Renovation of the Max-Joseph-Metzger Platz in Berlin From a LCA perspective

Silvia Binet
GreenDelta GmbH

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Abstract

Green areas in modern cities play relevant social and environmental roles. Independently of their size, parks function as site for community aggregation and often define the character of neighbourhoods and, by extension, of full cities. Beside their social aspect, green areas are sometime referred to as *cities' lungs* due to the presence of plants and trees. Recent trends in city planning perceive green areas as much more than a simple place for recreation but rather as proper *sustainable hotspots* of a city - from an energy and waste point of view.
In this context, careful evaluation of the environmental impacts due to parks construction and maintenance is of extreme relevance, and a cradle-to-grave approach is needed.

In this study the renovation works of a green area in the district of Wedding in Berlin is evaluated from a life cycle assessment perspective.
First, we point out which phases of the renovation are the most important on specific impact categories. Then, the causes for this finding are explored and the most impactful processes are reported. Furthermore, the differences in resources for the operation of the park prior and after the renovation are discussed. Finally, impact mitigation options are proposed.
All the results of the report are to be interpreted with caution being based on quantitative estimations of the resources employed.

List of abbreviations

a	Years
ALOP	Agricultural Land Occupation
CFC	Chlorofluorocarbons
CO_2	Carbon dioxide
DCB	Dichlorobenzene
Eq.	Equivalents
FDP	Fossil Depletion
FEP	Freshwater Eutrophication
FETPinf	Freshwater Ecotoxicity
GWP100	Global Warming Potential (time horizon 100 years)
HTPinf	Human Toxicity
IRP_HE	Ionising Radiation
ISO	International Organisation for Standardization
J	Joule
kg	Kilograms
km	Kilometres
l	Litre
LCA	Life Cycle Assessment
LCI	Life Cycle Inventory
LCIA	Life Cycle Impact Assessment
m	Meters
MDP	Metal Depletion
MEP	Marine Eutrophication
METPinf	Marine Ecotoxicity
N	Nitrogen
NLTP	Natural Land Transformation
NMVOC	Non-methane Volatile Organic Compounds
ODPinf	Ozone Depletion
P	Phosphorus
PM	Particulate Matter
PMFP	Particulate Matter Formation
POFP	Photochemical Oxidant Formation
SO_2	Sulphur dioxide
TAP100	Terrestrial Acidification
TETPinf	Terrestrial Ecotoxicity
U_{235}	Uranium isotope 235
ULOP	Urban Land Occupation
W	Watt
WDP	Water Depletion

Introduction

Life Cycle Assessment

Life-Cycle Assessment (LCA) is a methodology that allows determining the environmental and social impact of products and services, based on the consumption of resources (materials, energy, waste) and emissions. It is a *cradle-to-grave* approach that aims at giving a full description of the object of the analysis, from the earliest stage of its production until its end of life. [1] The cradle of any product is commonly the material extraction, followed by the processing manufacture, distribution and use phases until the disposal of the product and eventually the recovery of the material for further productive use. Each step can involve energy consumption or production and production of waste and emissions.
LCAs are currently executed according to the global framework of the ISO 14040 [2].

LCA in the construction sector

The system in Figure 1 (readapted from ref. 3) is specifically designed to include the typical Life Cycle phases, detailed with respect of the specificity of building construction processes. The product stage (**1**) includes the extraction of raw materials (i.e. fossil fuels, limestone, steel), the transportation and manufacture of building materials (i.e. concrete, bricks). These are used in the construction process (**2**) after transportation to the building site. The use stage (**3**) consists of the resources required during the operational time of the building, for a proper use and maintenance. In the end of life stage (**4**) are accounted the energy and resources required to demolish and dispose elements or structures that are no longer functional.

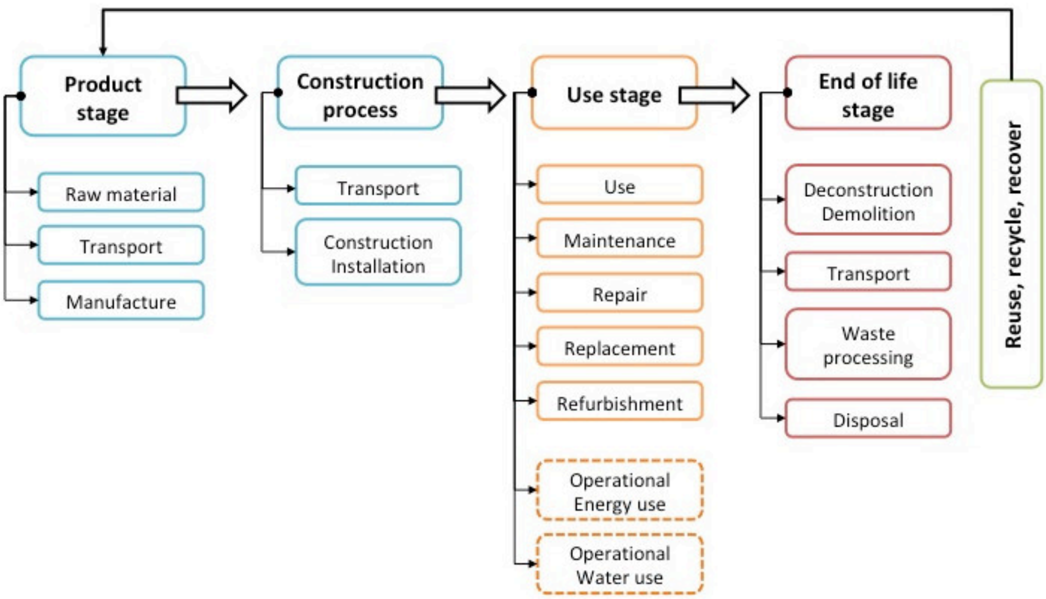

Figure 1: Model for LCA of building [readapted from ref. 3]

Case study: Renovation work of Metzger Platz, Berlin.

Background

The Max-Joseph-Metzger Platz is the park area between the Gerichtstraße and Müllerstraße in the neighbourhood of Wedding, Berlin. It covers an area of 14,200 m^2. Following a community survey in 2015, the Berlin Mitte Bezirksamt (district authority) has decided to redesign the area to remedy its degraded conditions. A public competition for proposals was run in order to improve the area liveability.

