

# The working forest – a view from British Columbia

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‘Red attack’ damage caused by the mountain pine beetle near Barkerville, British Columbia

## Abstract

British Columbia’s forest sector is facing some significant challenges, with the most important being restrictions on timber supply brought about by disturbances and changes in governance of the land base. In the past the concept of a ‘working forest’ was proposed, defined as the forested land area that would be reserved for growing and harvesting timber. This would have prevented land from being selected for another purpose, such as reserves to protect biodiversity. While this idea has not received widespread acceptance, it is worth reconsidering but in a broader context. All forests ‘work’, but not all types of ‘work’ are recognised and given monetary values.

However, we are seeing increasing numbers of examples where non-timber goods and services from forests are being assigned economic value, including wetland, biodiversity and carbon credits. These, combined with a move to higher value products coming from forests, could result in a renaissance of the

sector. A clear, insightful and long-term plan needs to be developed by the agency (i.e. the Crown) responsible for the management of the land base.

## Introduction

At first glance, the forest sector of British Columbia (BC) appears to be in great shape. The BC Council of Forest Industries reports that 60,000 people are directly employed in forestry, 140,000 jobs (one in 17) in BC are tied to the forest industry, and 140 communities are dependent on forestry. More than one in four manufacturing jobs are in the forest sector and more than C\$8.6 billion (NZ\$9.6 billion) in wages is generated annually. Total outputs of the forest industry are calculated to be C\$33 billion, with a C\$12.9 billion GDP contribution.

These numbers are accurate, but only give part of the picture. For example, while there may be 60,000 people directly employed in the forest industry today, statistics from Natural Resources Canada indicate that in 2000 there

were 99,100. According to the same source, the volume of timber harvested in 2000 was 78.5 million m<sup>3</sup>, whereas in 2015 it was 67.9 million m<sup>3</sup>. The reduction in the level of harvest reflects a number of issues, discussed below, whereas the reduction in employment is in large part due to mechanisation and increased efficiency in the sector.

### Annual allowable cut

The decline in the volume of timber being harvested reflects increasing pressure on the forest resource, and a concomitant reduction in the annual allowable cut (AAC). Several major problems have arisen in recent years, including the mountain pine beetle (*Dendroctonus ponderosae*) infestation. According to the BC Provincial Government, the mountain pine beetle outbreak, the most recent of which began in the early 2000s, has killed 731 million m<sup>3</sup> (54%) of BC's merchantable pine volume. The province is now contending with a major outbreak of the spruce beetle (*Dendroctonus rufipennis*), which in 2017 had been found in 500,000 ha of its forests. Other bark beetles seem poised to become serious problems in specific ecosystems, including the western balsam bark beetle (*Dryocoetes confusus*) and the Douglas-fir beetle (*Dendroctonus pseudotsugae*).

Another significant pressure on the AAC has been the forest area lost to fire. Some fire damage can be salvaged, but much is of insufficient economic value to be used. The amounts of timber lost are significant and have affected the mid-term timber supply for the province. Much attention focused on the record-breaking fires of 2017 when 1.2 million ha of forest were affected. Most of this was in the Cariboo region of the province, which lost about 609,000 ha of its timber harvesting land base (the area of forest considered to be accessible to harvesting). In the three affected timber supply areas, the mid-term AAC is expected to drop by about 3.8 million m<sup>3</sup>.

There have been other important (for timber supply) fire seasons in recent years. For example, in 2014, 136,000 ha of the timber harvesting land base were burned, amounting to 24 million m<sup>3</sup> or 30% of the provincial AAC that year. Only about 3 million m<sup>3</sup> of this was salvaged and the losses in 2014 were valued at over C\$1 billion.

### Treaty negotiations

Another major source of uncertainty over future timber supply relates to the potential loss of access by industrial licencees to the Timber Harvesting Land Base following treaty negotiations with First Nations. The treaty process is a complex and drawn out process, and many First Nations are choosing to proceed through the courts rather than through formal treaty negotiation. For example, in a judgment issued on 24 June 2014 the Supreme Court of Canada ruled that the Tsilhqot'in First Nation had a claim to 175,000 ha of land that they had historically occupied, much of it comprising forest lands.

