



"Sustainable growing media": why we're using the term incorrectly and what to do about it

Dr. Alexander Sentinella,
Director of Science
Growing Media Europe

What does “sustainable” mean?



The challenge of defining “sustainable growing media”: why the term is used incorrectly and what needs to be done about it

Siv M. Aurdal^{1†}, Alexander T. Sentinella^{2*†}, Gerald Schmilewski^{2,3},
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frontiers
in Horticulture

TYPE Perspective
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History of “Sustainability”

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*"Therefore, the greatest art/science/diligence and organization of these lands will consist in how to establish such conservation and **cultivation of wood that there is a continuous, constant and sustainable use**, because it is an indispensable thing without which the land cannot remain in its essence."*

*Sylvicultura oeconomica, oder haußwirthliche
Nachricht und Naturmäßige Anweisung zur wilden
Baum-Zucht (1713)*

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Three pillars:

- Economic growth
- Environmental protection
- Social equality

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Led to eventual consolidation of sustainability into three pillars

- Environmental
- Economic
- Social

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“This scheme has not been designed to rule in or out certain source-specific materials.”

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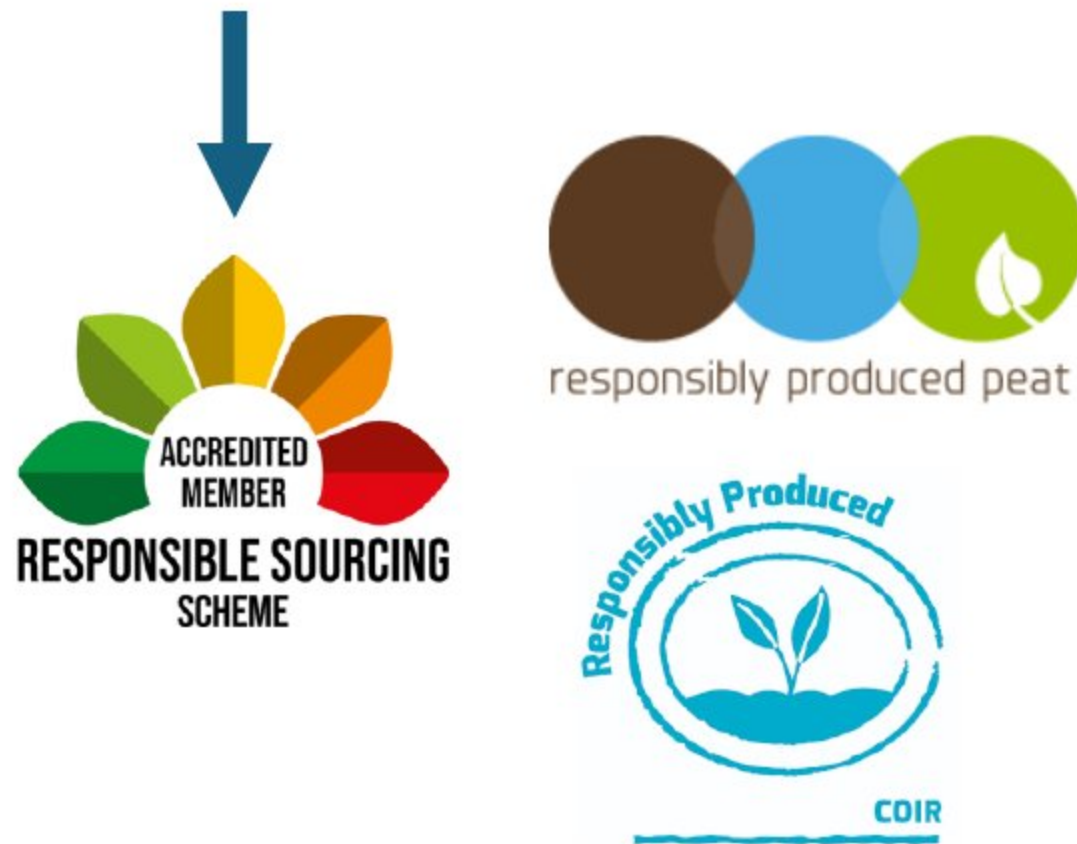
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“Responsible”



“Environmental impact”
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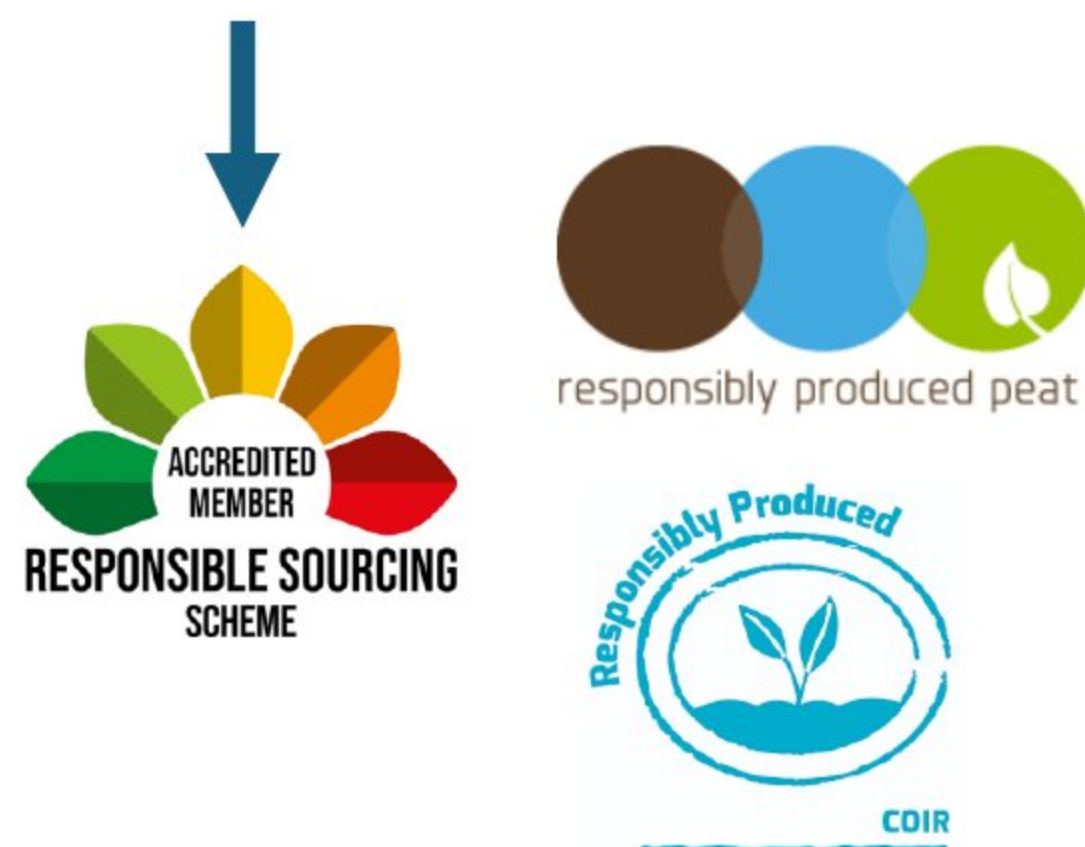
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“Responsible”



“Environmental impact”
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Going peat-free,
protecting the climate

The Peat Use Reduction Strategy of the Federal Ministry of Food and Agriculture



Peat exit plan



“Peat”
“Climate” (?)