To project has been assigned to the Berlin-based landscape architects *bgmr Landschaftsarchitekten* and the construction works have started in October 2017. While running the renovation work, a large amount of contaminated soil has been found as well as a large amount or remnants from World War II (weapons, ammunitions, etc.) impairing the course of the work. At the time of publication, the project is expected to be completed before the end of 2018.

Figure 2: Map of the renovation work site: Max-Josef Metzger Platz (52.5445° N; 13.3640° E)

According to survey's result, the project proposed by the landscape architects group **bgmr**, includes the following community services:

- Two playgrounds for children
- Leisure time area (street-workout installations, table tennis, a bowls area)
- Climbing area with installations for children and adults
- Running path connecting the historical elements of the park
- Gravel walking path

Figure 3: Renovation works planning (From ref. 4)

Objective

The purpose of this study is to assess the environmental impacts of the renovation of the Metzger Platz in the neighbourhood of Wedding, Berlin.

Methodology

The impact assessments carried out in this study measures the impact categories reported in the following table as in the ReCiPe (H) method.

Table 1: Impact categories and respective indicator units

Impact categories	**Indicator Unit**
Agricultural land occupation - ALOP	m^2a
Climate change - GWP100	kg CO_2 Eq
Fossil depletion - FDP	kg oil-Eq
Freshwater ecotoxicity - FETPinf	kg 1,4-DCB-Eq
Freshwater eutrophication - FEP	kg P-Eq
Human toxicity - HTPinf	kg 1,4-DCB-Eq
Ionising radiation - IRP_HE	kg U_{235}-Eq
Marine ecotoxicity - METPinf	kg 1,4-DCB-Eq
Marine eutrophication - MEP	kg N-Eq
Metal depletion - MDP	kg Fe-Eq
Natural land transformation - NLTP	m^2
Ozone depletion - ODPinf	kg CFC-11-Eq
Particulate matter formation - PMFP	kg PM_{10}-Eq
Photochemical oxidant formation - POFP	kg NMVOC
Terrestrial acidification - TAP100	kg SO_2-Eq
Terrestrial ecotoxicity - TETPinf	kg 1,4-DCB-Eq
Urban land occupation - ULOP	m^2a
Water depletion - WDP	m^3

After gaining a full overview of the impact on each category, the study aims at identifying which elements of the renovation project have the most important environmental impacts. Mitigation options can therefore be proposed accordingly.

The data for the Life Cycle Inventory were estimated based on publicly available planning documents and complemented with desktop research. The *ecoinvent version 3.4 cutoff* life cycle inventory database was used and completed with external sources when needed (further details are provided in the appendix). Life Cycle Impact Analysis (LCIA) were run with the ReCiPe (H) midpoint categories impact methods. To run the impact analysis reported below, openLCA 1.72 by GreenDelta GmbH was used.

System boundaries and assumptions

The functional unit of the assessment conducted in this study is the renovated park with a reference time of 10 years. The system boundaries include the materials and energy required to carry out the renovation works as well as the resources to maintain the park operational for the reference time considered.

Figure 4 (below) highlights all processes within the system boundaries. Within the use stage only operational energy and water use have been considered assuming a reference study period of 10 years. For the specific case under analysis (park), the "use" is not expected to consume any resource or energy. The repair, replacement and refurbishment will be out of the system boundaries. With the white-grey texture are represented the processes that presented the highest challenges in finding data in the available database or external references. The energy required to manufacture specific elements (in the product stage) and the installation (in the construction stage) has been neglected in this study.

A further assumption concerns the distances of supplies transportation. Three categories have been created and each supply assigned to one of them. Most of the construction material can supposedly be found in the Brandenburg region, while park accessories are available within the city of Berlin.

Table 2: Average distances considered for the LCI

Region	Average distance (km)
Berlin	25
Brandenburg	100
Germany	400

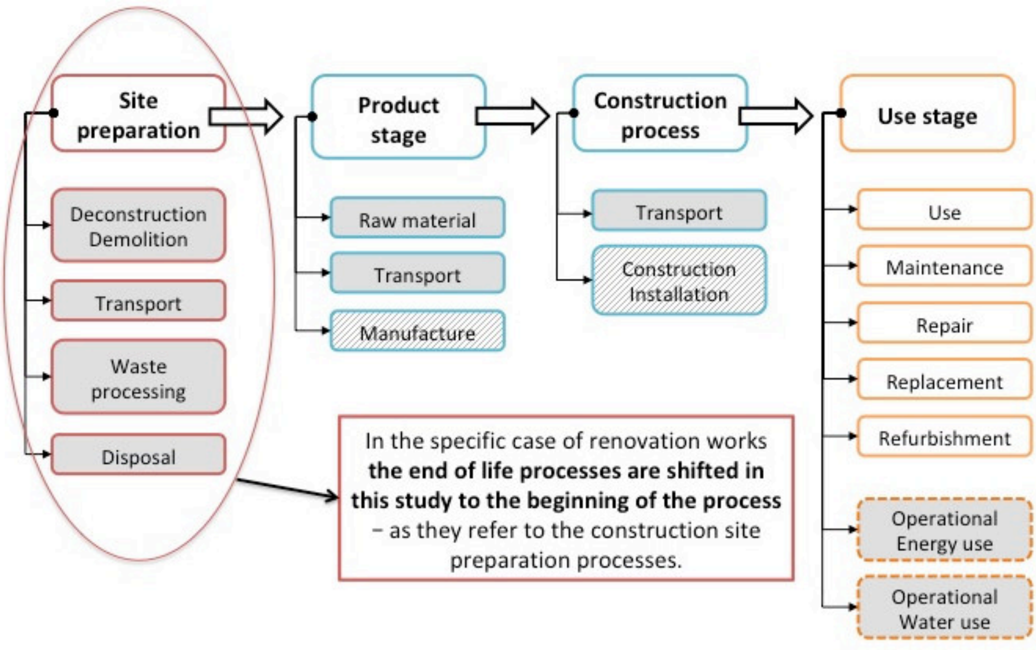

Figure 4: System structure and system boundaries (sections highlighted in grey are within the system boundaries of the assessment)

Life cycle inventory analysis

For the sake of clarity and for the analysis run in the following section, the overall product system has been classified in the following way: (1) Site preparation, (2) Construction (3) Park accessories (4) Operational park.

- The first phase corresponds to the work required to remove old accessories, and even more importantly to dispose war remnants and replace contaminated soil.