In effect, this decision transferred Crown lands to Aboriginal title and set the precedent for similar decisions throughout the province. Many First Nations now have Forest Consultation and Revenue Sharing Agreements

with the Crown, enabling forest licencees to operate in the traditional and unceded lands of the First Nations, but treaties are actually transferring direct control of the land to them. This is creating uncertainty for the existing licencees and some are entering into direct agreements with First Nations (an example is the Memorandum of Understanding signed between Interfor and the Penticton Indian Band on 30 May 2018). A June 2018 decision that salmon farms operating in the traditional territories of First Nations would require their permission before their leases were renewed has major potential implications for forest licencees harvesting timber in the traditional territories of First Nations, if a similar procedure is adopted.

It is very unclear what First Nations will do with their land once they acquire control of it. Some believe that they will never gain control, but the evidence from treaty negotiations and court decisions suggests otherwise. Most First Nations with current or potential access to timber are likely to seek some economic benefits from the forest, although the nature and extent of these will vary. The Gitxsan Development Corporation, for example, has joined up with Airex Energy (a Quebec-based company) to develop a pellet plant aimed at producing 100,000 tonnes of torrefied or carbonised pellets annually. The fibre will be sourced from sawmill waste and from fibre left in the bush following logging operations. This has previously been uneconomic to harvest, but with a carbon tax being applied to any slash burnt on-site the economics are changing.

Other First Nations have set up more traditional forestry operations that harvest timber and sell it to local mills or export the logs. Companies such as Ntityix Resources (owned by the Westbank First Nation) and Coast Tsimshian Resources (owned by the Lax Kw'alaams First Nation) have obtained sufficient access to timber to enable them to run a significant and economically viable forestry operation. The Coast Tsimshian Resources operation has not been without controversy; it relies on harvesting low quality hemlock and balsam and exporting the logs to Japan, Korea and China (unlike other licencees First Nations can export logs if there is no local demand). In doing so, it has provided between 60 and 80 full-time jobs and annual revenues of between C\$12 million and C\$26 million. These revenues have enabled the First Nations to diversify into other activities, including a cedar mill and a fish processing plant. However, many First Nations have been granted access to very small areas of timber, making it difficult to create the critical mass necessary for an economically viable operation. In such cases, First Nations' foresters have formed companies such as the Stuwix Resources Joint Venture that operates across multiple small First Nations.

### Endangered species

BC is home to the greatest diversity of species of any Canadian province. Some of these species have been reduced to critical population levels, often as a result of habitat disturbance. Forest-related examples include the spotted owl and marbled murrelet. Particular concern has





On-site chipping converts slash to a product that can be sold

arisen over the need to provide protection and recovery plans for endangered species, specifically caribou. Endangered species legislation is a federal responsibility, and the federal government has taken an increasingly strong stance against provinces that have been slow to develop caribou recovery plans and have failed to protect critical habitats.

The forest industry has responded by claiming that endangered species protection is important, but that jobs in rural communities are also important and that a 'balance' must be found. This is reminiscent of language about 'trade-offs', which environmental advocates have frequently interpreted as a forest sector euphemism for what must be sacrificed in order to maximise timber outputs. The federal position is not supported by strong science, especially in different situations across the country, causing frustration across a broad range of stakeholders. However, any caribou recovery plans will inevitably involve reductions in the timber harvesting land base.

## Social licence to operate

Partly related to endangered species, but also related to the concerns that many people have over the loss of old growth in the coastal and inland rainforests of BC, there has been much debate over the extent of the social licence to operate (SLO) of the logging industry. Interest in this has varied over time, and forests have at various different times been the focus of significant

protest. Examples include the Lyell Island blockade (1985) when members of the Haida Nation and others blocked the logging of Lyell Island in the Haida Gwaii, and the Clayoquot Sound protests in the 1990s on the west coast of Vancouver Island.

Repetition of this was avoided on the mid-coast with the development of the Great Bear Rainforest Agreement in 2016, and although this has been recognised internationally (e.g. as a Queen's Commonwealth Canopy site), it involved both significant cost and the withdrawal of large areas of forest from the timber harvesting land base. Curiously, it seems that the SLO of forestry is once again being threatened, with two current flashpoints. One is located in the Haida Gwaii, and involves the logging of old growth western red cedar on Crown land by Husby Forest Products. The other is on Vancouver Island, and involves the logging of old growth rainforest in the Nahmint Valley by the government's own harvesting arm, BC Timber Sales.