Three pillars of sustainability



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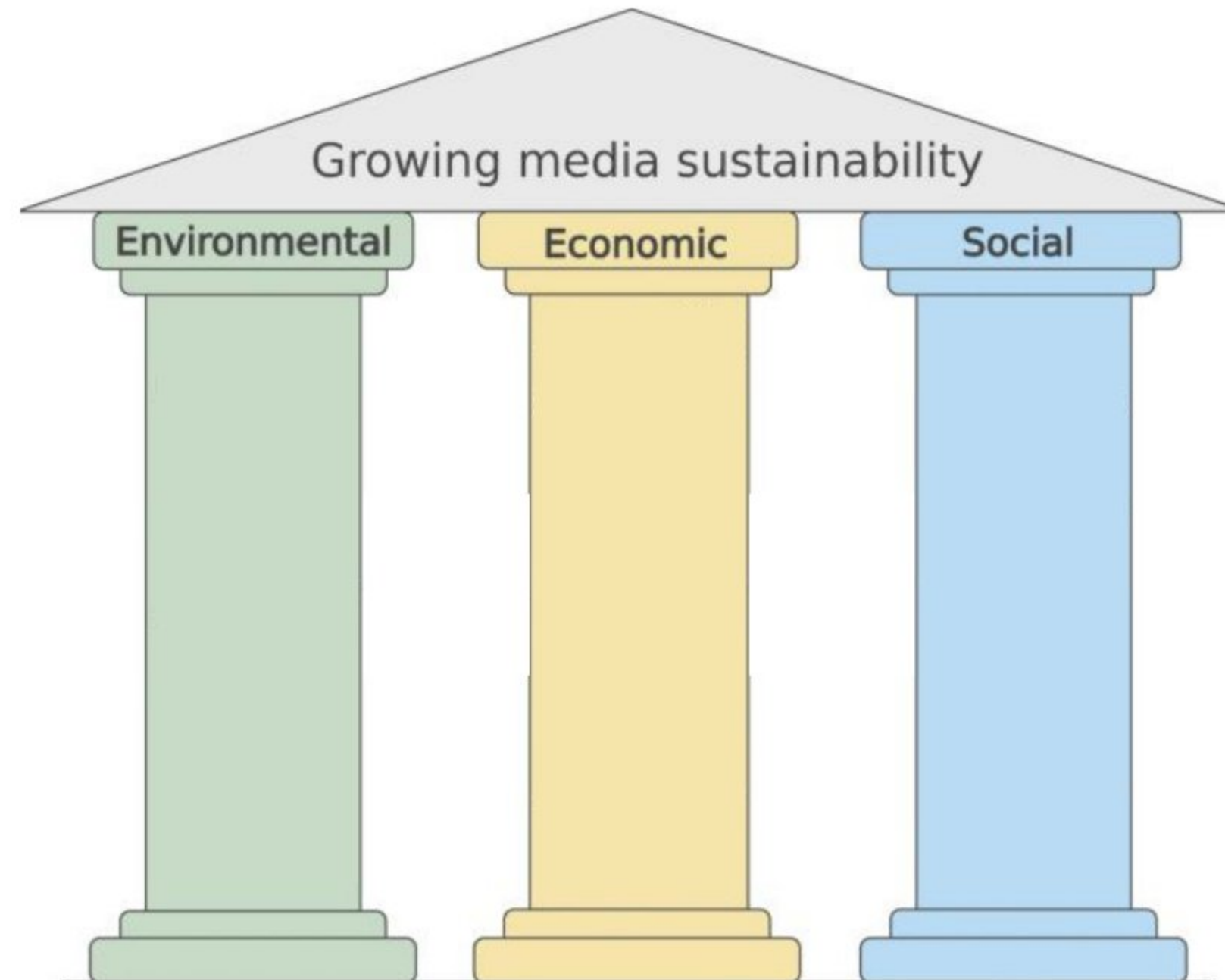
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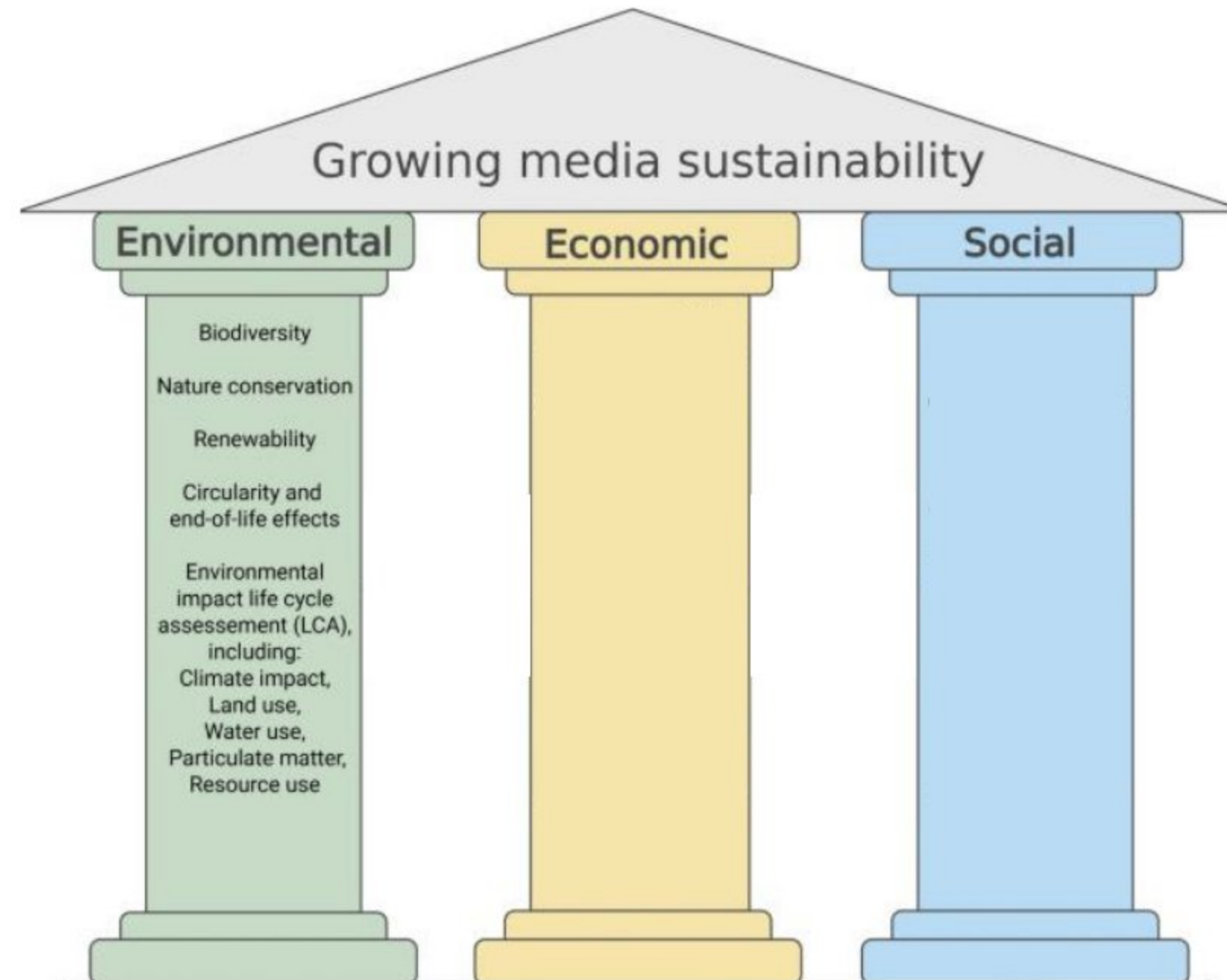
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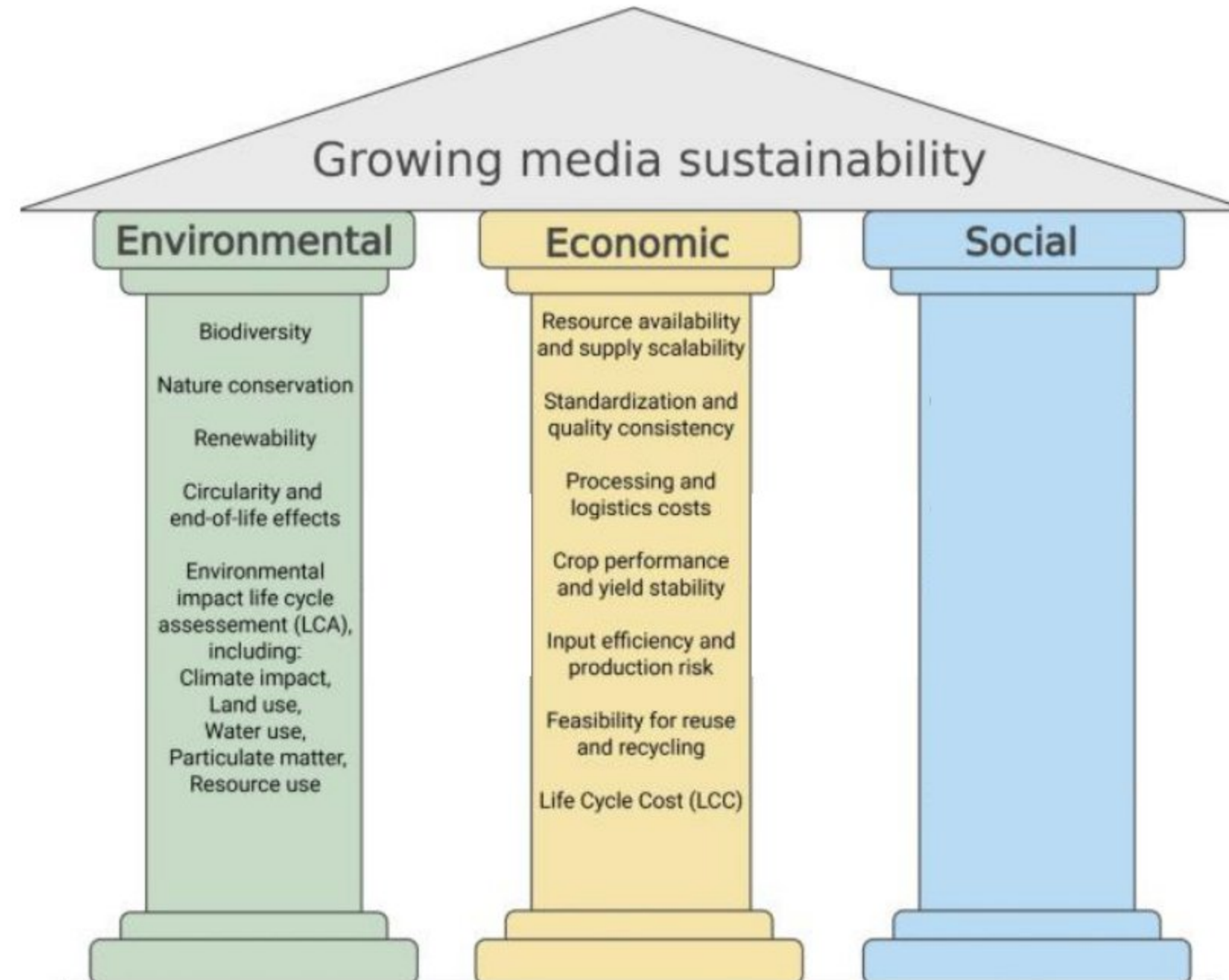
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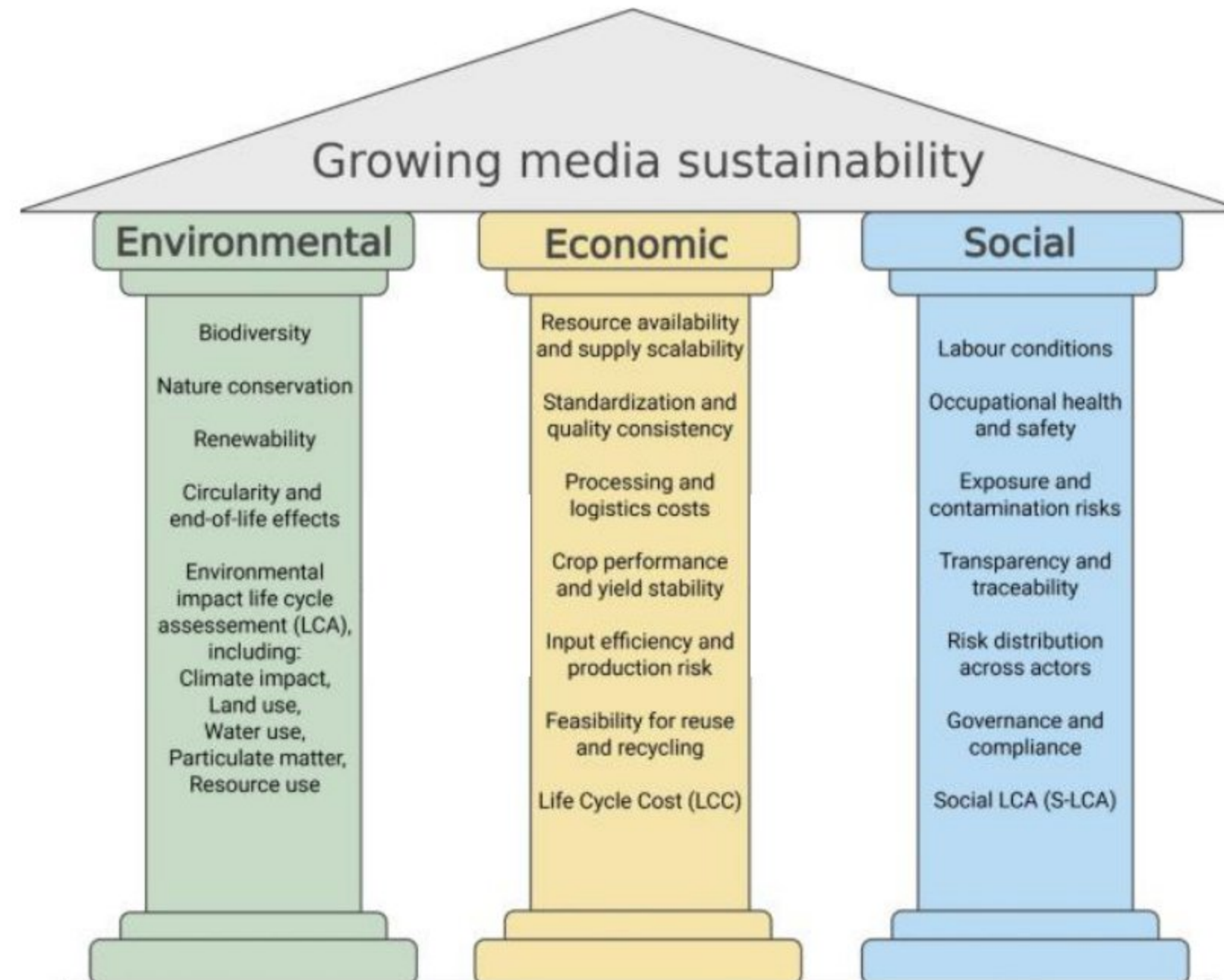
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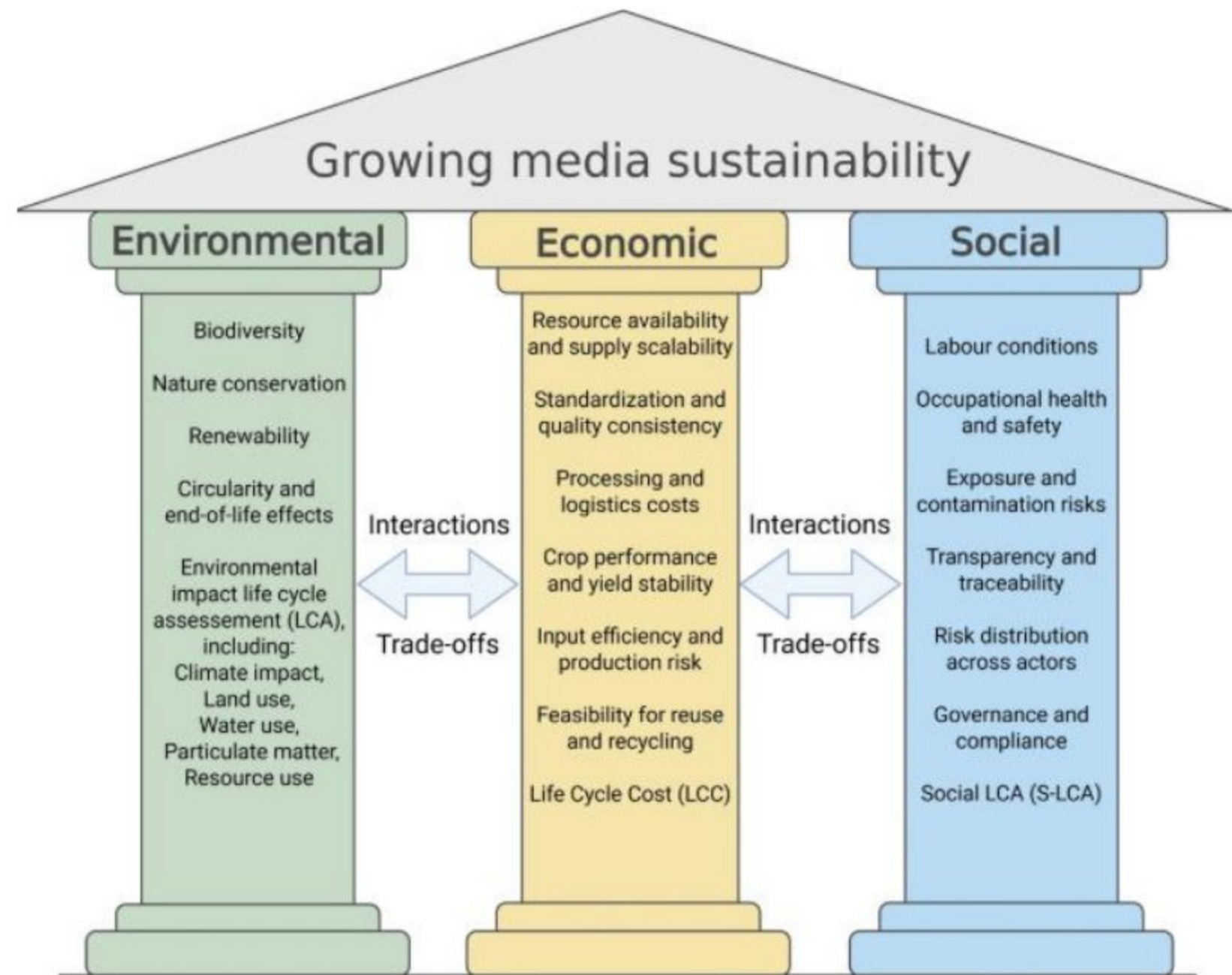
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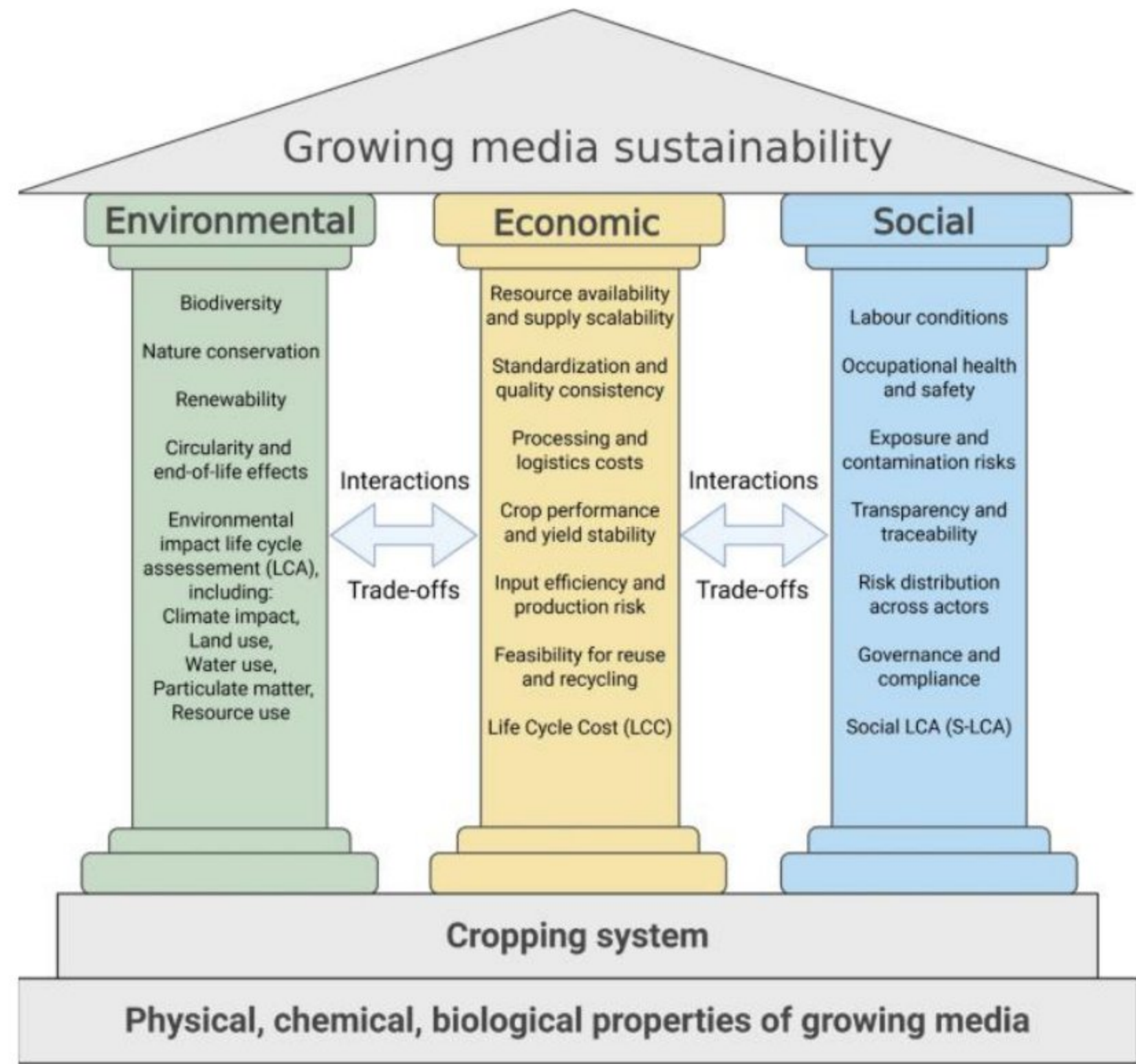
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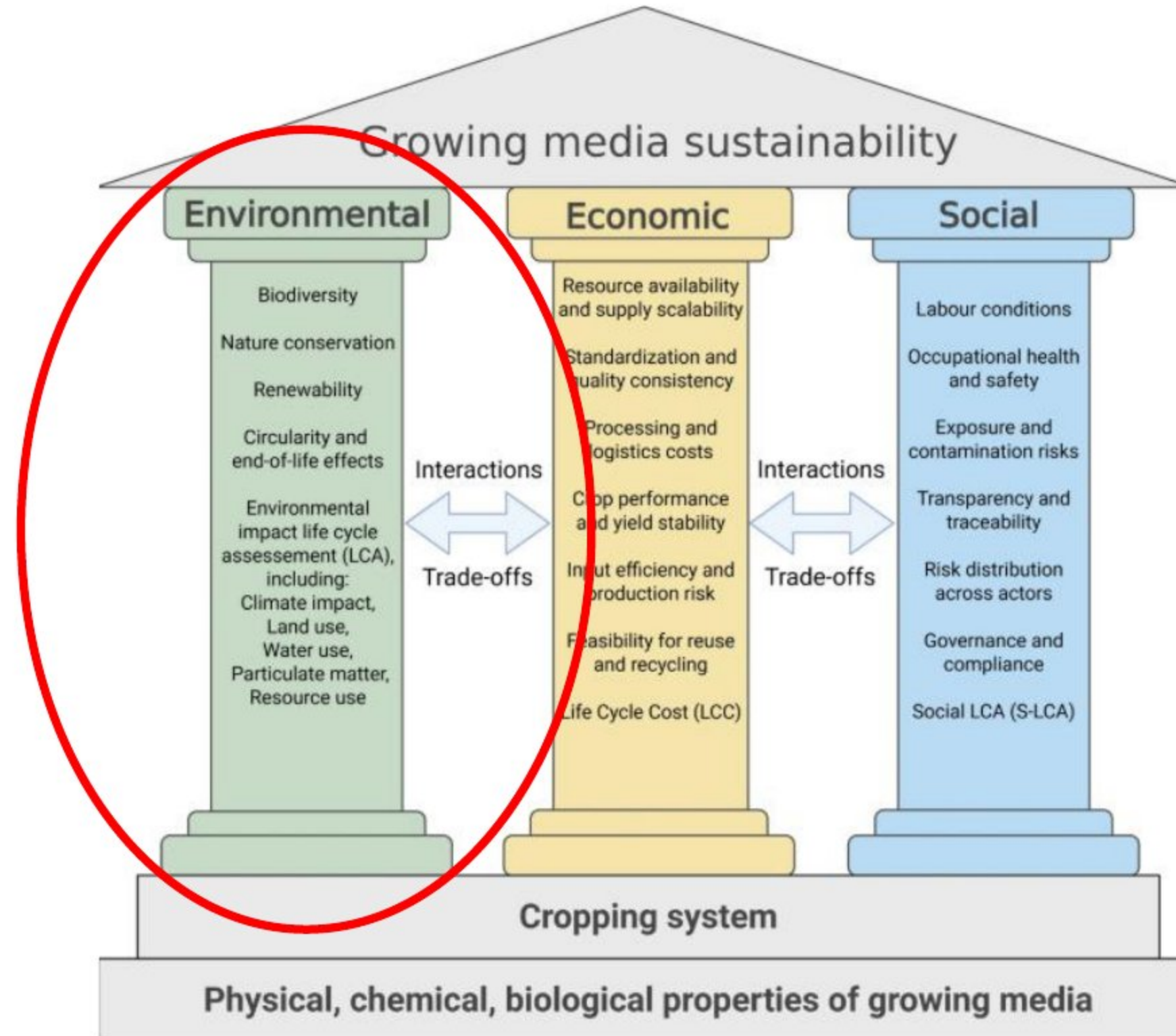
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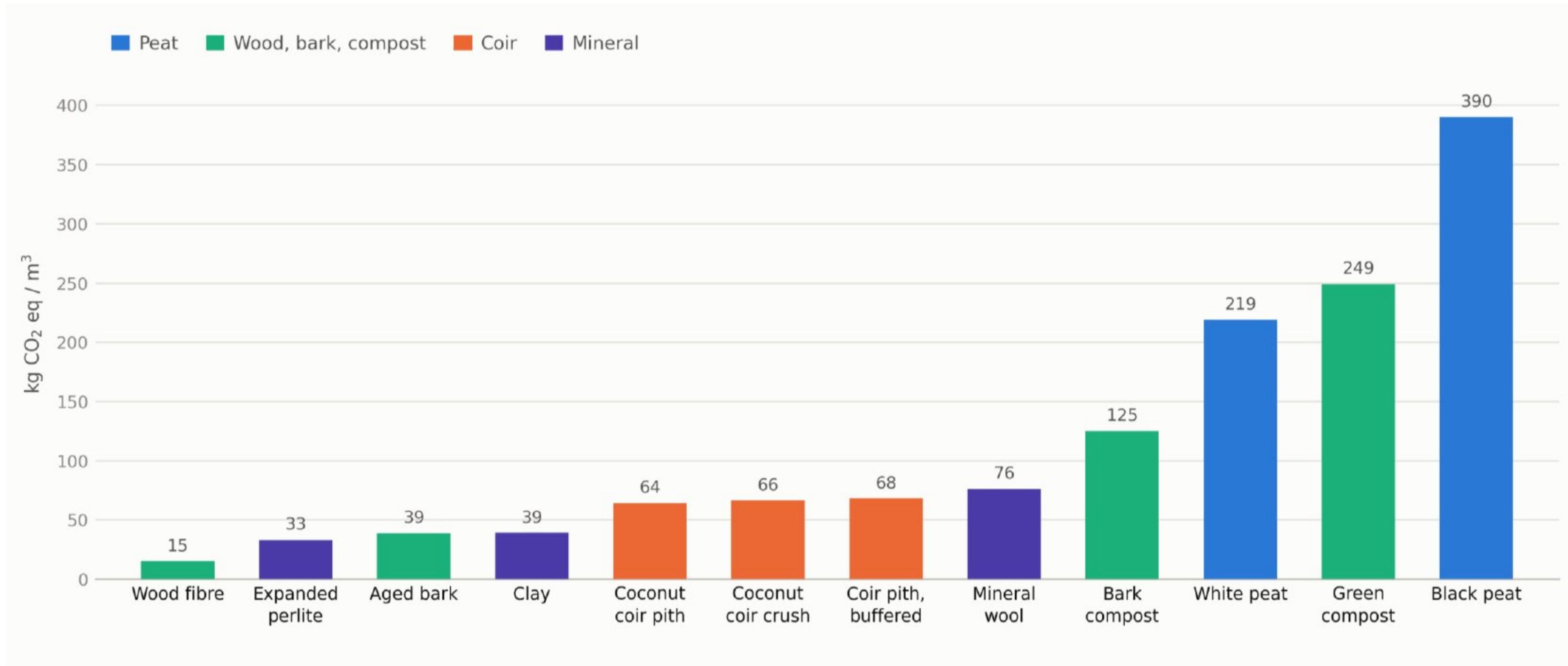


