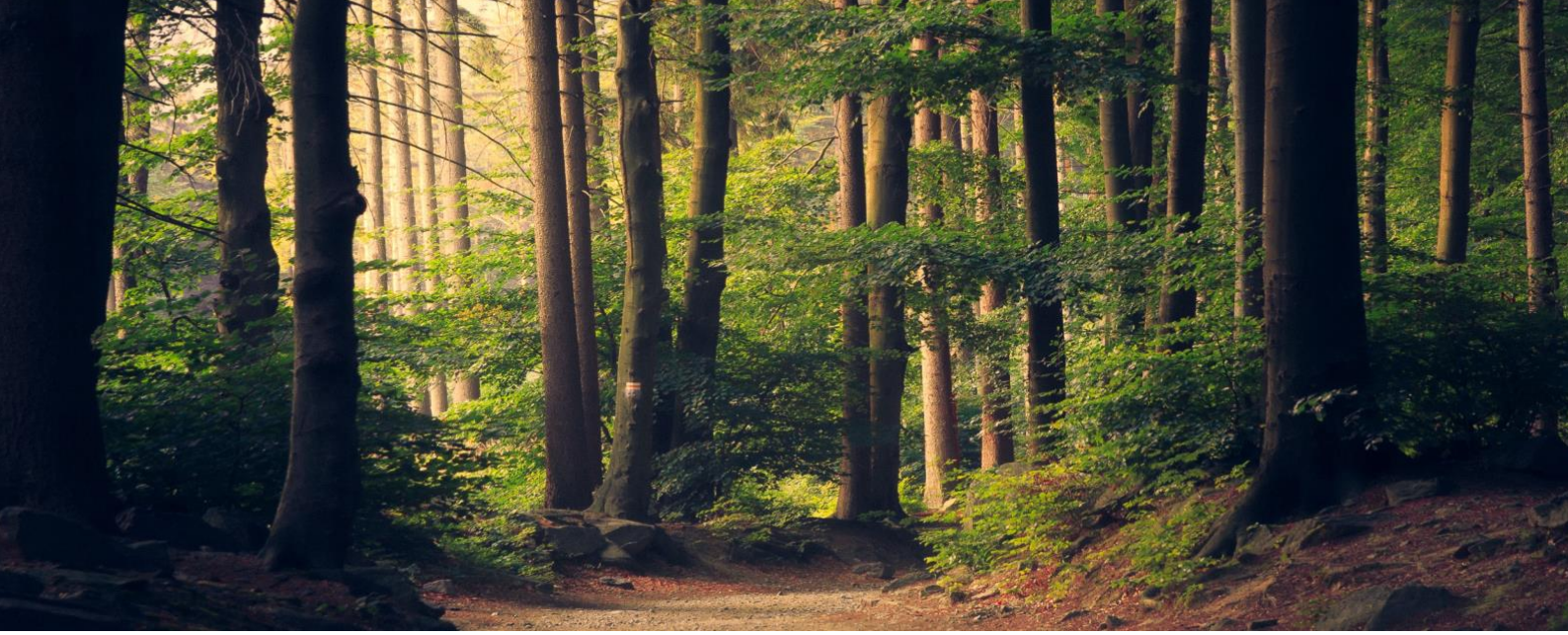

Dutch scientists respond to concrete and cement industry report acknowledging role of biobased materials, questioning numerous assumptions and findings.

As the construction sector continues to steam ahead with current building practices, it's clear that we will exceed our 1.5-degree CO_2 budget within five years – and it's clear that time to act is running out. In a recently published report, the concrete, ceramics and cement industry has assessed the potential climate impact of biobased building materials.

As a group of concerned and engaged Dutch scientists and climate ambassadors, we welcome the direction of the report and the dialogue it stimulates, but it has become necessary for us to fact-check the content of this report and refute several of the claims and conclusions of the report.

At the beginning of June 2022, a consortium of organisations in the European fossil building materials sector (ceramics, cement and concrete) published a report (Version 3 published 06.08.2022) entitled 'Carbon Accounting 4 Building Materials', serving as their investigation into the potential of biobased building materials as a solution to climate change.

