Supplementary Material: S3. Interviewee profiles and thematic analysis grids

Table S3.1 Interviewee profiles

				Forest products			
Code	**Organization**	**Type**	**Province**	**Lumber**	**Particleboard**	**Cardboard**	**CTMP**
Gov1	Provincial ministry or agency	Government	BC	X			
Gov2	Provincial ministry or agency	Government	QC	X	X		
Gov3	Provincial ministry or agency	Government	QC	X	X		
Gov4	Provincial ministry or agency	Government	BC	X			
Gov5	Provincial ministry or agency	Government	QC			X	X
Gov6	Regional agency	Government	BC	X	X		
Gov7	Municipal government	Government	BC	X	X		
Ind1	Extended producer responsibility program operator	Industry and affiliated research institutes	BC			X	X
Ind2	Contractor	Industry and affiliated research institutes	BC	X			
Ind3	Private R&D institute	Industry and affiliated research institutes	QC	X	X		
Ind4	Private R&D institute	Industry and affiliated research institutes	QC			X	X
Ind5	Private R&D institute	Industry and affiliated research institutes	QC	X	X	X	X
Aca1	College research centre	Academia	QC				X
Aca2	University	Academia	ON	X	X	X	X
Aca3	University	Academia	BC	X			
Aca4	College research centre	Academia	QC			X	

Table S3.2 Thematic analysis grid for lumber

	Which strategies are currently being applied?	Which strategies could easily be applied in current designs?	Characteristics that allow or hinder application of strategies	What is the most promising circular economy strategy?
Lumber	Sawmills have implemented technologies to make more lumber out of logs. Aca2, Gov1, Gov7, Ind5, covers harvesting, log management and sorting, scanning, manufacturing, Aca3. Reuse and recycling is not common, Aca3, limited to niche markets Gov3-Gov2, Gov7, for example reclaimed old growth flooring: Gov1, or stores (matériauthèques) for sorted products Gov3-Gov2, with reuse for structural applications being limited by dispositions in building codes. Ind2 Energy recovery is the more common, for example in district energy systems (UBC) or industries, Ind3, Gov3-Gov2, Gov6, Gov7. Can also be chipped and turned into mulch, Gov4. Reuse and recycling requirements apply to demolition waste for houses built before 1950 in Vancouver (green demolition bylaw), Gov1, Gov6. A few other cities also have deconstruction requirements (e.g. Vancouver, single-detached homes constructed before 1910), Gov2-Gov3, Gov6. When even energy recovery is not possible, can end up as subgrade in landfills, Gov7.	Further measures could be implemented to derive more structural products from sawlogs, Gov1, Ind5, namely engineered wood products using smaller pieces of lumber, Aca2, Gov3-Gov2. However, larger, modern sawmills have less room for improvement, Gov4 Larger amounts of sawmills residues could be valorized, but in some cases there is a lack of markets, Ind5. Lumber, if untreated or not exposed to the environment, is a high quality material that can be reused for structural applications (if tested or if the proper grading rules are in place, Oregon, Washington State), Gov4, or in non-structural applications (non load-bearing walls), OSB (Aca3), MDF, PB, etc. Ind3, Ind5, Gov7. Design for disassembly could be implemented, Gov1, Aca2, from a technical and cost standpoint (connectors) Ind3 Standardizing the design of interior wall and where services are located (wires, piping, etc.) would avoid mixing materials and facilitate recycling. Ind3, Gov3-Gov2. Reuse and recycling can be increased by extending requirements homes built after 1950 and other building types in Vancouver, Gov6. More advanced energy recovery technologies (pyrolysis) could deal with contamination and generate valuable co-products (pyrolysis oil, biochar), Gov1. Pyrolysis and other valorization technologies could be installed directly at landfills, Gov1. Resources reduction through smaller houses, Gov3-Gov2.	Allow: Clean material, no treatment. Large pieces that can be turned into stands, chips, fibre or particles.Ind3, Gov4, Gov7. Does not require adhesives, Gov4 (although they are increasingly used in some assemblies, Ind2) Older designs facilitate deconstruction, Gov1. CRD waste for energy, low price, Gov2-Gov3. Existing infrastructure (sorting centres / écocentres) in QC, Gov3-Gov2. Old growth lumber has high value, Gov6. Reclaimed lumber can reduce embodied carbon in buildings, Gov6. Hinder: Most buildings have not been designed for deconstruction / disassembly, Gov4, Aca2, Gov1, Gov3-Gov2 and are not now either, with contractors / builders focusing on low cost, Gov7. Use of glues / foams hard to remove. Ind2 Contamination of construction waste, Gov1, or treatment (creosote, CCA), Gov7, Ind5, can also limit energy recovery. Can still be used in high temperature conditions (cement kiln) but requires stack testing, Gov7. CRD waste for energy, low quality, Gov2-Gov3. Plates or nails are hard to remove. No automation for nail / fastening removal, Ind2, Ind3, and labour intensive, Gov3-Gov2. Poor sorting of waste material on construction sites. Ind2, Gov3-Gov2, Ind5, resulting in messy piles of debris, Aca3. Sorting and scale makes panel production (OSB, MDF, PB) or engineered wood from	Requires changes in how current buildings are designed to allow for easier not as labour intensive deconstruction / disassembly. Ind3, Gov7, Ind5, Aca3, Aca2. Switch from on-site to off-site construction facilitates design for disassembly, but also waste reduction, quality control, Gov4. Is also driven by increasingly stringent energy Codes. Requires greater adoption of automation in forest / construction industries. Information needs to the follow the material and remain available (tag or code) Ind3. Limit the use of glues, blown-in insulation, but also nails / screws / plates as much as possible, Gov7. Reuse (in wall assemblies) is the most promising strategy, perhaps in places where lower structural strength is required, Gov3-Gov2. Requires fundamental changes in how existing buildings are deconstructed (e.g. mandatory in Vancouver) and waste is sorted, Ind2, Ind5, Aca3 (more immediate gains than how buildings are designed). Creating markets for recovered material (mandating recovery is useless if there's no market for recovered materials Gov3-Gov2, Gov6) (easier for old growth Douglas fir than common SPF lumber). Ind2 Creating this market can be done through public procurement, Gov6. Cascading use is preferable: reuse as lumber / engineered wood products, than OSB, PB, energy, Aca3. Streamlining the certification process for salvaged lumber would also help, Gov7. Spend more time on the design phase, so wood buildings are designed for