## A working forest

Pressures on the timber harvest land base have led the forest industry to call for the designation of areas where timber harvesting will be given priority. The US National Alliance of Forest Owners states:

*The term 'working forests' refers to forest lands carefully managed to supply a steady, renewable supply of wood*

*for lumber, energy, paper and packaging, and more than 5,000 items that consumers use every day.*

The idea was co-opted by BC in the early 2000s, and it was proposed that 45 million ha of forest in the province be designated as BC's working forest. It would include all Crown forest lands outside protected areas and parks. The aims were:

- To maintain and increase the economic and social benefits flowing from the working forest
- To identify and provide additional certainty and access about those lands within the working forest which had specific priorities for timber and a variety of other values and uses
- To assure that land-use decisions affecting the working forest were supported by a consistent and transparent process that recognised forestry and also addressed all other identified values
- To assure that society's environmental goals were achieved in the working forest.

It was actually an election manifesto commitment of the BC Liberal Party who assumed power in 2001 to, 'Establish a working forest lands base to provide greater stability for working families and to enhance long-term forestry management and planning.'

The concept of a working forest, as explicitly stated in the election manifesto of the BC Liberal Party and implicit in all the public relations outputs of the forest sector, is that the role of forests is to generate forest products, specifically timber. This reflects the North American emphasis on logging and forest products, rather than on forestry. Some industry organisations make this explicit in their names: the Forest Products Association of Canada, the Interior Lumber Manufacturers Association, the (former) Coastal Forest Products Association, and the Truck Loggers Association. Others are more ambiguous such as the BC Council of Forest Industries and the Association of British Columbia Forest Professionals.

Curiously, the term 'forestry' seems to be virtually absent, an exception being the Canadian Institute of Forestry, which is a national organisation based in eastern Canada. Forestry is defined in the Society of American Foresters' *Dictionary of Forestry* as, 'embracing the science, art, and practice of creating, managing, using, and conserving forests and associated resources for human benefit and in a sustainable manner.' However, in many parts of North America the concept of human benefit has been heavily, if not exclusively, biased towards economic benefit.

In BC, where forest products companies obtain a licence to fell forests and utilise the products on the condition that they reforest afterwards, there is little incentive to do anything other than the minimum reforestation requirements. Seedlings are planted with a view to achieving a 'free-growing stand' as quickly as possible. This threshold is a government stipulated requirement that the Forest and Range Practices Act 2004

refers to as, 'a stand of healthy trees of a commercially valuable species, the growth of which is not impeded by competition from plants, shrubs or other trees.' Silviculture largely focuses on this stage of forest development. Pre-commercial thinning is unheard of, and even commercial thinning is the exception rather than common practice. This is curious, given the timber supply problems described above.

A key aspect of the entire forest sector of BC is that it is almost exclusively focused on the production of timber. It has become world-leading (a favourite term of the Canadian resource industries) in converting forests to dimensional lumber. Its forestry practices have, however, been questioned by many (and it is not only in BC that questions about forest practices have been raised). This resulted in what has become known as the 'war in the woods', with the major stand-offs between environmentalists and loggers in the 1980s and 1990s described above. The result was the Forest Practices Code, detailed and highly prescriptive legislation that ruled how forestry should be conducted. This was subsequently repealed by a Liberal Government, which replaced it with a Forest and Range Practices Act 2004 that shifted responsibility away from prescriptive legislation to professional accountability.

This new Act was initially seen as a positive step: surely forest professionals should be trusted to practice forestry. The potential conflict that existed through those forestry professionals being employed by logging companies was never really addressed. Instead, it was assumed (and frequently stated) that the forest professionals would uphold the interests of the Crown above the interests of their employers. The legislation, which made foresters and their employers liable for errors, created some interesting impacts. Forest management plans became short statements aimed at minimising liability, written with more input from lawyers than professional foresters. Very often default practices were relied upon, with those defaults being specified in the guidebooks that accompanied the Forest Practices Code.

The idea that professionals can be trusted to do the job properly has been questioned following a number of high-profile problems, including the Mount Polley tailings dam failure in 2014, when a retaining berm failed and tailings entered Polley Lake, Hazeltine Creek and ultimately Quesnel Lake. In 2017, when the Liberal Government was finally replaced by a New Democratic–Green Party coalition, an early action was to instigate a review of the entire concept of professional reliance. Statements from the government assure that this was not specifically intended at forest professionals, but forest professionals are included. The report, which was released in June 2018, is very critical of current arrangements associated with professional reliance and recommends much greater oversight by the government.