We are encouraged that the authors say they are taking climate change seriously and are investigating new approaches and potential solutions. We would be even more encouraged, however, had the authors consulted and collaborated with representatives of the biobased industry as opposed to relying solely on input from six CO_2 intensive sector players.

While we agree with and support certain conclusion in their report, we know that various findings and assumptions in the report are not correct and may mislead readers. We are also troubled by the doubts that allegations in the report seem to wish to raise. Sowing doubt is a well-known avoidance strategy – it delays action – and, given the great urgency to reduce CO_2, we cannot permit this.

We will share our interest up front, which is the societal interest of quickly reducing our CO_2 emissions and remain within the 1.5-degree carbon budget. With this as our stated intention, in this article we delve deeper into the conclusions and assumptions made in the 'Carbon Accounting 4 Building Materials' report.

We support the following conclusions in the report (presented as written):

- Forestry and subsequent biobased production are important climate mitigation tools available to governments, as atmospheric carbon gets taken up into the wood.
- When wood is used for long- lived wood products, carbon is effectively removed from the atmosphere, indirectly dampening the increase in global temperatures (15). It should be noted that this holds only true when assuming that the overall forest system these products are originate from show a net increase of their carbon sink.
- (…)These studies combined with the long payback and parity times related to forestry show the importance of the temporal aspect of the carbon balance in HWP. In the long term wood substitution of fossil carbon based products can be beneficial, if carbon uptake outnumbers emissions from forestry, the harvested wood is used in long-lived products and the production processes of substituted materials do not decarbonise.
- For timber to have a positive impact on climate change mitigation, sustainable forestry and parallel active reforestation is a precondition (206).
- Biobased products with short rotation periods related to biomass growth may be better suited for temporary carbon storage if a similar or longer life span of the resulting products is realistic (207). Long term mitigation solutions are necessary to avoid climate change in the long term, but temporary solutions may play a positive role in terms of avoiding to cross certain critical and potentially irreversible climatic tipping points.
- The potential value of temporary carbon storage in terms of climate change mitigation in the long term is subject of ongoing academic discussion. When focusing on the construction sector, there are several approaches to store

carbon in the built environment. In fact, implementing buildings as carbon sinks has gained status as a mitigation strategy and is promoted by several policy initiatives such as the Renovation Wave Strategy (211) and the new European Bauhaus initiative (212).

Unfortunately, some statements are also made (and reiterated in an interview with the authors of LBP Sight in Cobouw and its website) that are inaccurate. The most important and damaging misconceptions are addressed below.

Biobased materials will be incinerated in the future which will release the CO_2 within the foreseeable future **= false**

By using the term 'temporary' the authors suggest a likelihood that the carbon stored in trees and timber will by definition be released at some point. This is a misinterpretation that rests entirely on how we have used raw materials and materials in the past, which will be completely unimaginable in an economy that must meet (Dutch) government goals to be entirely circular and carbon neutral by 2050. It is likely that after 2050, all efforts will be on reusing biobased materials and the current practice of incineration for energy production without capturing the CO_2 will no longer be accepted. In the case of biobased building materials, it is therefore more accurate to refer to their permanent storage potential. Apart from this, biobased building products, and the large-scale solid wood and mass timber products (glulam, CLT, LVL) in particular, can be reused several times. In a further positive multiplier effect, after hundreds of years fibres from these products can be reused as board materials or biochar (for soil improvement), or in the biochemical industry.

There is still little certainty that sustainably managed forestry is being done at a large scale…Furthermore, there are few concrete plans of action in Europe that strive for a carbon neutral society, and not in connection with forestry either. **= false**

There is no other raw materials sector which has a more transparent supply chain than the European wood supply sector. This transparency is created by national and European forestry regulations as well as the independent Chain of Custody forest certification programs that upholds strict criteria throughout the chain in the areas of ecology (management planning, biodiversity, CO_2 storage, water buffering, soil) and society (safety, rights of indigenous peoples, labour conditions etc). There are two systems that meet the strict admission requirements of the

Dutch Government with regard to sustainable wood through the independent Timber Procurement Assessment Committee TPAC. These are PEFC and FSC.

More than 60% of Europe's forests comply with these certifications and that percentage is even higher, at about 75%, for the five largest wood-producing countries in Europe (see the red outlined bars in the graphic from the 'LBP Sight' report). Apart from that, if they are not certified, it does not mean that the forestry management is poor or not sustainable. Many relatively small owners meet all the criteria but are not certified because of the associated costs of certification.