- Phase (2) and Phase (3) correspond to the construction of the infrastructure and manufacturing of park accessories for sports and recreation. These two phases include both a product stage (raw material extraction, transport and manufacture) and a construction process (transport, installation). In phase (2), the quantitative data for the required materials have been estimated based on architectural planning materials published online [4]. The data for phase 3 was estimated through desktop research of commercially available park accessories. As mentioned in the previous section "system boundaries and assumptions", manufacture of park accessories was not considered in this study.

- Last, phase (4) accounts for the resources continuously required for maintenance and functional operation of the park.

More detailed information about processes inputs and outputs are provided in the Appendix

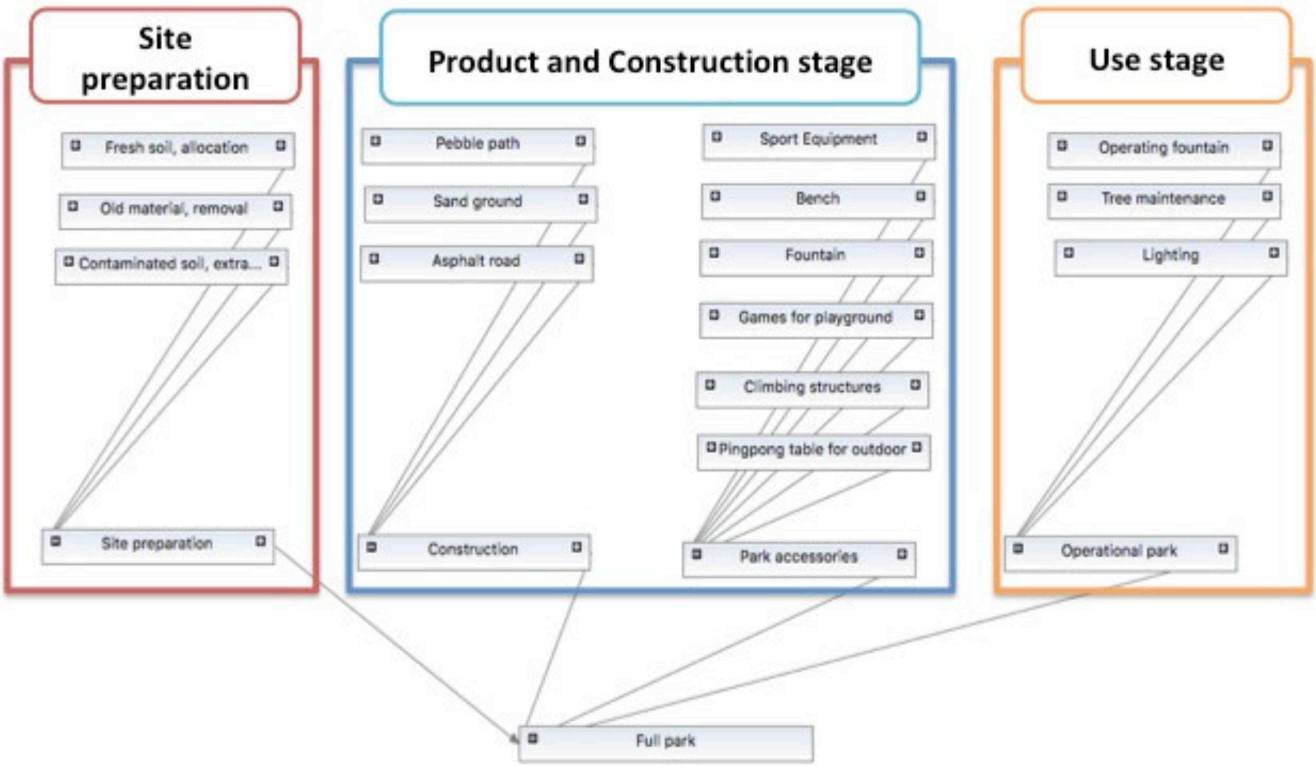

Figure 5: Full product system model graph in openLCA

Results: Life Cycle Impact Assessment

The numerical results for the impact categories assessed are shown in the following table.

Table 3: Results of the LCIA

Impact category	Reference unit	Results
Agricultural land occupation - ALOP	m^2a	$1.15\ 10^4$
Climate change - GWP100	kg CO_2-Eq	$1.78\ 10^5$
Fossil depletion - FDP	kg oil-Eq	$7.06\ 10^4$
Freshwater ecotoxicity - FETPinf	kg 1,4-DCB-Eq	1194.53
Freshwater eutrophication - FEP	kg P-Eq	23.78
Human toxicity - HTPinf	kg 1,4-DCB-Eq	$6.25\ 10^4$
Ionising radiation - IRP_HE	kg U_{235}-Eq	$1.68\ 10^4$
Marine ecotoxicity - METPinf	kg 1,4-DCB-Eq	1654.21
Marine eutrophication - MEP	kg N-Eq	250.67
Metal depletion - MDP	kg Fe-Eq	8548.84
Natural land transformation - NLTP	m^2	101.21
Ozone depletion - ODPinf	kg CFC-11-Eq	0.03
Particulate matter formation - PMFP	kg PM10-Eq	362.77
Photochemical oxidant formation - POFP	kg NMVOC	956.53
Terrestrial acidification - TAP100	kg SO_2-Eq	621.32
Terrestrial ecotoxicity - TETPinf	kg 1,4-DCB-Eq	158.87
Urban land occupation - ULOP	m^2a	$1.54\ 10^4$
Water depletion - WDP	m3	240.95

To understand the origins and put into context such environmental impacts, the four phases of the renovation works are compared to one another. It appears evident how the major impacts on almost all impact categories are due to the first phase, namely the site preparation due to the large amount of contaminated soil that need to be removed and replaced with fresh soil.

