

# Building Related Environmental Impacts - Hidden Aspects

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**Building Research  
& Innovation**

# Building Related Environmental Impacts - Hidden Aspects Biodiversity Loss and Land Use Change

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1

Biodiversity Loss and Land Use Change  
are most relevant.

Yet, they are not represented in LCIA of  
the built environment

# Biodiversity Loss and Land Use Change

## Facts and Figures

- Since 1900, within agricultural crops, 75% of the genetic diversity has been lost.<sup>1</sup>
- Worldwide, 60% of all ecosystems are reported to be in danger.<sup>2</sup>
- WWF Living Planet Index shows an overall decline of 60% in species population sizes between 1970 and 2014, while current rates of species extinctions are 100 to 1.000 times higher than the background rate.<sup>3, 4</sup>
- A prolongation of the last decade's rate of agricultural land use change in Austria would lead to full loss of Austrian agricultural land within approx. 200 years.<sup>5</sup>

Quelle 1,2: BIODIVERSITÄTS-STRATEGIE ÖSTERREICH 2020+ BMLFUW, 2014

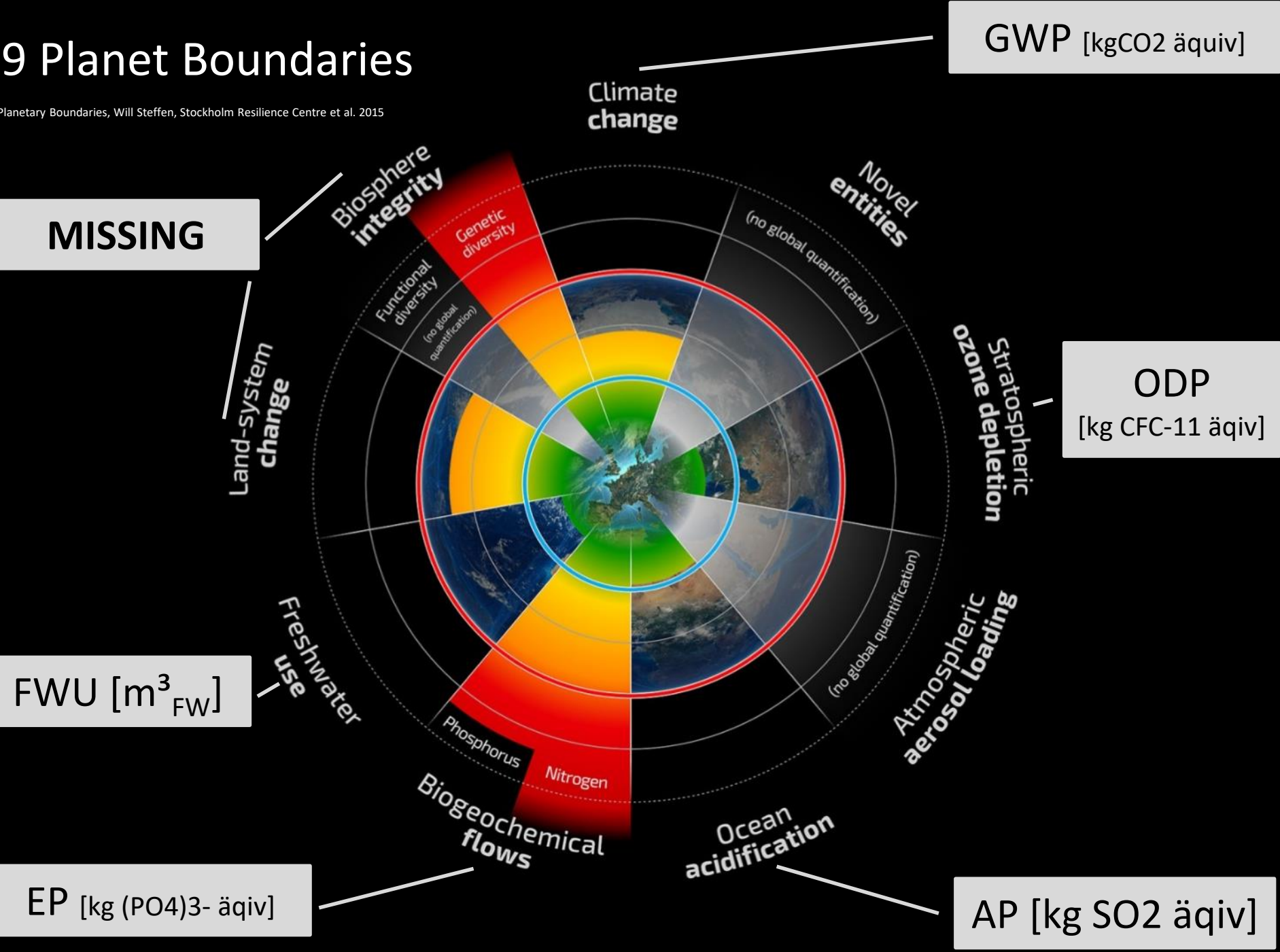
Quelle 3: WWF, 2018: Living Planet Report 2018

Quelle 4: IPBES. 2019. Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.

Quelle 5: <https://www.hagel.at/presseaussendungen/bodenverbrauch-gefaehrdet-die-lebensgrundlage-der-naechsten-generationen/> (07.09.2019)