### A new concept for a working forest

For many years, the basic idea of a working forest in BC (and elsewhere) has been a forest that provides work



for people. Perhaps it is time to rethink this concept? An alternative idea is that a working forest is a forest that:

- Maintains biodiversity
- Maintains ecological productivity
- Can regulate its health and vitality
- Maintains soil and water
- In itself, and also through its sustainably harvested products, contributes to the maintenance of global carbon cycles
- Provides social, cultural, spiritual and economic benefits.

The role of foresters is to manage the forest in such a way that it can work to maintain these objectives. As many will guess, this isn't a new concept at all. It is one that has been expressed many times in relation to the sustainable management of forests, and describes the basic criteria listed in the Montreal Process, to which both Canada and New Zealand are signatories.

In such a forest, we would rethink the way we value the goods and services that it provides. As has been increasingly demonstrated, it is possible to monetise many of the goods and services generated by forests. Instead of quantifying the benefits of forest in terms of the number of jobs generated, we should be taking a much broader perspective. As an example, carbon is a product that has increasing value. We can attach a monetary value to the carbon released when a forest is lost, the carbon that is sequestered from the atmosphere when a forest is planted and grows, and the carbon that is stored in the wood products generated from a forest.

This can (and has) led to simplistic assumptions, such as that a standing forest has a specific volume of carbon that is all lost if the forest is logged. While some carbon emissions occur during the process of logging, a significant amount of the carbon is stored in forest products. The duration of that storage is highly variable, with some products being burnt almost immediately and some going into products such as buildings that may have a considerable lifespan. Of course, there is the complicating factor that some of the wood that is burnt may be replacing fossil fuels, and we have to consider the fact that wood is less efficient (in terms of carbon emissions) as a fuel than most fossil fuels. On the other hand, over decadal or longer time-scales wood is more efficient as it is renewable.

## Forest products of the future

While it is possible to envisage a different approach to forests, it is also still important to consider the products that it produces. A forest that works will provide many benefits, including economic, social, cultural and environmental. It will not produce as much fibre as under more traditional management regimes, and it is therefore important that any economic yield that it produces be maximised. There is a huge range of products that can now be derived from the basic constituents of wood, yet doing so will require significant investment.

## Bioproduct mills

An indication of the future is provided by MetsäFibre's Äänekoski bioproduct mill in Finland. This mill, which is valued at EUR1.2 billion (NZ\$2 billion), is expected to consume 6.5 million m<sup>3</sup> of wood annually. It will produce a range of products in addition to pulp, including tall oil, turpentine, bioelectricity, product gas, sulphuric acid and biogas. Research at the mill on the upgrading of lignin and the manufacture of biotextiles, as well as other products, is ongoing.

## Other forms of wood

The market for lumber will continue to be important, but it is possible that there will be a change of emphasis in the final use of the lumber.

Currently, BC exports the vast majority of wood as dimensional lumber, with it being further processed in its export destinations. Yet there is growing demand for other forms of wood, ranging from engineered wood products including cross-laminated timber (CLT), dowel-laminated timber (DLT), laminated veneer lumber (LVL) and glulam, to even more sophisticated products such as prefabricated housing modules. In Europe, building upwards using lightweight wooden modules is seen as one of the answers to the housing crisis in cities, and such innovations may eventually be adopted in North America.

## Liquid and solid fuels from wood

A huge amount of research has gone into the creation of liquid fuels from wood. The primary interest is in creating a range of liquid fuels that could replace fossil fuels. While this would have considerable environmental benefits, the challenge will be to produce fuels at competitive pricing. Progress has been made and there are a number of operational plants producing ethanol from wood-derived cellulose.

A good example is SEKAB's Domsjö biorefinery in northern Sweden, which produces a range of different products based on ethanol. These include products such as thermol, a heat transfer fluid used in geothermal and other heating and cooling systems. The market for biofuels is substantial and projected to increase. In 2017 in Sweden, biofuels accounted for 20.8% of all fuels supplied for vehicle operations and biodiesel accounted for 26.6% of all diesel used. In BC, Canfor has formed a partnership with Australian-based Licella Fibre Fuels to produce biocrude and believes that within a few years it could be producing 400,000 barrels a year.

