CARBON SEQUESTRATION IN FOREST BASED BUILDING PRODUCTS – SUMMARY NOTES

Introduction

Reducing Greenhouse Gas (GHG) emissions associated with the built environment is now a major issue in efforts to alleviate the impacts of climate change. Promoting the construction of more energy efficient and climate resilient buildings has become a key public policy focus in many jurisdictions.

Heroic efforts have been made in recent years to promote the greater use of wood building products due to their "green" attributes, most notably that long-lived wood products can act as a carbon storage medium. That is, because some of the carbon initially absorbed by a living tree remains in harvested wood products during and following their active service lives.

Several concrete related organizations in the Pacific Northwest banded together to address some questionable messaging from other sectors about these assertions. United under the banner of the 'Pacific Northwest Building Resilience Coalition' were:

- Northwest Cement Council
- Washington Aggregates and Concrete Association
- Concrete BC
- Oregon Concrete and Aggregate Producers Association
- Portland Cement Association
- The Masonry Institute of Washington
- The Northwest Concrete Masonry Association, and
  The Concrete Reinforcing Steel Institute.

We contracted with Vancouver-based GLOBE Advisors to undertake an evidence-based analysis of carbon sequestration and related climate impacts of wood products used in building construction. We asked GLOBE to translate the findings of peer-reviewed scientific studies into user friendly messages to help policy makers, building designers, contractors, property managers and the public to understand the environmental and climate related impacts of wood building materials from the point of harvest through to end of life decomposition or reuse.

As expected, there are many differing perspectives on the carbon impacts of wood use in the built environment, and predictably many uncertainties on the journey from seedling to landfill.

Findings from the Analysis

- The analysis confirmed is that the full story about carbon sequestration in our forests, the impacts of wood harvesting and manufacturing, and the use of wood in the built environment, was not being accounted for in the more commonly reported studies and statistics.

- Nor was it being reported on in a balanced way in much of the promotional literature supportive of greater use of wood, particularly for tall structures incorporating mass timber building products.

- In very broad terms, forest management practices, as well as the impacts of climate change are altering the current an future stock of carbon sequestered in our forests.

- So too, the harvesting of wood and the conversion of that wood into either long-lasting or short-term products has a climate-related impact that is not always well described in published statistics or studies.

- Aside from the fact that a relatively small amount of the carbon initially sequestered in a living tree ends up in a long-lasting wood product, the carbon emissions over the life span of a building far outweigh the initial embedded carbon of building materials.

- Life cycle analysis comparisons of building materials types are of questionable value given the multiplicity of factors in play.

- Over the lifetime of a building, design and location factors are more important than the greenness of the building materials used in its construction.

- The GLOBE analysis revealed there is considerable uncertainty in the field work regarding the carbon-related behavior of wood in landfills.

- There is a huge disparity between lab models in terms of predicted rate and extent of decay and associated emissions.

- Simply put, not enough is known about the effects of landfilling to make concrete claims, especially in the wet regions of the Pacific Northwest.

- Accounting for carbon, either sequestered or released into the atmosphere on a 'cradle-to-grave basis, is an extremely complex, and often misunderstood endeavour.

- In broad terms, all sources of emissions are not always included in carbon accounting models, or reported in official statistics.

- For example, in all three jurisdictions, British Columbia, Washington and Oregon, biogenic emissions for forestry and forest products, while measured but are not included in the official provincial and state greenhouse gases emissions totals, on the premise of 'carbon neutrality'.

- The carbon neutrality hypothesis asserts these emissions represent only the return to the atmosphere of the carbon originally absorbed by trees while living. As such they can be considered 'net neutral' and need not be counted in official statistics.

- From a climate change perspective, when wood is harvested, transported, converted to building products, or burned, it generates carbon emissions with immediate impacts.
- The simple fact is that carbon emissions are carbon emissions. Separating out 'green emissions' from 'black emissions' is an artificial distinction at best.
- Full carbon accounting for wood products should include all emissions, both industrial and biogenic, from cradle-to-grave, alongside net carbon sequestered.
- That is why it is important to include all emissions in wood product carbon accounting from point of origin and manufacture, to use in a building, and eventually to the point of decommissioning and disposal.
- One of the overriding facts that emerged from the GLOBE analysis was the enormous complexity of the many issues pertaining to carbon sequestration in wood based building products, and the wide diversity of expert opinion on these issues.

Key Messages

The key messages emerging from the analysis are as follows:

Carbon in the Forests

- Pacific Northwest forests are the "sequestration champions" of North America, accounting for ten of the nation's top carbon-storing forests. Acre-per-acre, the region's standing trees and soil organic carbon are among the most productive carbon sinks in the world.
- Old-growth forests in the Pacific Northwest store more carbon per unit area than any other biome on our planet. Due to their far greater carbon storage, logging, and conversion of these forests to managed stands, incurs a carbon debt that could take up to two centuries to repay.
- Old-growth forests in the Pacific Northwest are unequivocally a non-renewable resource.
- Many carbon sequestration models assume that wood is being harvested from sustainably managed forests. However, many of the studies reviewed for this report suggest that not all forests in the United States are being sustainably managed from a carbon perspective.
- Forest management policies and practices are critical elements determining the extent of carbon that is sequestered in our forests. A sustainably managed forest that encourages healthy and robust growth may have a higher rate of CO_2 absorption over the long term.
- Rotation lengths for certain fast growing evergreen species in parts of the Pacific Northwest can be very short, 25 - 35 years in some cases. This can have deleterious effects on long-term sequestration productivity, soil carbon stock, and many other environmental impact areas, such as biodiversity.
- While some argue that young trees grow faster than mature ones, and therefore sequester atmospheric carbon more productively, current research shows that the rate of tree growth, and of carbon storage, increases continuously with size (and age) for up to 175 years.