# 9 Planet Boundaries

Planetary Boundaries, Will Steffen, Stockholm Resilience Centre et al. 2015



## 2

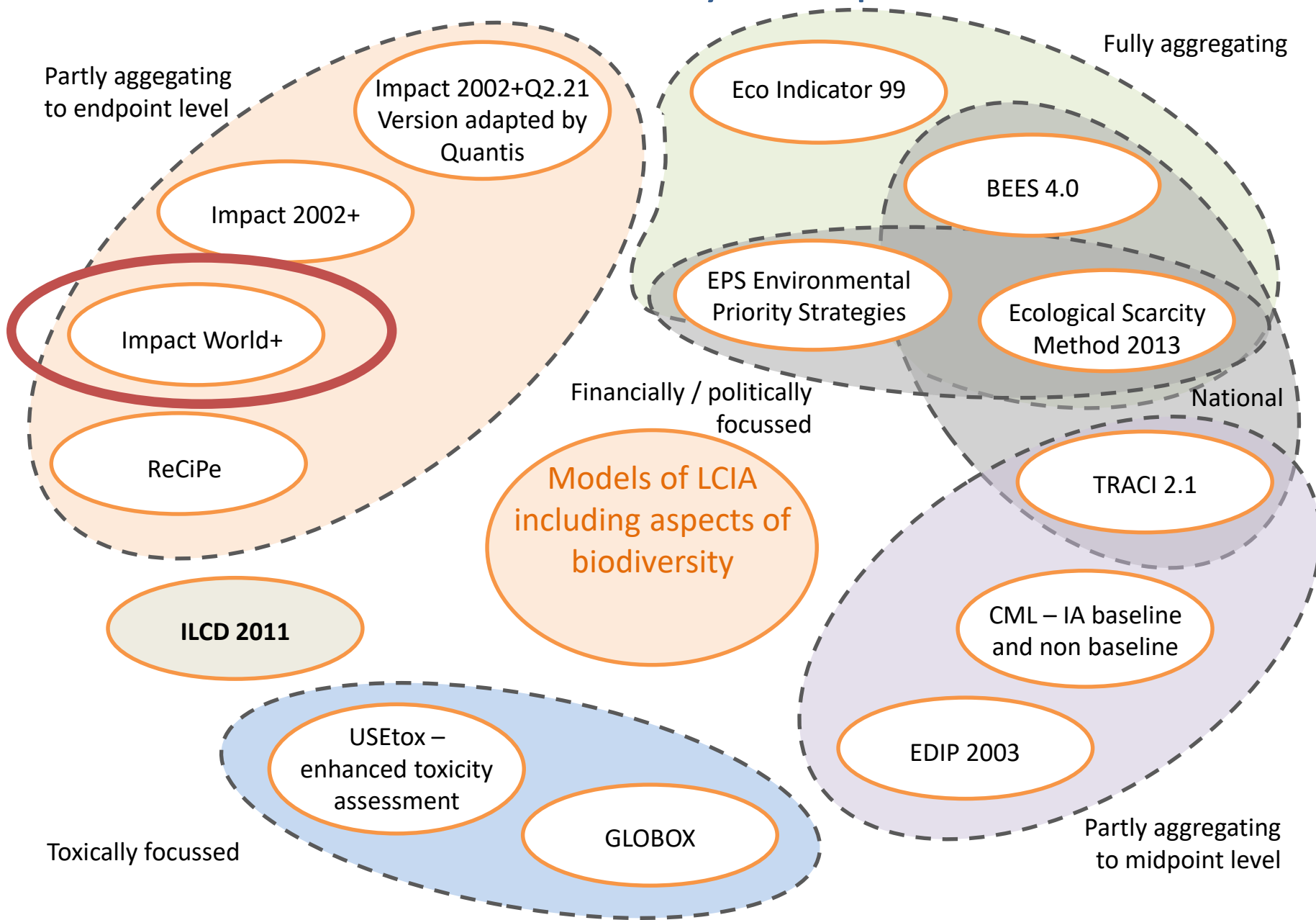
Already now, biodiversity loss and land use change formally may be considered within LCIA.

Already now, models exist to identify and proportionally quantify the causes of biodiversity loss.

# Biodiversity Loss and Land Use Change within int. LCIA standards

- » **ISO 14025 (2006) Environmental labels and declarations — Type III environmental declarations — Principles and procedures**  
*Chapter 7.2.3 Additional environmental information: Impacts and potential impacts on biodiversity are already suggested as additional environmental information.*
- » **EN 15643 – 2 (2011) Sustainability of construction works. Assessment of buildings. Framework for the assessment of environmental performance**  
*Appendix B.2.1: Both biodiversity and land use change are already listed as “further indicators of current practice”.*
- » **ISO 21931 – 1 (2010) Sustainability in building construction - Framework for methods of assessment of the env. perform. of construction works - 1: Buildings**  
*Chapter 5.6.2 Environmental impacts: “local impacts on biodiversity and ecology” are already listed within the “List of issues for assessment”.*
- » **prEN 15804 (2018) Sustainability of construction works — Environmental product declarations — Core rules for the product category of construction products**  
*No consideration of biodiversity and land use change*

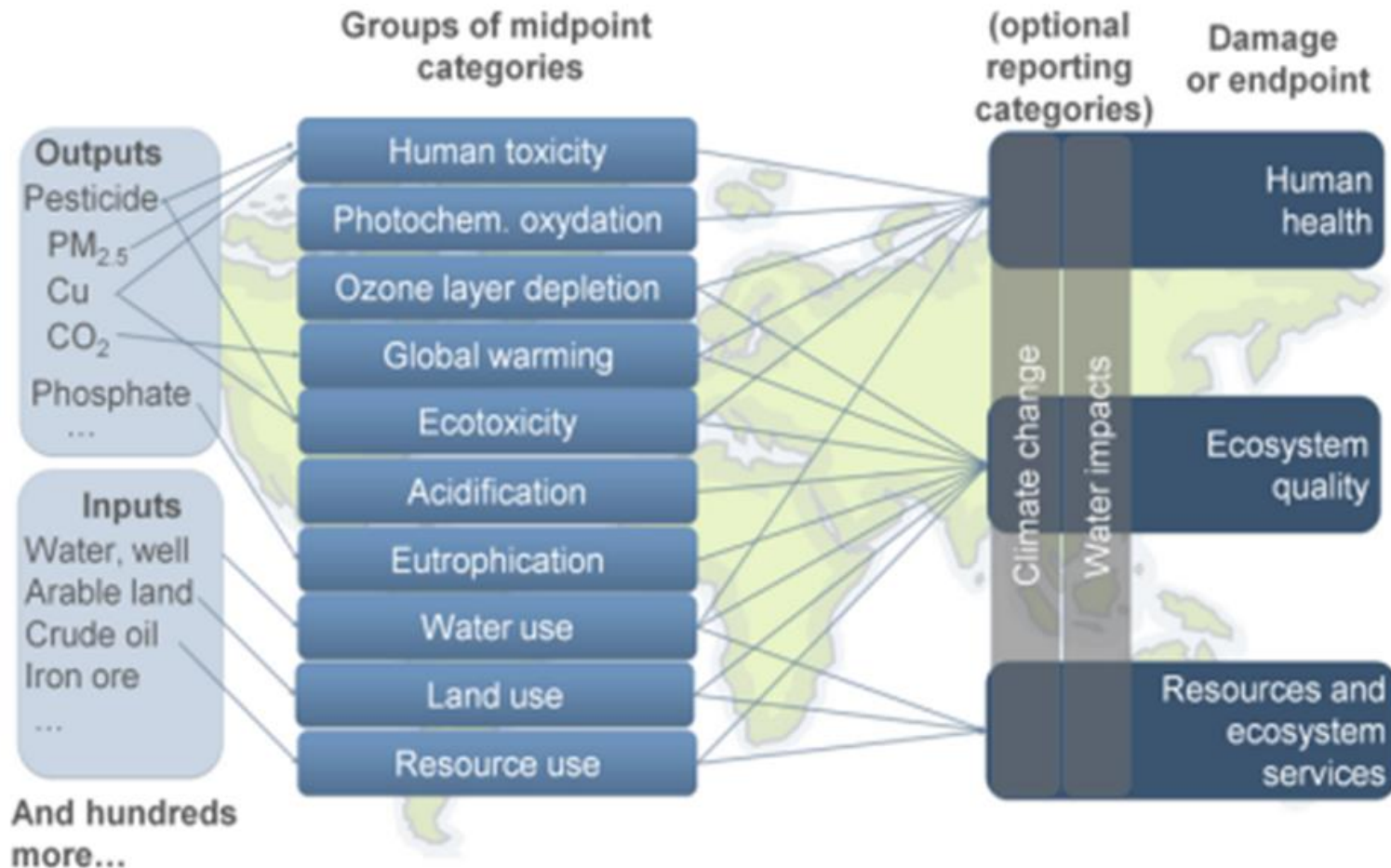
# International Models of Life Cycle Impact Assessment