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		Preventive maintenance can avoid premature end of life / demolition, Gov3-Gov2. Develop standards for reuse of lumber (like in Oregon and Washington States), Gov4. More on-site sorting (to increase reuse/recycling, ideally with companies that have the right expertise) and more prefab/modular (greater control of reduction potential), Ind2.	recovered lumber non-competitive vs virgin fibre (logs or sawmill residues), Aca3. Quality of fibre from recovered lumber can be more variable lower than virgin fibre, Aca3. Materials are mixed together in a random fashion in wall assemblies. Ind3 There is not a significant market for ordinary dimensional lumber (2x4, 2x6) Ind3, Gov7 (too small to justify large investments), cost of recovered lumber higher than virgin Gov4, Aca3. Re-use is higher cost, Gov6, complicated under the current Building Code (reuse of lumber needs to be certified by P.Eng, Gov6, Gov7, Ind2, and deconstruction complicated under collective agreements with trades, Gov3-Gov2. Demolition is faster than deconstruction, Gov7. Perception that salvaged lumber has lower strength, durability, Gov6. Very long time for return on investment for extra costs of design for disassembly (end of life of building) Ind3, Gov7. Education, along the value chain (engineers, architects, trades, demolition companies) Ind3, workforce implications need to be considered, Gov6. Energy recovery is constrained by low energy prices in certain jurisdictions (BC, QC), Gov4. There is no information on the product (technical, origin, etc.) Gov1 or what composes the building as a whole, Gov3-Gov2. Emphasis on low cost and fast delivery makes it difficult to explore higher performance, flexible / adaptable designs, Gov3-Gov2.	maintenance and end of life, this enables other strategies (reuse, recycling, energy), Gov1. Without regulations, it will be difficult to see change at a large level, given that demolition is easier, Gov3-Gov2. More stringent requirements on embodied carbon would favour salvaged lumber, Gov7. Credits can also be give in green building certifications, Gov7. Higher tipping fees at landfills, Gov6. Material specific recycling targets, as concrete makes up most of weight of demolition waste, Gov6. Given the early stage, documenting and showcasing best practices is important, Gov3-Gov2. Information (through marking, Gov1) need to follow the materials (materials passport) and the buildings (buildings as materials banks) for tracking purposes, Gov6, Gov7, Ind3, to enable better management of material flows, Gov2. Incentive maintain materials in good condition and preserve their value, Gov7. A national roadmap for a circular building sector is the needed next step, Gov6. Update building codes to favor recovery and reuse, Ind2

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			Permitting is done at the local level, so difficult to have a uniform model at the provincial / national level, Gov3-Gov2. A majority a construction companies are small / very small, making it difficult to train / disseminate best practices, Gov3-Gov2, Gov7.	