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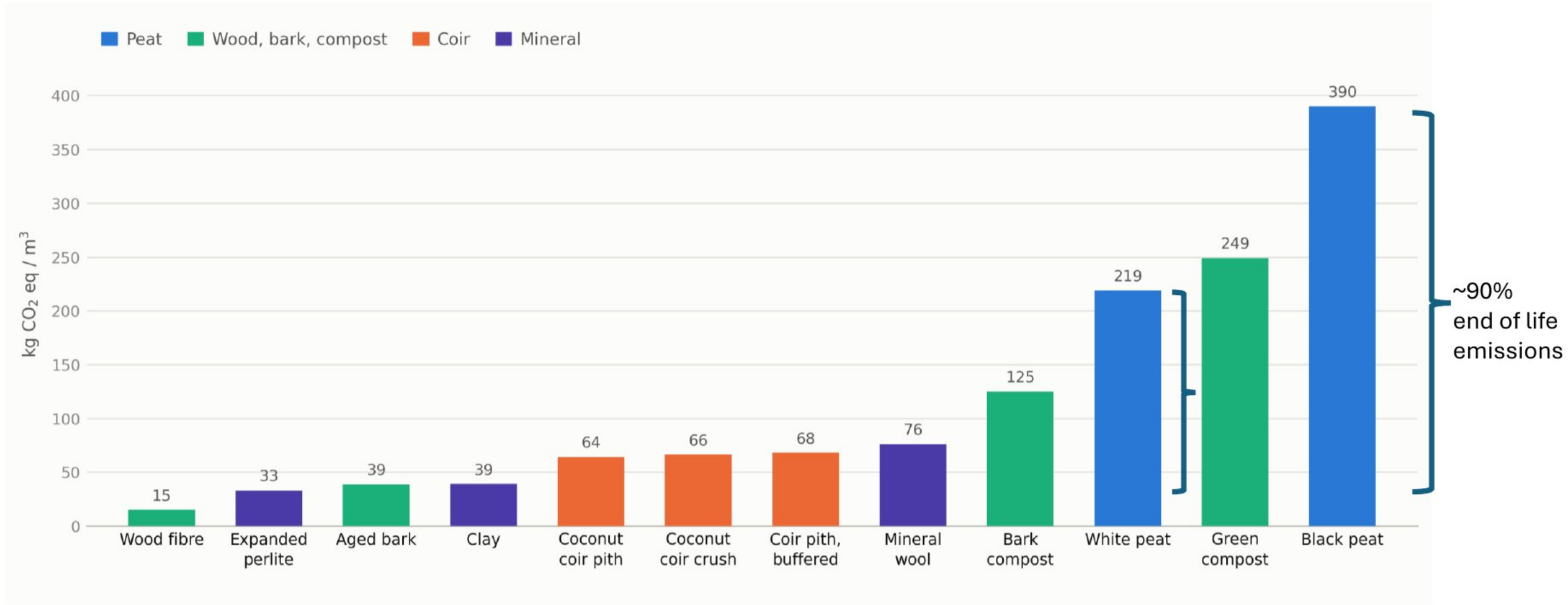
Level 1: Material level impacts – Climate Impact

