BamCore's Uniquely Promising Carbon Footprint

This BamCore commentary presents the results of the cradle-to-grave carbon footprint analysis (Life Cycle Assessment) recently completed by the international sustainability consulting firm Quantis. Citations in italics are to the Quantis Report (QR).

Problem. While significant focus and substantial capital investment has been directed at mitigating the impacts of global climate change, two of the more immediate and powerful mitigation opportunities are relatively overlooked: (1) **the built environment** and (2) **carbon sequestration**. First, the sector responsible for the most Green House Gas (GHG) production—the built environment—has received the least focus and investment. The proportion of GHG production related to the built environment ranges form 38% to 49% and exceeds that from transportation, industry or food and agriculture. Investment in the other sectors is driving significant innovation and in some cases shifts in fundamental economics and ultimate demand. The building sector, despite being the largest GHG polluter, has remained stubbornly resistant to any degree of fundamental innovation.

Second, the majority of climate change mitigation investment to date has been directed at producing improved energy efficiency or renewable energy solutions for current and future energy demand. Success in reducing energy consumption or producing cleaner energy will, of course, lower the rate of growth of GHGs in the atmosphere. However, almost no attention is given to solutions that can actually lower the already crippling GHG levels in the atmosphere. This is because removing or sequestering GHGs from the atmosphere is not amenable to direct applications of technology without first requiring a significant energy inputs itself or without risking unknown disruptions to the earth's natural processes and systems.

Solution. BamCore's patented and building code compliant Prime Wall System is a fundamental innovation that combines reduced energy consumption and demand-driven sequestration in the built environment. By harnessing the strength of highly renewable timber bamboo, BamCore Prime Walls can eliminate the vast majority of the thermal bridging found in conventional stud-based framing. The sustainability consulting firm Quantis has estimated that the BamCore Prime Wall System can contribute to a **reduced 125 metric tons of CO2** *(QR p.45 & Figure 17)* over the 70-year service life of an average house in the average US climate zone. Moreover, using timber bamboo can contribute to demand for conversion of grazing, sugar, cotton or other acreage to timber bamboo and in doing so can contribute to an estimated **permanent sequestration of 337 metric tons of CO2 per hectare** *(QR p. 37)*. These initial results only apply to BamCore's Prime Wall System. As BamCore develops and commercializes its subfloor and roofing systems the carbon footprint benefits will multiply.

Quantis Life Cycle Assessment (LCA). The international sustainability consulting firm Quantis recently reviewed BamCore's production practices and plans in order to estimate the carbon footprint benefits that results when a building is built with BamCore's Prime Wall System compared to conventional wood studs. Quantis projections show that incorporating BamCore's Prime Wall System in a new US home of average size in an average climate zone **reduces the CO2 footprint by 125 metric tons** *(QN p.45 & Figure 17)* over the service life of the house. In the coldest US climate zone where one third of the population lives, the CO2 savings estimate reaches 166 metric tons.

In addition, timber bamboo is nature's fastest growing botanical fiber. Since it grows to full height and full diameter in its first 150 days, substantial carbon is sequestered when land use is converted to growing timber bamboo. Converting just the amount of land necessary to produce walls for a single average sized house from grazing to bamboo **permanently sequesters another 91 metric tons of CO2** *(QR p. 37)*. The regenerative speed of timber bamboo allows building nearly four times as many houses from a given area of plantation or forest when compared to Douglas fir. Also because conventional LCA analyses only consider above ground carbon storage in forests, this estimate is likely conservative. Timber bamboo can have as much as 20% of its total biomass below ground in rhizomes.

Understanding that many assumptions were required to complete Quantis' initial assessment of the Prime Wall System, BamCore is continuing to test its products and analyze their environmental performance over time. Still, the projected benefits above are significant when compared to most other carbon footprint reduction options. While BamCore has only recently begun commercial production, as we grow, carbon offset benefits in the above range can scale globally to a significant level to help mitigate climate change (see below).

Personal Context. To put the above carbon footprint benefits in context consider that annual *per capita* CO_2 production in the US is about 19.8 metric tons. The 125 metric tons CO_2 carbon footprint savings from a BamCore Prime Wall System in an average house is the same amount of CO_2 as an average American generates for all sources in more than six years. Similarly, since the average household is 2.68 people, the 125 metric ton savings is like a full household having no carbon pollution from all sources for about 2.5 years. If you add in the one time conversion of grazing to bamboo plantation, the total benefit is like a person living for over ten years with no carbon pollution or a full household operating for nearly four years with no carbon pollution.

Scaling the Carbon Benefits. Addressing our global climate crisis will require collective action on a very large scale. California is moving in this direction with the statewide requirement that all new residential construction starting in 2020 be zero net energy. To gauge the impact of an initial scale response, Quantis analyzed the carbon outcome if 100,000 average houses per year (8% of the total US annual starts) were built using the BamCore Prime Walls instead of stud-built walls. Over a 20-year period the improved carbon footprint from in-service performance and sequestration would total nearly 260 million metric tons of CO_2 *(QR p.46).* When viewed over a 50-year period the combined CO_2 benefit reaches over 630 million metric tons *(QR p.46)*. It is important to remember that these benefits derive only from the use of the BamCore Prime Wall System in 8% of US housing starts. The BamCore innovations are extendable to the whole building (subfloor and roofing systems), to all low-rise building (residential is 39% of total US construction) and to other countries.