- While the rate of carbon absorption varies with species, simulations show that with a 50-year rotation in various tree species common in Pacific Northwest ecosystems, less than 40% of the carbon initially harvested from a mature stand is reabsorbed by growing trees.

Harvesting Carbon

- Forest ecosystem carbon resides in several pools, including the soil, below ground biomass, live trees, dead trees, and biomass on the forest floor. Soil organic carbon is the largest pool, making up nearly 50% of total ecosystem carbon in many of the Pacific Northwest forests.

- The disruption to soil carbon pools is not always accounted for in sequestration models, despite unambiguous evidence that this pool can be adversely affected by logging, especially clear cutting.

- Carbon sequestration models and studies do not consider the effects of conversion from old to young growth forests, and the irreversible loss of carbon capital this entails.
- Because of soil conditions specific to the Pacific Northwest, harvesting residue and waste (slash) is burned or left to decompose on the forest floor, the latter practice being necessary to return soil nutrients to the ecosystem. Either way, there are large associated carbon emissions.

Manufacturing Wood Products

- It is estimated that of the carbon initially stored in a living tree, only fifteen to thirty percent is transferred to long-lived wood products.

- In many mills only, half of a log entering a sawmill ends up lumber or veneer, the remainder being burned for energy or used for pulp and paper production.

- The wood product mills in the Pacific are mostly powered by burning waste wood residues or biofuels.

- Based on current carbon protocols, these biomass emissions are exempt and not officially included in the respective jurisdictions' official greenhouse gas books.

Carbon in the Built Environment

- As much as 90% of the emissions of a building are incurred over its Use Phase. The initial embodied energy of a building's materials is a relatively small portion of its overall footprint.

- The focus on 'carbon sequestration' in wood products is centered on initial embodied energy of wood products, in other words, on only 10% of the issue. Most sequestration models do not consider operational (i.e. lifetime Use Phase) energy emissions.

- Many factors effect a building's lifetime emissions beyond choice of materials, including location, design, and construction methods. In fact, the building's location may be the key determining factor in the lifetime carbon footprint of a building.

- Life Cycle analysis comparisons of building materials types are of questionable value given the multiplicity of factors in play.

End of Life Carbon

- In landfills, discarded wood is subject to decay which produces roughly equal parts of carbon dioxide and methane gas. Methane has a GHG potential 28-34 times that of CO2. Not all carbon sequestration accounting is sensitive to the full range of decomposition and emissions scenarios for wood placed in landfills.

- Broad conclusions about the permanent sequestration benefits of wood products stored in landfills may be unfounded for the wet conditions of the Pacific Northwest, especially as these landfills are not building and operating moisture-free, dry underground storage units.

- There is considerable uncertainty in the field work relating to wood in landfills. There is a huge disparity between theoretical models in terms of predicted rate and extent of decay and the resultant emissions.

- Simply put, not enough is known about practical landfilling effects to make definitive claims.

- While landfills do house some carbon in waste wood in a semi-permanent state, in a broader context, this is a poor land-use and land management strategy.

- From an optimal use perspective wood should be never landfilled. Disposal of wood in landfills should be a last resort. Recycling and composting are more viable alternatives.

- Methane and carbon dioxide are emitted from wood disposed in landfills. Methane (CH4) is a matter of grave concern as its global warming impact is much higher that of carbon dioxide.

- Caution must be taken in projecting model-based simulations into real world situations, particularly regarding the longevity of carbon sequestration of wood products in landfills.

Life Cycle Analysis

- Not all life cycle modelling includes all emissions from the cradle to the grave. Some models examine only emissions from the cradle to the factory gate. Others include only the factory gate to the grave (landfill). The better models include cradle to factory gate and factory gate to landfill.

- The more commonly used carbon sequestration material tends to focus only on the cradle-to-gate portion of the products life cycle, and the Initial Embodied Energy of wood building products.

- It is inappropriate to draw definitive conclusions about different building materials from comparative life cycle analyses of individual buildings.

- Variables such as raw material sources, harvesting methods, supply chain processes, transportation distances, construction practices, design choices, location, climate, and operating practices, all combine to determine the lifetime carbon footprint of a building.

- Comparing building materials types such as concrete to wood is misleading, as there are far too many other components and variables contributing to a building's embodied emissions.

Counting Carbon

- Despite the variations in accounting models used to analyze the flow of carbon along the processing chain of wood products, in their net carbon equivalent emission figures they typically do not account for the loss of old-growth carbon storage, nor emissions from disruptions to soil carbon, the single largest carbon pool in the forest.

- The simple fact is that live trees sequester carbon. Wood products are the result of industrial processes that emit carbon. However, not all emissions are always included in many carbon accounting models or are reported in many studies or industry publications.

- Classifying biogenic emissions as carbon neutral is a crucial point in current carbon accounting models. Allowing these emissions to be omitted from emissions figures gives wood products a decided advantage when comparing the carbon footprints of various other building products.

- In all three jurisdictions, British Columbia, Washington and Oregon, biogenic emissions from forestry, while counted, are not form part of the official provincial or state carbon emissions totals, on the premise of the carbon neutrality hypothesis.

- Full carbon accounting for wood products should include all emissions, both industrial and some biogenic, from cradle-to-grave, along with net carbon sequestered.