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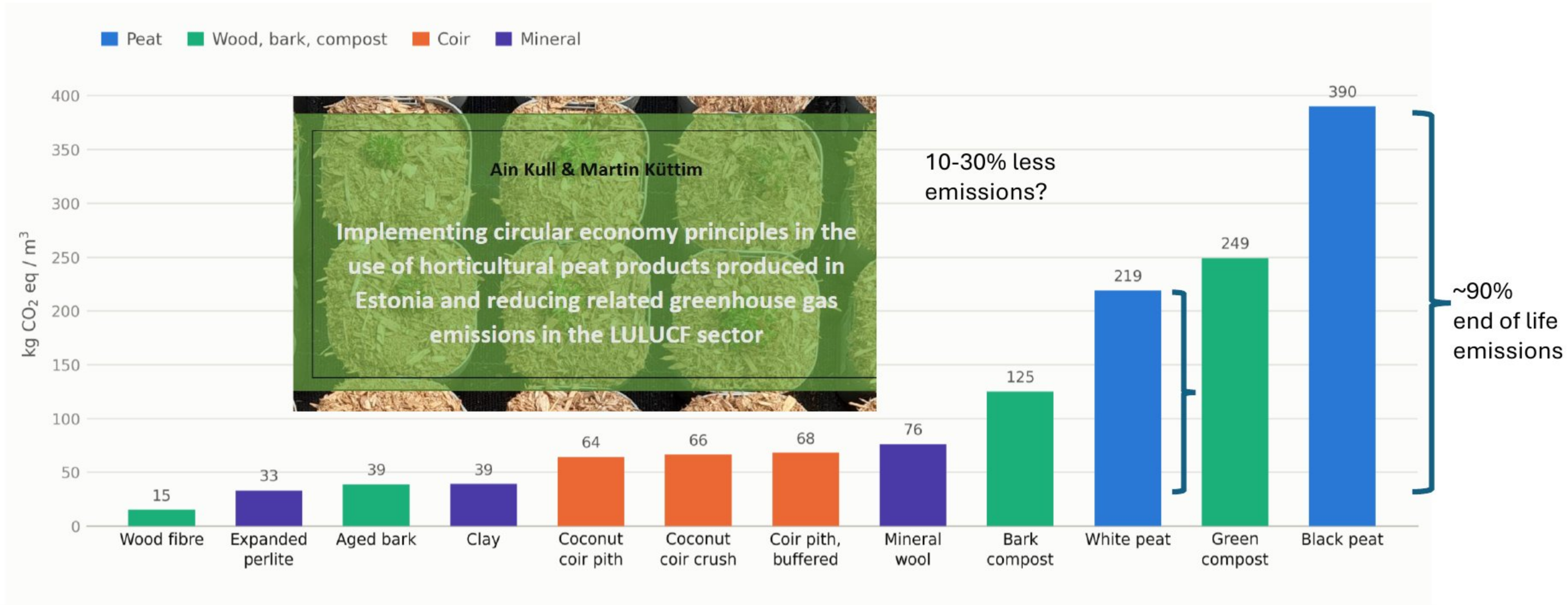
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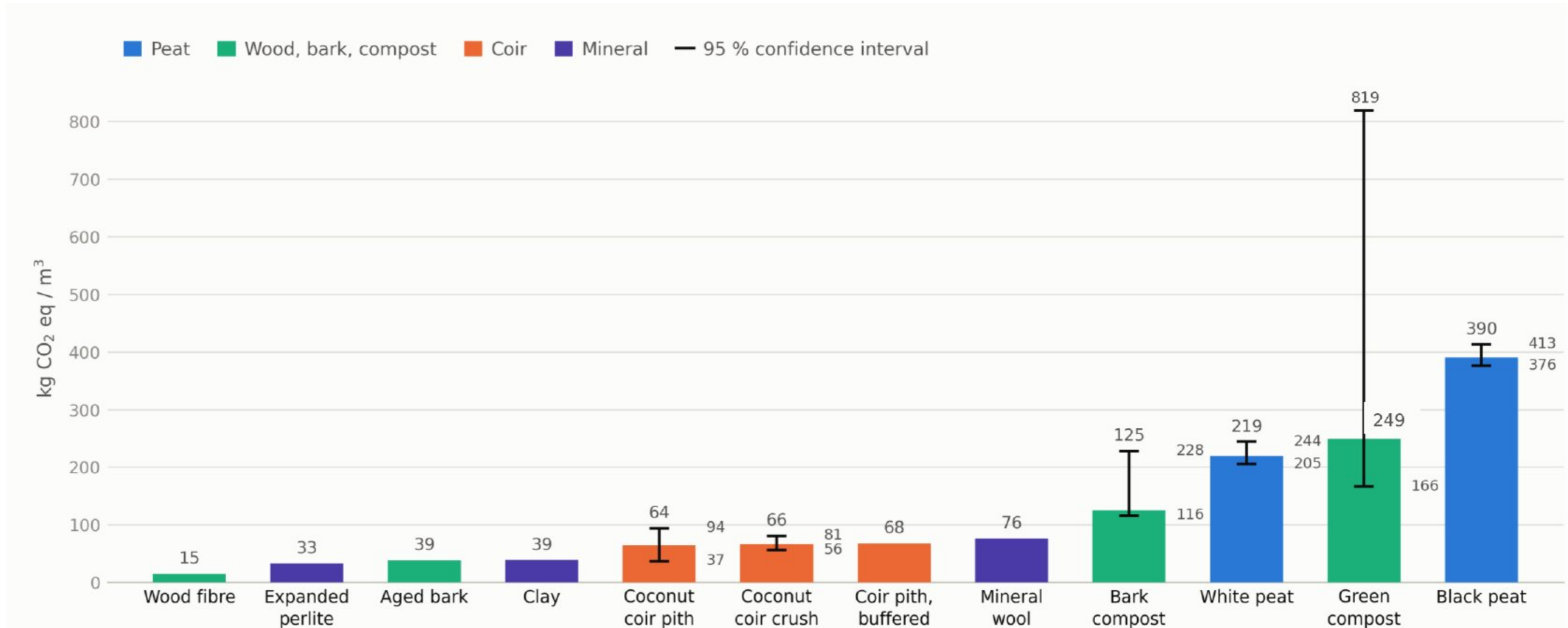
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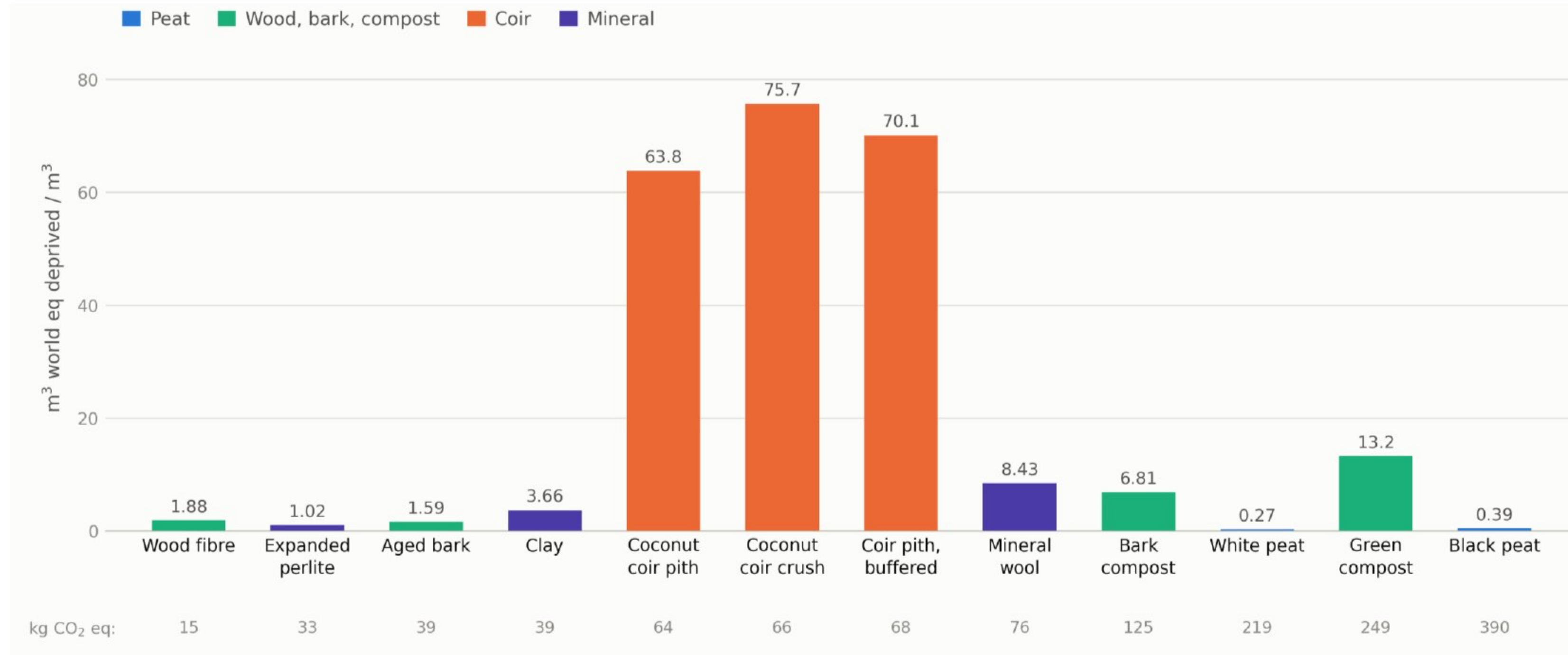
Level 1: Constituent level impacts – Climate Impact



Baseline values from the midpoint results table. Intervals are the paper's partial uncertainty analysis (Monte Carlo, 95 %), which covers six constituents only; they are not symmetric about the baseline, and for both composts the distribution mean sits above it. Green compost, bark compost and coir pith intervals are as stated in the text; coir crush, white peat and black peat are read off Figure 6, approximate to about 2 kg.

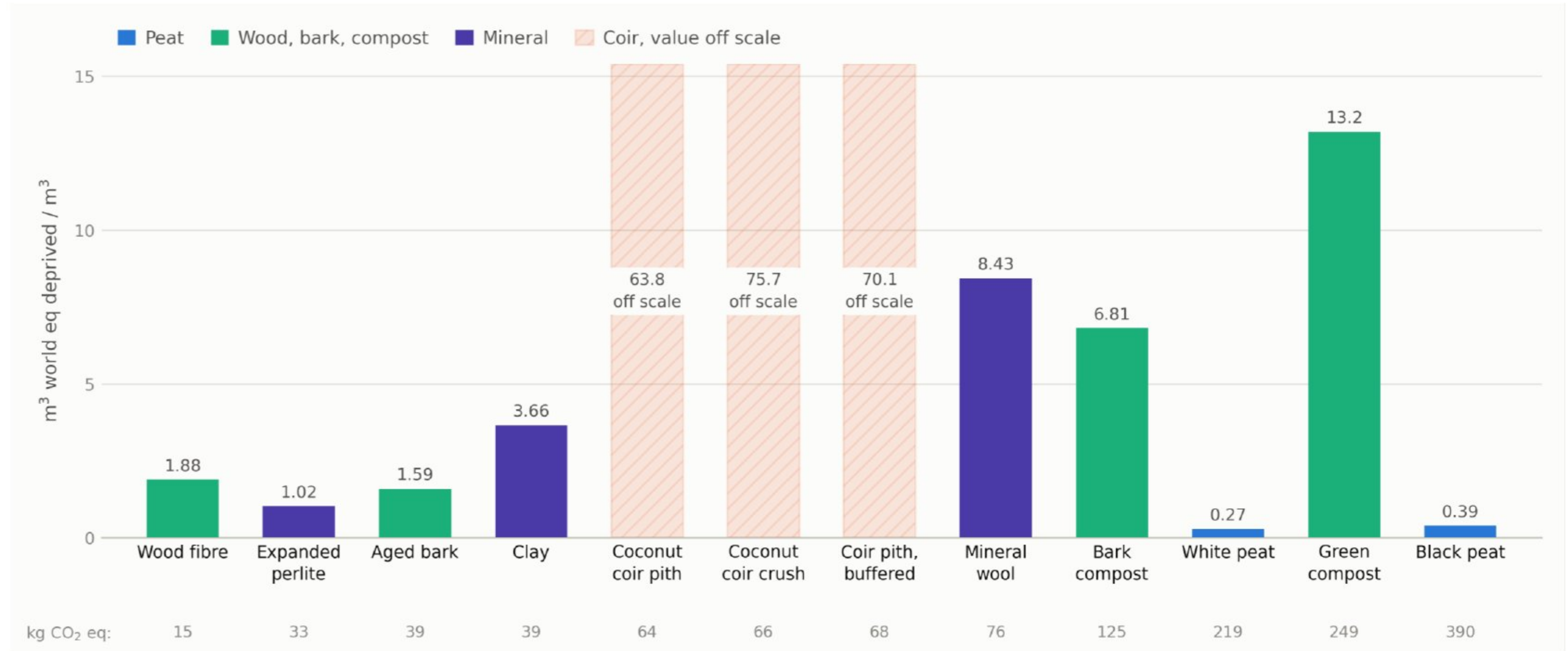
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Level 1: Material level impacts – Water Impact