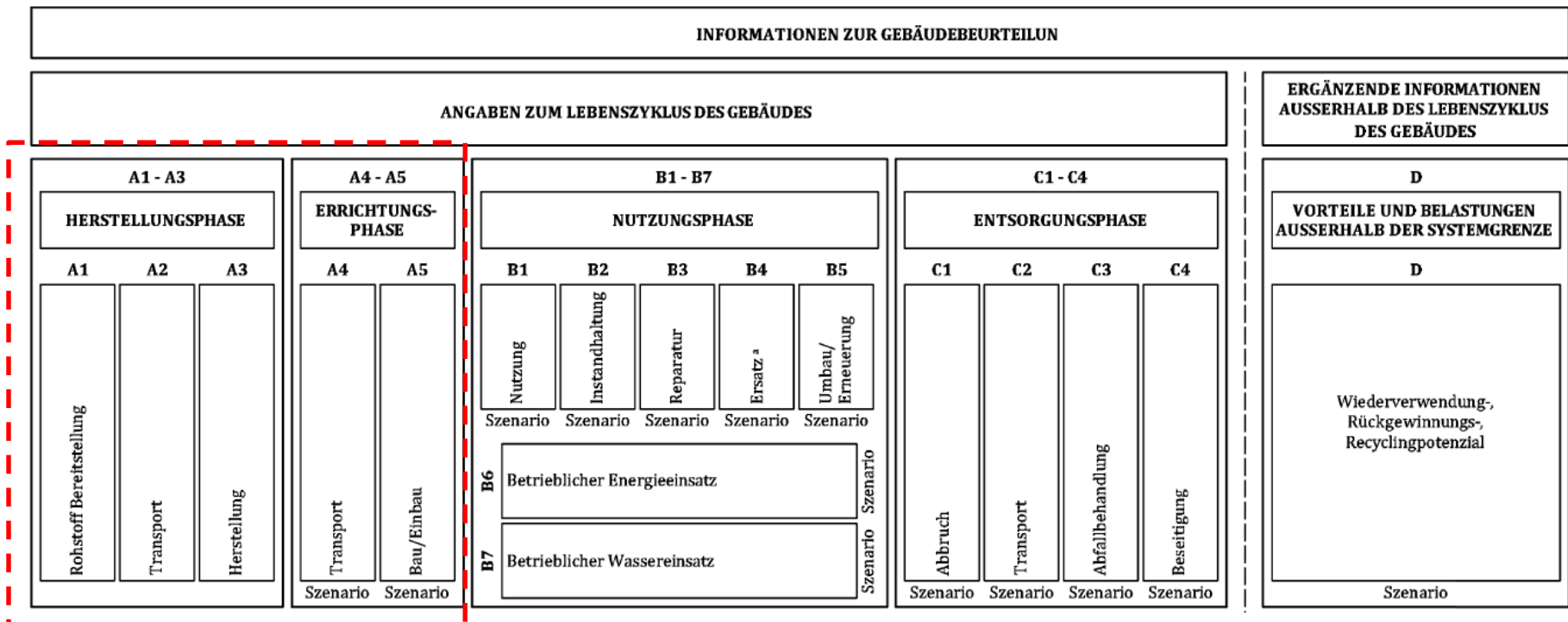


# LCIA systematic by example of IMPACT World+

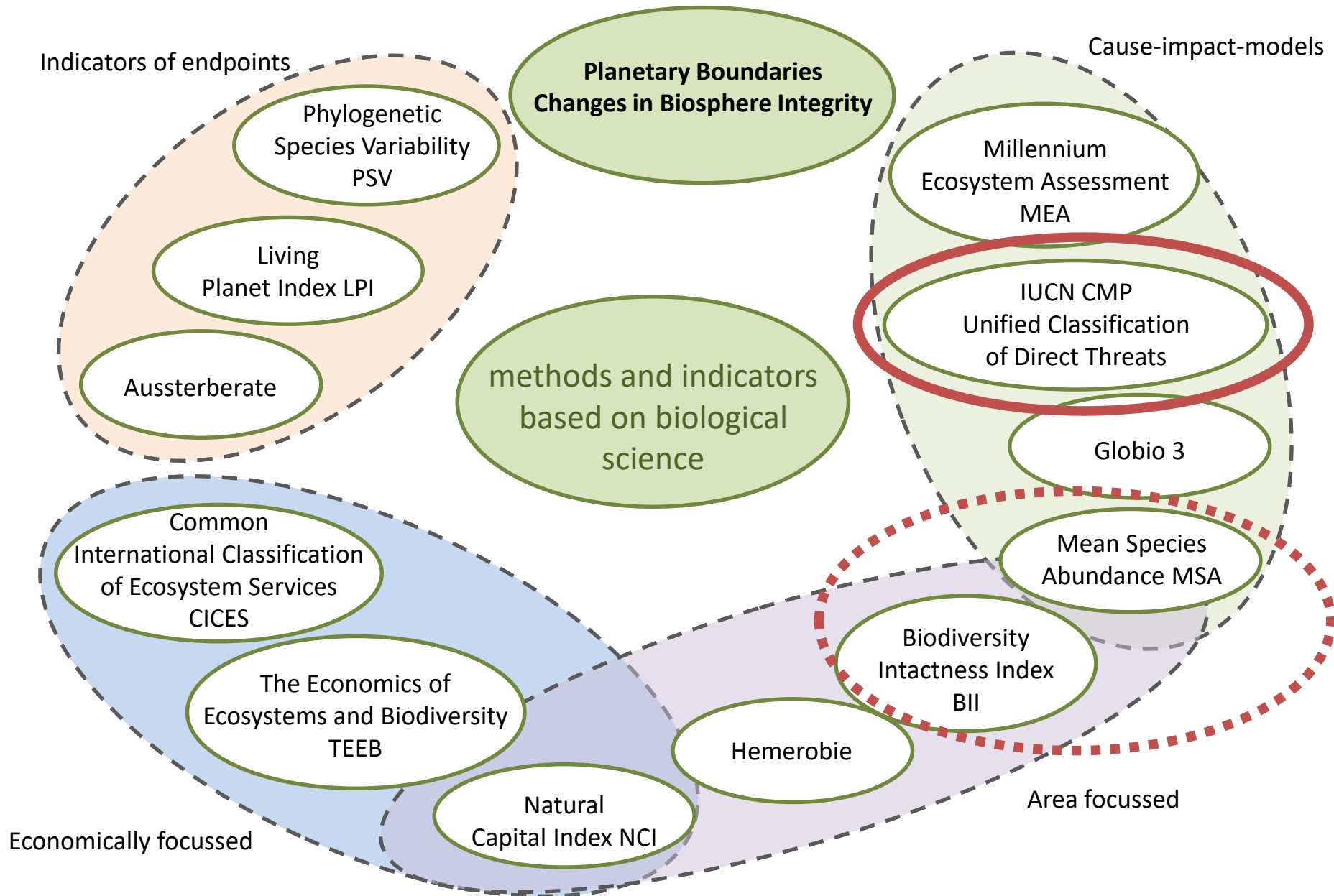
## Inventory Analysis – Impact Analysis – Interpretation



# LCIA sub-structuring along the lifecycle of buildings, according to EPD systematic of EN 15804 Sustainability of construction works — Environmental product declarations



# Biodiversity- and Biodv.-Loss-Models of Biological Science





International **U**nion for  
Conservation of **N**ature and Natural Resources  