Solid fuels have also been very popular. One of the best examples is provided by wood pellets, for which there is a growing market. The pellets come in various different forms and large power stations, such as Drax in the UK, have been adapted to burn them or to burn pellet-coal mixes. It is possible to convert wood into 'biocoal' but the cost of the product, which is more than coal, prevents its widespread use unless special incentives are

introduced to encourage its use. Incentives have played an important part in encouraging the use of pellets in Europe (which now annually imports 7.0 million tonnes of pellets from the US alone) and elsewhere, and an increasing number of biomass-fueled power plants are being established around the world. This is driving the establishment of new pellet plants, including in BC. For example, an Edmonton-based bioenergy company, 4Leaf Corp, is planning to invest C\$90 million in a torrefied pellet plant in McBride, BC, with an eye to the growing market in Japan. Torrefied pellets can be mixed with coal dust in coal-fired power stations and are currently much more economically viable than biocoal.

Canada currently exports pellets to a variety of countries, with the UK being the largest market (taking 70% of the 2.37 million tonnes produced in 2017), and Japan being the second largest. Japan has been investing heavily in biomass-based power plants, with 18 dedicated biomass plants (totaling 282 MW capacity) coming online in 2015 alone. Woody biomass is of course the primary source of power for 2.6 billion of the world's poor. Its more efficient use would help avoid the current estimates of 4.3 million premature deaths annually due to indoor air pollution.

Torrefaction appears to offer considerable possibilities for regions such as BC where transport costs are important. In Europe, the EU-funded SteamBio project has demonstrated that not only can the costs of transporting wood chips be reduced by switching to torrefied materials, but that a variety of valuable platform chemicals can be derived during the torrefaction process. The final product weighs less, has an improved calorific value and can be ground into powder more easily. It can be used in coal-fired power stations to replace coal without changing the combustion system.

Research in this area is ongoing, and while there are many ideas some remain fairly distant from commercialisation. Not all involve large-scale investments of the type being made in Scandinavian biorefineries. For example, the Christian Doppler Laboratory for Sustainable Syngas Chemistry has been producing hydrogen (for use as a fuel), using a catalyst and solution that uses sunlight to power the conversion.

### Utilising BC forest material

The potential for better utilisation of forest material in BC is evident. A 2010 report by BC Hydro, entitled *Wood Based Biomass Energy Potential of BC*, indicated that an average log used in the production of lumber produces 47% lumber and veneer, 33% wood chips for pulp, 7% for sawdust, 8% for shavings and 5% bark. The sawdust and shavings go to pellet plants, whereas the bark is used in power plants. These figures do not however take into account the 20%–30% of the biomass that is piled at the roadside during a harvesting operation and which is subsequently burnt.

Other material is also available: the village of Telkwa in northern BC uses biomass derived from its wildfire



Pellets are made in British Columbia from the waste stream and mostly exported

mitigation management system to power a district heating system. This not only involves the use of thinnings from initial fire hazard mitigation, but also the regrowth in areas that have been treated. Other communities are following this example. The Teslin Tlingit First Nation in Yukon is, for example, installing 10 wood chip boilers connected to three district heating systems, with the objective of encouraging fire-proofing around the communities, while also reducing their reliance on diesel.

### Biotextiles and bioplastics

A range of biotextiles is also being produced. One that is gaining increasing market share is lyocell, a product derived from dissolving pulp. Production of this has improved significantly, and Tencel® is produced by Lenzing AG using a closed loop system that involves the much lower use of solutes. This is a modern version of rayon and has the advantage of being more environmentally friendly than cotton. Growth in this area is being fueled by a shortage of cotton and consumer preferences for clothing made from viscose rather than polyester. Global demand for dissolving wood pulp was estimated at slightly less than 7.0 million tonnes in 2017 and is projected to rise to 8.5 million tonnes by 2020.

Bioplastics is another area with huge potential. Petroleum-based plastics appear to dominate our lives and are ubiquitous. Unfortunately, plastic waste is equally ubiquitous, which is hardly surprising given that 95% of plastic packaging is single use. Bioplastics now represent 1% of the global plastics market and are set to grow. Polyethylene terephthalate (PET) bottles have been a particular target and, for example, Coca-Cola has distributed more than 50 billion of its PlantBottles (which are 30% plant-based) since their introduction in 2009. 100% plant-based PET bottles are possible, but not yet commercially available. With China no longer accepting

bales of mixed plastics for recycling, pressure is growing for bio-sourced plastics. Nestlé Waters, Danone and Origin Materials are partnering to establish a pioneer plant in Ontario that will produce 15,000 tonnes of bioplastic annually and it is expected to be operational in 2019.