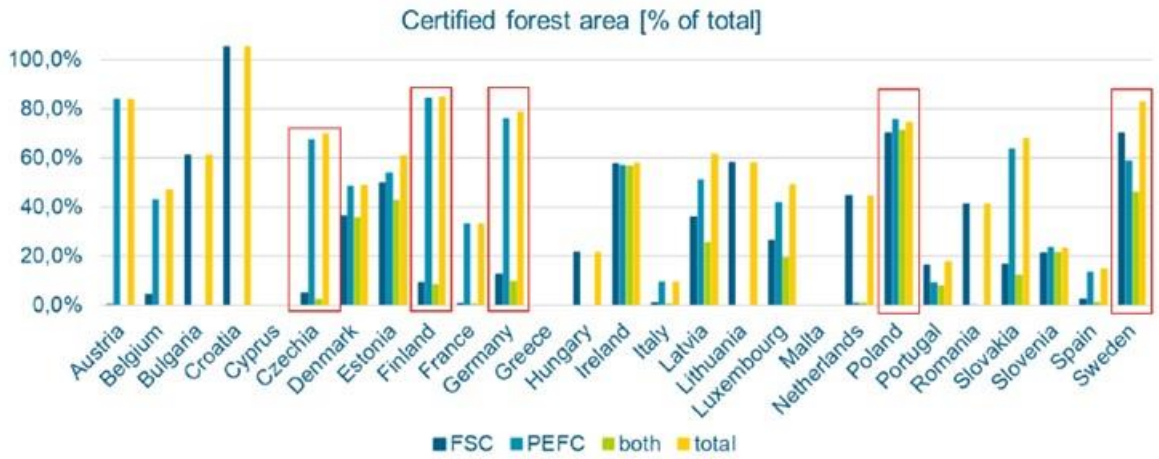

Figure 5.4
Share of forest under third party Forest management certification, FSC and PEFC.

Furthermore, the level of certification in Europe is not only stated in the 'LBP Sight' report, but also in forest inventories across the world such as Kraxner et al. (link). These state the acreage of both FSC and PEFC certified forests as being around 80 million hectares in Europe.

Both PEFC and FSC require the balanced harvesting of forests, meaning that harvesting must be equal to or preferably lower than growth by acreage. This safeguards the carbon neutrality of the forest. They also specify that a solid management plan must be implemented that includes aspects including the ecology, soil, water and society.

This also applies at the macro level where the CO_2 balance is negative (i.e. more storage than emission). The sustainable management of European forests has supplied a continuous flow of products for decades while the forest acreage has continuously increased by about 0.3 million hectares, equivalent to 500,000 football fields a year. Furthermore, annual forest expansion in Europe exceeds

harvesting, 800 million cubic meters versus 500 million cubic meters harvested. This positive balance (more planting than harvesting) goes for all production areas in Europe as well as for the USA, Canada and Russia.

It is true that in some parts of Europe the harvest is on the high side and that drought resulting from climate change is making forests more vulnerable to 'natural disturbances', negatively affecting 3% of Europe's forests (link). These disturbances include forest fires and the bark beetle infestation in Central Europe which could occasionally warrant more harvesting than planting. Considerable investment is directed toward planting more diverse, climate-resilient forests - 'Climate Smart Forestry' (link) - to reverse this trend.

Any allegations of 'few concrete plans' to improve sustainable forestry management and carbon neutrality in the forestry sector in Europe are simply not true. All European countries have forestry laws that strive towards sustainable and varied forestry management. These are closely upheld, with considerable data and statistics available on acreage, management, harvesting, trade, certification etc. compiled in independent databases of the United Nations (FAO) and the EU itself. Finally, there are the Green Deal plans (including sustainable finance, biodiversity regulation, restoration regulation, and forestry strategy), with more criteria being added which are internationally and legally binding.

Retaining primary forests in the EU is an important mitigation strategy **= misleading**

As the authors show in Table 5.2, the percentage of primary forest in Europe is very low at around 2.5% (Note that this does not mean that the non-primary forest does not have environmental value. Consider the "Veluwe National Park" in the Netherlands where wood production, nature and recreation coexist well in a Natura 2000 area).