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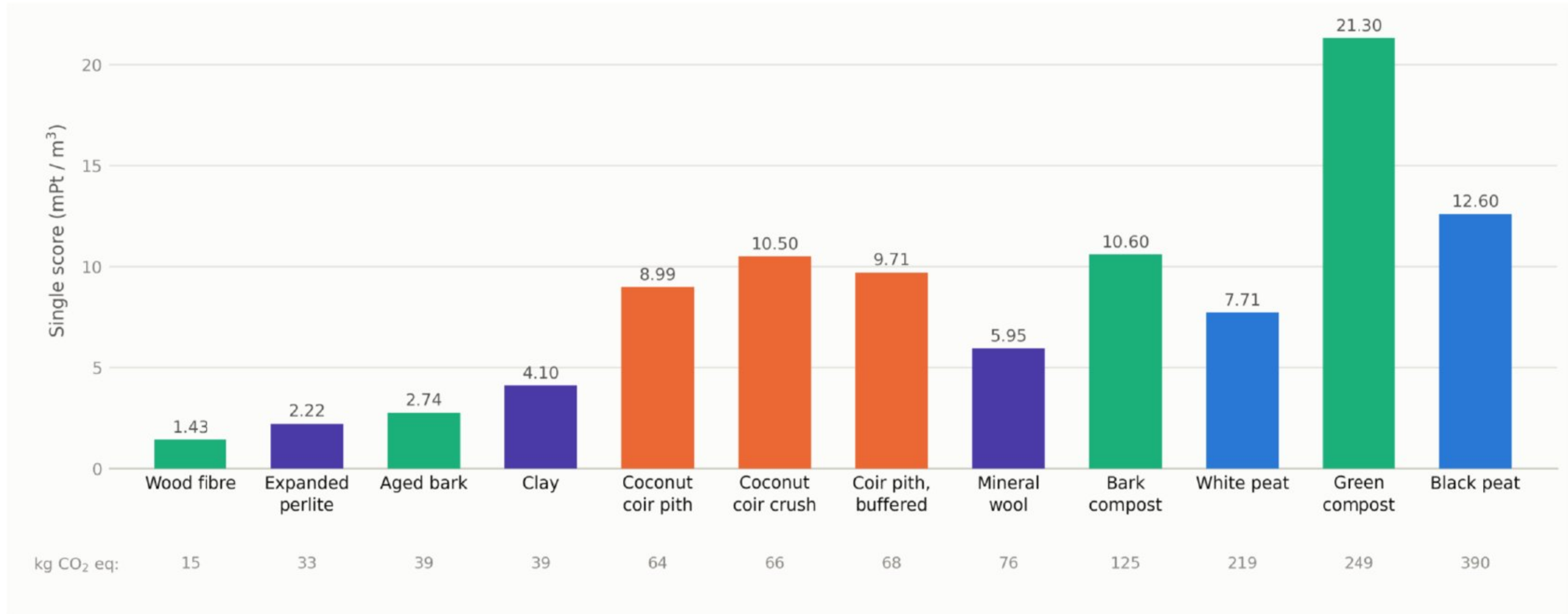
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Level 1: Material level – Total Environmental Impact

Weighted single score across all sixteen impact categories.

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Level 2: Mix level – Total Environmental Impact

Weighted single score across all sixteen impact categories.

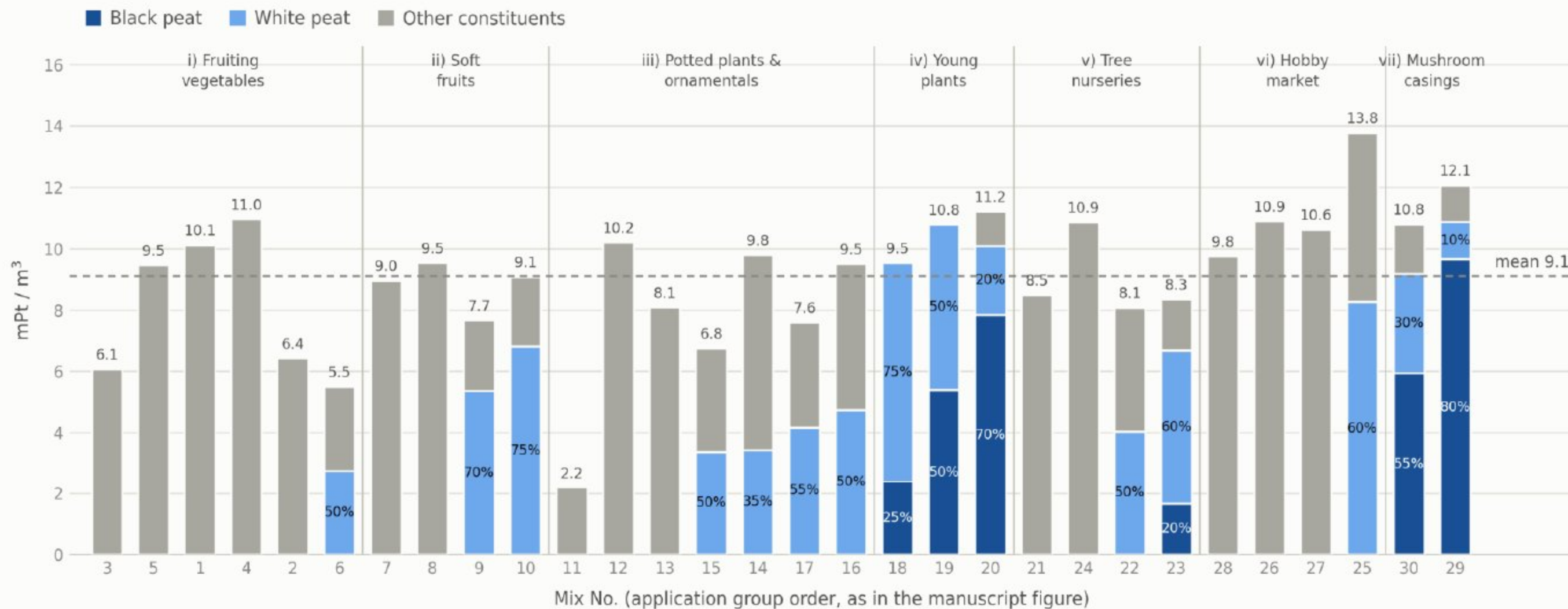
Level 2: Mix level – Total Environmental Impact

Weighted single score across all sixteen impact categories.

Single score of 30 growing media mixes, split by mix composition

Bar height is the total environmental impact, mPt per m³ of mix, EF 3.1 weighted and normalised across all 16 impact categories.

Segments divide each bar by the volume share of black peat, white peat and all other constituents. Peat shares labelled where the segment allows.



Segments show how much of the mix each material is, not how much of the impact it causes: a 50 % segment is not 50 % of the impact.
Composition read from panel C of the manuscript figure; all 30 mixes sum to 100 %.

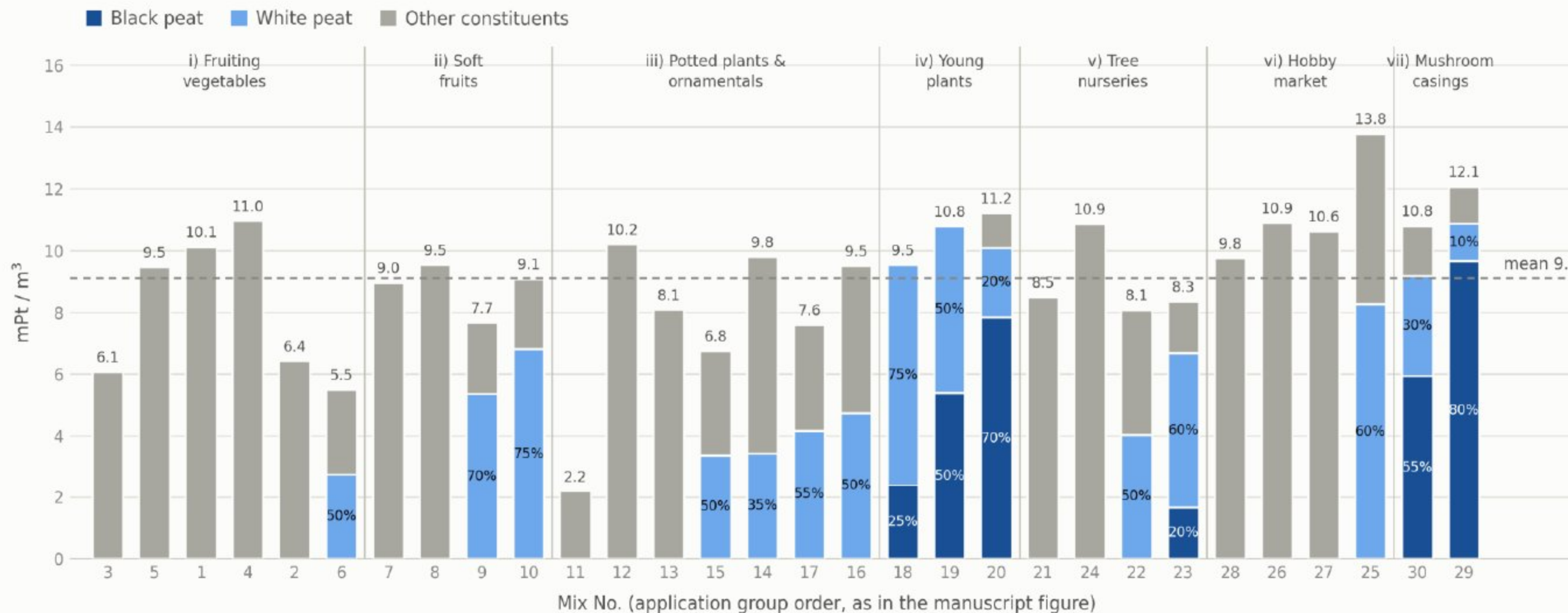
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With black peat **10.5**

White peat only **8.6**

Peat-free **8.8**

Full range across all thirty: 2.2 to 13.8

**Peat content does
not order the
environmental score.**

Everything you have just seen was measured per cubic metre of growing media, at the factory gate.

Growing media is used to grow plants

What proportion of a plant's impact is from growing media?

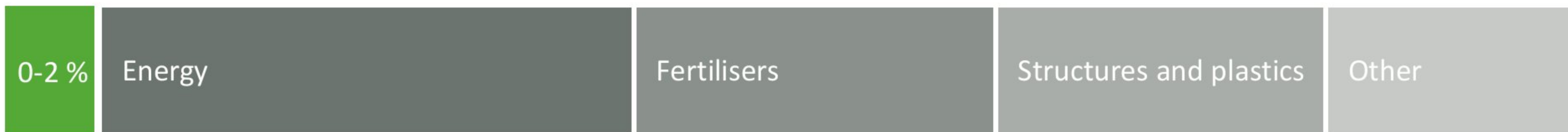


Growing
media
impact
(2,56 - 37,43)



What proportion of a plant's impact is from growing media?

Total impact of tomatoes = 1709 kg CO₂e / t



Indicative example: Tomatoes grown in heated greenhouse

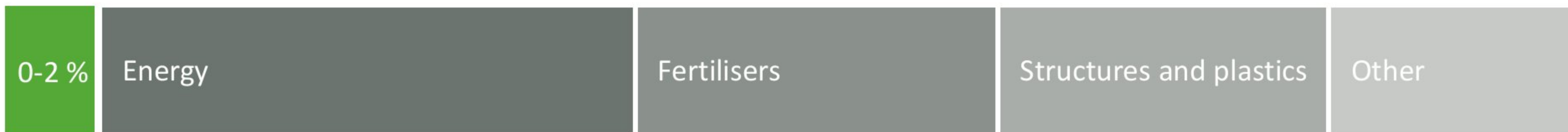
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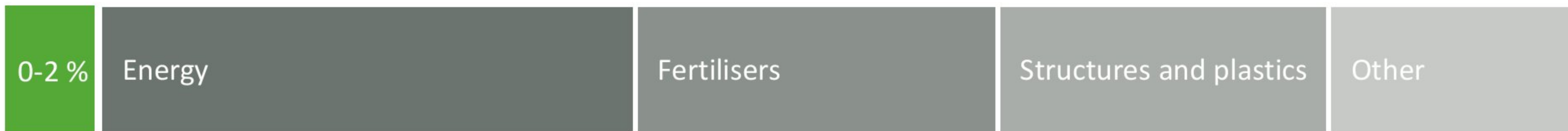


Indicative example: Tomatoes grown in protected growing without heating



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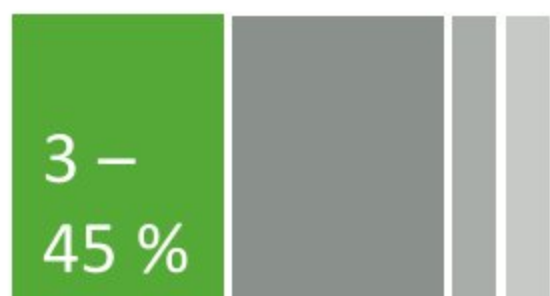


**Growing
media
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Indicative example: Tomatoes grown in heated greenhouse

NOT TO SCALE

Total impact of tomatoes = 83 kg CO₂e / t



Indicative example: Tomatoes grown in protected growing without heating



What proportion of a plant's environmental impact is because of growing media?

