Inorganic	DALY	2.5E-06	4.42E-06	-1.96E-06
Climate Change	DALY	7.4E-07	0.0000011	-3.55E-07
Radiation	DALY	1.8E-08	1.19E-08	5.94E-09
Ozone Layer	DALY	2.8E-10	2.71E-10	1.26E-11
Ecotoxicity	PAF*m2	1.62	1.61	0.0141
Acidification/Eutrophication	PDF*m2	0.0117	0.0759	-0.0642
Land Use	PDF*m2	0.109	0.107	0.00186
Minerals	MJ surpl	0.109	0.0658	0.000671
Fossile Fuels	MJ surpl	4.28	13.7	-9.45

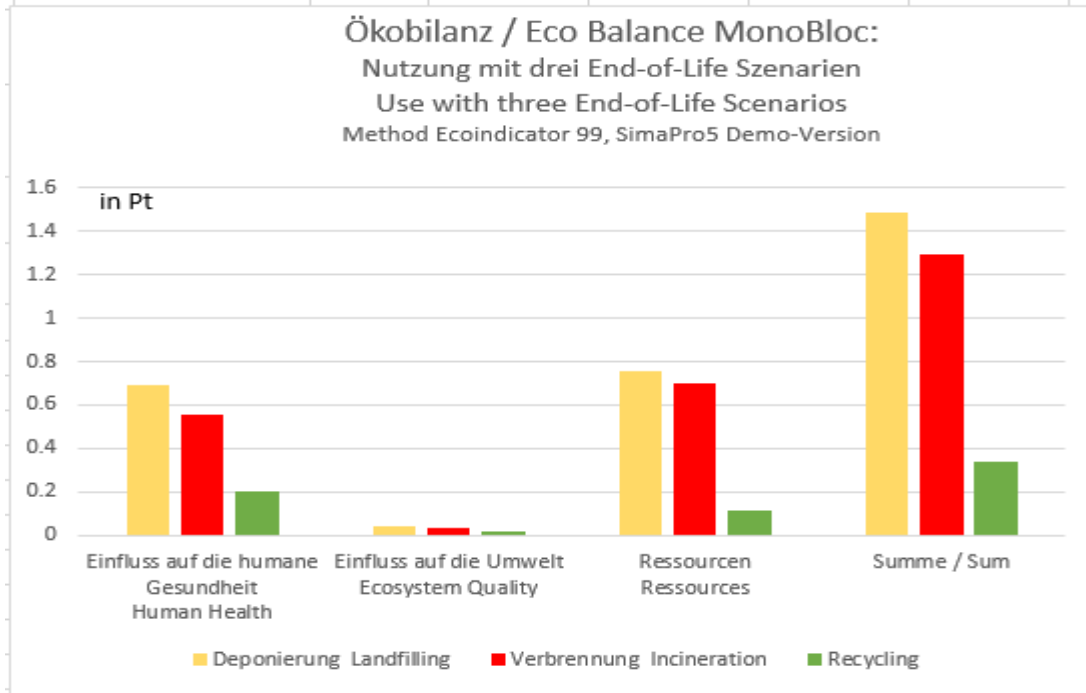
Schadenskategorie Damage Categories	Einheit Unit	Nutzung Use	Recycling	Summe Sum in Pt
Gesundheit für die Menschen/ Human Health	Pt	0.306	-0.103	0.204
Umweltauswirkungen / Ecosystem Quality	Pt	0.024	-0.00426	0.0198
Ressourcen / Resources	Pt	0.366	-0.25	0.115
Summe / Sum	Pt	0.696	-0.357	0.339

1 Pt (Eco Point) stands for 1/1,000th of the annual environmental impact (Environmental Load) of an average European citizen.



**SECTION 3 GROUP DISCUSSION „MONOBLOC“ and the problem with plastic waste**

The final presentation of the results (via keynote, powerpoint, padlet or as poster) and discussion (as group puzzle / panel discussion / expert round) succeeds in communicating the results of the three utilization scenarios to the entire learning group



The pollutants and impact parameters are intended to provide the pros & cons of the MonoBloc product and the three scenarios for disposal, incineration or recycling as an argumentation aid in a panel of experts.

Results from the LCA Ecoindicator 99 with SimaPro5 in the DEMO version:  
1 Pt (Eco Point) stands for 1/1,000th of the annual environmental impact (Environmental Load) of an average European citizen.

Schadenskategorie Damage Categories	Einheit Unit	Deponierung Landfilling	Verbrennung Incineration	Recycling
Einfluss auf die humane Gesundheit Human Health	Pt	0.692	0.555	0.204
Umwelt Ecosystem Quality	Pt	0.0405	0.0357	0.0198
Ressourcen Resources	Pt	0.758	0.698	0.115
Summe / Sum	Pt	1.49	1.29	0.339

**INTERPRETATION**

The production and use of the Monobloc have the main adverse impacts on the considered endpoints health, environmental impact and resource consumption of this LCA. The production of the PP granulate is fossil-based. This and the type of electricity mix used for this purpose have a significant impact on the LCA. However, through recycling, the material and energy resources contained in the plastic chair are available again for downstream use.

**TASKS/QUESTIONS:**

5. What categories of harm are most impacted by the production of the Monobloc?
6. What are the health, environmental, and resource impacts of the three disposal scenarios?
7. Why is landfilling so harmful to health and has negative impacts on the environment?
8. Explain how incineration affects the climate change damage category.

Setting Impact Categories	Classification & Characterization	Normalization	Grouping	Endpoint Area of Protection	
Pollutant	act on	flows into damage category	Impact	Endpoint	
Lead, Cadmium, Nickel, Cobalt VOC (volatile organic compounds) Arsenic, Antimony, Quicksilver	Human toxicity potential	Carcinogens Resp. Organics Resp. Inorganic		<b>Human Impacts</b>	
CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O	Global Warming Potential	Climate Change			
UV, radiation, noise		Radiation			
VOC (volatile organic compounds)	Formation potential of tropospheric ozone photochemical oxidants	Ozone Layer			
FCKW, C <sub>2</sub> H <sub>4</sub> , CH <sub>3</sub> COCH <sub>3</sub> , H <sub>2</sub> CO	Depletion potential of the stratospheric ozone layer				
dust, soot, particles	Smog / Fog / Particulate Matter Formation				
Heavy metals, toxic micro pollutants	Freshwater aquatic ecotoxicity potential Marine aquatic ecotoxicity potential Terrestrial ecotoxicity potential Abiotic depletion potential for non-fossil resources	Ecotoxicity			<b>Ecosystem Impacts</b>
HNO <sub>2</sub> , HNO <sub>3</sub> , H <sub>2</sub> SO <sub>4</sub> , H <sub>2</sub> SO <sub>3</sub> , acid rain	Acidification potential of land and water	Acidification			
PO <sub>4</sub> , NO <sub>3</sub> from manure & fertilizers	Eutrophication potential	Eutrophication			
land area	Land consumption	Land Use			<b>Resource Depletion</b>
minerals	Resource consumption	Minerals			
mineral oil, petroleum	Resource consumption	Fossile Fuels			

Figure: Damage classification in LCA - pollutants, categories and impact parameters.