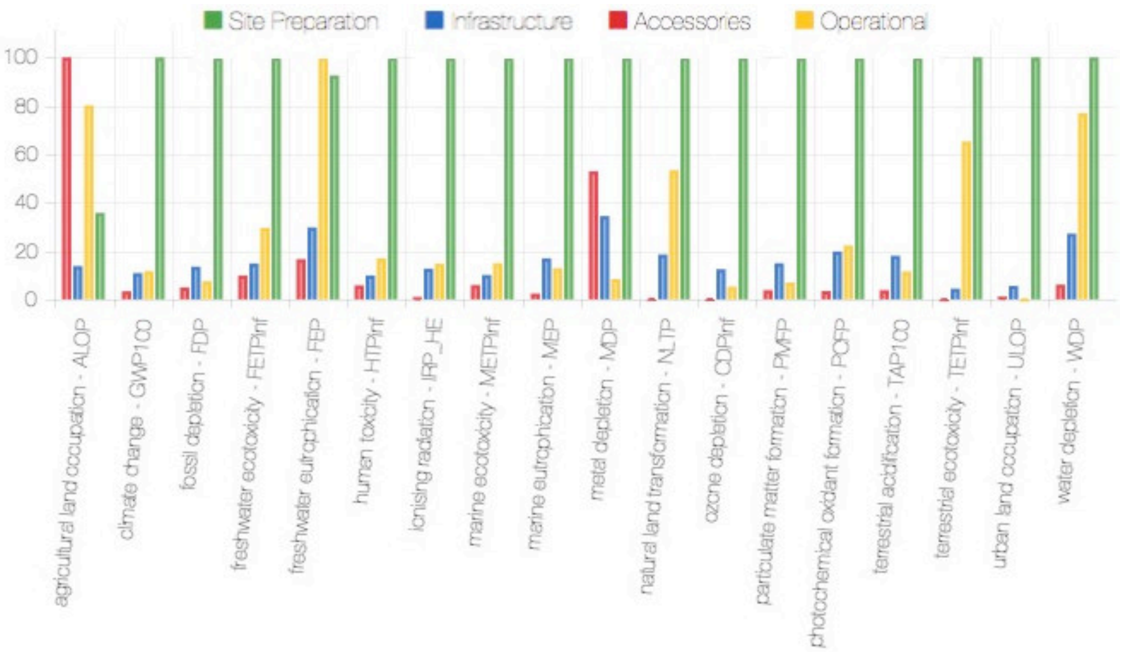

Figure 6: Relative contribution of the four project phases to each impact category

Impact categories agricultural land occupation (ALOP) and freshwater eutrophication (FEP), are the only one not being mainly affected by the phase “Site preparation”. The reason for this observation on the impact category ALOP concerns the wood required for the construction of new park accessories (from playground, to sport equipment and benches), while on FEP is related to the electricity for lighting, as explained in more detail below. However, soil contamination being a very peculiar characteristic with large environmental impact on almost all impact categories, it will be excluded from the following analysis to allow a better resolutions on other effects.

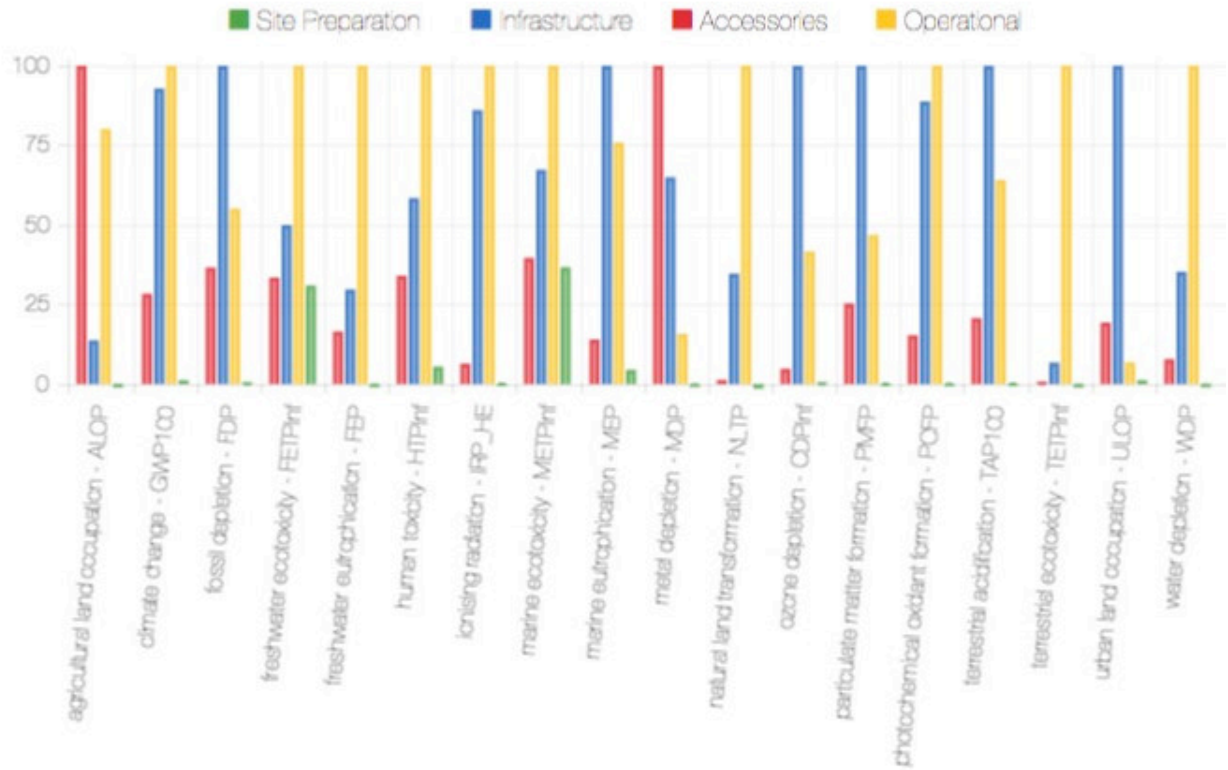

Figure 7: Relative contribution of the four project phases to each impact category - excluding soil contamination remediation. For each indicator the maximum result is set to 100% and the results of the other variants are displayed in relation to this result.

With the exclusion of the process for soil contamination remediation, the site preparation phase (in green in Figure 7) becomes almost irrelevant, while it emerges the major effect of building infrastructures on several impact categories (fossil depletion, marine eutrophication, ozone depletion, particulate matter formation, terrestrial acidification and urban land occupation). More specifically, the processes *market for pitch*, *market for diesel*, *market for gravel* are the one with the largest impact on the categories mentioned. The impact of new park accessories after exclusion of the contaminated soil transportation becomes evident not only on the agricultural land occupation (as in Figure 6), but also on the category metal depletion (Figure 7). Even though with less intensity, considerable contributions are observed for freshwater ecotoxicity, fresh water eutrophication, human toxicity and marine ecotoxicity. In terms of impact on these categories, the processes *market for steel, low-alloyed* and *market for sawnwood* are the more relevant. Concerning the last phase “Operational park”, the major impacts are observed on a considerable number of impact categories, mainly due to the process *market for electricity and market for soybean oil* (within *power sawing* accounted in the modelling for tree maintenance over the course of time). In table 4 (Appendix) the processes with impact larger than 10% on each category are reported to highlight the importance of individual processes.