Yield	Energy use
Grade	Uniformity
Crop loss	Water demand
Fertiliser demand	Crop duration



**The growing medium's main environmental effect is not what it is made of.
It is how well it grows the crop.**

Which means the largest environmental lever in growing media is held by the grower, not the manufacturer.

PER CUBIC METRE · the basis the sector uses today

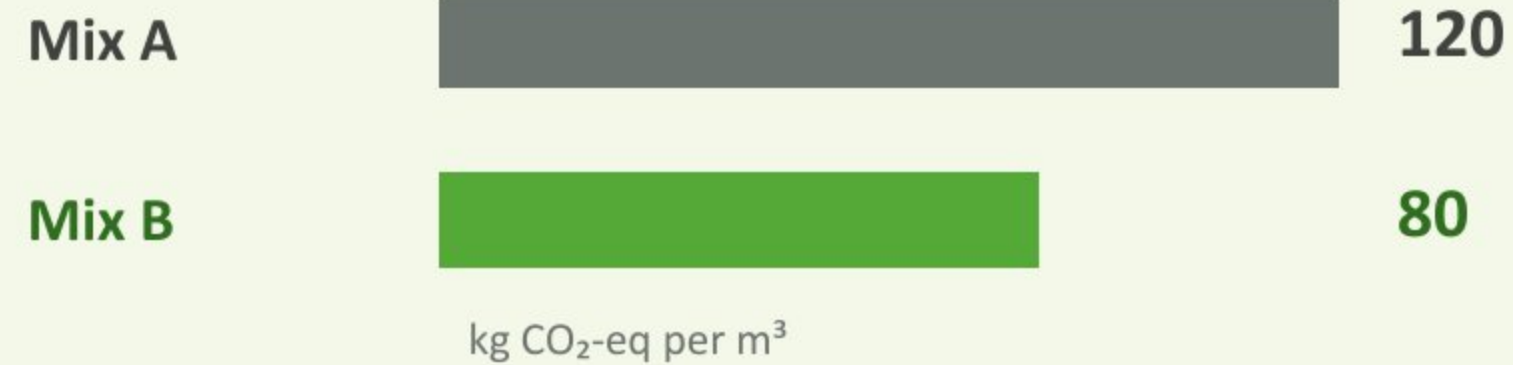
Mix A  **120**

Mix B  **80**

kg CO₂-eq per m³

Mix B is a third lower. An easy decision, and most of you would be told to make it.

PER CUBIC METRE · the basis the sector uses today



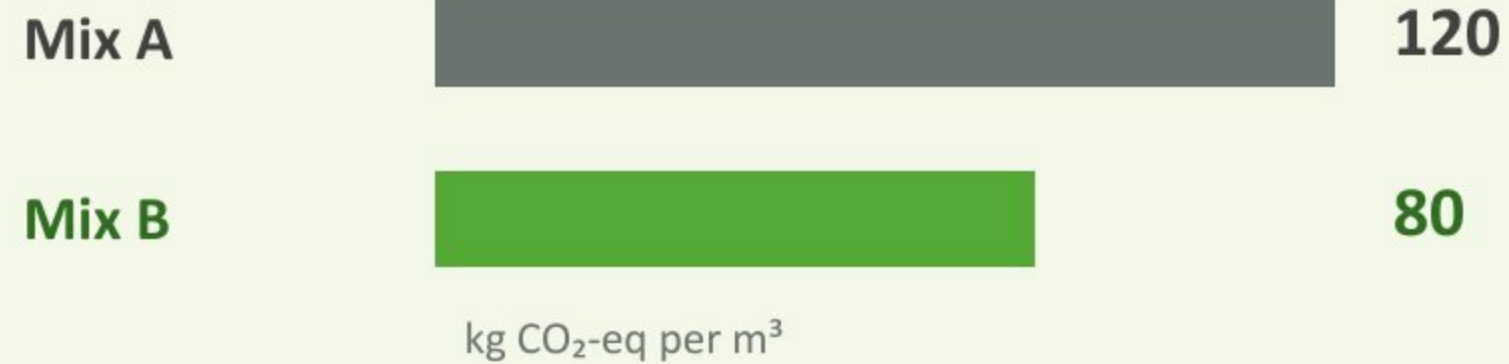
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PER SALEABLE PLANT · 500 plants per m³, medium = 10% of crop footprint



The ranking reverses. The mix that lost on the bag wins on the crop.

PER CUBIC METRE · the basis the sector uses today



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The ranking reverses. The mix that lost on the bag wins on the crop.

Break-even is a 3.3% loss in saleable plants. That is the same 3.3% as the largest saving the reformulation could ever deliver. Whatever a reformulation can save, a three per cent drop in saleable plants cancels it.

Environmental Sustainability

Four aspects LCA does not captures well:

- Biodiversity effects
- Nature conservation outcomes
- End of life and circularity (partial)
- Renewability



How much peatland does “slowly renewable” require?

	Global	Europe
Peatland area	~ 6 000 000 km ²	~333 000 km ² (excluding Russia and Belarus)
Degraded peatland area		
Current area of extraction		
Global peat extraction volume		
Typical peat accumulation rate		
Theoretical area needed for compensatory accumulation		

*Rough estimates (better data needed)

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Typical peat accumulation rate	~1 mm/yr; ~1 t dry matter/ha/yr; ~10 m ³ /ha/yr	~1 mm/yr; ~1 t dry matter/ha/yr; ~10 m ³ /ha/yr
Theoretical area needed for compensatory accumulation		

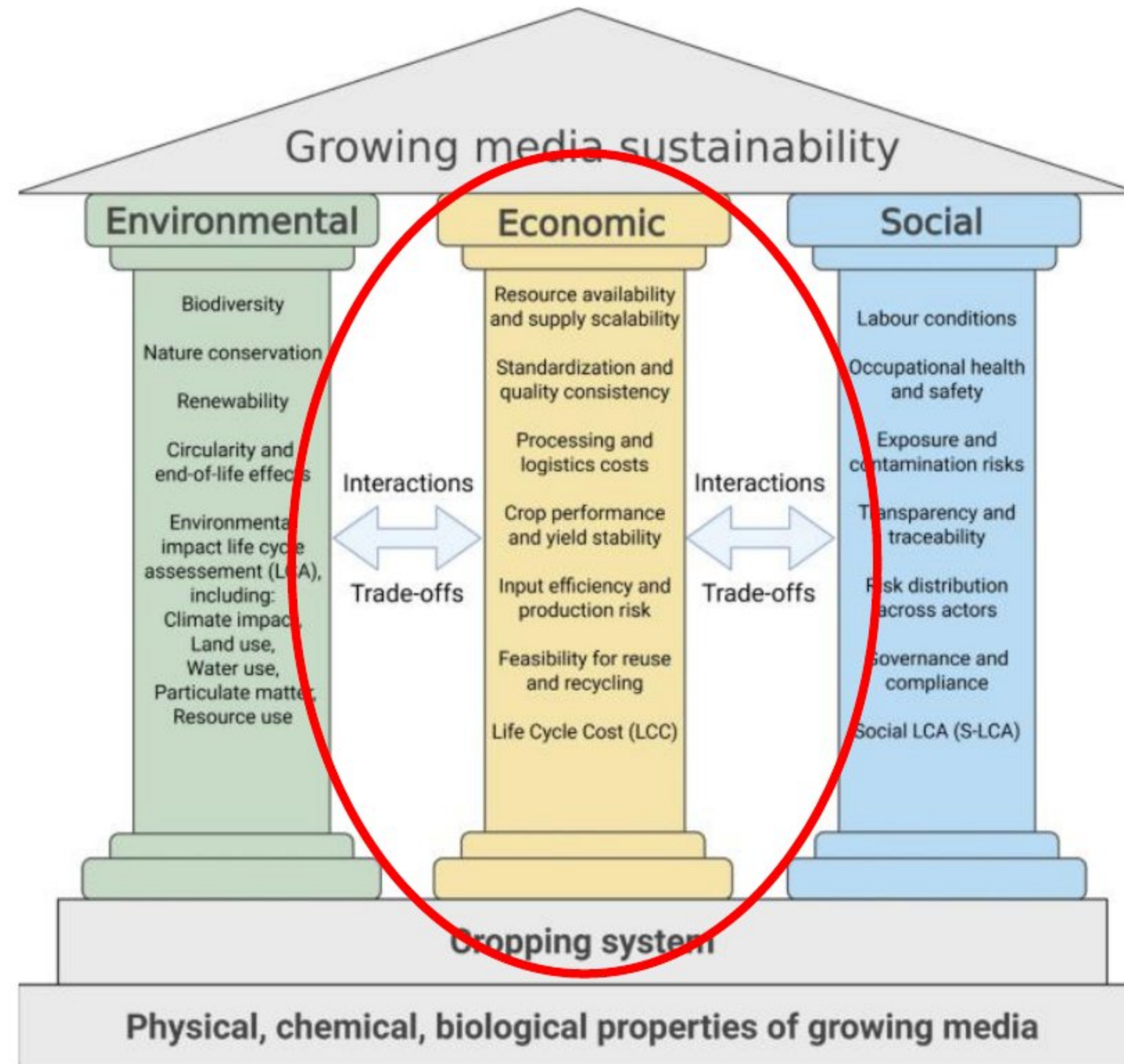
*Rough estimates (better data needed)

How much peatland does “slowly renewable” require?

	Global	Europe
Peatland area	~ 6 000 000 km ²	~333 000 km ² (excluding Russia and Belarus)
Degraded peatland area	~ 850 000 km ²	~150 000 km ²
Current area of extraction	2 000 km ² (estimate) (0.03%, 0.12% of degraded)	600 km ² (estimate of active area) (0.18%, 0.4% of degraded)
Global peat extraction volume	~60 M m ³ /yr	~48 M m ³ /yr
Typical peat accumulation rate	~1 mm/yr; ~1 t dry matter/ha/yr; ~10 m ³ /ha/yr	~1 mm/yr; ~1 t dry matter/ha/yr; ~10 m ³ /ha/yr
Theoretical area needed for compensatory accumulation	60 000 km ² (30 times current extraction area, ~ 1% peatlands)	48 000 km ² (80 times current area, ~15% peatlands, 30% mires)

*Rough estimates (better data needed)

Three pillars of sustainability



The challenge of defining “sustainable growing media”: why the term is used incorrectly and what needs to be done about it

Siv M. Aurdal^{1†}, Alexander T. Sentinella^{2*†}, Gerald Schmilewski^{2,3}, James Altland⁴, Jean Caron⁵, Paul Alexander⁶, Martine Holtkamp⁷, Bart Vandecasteele⁸ and Beatrix W. Alsanus⁹



frontiers
in Horticulture

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Economic Sustainability

Manufacturing: raw material cost, availability, consistency, processing, energy, logistics, quality assurance.

Use: yield stability, crop duration, water and nutrient use efficiency, disease pressure, management complexity.

Reuse: sterilisation, quality testing, handling, risk when spent media re-enter production.

Any increase in variability, risk or compensatory inputs is an economic penalty for the grower, and the fastest way to stop a constituent being adopted as a growing media.