Table S3.3 Thematic analysis grid for particleboard

	Which strategies are currently being applied?	Which strategies could easily be applied in current designs?	Characteristics that allow or hinder application of strategies	What is the most promising circular economy strategy?
PB	Particleboard itself is made from residues or post-consumer waste, so doesn't require dedicated harvest. Provides a needed outlet for sawmill residues. Ind3 Lumber is also be used as an input, Gov3-Gov2, Gov7 (example of Tafisa). Optimization of manufacturing processes, Ind5, for example where smaller panels are cut in larger ones with minimal losses, Gov3-Gov2. Otherwise, very little is done and PB usually ends up in landfill at the end of life Ind3, Gov1, Gov7, which can be shorter than other wood products. Aca2 There can be some energy recovery in high temperature applications, Gov7.	Large pieces of PB recycled through take back programs (e.g. IKEA) can be used to produce smaller pieces, Aca2, Gov7. Isolate from other streams at sorting centre or with installers, Gov3-Gov2. Can also replace a fraction of clean residues used for PB manufacturing. Ind3, Gov3-Gov2, Aca3 (can be mixed with cement – cold set - instead of resin- hot press). More important volumes could be sent to energy recovery, Ind5, especially using more advanced processes (pyrolysis), Gov1.	Allow: Hinder: easily breakable, low resistance to wear, Aca2, Gov3-Gov2, or moisture, Gov7. Short fibres in wood particles, limits other uses. Ind3, Gov3-Gov2. Use of resins Ind3, Ind5, and laminates Gov3-Gov2 with potential emissions at combustion. Plastic overlays makes PB more difficult to recycle / reuse, Aca3. Formaldehyde resins are phased out because of emissions, but they were easier to break down than methylene diphenyl diisocyanate (MDI) resins, Aca3. Fastening systems make disassembly / reassembly difficult, Aca3. Can have a small portion in clean waste wood for energy, but not too much, Gov3-Gov2. Large variability (size, quality), Gov7. Lower energy content than fossil fuels, Gov3-Gov2. Mixed with several other construction / household waste at the end of life, hard to recover, Gov3-Gov2. No market, Gov7.	Energy use seems like the only realistic end of life fate, given the product characteristics, Gov7. Resins need to be non-emitting under mid-temp combustion conditions (ex. lignin-based), Ind3 or if not, used only in high-temp combustion to meet emission requirements. Aca2, Gov3-Gov2. Recycling would be possible by reintroducing some portion of used PB in PB production, Ind5, or using "reversible" or "dissolvable" resins that would allow separation of the particles from the resin. Aca2, Aca3 (at the R&D stage now) or easily removable overlays, Aca3. Replacement with higher quality m material (MDF) would make repairs / reuse easier, Aca2, Gov7, might see less of this material over time, Gov6. Combination of OSB (strength) and PB (smoother surface) would result in longer-lasting furniture, Aca3. Furniture designed for disassembly, Aca3. Higher tipping fees at landfills, Gov6. Material specific recycling targets, Gov6. Information need to follow the materials (materials passport), Gov7.