(Weltnaturschutzunion)

**IUCN CMP**  
**Unified Classification**  
**of Direct Threats**

Conservation **M**easures **P**artnership

**Direct Threats: 12 specific midpoint impact categories, which cause vascular plants to be listed on the IUCN Red List, meaning danger of extinction.**

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Changes within an ecosystem  
may successfully be described within  
an areal evaluation structure

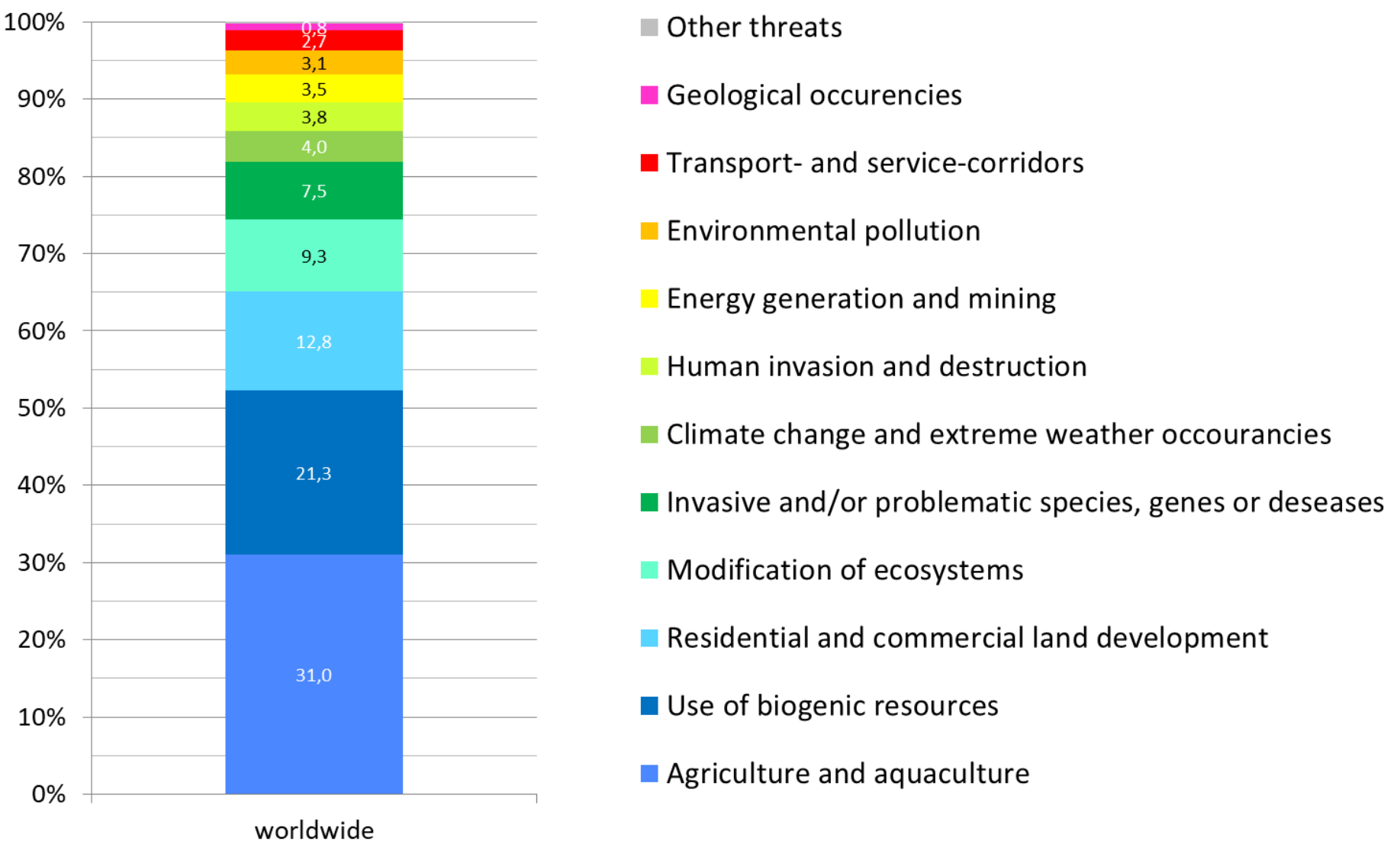
Biodiversity  
Intactness Index  
BII<sup>2</sup>