There are already a large number of biochemicals derived from wood. An example is Lineo™, a lignin product that can replace the oil-based phenolic materials used in resins for plywood, oriented strand board, LVL, paper lamination and insulation material. It is produced commercially by Stora Enso at its Sunila Mill in Finland, with the production level being 50,000 tonnes annually. Many other such products exist, and Stora Enso have claimed that all fossil-based materials could be replaced by products based on wood and other renewable materials.

A variety of other products are emerging. For example, a New Zealand company, CarbonScape, has patented a process to turn sawdust to graphite. While the process is not yet commercially viable or even perfected, it is illustrative of the range of bioeconomy-related products that are emerging.

## Solid wood

The emphasis of alternative uses of wood does not mean that the market for solid wood products will disappear. In fact, the reverse is the case. New forms of engineered wood such as CLT are enabling much greater use of wood. Architects are currently competing to see who can build the highest wooden building and they are going ever higher. The 53 m Brock Commons at the University of British Columbia held the record as the tallest (modern) wooden building. Using prefabricated CLT panels and glulam columns, the structure was completed in 70 days. It was made possible by grants from the Canadian Government, which covered the added costs associated with designing a wooden building of this magnitude.

There are major opportunities outside these flagship buildings. In particular, there is much greater potential for the use of wood in mid-rise buildings and also within industrial buildings. The speed of construction (especially with prefabricated materials), low levels of waste and good performance of wood all indicate that there is considerable potential for greater use of wood in buildings.

## Sustainable intensification of forestry in BC

Is the greater use of harvested products incompatible with the evidence in BC of a shrinking AAC? It is interesting to note that in Sweden the standing forest biomass has doubled over the last 100 years, at the same time as the annual harvest has doubled. While the type of intensive forestry practised in Sweden would be of concern in BC, it perhaps represents a suitable use of forest lands that have been disturbed by insect attack or fire. There is growing interest in the possibility of

the sustainable intensification of forest production, especially as we recognise more and more the benefits of replacing an economy based on fossil fuels with a bioeconomy.

BC (and Canada) prides itself on its extensive form of forestry, suggesting that it is something like near-to-nature forestry. The evidence for this is limited, and most forest ecologists would argue strongly that the second growth forests that develop in areas that have been harvested have little in common with the old growth forests that they replace. This raises the question of why we persist with the current model. It has long been argued, seemingly in vain, that we could reduce the area of pristine forest being logged if we increased the production of timber in areas that have already been disturbed. This would mean that some forests would look a lot less natural than they do today, but the gain would be in the ability to reserve larger areas from harvesting activities.

Extensive forestry would still have a role in much of the province. This landscape-scale system of management, known as TRIAD, has received sporadic attention since it was first proposed more than 30 years ago. It is receiving renewed attention outside Canada as environmental groups and industrial forestry companies edge towards an agreement that sustainable intensification of tree production in some specific areas might be an appropriate way to move towards a bioeconomy.

A key factor is also the value obtained from a log. Companies such as Timbre Tonewood in Abbotsford BC are small, but generate high values from small amounts of timber by producing tonewoods for musical instrument makers. While this is obviously a niche market, there are many such niches and the increasing range of products made using wood will only serve to grow these markets. In some cases, potential benefits may be gained from associating the product with particular locations. Certification begins this process by saying the wood comes from sustainably managed forests. However, there are marketing advantages to be obtained by linking the product to particular locations and management situations that have rarely been exploited.

## Forests and carbon

While the climate change community has placed a great deal of emphasis on the carbon being sequestered by forests, the forest sector, particularly in BC, has tended to focus on the carbon stored in wood products. Yet, this in an area where the entire global forest estate works for us – removing CO<sub>2</sub> from the atmosphere that we continue to emit in unacceptable quantities. When talking about how much carbon a new wood building sequesters, it is often stated in terms of the numbers of cars taken off the road (presumably for one year). It is rare to see the wood expressed in terms of how long it takes to form. An exception is the Naturally:Wood website that claims that UBC's tall wood building,



Brock Commons, utilised 2233 m<sup>3</sup> of wood, equivalent to six minutes' growth of forests in Canada and the US.