Table 5.2

Overview of selected states' total forest area and shares of forest types (planted, naturally regenerating, and primary forest, of total forest area)

Country	Total forest area [ha]	% planted forest	% naturally regenerating (excl. primary)	% primary forest
Sweden	**27.980.000**	47.9%	43.5%	8.6%
Finland	22.409.000	32.9%	66.1%	1.0%
Spain	18.559.300	13.9%	86.1%	0.0%
France	17.002.800	13.7%	86.3%	0.0%
Norway	12.156.600	0.9%	**97.8%**	1.3%
Germany	11.419.000	50.0%	50.0%	0.0%
Poland	9.447.000	78.0%	21.1%	0.6%
Italy	9.404.700	6.8%	92.2%	1.0%
Romania	6.929.050	12.9%	83.0%	4.1%
Greece	3.901.800	3.6%	96.4%	0.0%
Austria	3.888.380	43.0%	54.0%	2.9%
Bulgaria	3.854.000	20.9%	63.6%	**15.5%**
Latvia	3.399.180	13.2%	86.3%	0.5%
Portugal	3.312.000	68.1%	31.2%	0.7%
Czech Republic	2.671.660	**95.3%**	4.3%	0.4%
Estonia	2.438.400	8.8%	88.8%	2.4%
Lithuania	2.196.000	27.5%	71.3%	1.2%
Hungary	2.057.270	38.3%	61.7%	0.0%
Croatia	1.931.608	3.8%	95.8%	0.4%
Slovakia	1.925.900	38.9%	59.9%	1.2%
Slovenia	1.243.930	3.7%	92.4%	3.9%
Ireland	770.020	86.0%	14.0%	0.0%
Belgium	689.300	63.6%	36.4%	0.0%
Denmark	625.600	70.9%	23.7%	5.4%
Netherlands	366.700	89.3%	10.7%	0.0%
Cyprus	172.590	18.9%	73.4%	7.7%
Luxembourg	88.700	33.8%	66.2%	0.0%
Malta	420	9.5%	90.5%	0.0%
European Union (27)	*158.684.308*	*66.9%*	*30.6%*	*2.6%*
EU27 + Norway	*170.840.908*	*62.2%*	*35.4%*	*2.5%*

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While retaining primary forests is an important part of mitigation efforts, they do not play a role in supplying wood for construction. There is no legal tree felling in primary forests in Europe, and the acreage of protected woodland in Europe is only increasing over time. See the figure below (Forest Europe, 2011).

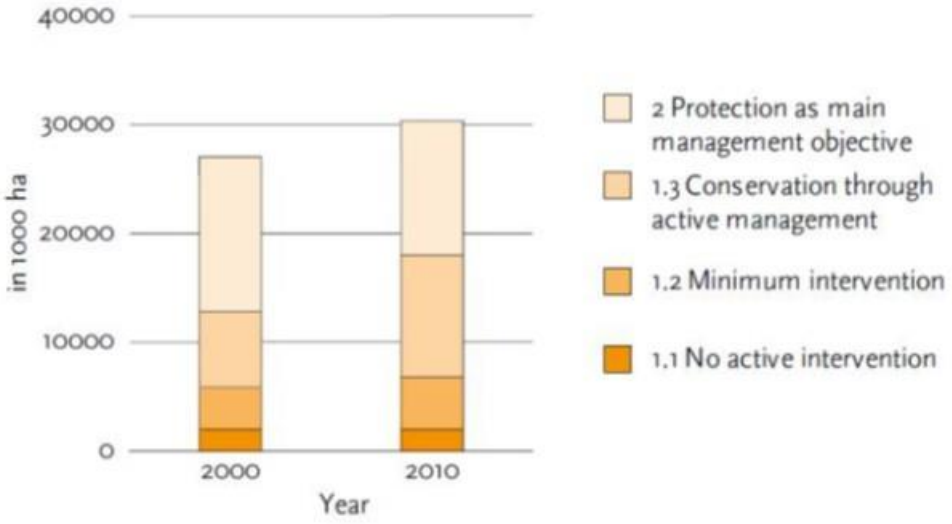

Figure 5. Development of protected forest areas 2000–2010 (data source: FOREST EUROPE 2011).