The likelihood of achieving large scale change in both building and land use is entirely possible. Considering the possibility of the change, we see a confluence of events that will drive building to be greener and more efficient. These include incorporation of technology that delivers pre-fab customized housing with faster construction and lower waste, lower cost alternatives to current lumber based products, regulatory and social pressure toward zero net energy building (e.g. CA's zero net energy requirements for residential building (2020) and commercial building (2030).

Bamboo Did It Once Before. Three separate studies by various climate scientists, anthropologists and botanists point to a period of rapid reforestation by timber bamboo in Latin America as the most likely cause of the Little Ice Age (~1650 to

1850).[1,2,3] These studies observed that the population collapse that happened in South America following the initial European conquest resulted in a sudden expansion of timber bamboo as it grew quickly in the hundreds of thousands of acres of abandoned fields.

Other Large Scale Natural Sequestration Opportunities. At least four large-scale natural sequestration opportunities have been proposed in the academic literature: (1) expansion of bamboo, especially timber bamboo, as a fiber source, (2) soil storage of CO2 through changes in farming practices primarily biochar storage, (3) coastal mangrove forest expansion and restoration, and (4) deep ocean based storage, usually derived from forced algal blooms.

Fighting climate change will need to thoughtfully pursue the four above opportunities and more. Compared to the later three options, timber bamboo has four advantages. First, the expansion can be demand-driven through current consumption of products derived from timber bamboo fiber (like BamCore products). Second, the capture and storage of the CO2 only requires solar energy inputs. Third, the timber bamboo expansion can happen fairly quickly and with predictable and known consequences. Fourth, nature has already proven expanding timber bamboo plantings can lower atmospheric GHGs (see above). The disadvantage of the timber bamboo sequestration is that it may not be as nearly permanent as the other three options. However, relative to our climate crises, time is of the essence and expansion of timber bamboo planting might be the easiest, fastest and safest alternative.

To comment on the later three alternatives, first soil storage of CO2 has the advantage of being fairly permanent ranging from 100s to 1000s of years. But, while biochar is very beneficial to most soils and offers large scaling potential, large scale demand for biochar supplementation does not already exist and manufacturing biochar also requires additional energy inputs. Second, coastal mangroves are also a permanent carbon storage solution but require up to 80 years to build up to the maximum storage

---

1. Ruddiman, William F., "The Anthropogenic Greenhouse Era Began Thousands of Years Ago". Climate Change 61: 261-293 (2003).
2. Faust, Franz X, *et al*. "Evidence for the Postconquest Demographic Collapse of the Americas in Historical CO_2 Levels". Earth Interactions Volume 10, Paper No. 1 (2006).
3. R.J. Nevle *et al*., "Ecological-hydrological effects of reduced biomass burning in the neotropics after A.D. 1500," *Geological Society of America Meeting*, Minneapolis MN, 11 October 2011. abstract. Popular summary: "Columbus' arrival linked to carbon dioxide drop: Depopulation of Americas may have cooled climate," *Science News,* 5 November 2011. Bergeron, Louis (17 December 2008). "Reforestation helped trigger Little Ice Age, researchers say". Stanford News Service.

capacity. While mangrove restoration is important and valuable on many levels, expanding mangrove plantings is not strongly supported by product demand other than firewood. And unfortunately, mangrove sequestration, which occurs in shallow coastal underwater soil, may be disturbed as sea levels rise. BamCore did an internal analysis to estimate total carbon storage between new timber bamboo and mangrove plantations. Mature timber bamboo plantations can be harvested 25% every year with the resultant captured carbon stored in semi-permanent locations like buildings. Over an 80 year period when mangroves maximize their below ground CO2 storage, the analysis showed that timber bamboo removed similar amounts of CO2 from the atmosphere. Third, oceanic CO2 storage through algal or seaweed blooms are also not supported by current product demand and the risk of unknown consequences, including dead zones, merits great caution.

Background: Quantis Analysis. Quantis had previously completely a comprehensive analysis of various home building methods for the State of Oregon's Department of Environmental Quality. Using this work as a baseline, Quantis then analyzed BamCore's current and planned production activities and projected the performance of BamCore's Prime Wall System in the "average" house study for Oregon (2262 sq. ft.). These results were then compared to both conventional stud framing and to Structural Insulated Panels for all US climate zones. Care was taken to keep the analysis as comparable as possible, including tracking harvest differences, production activity and waste and transportation impacts.

Background: BamCore's Prime Wall System. BamCore's Prime Wall System is a dual panel hollow-wall that can be filled uniformly full with any blow-in insulation. In conventional framing, each wood element that spans the wall cavity (i.e. the studs, headers, posts and plates) is a thermal bridge that displaces and defeats the insulation. Energy analysts determine the effect of stud-based thermal bridging and calculate a "framing factor" to estimate how much of the wall is thermally bridged by the wood elements. In California, the average framing factor from conventional framing in 2002 was 27%. Since then, we believe the framing factor has increased due to increased structural engineering requirements. In contrast, BamCore's estimated framing factor for the "average" sized house using the Prime Wall Systems was only 2.5% *(QR Table 1).* This means that the BamCore exterior walls offer a much higher effective R-value. Understanding the strongly negative impact of thermal bridging, BamCore recently redesigned its original metal tracks that hold the dual panel wall in position. BamCore's new track system breaks any thermal bridge that the metal track previously contributed.