There have been many problems associated with the transaction costs involved in carbon monetisation. However, new technologies such as the Forest Carbon Works smartphone app are enabling small forest landowners to obtain payments for their carbon sequestration and storage. The difference in cost is substantial: Forest Carbon Works has a US\$75 application fee and \$1250 membership fee, whereas costs would previously have exceeded \$250,000. The landowners make the measurements themselves using a specially-modified smartphone, a process that can be done in a few days depending on the area of forest involved. What is less clear is the fate of any Crown land that has been used for carbon payments that is subsequently transferred to First Nations. As has been found in New Zealand (e.g. with the Ngāti Koata iwi), such carbon commitments can restrict the use of the land by the new owners.

### Size of investment required

The creation of a new chemical pulp mill requires serious investment: C\$ 2.5 billion for a mill capable of producing 1.4 million tonnes annually. Other types of product mills are, however, much smaller investments and a community can establish a small-scale portable sawmill for a few thousand dollars, with more sophisticated mills costing under C\$100,000. Many niche products require specialised equipment, but the level of investment required may not be particularly great and well within the range of communities.

Many of the larger operations will require substantial investments. Some of this will come from domestic sources, but overseas investment, particularly from China, is likely to grow. This is already happening with, for example, Paper Excellence owning several mills in BC. Chinese companies are also investing elsewhere. Hengan International is the largest shareholder in Finnpulp, a company preparing a €1.4 billion pulp mill in central Finland. Shanying Paper has taken a majority stake in Boreal Biorefinery's planned €950 million pulp mill while, also in Finland, Sunshine Kaidi New Energy Group is planning a €1 billion biodiesel plant in northern Finland, a project that is currently on hold. In the US in 2018, Nine Dragons Paper bought (for US\$175 million) two paper mills owned by the Canadian pulp and paper producer Catalyst Paper.

It is quite difficult to determine the scale of investment required for some activities, but a picture can be pieced together from the investments being made around the world. BC has only one CLT plant (Structurlam in Penticton; the new StructureCraft plant in Abbotsford produces DLT), but what would another cost since the demand is clearly there? A new CLT plant has been constructed by XLam in Wodonga in Victoria,

Australia at a cost of AUD\$30 million. It will produce 60,000 m<sup>3</sup> of CLT a year.

While it has taken time for markets to develop, cellulose nanofibers (CNFs) continue to attract interest. The scale of investment is relatively small. For example, Nippon Paper invested about 1.6 billion yen (C\$14.5 million) in a facility that will produce CNF from wood pulp at its Ishinomaki mill in Miyagi, Japan. The facility will have an annual production capacity of 500 tonnes. Oji Paper and Daio Paper have also started up pilot and demonstration plants for CNF production.

The processing of lignin has often been associated with very large biorefineries, such as those described above in Sweden and Finland. However, new technologies for processing lignin by companies such as the US-based Attis Innovations make it feasible to work with flow rates of 200 to 2000 tonnes of biomass a day. Thus even very small operations are possible, putting such operations within the reach of smaller communities and First Nations.

### Conclusions

The BC forest sector is facing a crisis as a result of a dwindling timber supply. There is currently over-capacity amongst sawmills in the province and some will be forced to close. Although significant tariffs have been imposed on BC forest products entering the US market, the record price levels have largely offset the tariffs and companies with adequate timber supplies are doing well. However, lumber processes are cyclic and current price levels are unlikely to last indefinitely. The US is BC's largest market, although China has grown significantly in importance.

Some companies have reduced their sales to China in order to take advantage of the US prices, a strategy that will pay in the short term but not necessarily in the long term. In the medium term, the reductions in the AAC and the transfer of control of timber resources to First Nations mean that some disruption to the sector is inevitable. This will provide the opportunity for a much needed rethink of the entire approach to forestry in the province. A compromise between current policies and practices in BC and those adopted by countries such as Sweden seems inevitable. The significant innovation and investment that is occurring in Scandinavia is not present in BC, providing evidence that such a change is necessary if the BC forest sector is to maintain its importance. Much will depend on the political willpower to bring about the necessary changes.

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