In addition, the greatest potential for climate mitigation in forestry and timber can be realised through the combination of more sustainable forestry management in line with Climate Smart Forestry practices, more reforestation and planting, and a higher conversion of the harvested wood for building materials to replace CO_2 intensive materials such as concrete (see also the next claim).

Further, the authors cite the inclusive figure on the right from the Bastin et al. (2019) report. This is unexpected as the figure shows that there is a huge potential for reforestation in Europe (in green). It is odd that the LBP authors refer to a study that shows considerable forest expansion, while arguing that little expansion is possible.

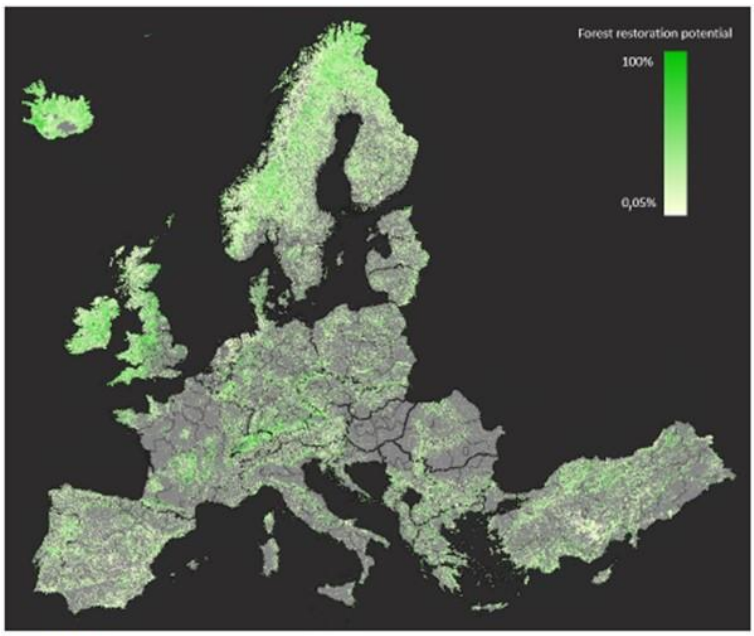

Figure 3.7
Area available for reforestation after subtraction of the areas used as existing forests, agricultural land and urban areas. Data source: Bastin et al. (40).

A more recent study by Bastin (2020) for the FAO specifically on the situation in Europe, reports a reforestation potential of 77 million hectares, mostly outside Natura 2000 areas. With an increase of almost half (48%) of the current EU forest surface area, this is a significant projection.

Moreover, we suspect that the economic or realistic potential -- taking food supply into account -- should be determined more conservatively. That said, it is clear that reforestation is a high-potential mitigation option. This is also confirmed in Frans Timmermans' Green Deal which promotes the planting of three billion trees.

The potential for the use of wood accounts for less than 1% of the European carbon emissions **= false**

The potential for building more in wood rests not only in the 'temporary' carbon storage of wood (which relates to the potential 1% mitigation effect), but in the additional combination of substitution (Leskinnen et al., 2018) by using timber instead of carbon-intensive building materials, coupled with more and better forestry practices. A greater demand for wood will ensure for a shift in production from paper and biomass to higher-value products such as engineered wood and mass timber.

If the mitigation potential of sustainable forestry management is realised according to Climate Smart Forestry (Forests, 2017), carbon-intensive materials (including cement, bricks and concrete) are replaced, and if all relevant measures are taken in Europe's forests, the total carbon reduction could be more than 20% of the annual European emissions (link, link). This even excludes the potential use of fibres from biobased materials through cultivation and using residual streams from agriculture. This is a potentially desirable situation which can be managed through good policy at a European level in the areas of forestry, agriculture and construction.

One relevant policy option is to consciously put efforts – especially involving small forest owners -- into creating more value for forestry products, especially wood products for use in construction projects (link). This scenario could lead to an additional reduction of 144 Mt CO_2 per year and free up 30-40 million hectares of land which would otherwise be used for bioenergy crops. By the way, we are not opposed to the use of residual streams from the agro-industry and forestry for bioenergy, but only if these are not suitable for long-term applications in the building sector.