Economic Sustainability

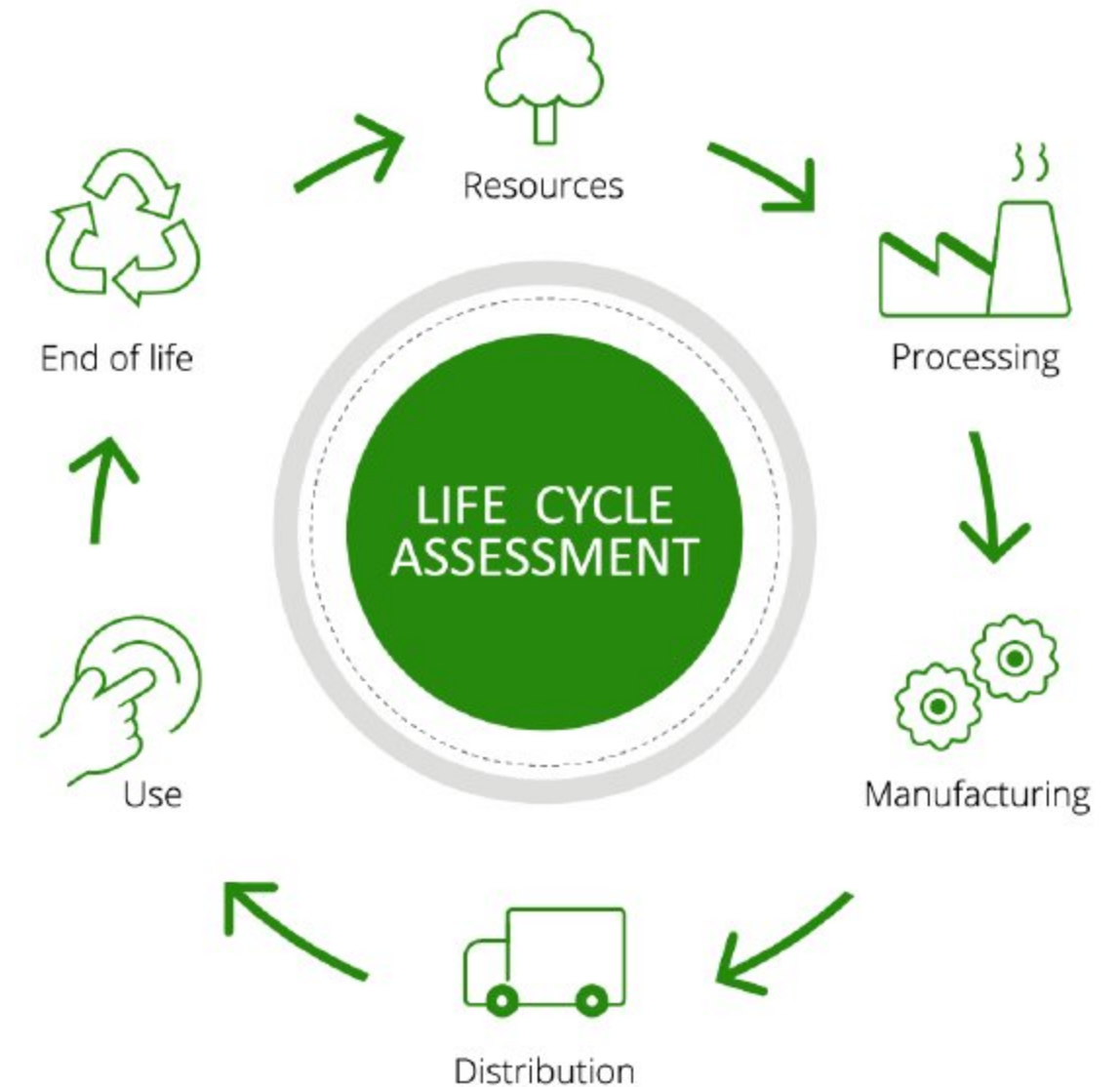
Life cycle work has spent twenty years on environmental impact.

The economic pillar is usually reduced to product price, or left out entirely.

Which means most economic claims about lower-peat formulations rest on short-term trials, optimistic assumptions about scale-up, or industry data nobody can check.

Five things worth measuring:

- Manufacturing cost and raw material availability
- Affordability and scalability
- Quality and consistency
- Crop performance and input efficiency in use
- The real cost of reuse



116 million m³  **289 - 335** million m³

2022 2050, across the three FAO scenarios

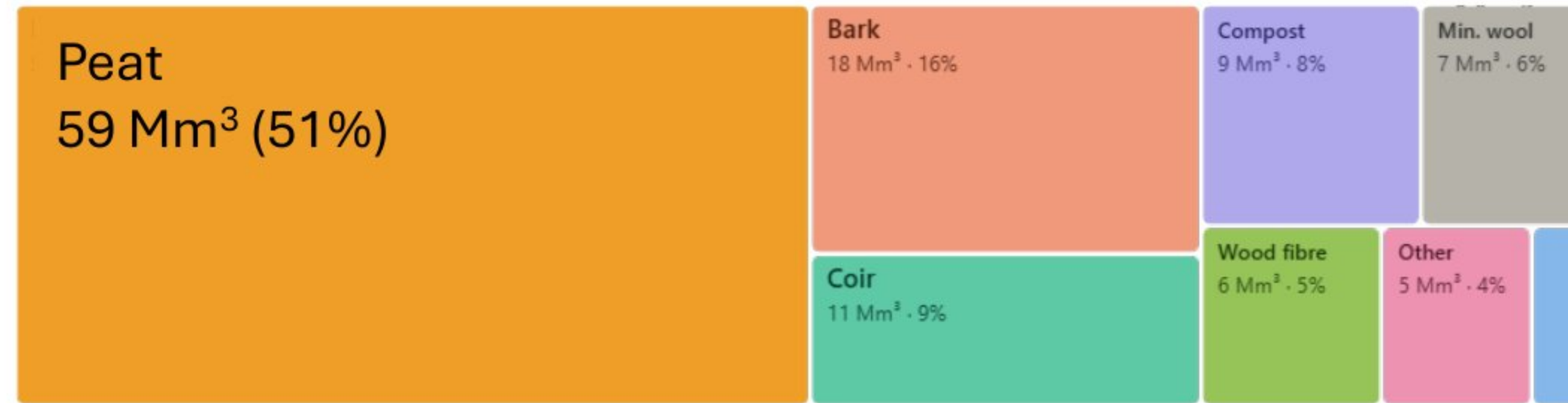
AND THE GROWTH IS IN YOUR SEGMENTS

Tree nurseries 34 → 100 Mm ³	Hobby market 33 → 83 Mm ³	Food crops 27 → 59 Mm ³	Ornamentals 17 → 41 Mm ³	Mushroom casing 5 → 9 Mm ³
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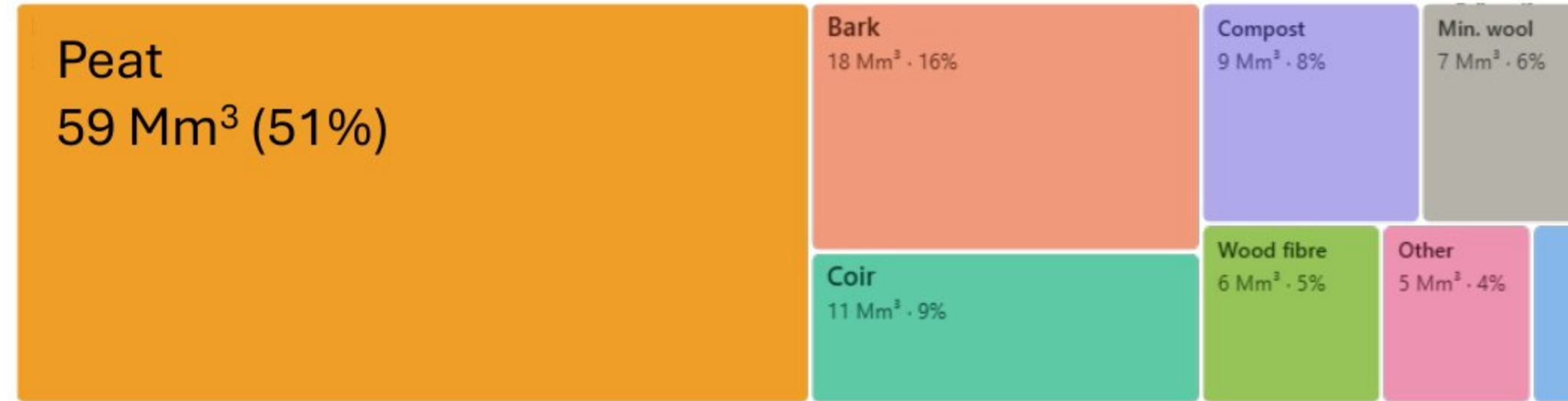
Three times as much growing media, and the fastest growth is in nursery stock and ornamentals.

Nguyen, V.T.H., Blok, C., Barbagli, T., Zheng, Z., Mondaca-Duarte, F. & Vandecasteele, B. (2026). The growth of growing media market by 2050: demand and availability of raw materials. Frontiers in Horticulture 5:1800056. Funded by the International Peatland Society. The hobby market is counted for Europe and North America only, so the total is likely conservative.

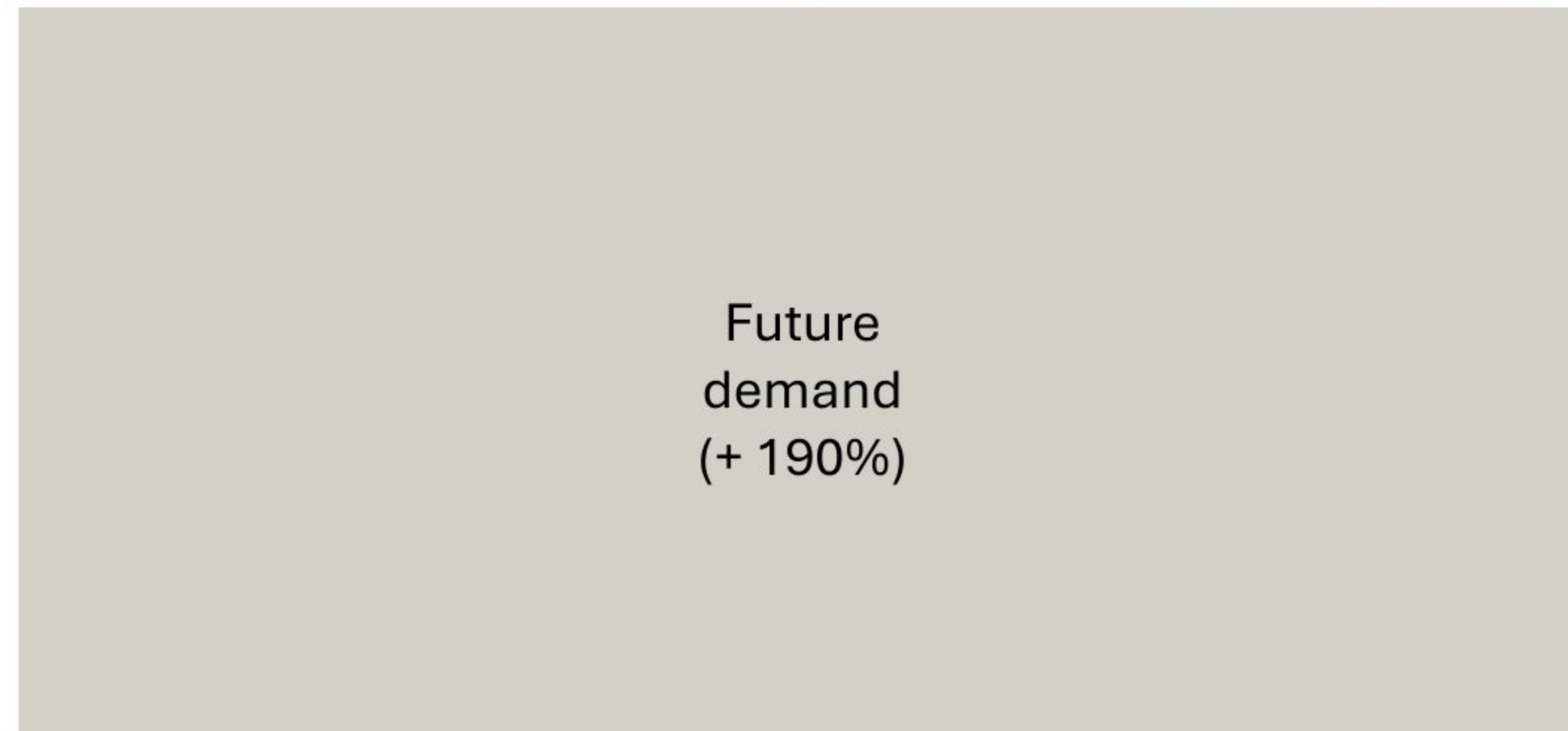
2022
global
usage
(116 Mm³)



2022
global
usage
(116 Mm³)