Mean Species  
Abundance MSA<sup>1</sup>

<sup>1</sup> MSA records the extinction of species. MSA is one specific indicator within the Natural Capital Index. MSA summarises cause – impact – relations in five categories of causes.

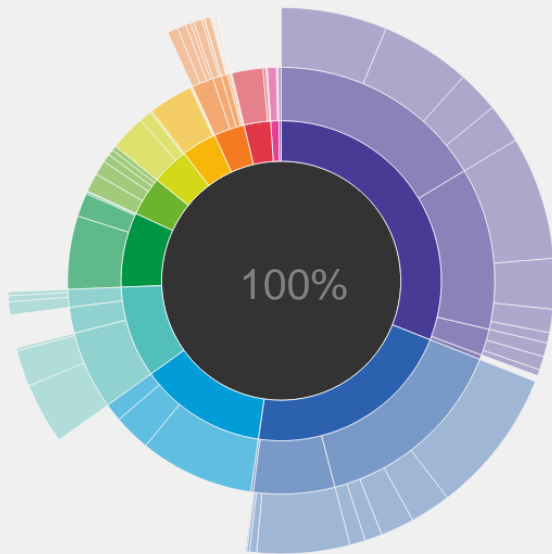
<sup>2</sup> BII rates remaining biodiversity, for which it establishes a cause – impact – relation, exemplary for seven states in southern Africa.

## Relative scope of impact within IUCN – CMP model of Direct Threats

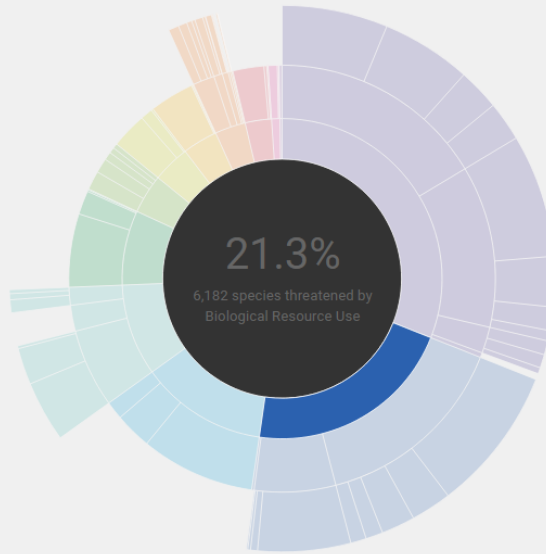


# IUCN CMP Classification of Direct Threats

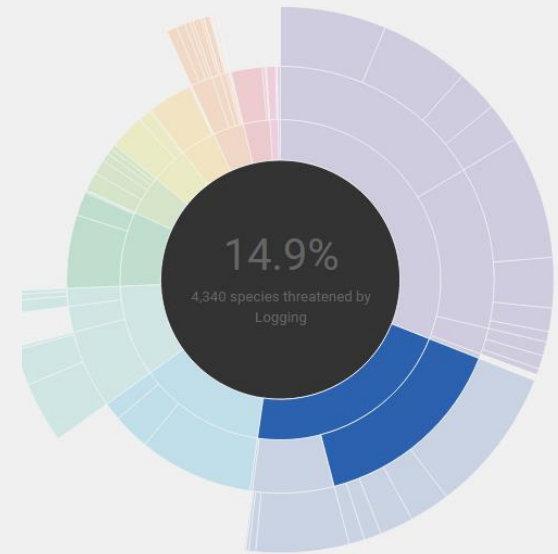
The effect-endpoint of IUCN CMP is the risk of extinction, evaluated for vascular plants, correlated to 12 specific midpoint-impact categories



> 20.600 plant  
species worldwide  
are on the IUCN Red  
List



For 21,3%  
(6.182 species), the use  
of biological resources  
is the dominant direct  
threat.