Discussion

Comparison: Non-renovated and renovated park operational impacts

A different amount of resources are required to operate and maintain the park prior and after the renovation works. Three elements are included in the operational phase:

- Tree maintenance
- Lighting
- Fountain operation

While the need for tree maintenance do not undergo any changes prior and after the renovation works, this is not the case for the two other elements. Therefore, in the analysis of this paragraph, only lighting and fountain operation are taken into account.
According to the results reported in the previous section and to the Additional information on LCIA results

Table 4 in the Appendix, the process *market for electricity* is highly impactful on a large number of categories (climate change, fossil depletion, freshwater ecotoxicity, freshwater eutrophication, human toxicity, ionising radiation, marine ecotoxicity, terrestrial acidification, water depletion). As part of the renovation works, a more efficient lighting system with LED lights is assumed to be mounted - able to provide the same illumination level with a decreased wattage. On the other hand, installation of a fountain increases necessarily the amount of tap water consumption, which explains the smaller decrease on the category *water depletion* in the renovated park compared to the non-renovated park.

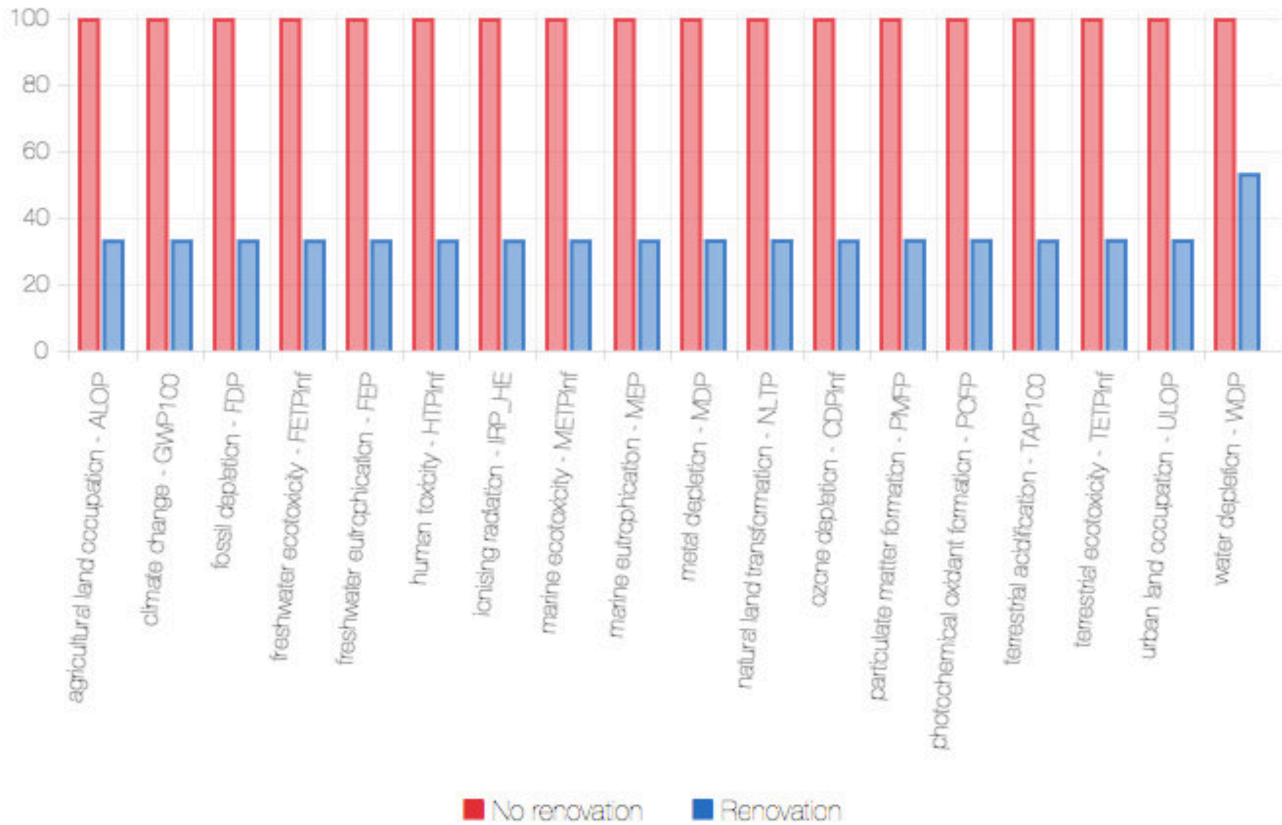

Figure 8: Comparison of resource consumption for the non-renovated (red) and the renovated park (blue). Only the operational phase (4th phase) is part of this analysis

Impact Mitigation Options (1): Soil contamination remedies

As highlighted from the LCIA results, the process "contaminated soil, removal" part of the Phase 1: Site preparation, results the most impactful process of the full renovation project on almost every impact category (Figure 6), mainly due to the large mass that need to be displaced to an appropriate soil treatment facility.
The exact type of remediation needed by a contaminated area depends on many factors such as the chemicals contaminants species and their concentration as well as the type of soil and its physical properties. Thus, it is challenging to propose a suitable remediation method without precise information concerning the chemical contaminants. According to the literature, soil remediation treatments can take place both *on-site* and *off-site:* the first option is to be favoured to minimize environmental impacts. *On-site* techniques have the advantage of avoiding transportation of large masses of soil that results in serious CO_2 emissions. [5]
Suggested on-site techniques includes: bioremediation (for organic contaminants including aromatic, phenolic and PAHs compounds) or physical/chemical treatment such as soil vapour extraction or soil flushing in case of metal contaminants and chlorinated compounds are present. Logically, implementations of such methods might in turn impact different LCA indicators and careful assessment is required before proceeding. [6]
Bioremediation, being based on the metabolic processes of microorganisms to degrade organic contaminants, has high potential for a limited environmental effect.