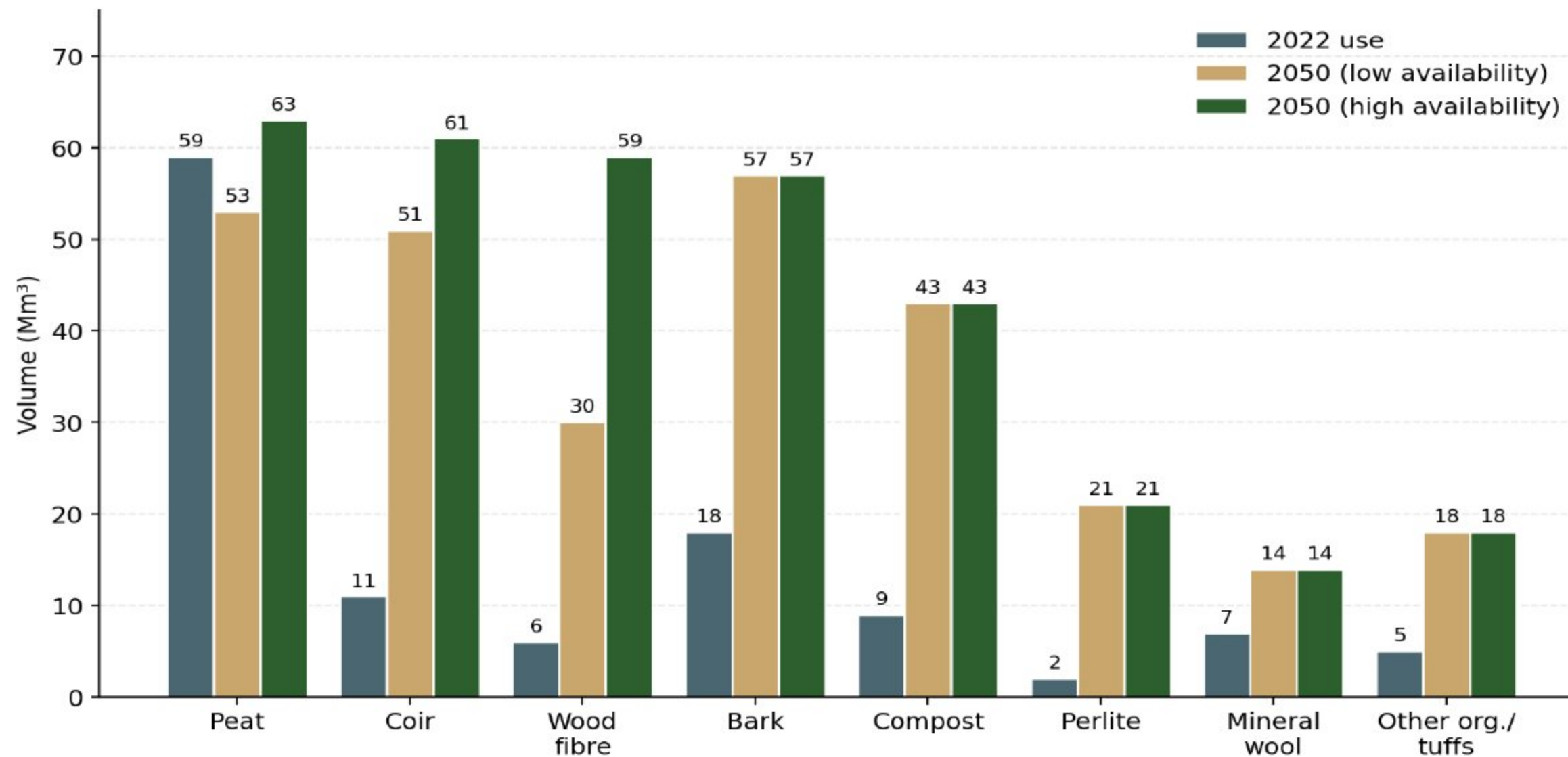
Additional
growing media
demand by 2050
(220 Mm³)



Projected raw material use in 2050

Compared to 2022 use, by material and availability scenario

Projected use of raw materials in 2050 vs. 2022



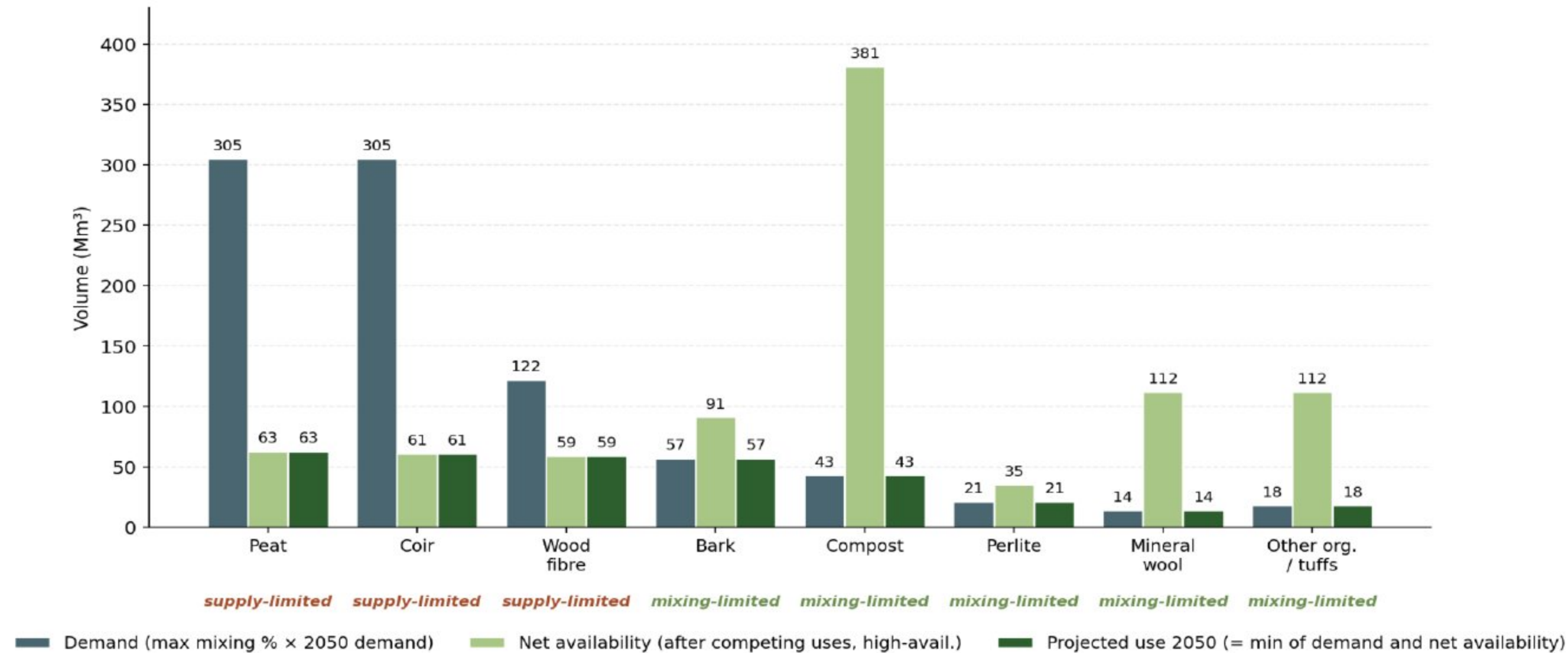
Peat volume barely changes; share of total drops from ~50% (2022) to ~20% (2050). Coir doubles; wood fibre 5–9x.

Takeaway. Peat barely changes in absolute terms; everything else grows. Coir nearly 6x, wood fibre 5–10x, perlite 10x. Compost and bark scale 5–6x each.

What is the future demand vs. 'real' availability vs. use?

Potential availability vs. projected use in 2050

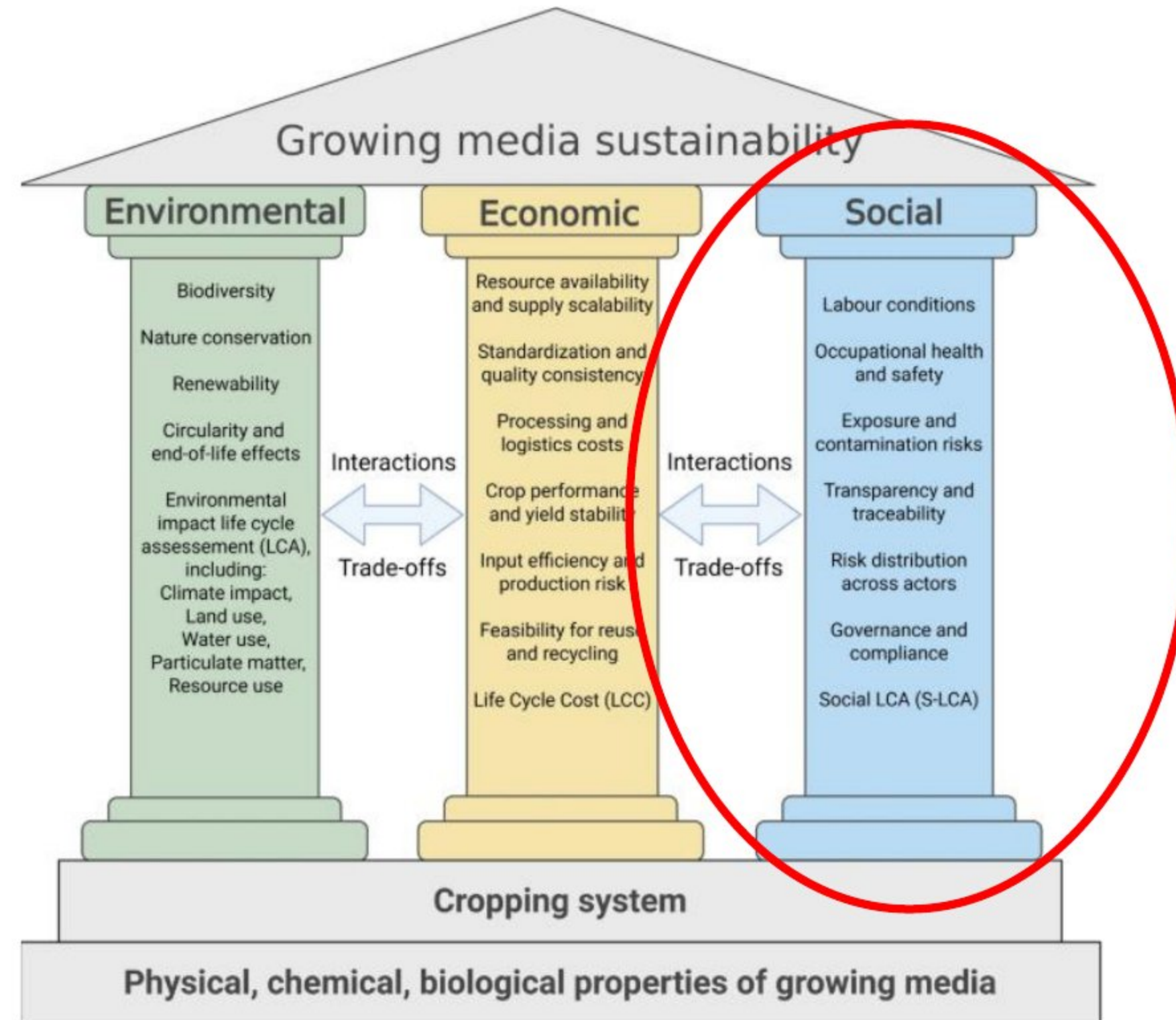
Supply headroom: demand vs. availability vs. projected use in 2050



Where net availability < demand → supply-limited (peat, coir, wood fibre). Where demand < availability → mixing-limited (bark, compost, perlite, mineral wool, others).

Takeaway. Peat and coir and wood fibre are supply-constrained. Bark, compost, perlite, mineral wool are limited by mixing percentages, not feedstock.

Three pillars of sustainability



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Social Sustainability

The least specified pillar

Social sustainability in growing media covers:

- **Labour conditions and community impacts** where constituents are produced.
- **Occupational health and safety** in manufacturing and in use.
- **Transparency and traceability** across supply chains that are often global and often long.

Environmental indicators do not capture any of this.



Social Sustainability

As more recycled and side-stream organic materials enter growing media, public and occupational health become live questions. e.g. poorly composted inputs can carry pathogenic microorganisms and exposure risk.

This is not an argument against circularity. It is an argument for explicit risk analysis, control measures, good processing, and honest communication of material quality to growers.



Making claims about sustainability

- | 1. Consider all three pillars |
|-------------------------------------|
| 2. Say which pillar you assessed |
| 3. Assess at system level |
| 4. Measure, do not infer |
| 5. Demonstrate it works and pays |
| 6. State trade-offs and uncertainty |
| 7. Avoid absolute claims |
| 8. Use precise descriptors |

Making claims about sustainability

	"Sustainable because peat-free"
1. Consider all three pillars	X
2. Say which pillar you assessed	X
3. Assess at system level	X
4. Measure, do not infer	X
5. Demonstrate it works and pays	X
6. State trade-offs and uncertainty	X
7. Avoid absolute claims	X
8. Use precise descriptors	X

Making claims about sustainability

	"Sustainable because peat-free"	"Peat is unsustainable"
1. Consider all three pillars	X	X
2. Say which pillar you assessed	X	X
3. Assess at system level	X	X
4. Measure, do not infer	X	X
5. Demonstrate it works and pays	X	X
6. State trade-offs and uncertainty	X	X
7. Avoid absolute claims	X	X
8. Use precise descriptors	X	X

Making claims about sustainability

	"Sustainable because peat-free"	"Peat is unsustainable"
1. Consider all three pillars	X	X
2. Say which pillar you assessed	X	X
3. Assess at system level	X	X
4. Measure, do not infer	X	X
5. Demonstrate it works and pays	X	X
6. State trade-offs and uncertainty	X	X
7. Avoid absolute claims	X	X
8. Use precise descriptors	X	X

Both fail all eight.

Both are statements about a material, used to make a claim about a system.

Peat-free is a composition claim.

It is not a sustainability claim.

-
- 1 Growing media sustainability is part of a system**
 - 2 There are three pillars and many aspects of sustainability**
 - 3 Sustainability claims need evidence (data), and need to be precise and clear**

Thank you!

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Members of the GME LCA working group and other technical experts

GME member companies, national association members, and other collaborating organisations (IPS, RPP)



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