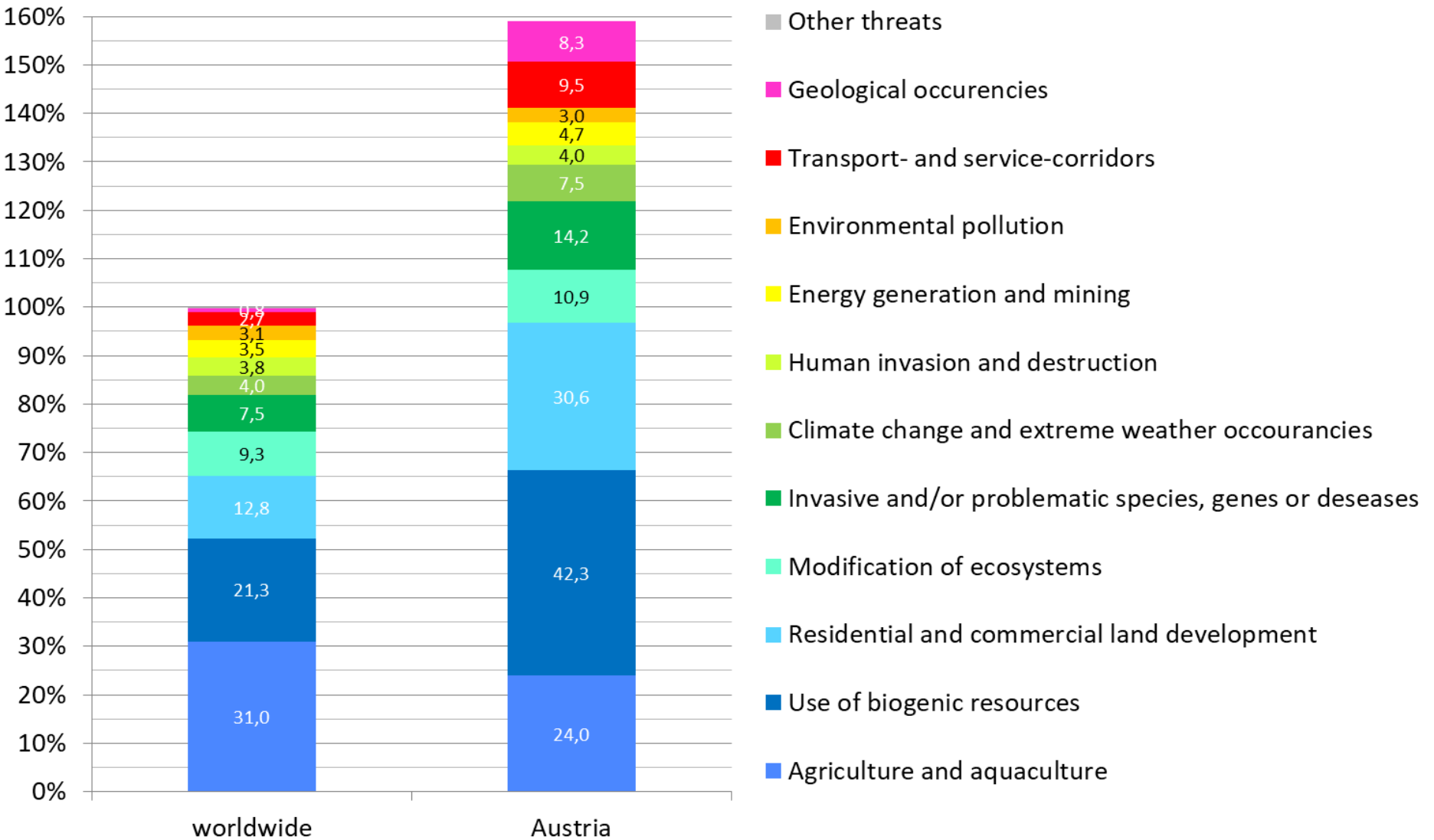


For 14.9%  
(4.340 species),  
forestry is the main  
direct threat.

3

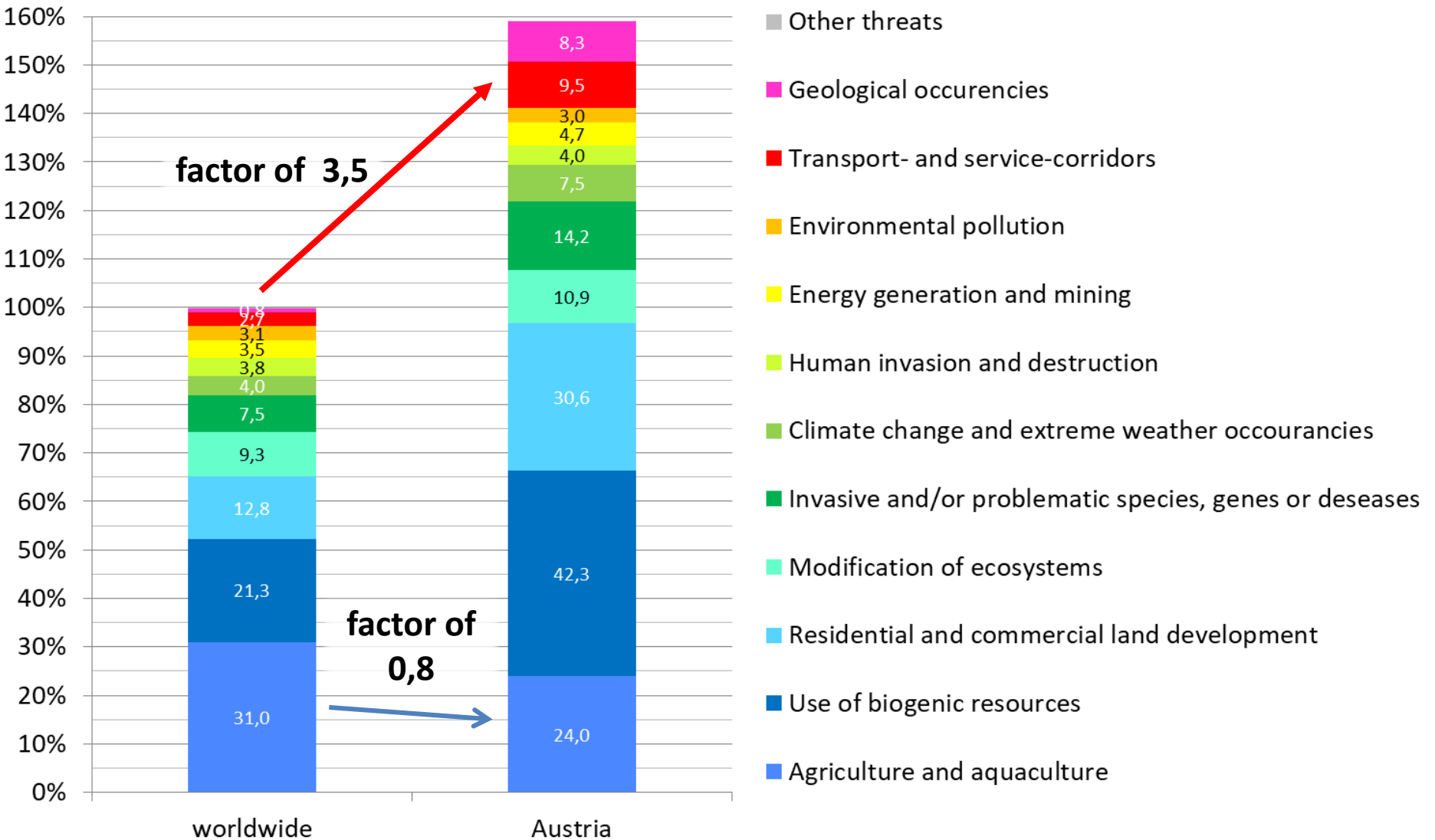
We transformed  
the IUCN Direct Threats model  
from worldwide scope  
to Austrian subsystem