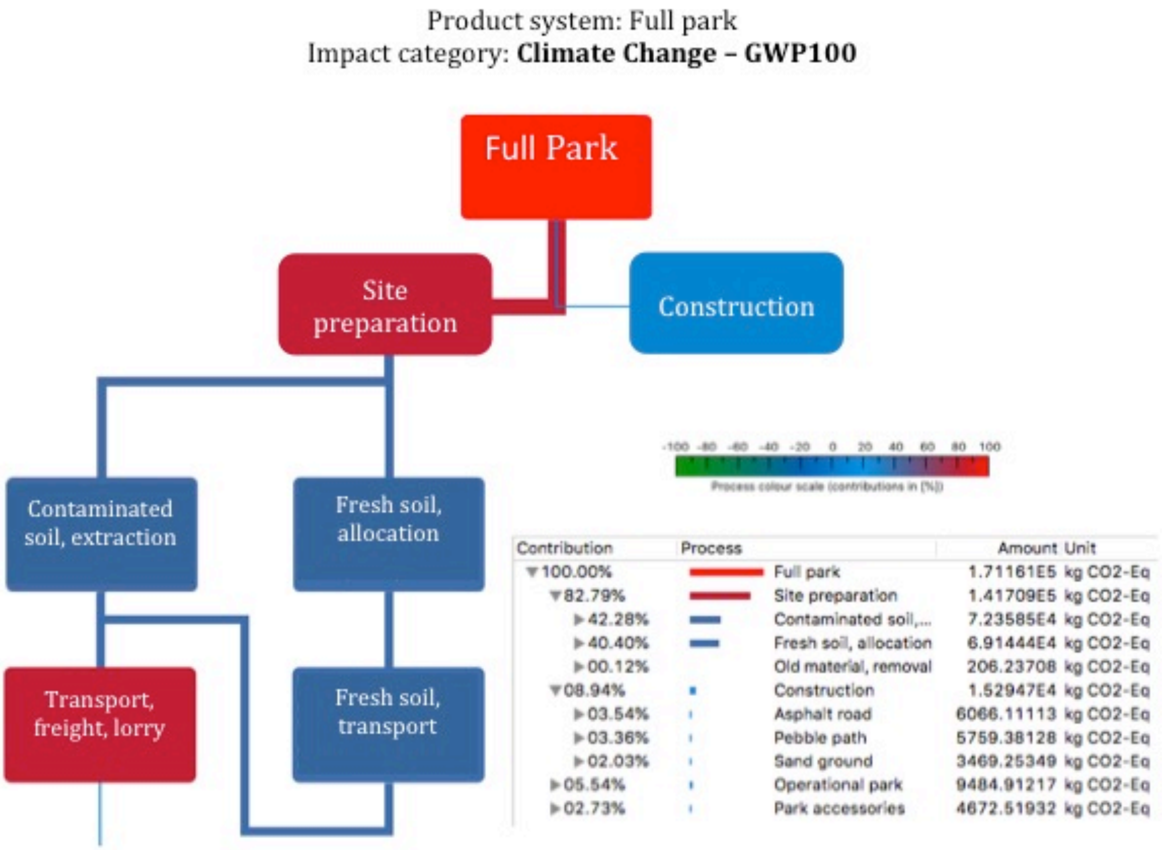

Figure 9: Sankey diagram for the impact category: Climate Change GWP100

Impact Mitigation Options (2): Asphalt Road and alternative options

To model the asphalt road in openLCA a process from the *ecoinvent* database was used (road construction, company, internal, RoW) with a scaling factor of ½ to take into account the reduced size of the road planned in the renovation work of Metzger Platz. Maintenance works are also accounted in this process, therefore including a time component as well. The reference time was set to 10 years, as in all the analysis.

According to the LCIA results, the construction of the infrastructures of the park (including an asphalt road, a pebble path and an area covered of sand for the playground area) contribute for the 52% of the overall project to the impact category fossil depletion, where more than the half of the impact is attributed specifically to the asphalt road.

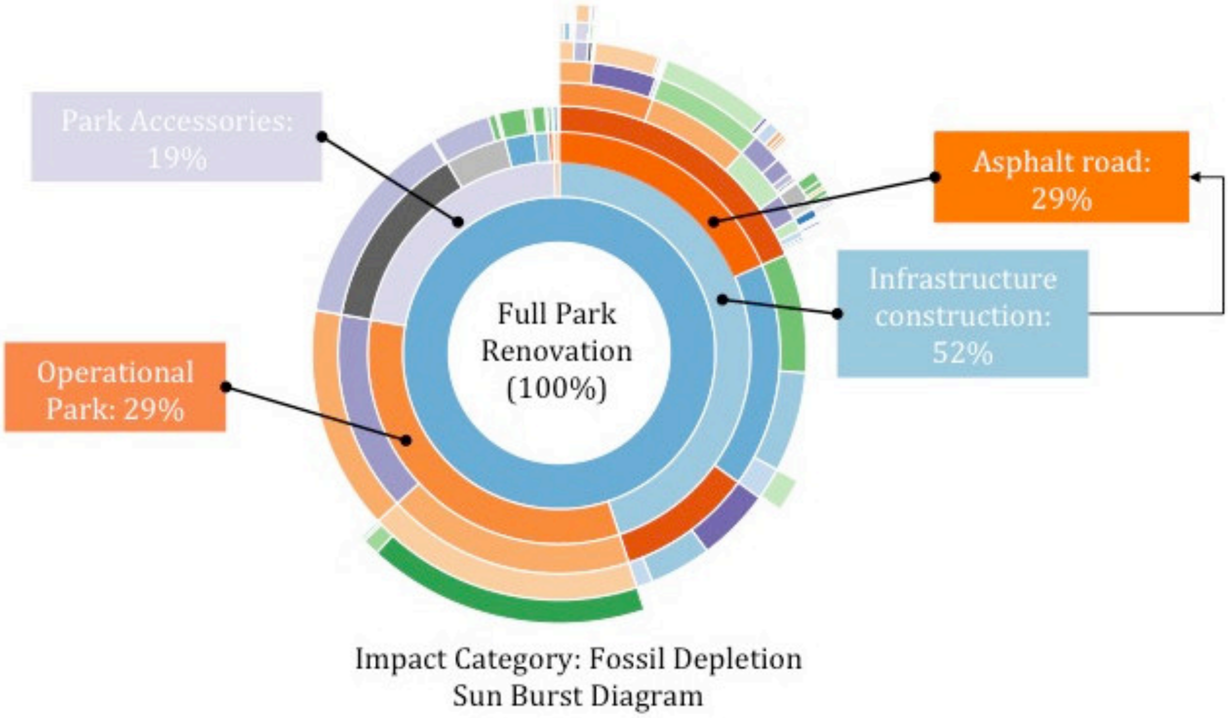

Figure 10: Sun burst diagram for the impact category: Fossil Depletion

Furthermore, porous materials are to be preferred with respect of non-porous ones for sustainable parks design. Thus, two alternatives are assessed:

1) 800 m path made of mulch. Mulch is a porous and natural material that requires no or only little maintenance, commonly used for parks and gardens.
2) 400 m of polyurethane running track (external circular path) + 400 m of mulch path

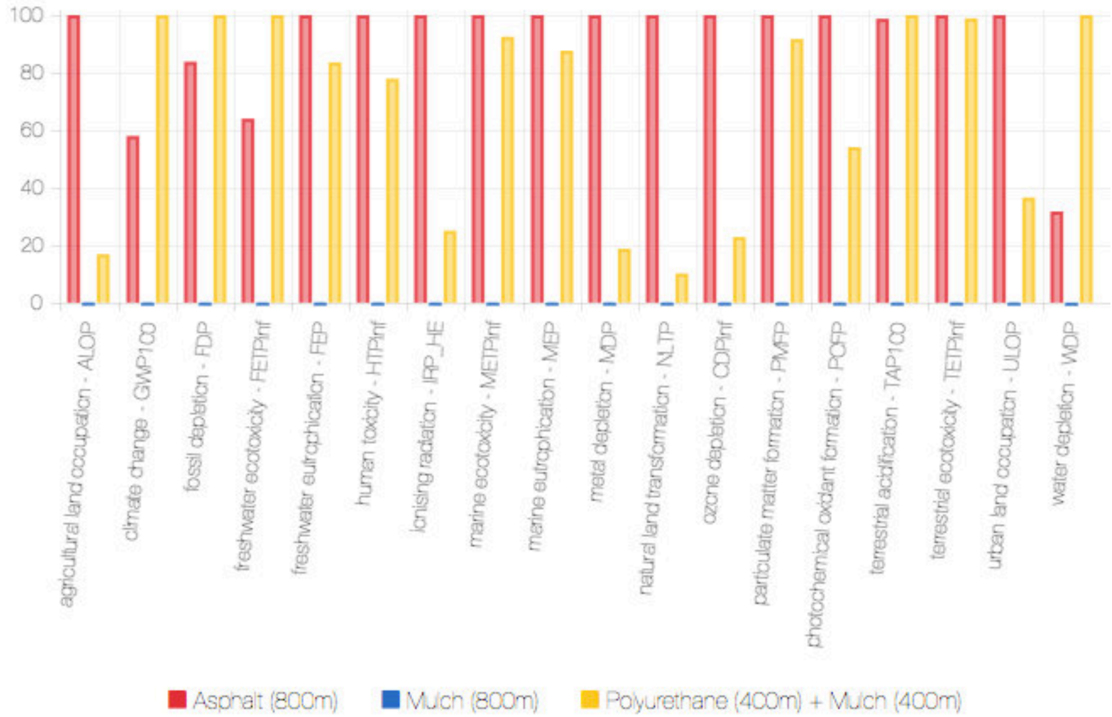

Figure 11: Relative indicator results for two alternative options compared to the asphalt road. For each indicator the maximum result is set to 100% and the results of the other variants are displayed in relation to this result.

The mulch path (Option 1, in blue in the graph) is by far the more environmental friendly solution and shows very little impact on all indicators with respect of the two other options. Option 2 (represented in yellow) is a better solution only with respect of some indicators, in particular with respect of agricultural land occupation (1), metal depletion (10), natural land transformation (11) and ozone depletion (12). It is worth noting that a polyurethane running track requires anyhow a base of asphalt (accounted in the analysis) but further maintenance over time of this layer is not needed.

Final Remarks

The assessments presented in this study are the results of numerical estimations based on publicly available site plan, which constitutes a considerable limitation to the representation of the real impact of such renovation works. Assumptions have been made concerning the complete dataset as detailed in the appendix. Thus, the reader should interpret the results with the due caution. Availability of the bill of material would be the first step required for a considerable improvement of the analysis.

Conclusion

The environmental impact of the works currently on going in the Max-Joseph Metzger Platz has been assessed on a reference time of 10 years based on the information obtained from the publicly available architectural plans of the renovation.
Frist, the most impactful process has been identified to be the transportation of large amounts of contaminated soil that has been excluded from subsequent analysis to get better resolution on other potentially impactful processes.

For each project phase the more relevant processes in terms of impact on different categories have been identified:

- Construction phase: *market for gravel, market for pitch, market for diesel*
- Park accessories: extensive use of wood and steel for new park accessories (*market for sawn wood, market for steel, low-alloyed, market for polyethylene)*
- Operational park over 10 years: Lighting system (*market for electricity)* and tree maintenance (*market for soybean oil, market for petrol)*
  ,

The resources needed for operations of the new renovated park have been compared with those of the non-renovated park: with implementation of a more efficient lighting system the renovated park results more environmental friendly, even though the impact category *water depletion* is slightly affected by installation of a drinking water fountain.

In conclusion, impact mitigations options have been proposed to contribute to an environmental friendly design of this urban area. For example, replacing asphalt with natural porous material could considerably reduce the impact on fossil depletion (up to 29% of the overall project). In terms of Climate Change avoiding construction of such a road would correspond to 5863 kg of CO_2 equivalents. It would take 280 years for a tree to absorb such amount of carbon dioxide!