The many benefits of sustainable forestry and reduction of carbon-intensive materials in construction also apply to a much-need needed transition in agriculture resulting from the nitrogen crisis in the Netherlands. By replacing the raising of cattle in certain farming areas with the cultivation of biobased raw materials (link), emissions from cattle can be avoided while also storing carbon in

fibrous crops, which in turn can replace CO_2 intensive fossil building materials – a threefold solution.

Old trees absorb more CO_2 than young trees **= false**

This assertion clearly shows that the authors did not consult many forest scientists. Old-growth forests are highly valuable, with their CO_2 stock often higher than that of younger forests. However, the annual absorption rate of CO_2 in younger and managed forests is much higher. In multi-functional or production forests, where growth and product flow are remain balanced, the CO_2 balance is similarly maintained. The harvest is fully deducted from the growth in the CO_2 balance, and the portion of the harvest that is used in long term durable wood products is added as a carbon sink.

In Europe we have <1% primeval forest and approximately 2-3% forest acreage that is older than 150 years. These old-growth forests are likely to be subject to greater protection. We believe that this is a positive trend that does not jeopardise the supply of wood for the construction industry as this is mainly sourced from younger production forests.

Therefore…

We are encouraged that the cement, ceramics and concrete industry sees the value and potential of biobased materials. It is unfortunate, however, that the report authors stated that the conditions for biobased material production, especially through sustainable forestry management principles, are not in place in Europe, while the lion's share of the European forests is well-organised according to these principles.

For the biobased building industry, sustainable forestry is a fundamental precondition, and thus the additional carbon storage in building materials (achieved through substitution and/or reforestation) is an additional benefit, especially if reforestation is executed on abandoned grasslands.

Furthermore, in our opinion, the report focuses on the status quo as opposed to the scenario where we need to operate within the available CO_2 budget to stay within 1.5 degrees temperature increase – a more beneficial and aspirational scenario, requiring clear policy decisions that would use the mitigation potential of biobased building to the fullest extent. A recent study by the Potsdam Institute for Climate Impact Research published in the scientific journal 'Nature' shows that a wide-scale transition to building wooden buildings in cities worldwide is

achievable in terms of land use and would also lead to a CO_2 saving of 106 Gt, or more than 25% of the carbon budget to stay within the 1.5-degree climate change parameter.

We look forward to similar research into the concrete and cement industry, echoing the researchers' belief that all sectors need to work on decarbonisation strategies. With the construction industry responsible for 11% of worldwide CO_2 emissions (excluding transportation), and more than half of these emissions emanating from the concrete and cement industries, the latter have a responsibility to either scale down or evolve their production processes and operate more sustainably to stay within the climate goals.

And this must be done quickly. For some time now, the target has not been the 50% CO_2 emissions reduction from the 1990 baseline, but rather a 50% reduction in current emissions within seven years, if we are to achieve our climate goals in the Netherlands. By actively managing CO_2 output through, for example, the Paris Proof Embodied Carbon protocol of the Dutch Green Building Council (link) and the UK Green Building Council (link) as part of the #buildinglife programme (link), it is eminently possible to reduce CO_2 emissions in alignment with the Paris Agreement.

The concrete and ceramic industry needs to take serious and definitive action to meet climate goals as defined in the Paris Agreement. It also appears that many of the stated mitigation strategies to lower the CO_2 emissions of concrete (carbonation, durability, thermal mass) are still completely inadequate (link) or assume residual streams from old economy - linear industry practices (relating to blast furnace slag, fly ash from coal-fired plants etc).

We encourage the concrete, ceramic and cement industry consortia to focus attention and energies on real and tangible CO_2 mitigation strategies and comprehensive circular processes. If your industry fails to accomplish this, our collective climate budget will be used up in no time, leading to a possibility that severe, unilaterally imposed regulatory CO_2 emissions bans are imposed to traditional non-renewable materials as we approach a "point of no return". Within such a scenario, the CO_2-intensive construction industry would greatly benefit from emissions being brought into balance quickly through use of materials with a negative footprint on both land (through sustainable forestry) and in construction (through biobased construction materials).

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The authors are a group of independent researchers, scientists and opinion leaders who operate independently and without commercial interest.

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