## Relative scope of impact within IUCN – CMP model of Direct Threats





## Relative scope of impact within IUCN – CMP model of Direct Threats



# 4

We analysed the Austrian production-processes of wood, concrete and brick as regards their share of the 12 impact categories of direct extinction threats.

within EPD-modules A1 to A5,  
which is raw material extraction to assembly

based on 1m<sup>3</sup> of building material

# IUCN CMP Classification of Direct Threats

## Relevance within the EPD modules

Construction wood	EPD Module - Produktstadium und Errichtungsphase				
	A1 Rohstoff- bereitstellung	A2 Transport	A3 Herstellung	A4 Transport	A5 Bau/Einbau
<b>IUCN CMP Category</b>					
Agriculture and aquaculture					
Use of biogenic resources	X				
Residential and commercial land development			X		
Modification of ecosystems					
Invasive and/or problematic species, genes or diseases					
Climate change and extreme weather events					
Agriculture and aquaculture					
Energy generation			X		
Mining					
Environmental pollution	X				
Transport- and service-corridors		X		X	
Geological events					
Other threats					

## Exemplary Impact category

### Residential and commercial land development

- There are 950 active saw mills in Austria
  - with a calculated total land use of approx. 19 Mio m<sup>2</sup>.
  - The total land use of storage- and industrial land use in Austria amounts to approx. 139,5 Mio.m<sup>2</sup>
  - Thus, saw mills cover 19,16% of the total Austrian land use of storage- and industrial developments in Austria.
- **The land use of the saw mills and wood-storage areas causes 2,41E-07 % of the biodiversity loss in Austria, per 1m<sup>3</sup> construction wood.**

# IUCN CMP Classification of Direct Threats

## Anteile in den EPD Modulen – Ergebnisse Holz

Construction wood	EPD Module - Produktstadium und Errichtungsphase					
	A1 Rohstoff- bereitstellung	A2 Transport	A3 Herstellung	A4 Transport	A5 Bau/Einbau	
IUCN CMP Category						$\Sigma_{\text{Teil}} [\%]$
Agriculture and aquaculture						
Use of biogenic resources	X					3,89E-8%
Residential and commercial land development			X			2,41E-7%
Modification of ecosystems						
Invasive and/or problematic species, genes or diseases						
Climate change and extreme weather events						
Agriculture and aquaculture						
Energy generation			X			6,07E-9%
Mining						--
Environmental pollution	X					8,46E-12%
Transport- and service-corridors		X		X		2,14E-10%
Geological events						
Other threats						
Relative contribution to biodiversity loss in Austria [% per m³]						2,87E-07%

# IUCN CMP Classification of Direct Threats

## Relevance within the EPD modules

Concrete	EPD Module - Produktstadium und Errichtungsphase				
	A1 Rohstoff- bereitstellung	A2 Transport	A3 Herstellung	A4 Transport	A5 Bau/Einbau
<b>IUCN CMP Category</b>					
Agriculture and aquaculture					
Use of biogenic resources					
Residential and commercial land development	X		X		
Modification of ecosystems			X		
Invasive and/or problematic species, genes or diseases					
Climate change and extreme weather events					
Agriculture and aquaculture					
Energy generation			X		
Mining	X				
Environmental pollution	X				
Transport- and service-corridors		X		X	
Geological events					
Other threats					

## Exemplary Impact category

### Energy generation

- Energy consumption of Austrian cement production is 3.588 GWh/a
  - Concrete production output in Austria is 14,25 Mio m<sup>3</sup>/a
  - Thus, energy consumption of concrete production is 252 kWh/m<sup>3</sup>
  - Energy generation (electricity) has a relative impact of 2,29 E-11 %/kWh to biodiversity loss in Austria.
- **Energy generation for concrete production causes 6,07E-09 % of the biodiversity loss in Austria, per 1m<sup>3</sup> concrete.**

# IUCN CMP Classification of Direct Threats

## Anteile in den EPD Modulen – Ergebnisse Beton

Concrete	EPD Module - Produktstadium und Errichtungsphase					
IUCN CMP Category	A1 Rohstoff- bereitstellung	A2 Transport	A3 Herstellung	A4 Transport	A5 Bau/Einbau	$\Sigma_{\text{Teil}}$ [%]
Agriculture and aquaculture						
Use of biogenic resources						
Residential and commercial land development	X		X			3,78E-8 %
Modification of ecosystems			X			4,04E-11%
Invasive and/or problematic species, genes or diseases						
Climate change and extreme weather events						
Agriculture and aquaculture						
Energy generation			X			5,76E-09%
Mining	X					1,09E-07%
Environmental pollution	X					1,59E-10%
Transport- and service-corridors		X		X		8,18E-10%
Geological events						
Other threats						
Relative contribution to biodiversity loss in Austria [% per m <sup>3</sup> ]						1,54E-07%



# IUCN CMP Classification of Direct Threats

## Relevance within the EPD modules

Hollow Brick	EPD Module - Produktstadium und Errichtungsphase				
	A1 Rohstoff- bereitstellung	A2 Transport	A3 Herstellung	A4 Transport	A5 Bau/Einbau
IUCN CMP Category					
Agriculture and aquaculture					
Use of biogenic resources					
Residential and commercial land development	X		X		
Modification of ecosystems	X		X		
Invasive and/or problematic species, genes or diseases					
Climate change and extreme weather events					
Agriculture and aquaculture					
Energy generation	X		X		
Mining					
Environmental pollution	X				
Transport- and service-corridors		X		X	
Geological events					
Other threats					