Appendix
Planning of renovated area

From ref. [4]

Detailed Life Cycle Inventory

- Reference study period =10 years
- Density values extracted from ref [7]

*Phase (**1**) - Work site preparation*

	Process	Input Flow	Output flow
Work site Preparation	**Old material, disposal [1]**	• Old park accessories • Transport, freight, lorry • (-) Waste polyethylene • (-) Waste wood • (-) Inert waste, for final disposal	Old park accessories, disposed
	Contaminated soil, removal [2]	• Contaminated soil, • Excavation • Transport, freight, lorry	Contaminated soil, disposed
	Fresh uncontaminated soil, transport [3]	• Soil • Transport, freight, lorry	Fresh soil, transported
	Fresh uncontaminated soil, allocation [4]	• Fresh soil, transported • Diesel, burnt in agricultural machinery	Fresh soil, allocated

Notes:
[1] Waste flows are entered as negative inputs, according to the opposite direction approach used by the *ecoinvent* database
[2] It was assumed that the contaminated area consisted of the 15% of the overall surface area of the park, for a total contaminated area of 2130 m^2. For a terrain depth of 3 m to be removed, that resulted in 6390 m^3 of soil.
[3] A volume equivalent to that of the contaminated soil was considered to be required as fresh, uncontaminated soil.
[4] The diesel consumption of a heavy agricultural machine is about 3.7 l/hour. It is assumed that half day of work is required to allocate the new soil (4 hours of machine operation) resulting in 540 MJ of diesel consumption
For all the processes in the worksite preparation phase, the distance of transport was taken as an average of 100 km.

*Phase (**2**) - Constructions*

	Process	Input Flows	Output flows
Constructions	**Asphalt road [5]**	• *Ecoinvent process* "Road construction"	Asphalt road
	Pebble path [6]	• Gravel • Machine operation, diesel, high load factor • Transport, freight, lorry	Pebble path
	Playground sand soil [7]	• Sand • Machine operation, diesel, high load factor • Transport, freight, lorry	Sand ground

Notes:
[5] From the architectural plans it was estimated that 800 m of asphalt road will be built in Metzger Platz. A road construction process was present in the ecoinvent database and used directly for the analysis. However, a park road being smaller in width than a standard road, a scaling factor of ½ was applied.
[6] The length estimated from the architectural plans for the pebble path was of 1200 m.
[7] The surface area to be covered with sand was estimated to be 300 m^2 (0.5 m depth), accounting for a volume of 150 m^3 (thus, 150 tons).

For all the processes in the "Construction" phase, the distance of transport was taken as an average of 100 km.

*Phase (**3**) - Park Accessories*

	Process	Input Flow	Output flow
Park Accessories	**Playground games, manufacture and transport [8]**	• Sawnwood, board • Steel, low-alloyed • Polyethylene, high density, granulate • Transport, freight, lorry	4 Activity towers, at park site
	Ping-pong table, manufacture and transport [9]	• Concrete, normal • Transport, freight, lorry	1 Ping pong table, at park site
	Benches manufacture and transport [10]	• Sawnwood, board • Steel, low-alloyed • Transport, freight, lorry	30 Benches, at park site
	Climbing structure, manufacture and transport [11]	• Polyethylene, high density, granulate • Transport, freight, light commercial vehicle	4 climbing structure, at park site
	Sport Equipment, manufacture and transport [12]	• Sawnwood, board • Steel, low-alloyed • Transport, freight, light commercial vehicle	10 sport equipment items, at park site
	Fountain, manufacture and transport [13]	• Limestone, crushed, washed • Transport, freight, light commercial vehicle	1 fountain, at park site

Notes:
Commercially available items online have been considered as reference for the following estimations.
[8] An "activity tower" for children has an average weight of 700 kg. Four towers were taken into account for the playground of Metzger Platz. Each tower was assumed to be made of plastic (40%), wood (40%), steel (20%) in weight.
[9] Outdoor ping-pong tables are fully made of concrete and weight on average 2 tons.
[10] The total weight of a bench being on average 50 kg, it was assumed that 50% of that weight is to be attributed to the wood and 50% to the steel structure. 30 benches have been included in the calculation, as designed by the architectural planning.
[11] Climbing structures are generally made 100% of plastic material. One commercially available bouldering block weight 250 kg. 4 blocks were taken into account for the climbing area of Metzger Platz.

[12] 10 different sport equipment items, with average weight 100 kg, composed of wood (50%) and steel (50%)

For all the processes in the worksite preparation phase, the distance of transport was taken as an average of 25 km, estimating that all the material can be found within the city of Berlin.

*Phase (**4**) Operational park (10 years).*

	Process	Input Flow	Output flow
Operational Park	**Lighting [14]**	Electricity	Operational lighting system
	Fountain [15]	Tap water	Operational fountain
	Trees maintenance [16]	Delimbing, sorting	Pruned trees

Notes:

[14] 5 street lamps will be installed according to the renovation plan. Assuming the use of LED lamps with average lumens/watt ratio:
50 W each LED lamp: 250 W overall. Light up 12 h/day on average.
[15] Water consumption: 3 L/day.
[16] Assuming 5 days of work per year to prune the trees, this corresponds to 50 days of operation of a pruning machine.

Additional information on LCIA results

Table 4: Most relevant contributions of individual processes to impact categories of the ReCiPe (H) methods. Only contributions >10% are reported.

Process	Impact category	Contribution to total
Market for soybean oil (Operational park)	Agricultural Land Occupation	36.4 %
	Climate Change	10.7 %
	Natural Land transformation	67.9 %
	Terrestrial Ecotoxicity	92.6 %
	Water Depletion	30.0 %
Market for gravel, round (Construction)	Ionising radiation	11.2 %
	Particulate Matter formation	11.4 %
	Terrestrial Acidification	11.3 %
	Urban land occupation	20.5 %
Market for pitch (Construction)	Fossil Depletion	17.8 %
	Ozone Depletion	25.7 %
Market for polyethylene (Accessories)	Fossil depletion	12.0 %
Market for steel, low-alloyed (Accessories)	Metal Depletion	54.3 %
Treatment of waste polyethylene (Site preparation)	Marine Ecotoxicity	14.9 %
	Freshwater ecotoxicity	14.4 %
Market for sawn wood (Accessories)	Agricultural Land Occupation	51.1 %
Market for petrol (Operational park)	Ionising radiation	10.4 %
	Ozone depletion	20.7 %
	Fossil depletion	14.7 %
Market for diesel (Construction)	Particulate matter formation	11.9 %
	Terrestrial acidification	11.0 %
Transport, freight, lorry (Construction)	Urban Land Occupation	34.5 %
Market for sand (Construction)	Urban Land Occupation	12.7 %
Market for electricity, medium voltage (Operational park)	Climate change	19.1 %
	Fossil depletion	12.8 %
	Freshwater ecotoxicity	35.3 %
	Freshwater eutrophication	64.6 %
	Human Toxicity	36.3 %
	Ionising radiation	40.4 %
	Marine ecotoxicity	35.6 %
	Terrestrial acidification	16.5 %
	Water Depletion	29.0 %

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