## Exemplary Impact category transportation and service corridors

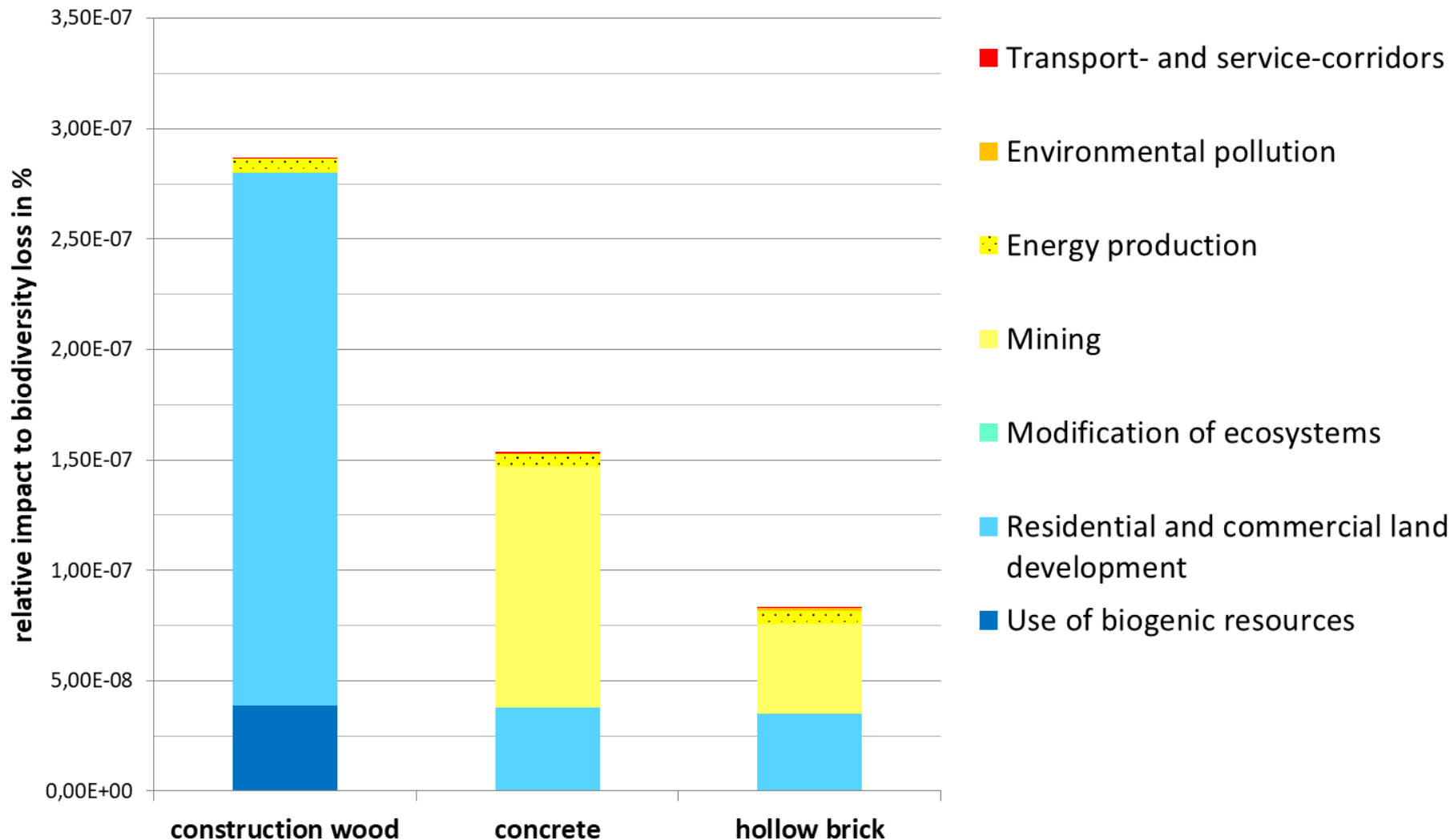
- Average transportation distance of brick products is 118 km
  - Total annual capacity of freight transportation in Austria is 38.509 Mio. ton.km
  - Impact sub-category of roads and railway-corridores count for 8,41% of Austrian biodiversity loss.
- **Transportation of hollow bricks causes 5,78E-10 % of the biodiversity loss in Austria, per 1m<sup>3</sup> hollow brick.**

# IUCN CMP Classification of Direct Threats

## Anteile in den EPD Modulen

Hollow Brick	EPD Module - Produktstadium und Errichtungsphase					
	A1 Rohstoff- bereitstellung	A2 Transport	A3 Herstellung	A4 Transport	A5 Bau/Einbau	
IUCN CMP Category						$\Sigma_{\text{Teil}} [\%]$
Agriculture and aquaculture						
Use of biogenic resources						
Residential and commercial land development			X			3,52E-8 %
Modification of ecosystems	X					
Invasive and/or problematic species, genes or diseases						
Climate change and extreme weather events						
Agriculture and aquaculture						
Energy generation			X			6,30E-9%
Mining						4,03E-8%
Environmental pollution	X					1,04E-9%
Transport- and service-corridors		X		X		5,78E-10%
Geological events						
Other threats						
Relative contribution to biodiversity loss in Austria [% per m <sup>3</sup> ]						8,35E-08%

## Share of direct threats to biodiversity loss in Austria, per m<sup>3</sup> of building material



5

Preliminary Conclusions

Open questions

Next steps

Invitation for Discussion

# Conclusions and open challenges

- The methodology proves to be applicable and trustful.
- The main challenge remains in data derivation:
  - normalising the Direct Threats from worldwide approach to the subsystem of Austria,  
  
including the question of a qualitative comparison, additional to the quantitative intensity of Direct Threats
  - identifying the share of building material production and assembly within the fuspecific Direct Threats categories. (EPDs form an excellent basis.)
- Another challenge is integrating import modules

# Next Steps

- Next step scheduled is to extend the methodology to an import module, i.e. steel.
- Establish cooperation and scientific exchange.  
Presentations so far took place to:
  - Bundesforschungszentrum Wald  
DI Dr. Klemens Schadauer, DI Alexandra Freudenschuß
  - Umweltbundesamt  
Dr. Klaus Peter Zulka, DI Alexander Storch
  - Bundesministerium für Nachhaltigkeit und Tourismus  
MR DI Gabriele Obermayer, Mag. Verena Wittmann

# Invitation

Let's close the gap  
and integrate biodiversity loss and land use change  
into LCIA of construction products.

With a warm invitation to exchange and cooperate.

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[renate.hammer@building-research.at](mailto:renate.hammer@building-research.at)

Thank you!



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