Table S3.4 Thematic analysis grid for cardboard

	Which strategies are currently being applied?	Which strategies could easily be applied in current designs?	Characteristics that allow or hinder application of strategies	What is the most promising circular economy strategy?
Cardboard	Efforts to minimize the use of water and energy at pulp and paper mills, Ind5. Cardboard shows very high recycling rates in Canada and the system has been in place for several years, Ind4, Ind1, Ind5. Increase the amount of recycled content, Aca4. It is made of high quality fibres that can be recycled multiple times and made back into cardboard, there is demand for the recovered material from pulp and paper, Gov5. Cardboard can also be composted if soiled, Gov5, Ind1. Work has been done to optimize the weight vs structural properties of cardboard boxes, Gov5, Aca4 (OptimEco tool from ÉEQ), namely by the addition of fillers, Ind5, or optimization of the structure of the corrugated medium, Aca4. Reduce the size of boxes, Aca4. Rethink pallet configurations / layouts to require less boxes / less strong boxes (secondary packaging), Aca4: more product transported by volume. Can be re-used in certain applications (moving companies, B2B packaging), Gov5, but still largely informal, Aca2.	Reduce the amount of oversized boxes, especially for home delivery (which grew significantly during the COVID-19 pandemic), Ind5, Ind1 or box in box, Ind1. Further work on light basis weight liners. Ind4, Ind5. Reduce the amount of water and heat for repulping, and heat for drying, Ind1. Reduce the amount of fibre loss by limiting shortening of the fibre during recycling, Ind5. Use of paper tape instead of plastic tape, Ind5. Reuse could be increased, especially in a B2B context, with boxes used for a short time and still in very good condition, Gov5, Ind1, Aca4. In certain settings (food delivery), coatings or other barrier materials used to increase resistance / strength (e.g. wax) could make recycling more difficult (trade-off), Ind1, Aca2. Improvement of materials separation to capture smaller boxes (optical sorting after paddle wheel), Ind1. Recycling could be improved, especially as mixing with other residential waste increases the proportion of cardboard going to mixed paper, lower value and lower quality uses. Separate streams is preferable, Ind5. Recycling for use as insulation material (can be made hydrophobic) or growing substrate, Aca4.	Allow: use of inks and glues compatible with recycling. Ind4, Aca2. Limited amounts of inks, Ind5. Quality fibre that can be recycled multiple times, Ind4, hence high value, Ind1. Fibre from sustainably managed forests (in Canada), Gov5. Minimal amount of tape (doesn't prevent recycling, easy to remove, but generates waste), Gov5, Ind1. Flexibility at box producers to adapt to new designs, Aca4. Properties not affected by changes in percentage of recycled content, Gov5 Hinder: recycling equipment not adapted to smaller boxes, Ind1. Recycling infrastructure represent large investments that must be operated over a long period of time for cost recovery, Aca4. Mixed roadside collection can reduce the quality (for example dampness, paint, solvent, oil, Ind1) and force downcycling (not used for cardboard, but other grades of paper), OCC is worth 80$/t and mixed paper 5$/t, Ind1. No control on imports and the boxes in which they come in, Aca4. Fluctuating prices and quality, Aca4. Lack of coordination / communication between generators, recyclers and manufacturers, as the recycler is not one of the final users, Aca4. Quickly degrades when moist or soiled, Ind5. Separation more difficult when mixed / assembled with other materials (plastics), Gov5.	Multiple options were raised across the value chain. Recycling remains a good (the best) option, Gov5, Ind1, but improvements need to done during collection and sorting to preserve the high quality fibre and make sure it doesn't end up in lower quality mixed paper bales, Ind1. Separate streams (not mixed with other recycled materials) improves quality, Ind5. The right selection of tapes / inks also facilitate recycling, Ind5. One fibre length is too short, can be used for other grades of paper, Ind1. A bit of room left for optimization (lighter liners, better assembly of liner with medium) Ind4. Use in longer-lived products (furniture / construction), Aca4, rather than single-use products. Ultimately, should be informed by LCA, Gov5., Aca2.

	Which strategies are currently being applied?	Which strategies could easily be applied in current designs?	Characteristics that allow or hinder application of strategies	What is the most promising circular economy strategy?
			Requirements for strength / water resistance limits the extent to which thickness can be reduced, Gov5. Each recycling cycle causes a shortening of the fibre, which limits the number of time it can be recycled, Ind4, Ind1. Pulp mill sludge and ashes need to be landfilled, but there are multiple potential applications, Ind5. Products made from cardboard are too easily recyclable, which results in a low number of use per product, Aca2 Efficiency of waste management systems depends a lot on the cardboard's origin (institutional or commercial vs residential), Ind4.	

Table S3.4 Thematic analysis grid for chemi-thermo-mechanical pulp (CTMP)

CTMP	CTMP can be recycled, even when it is a little bit soiled, Gov5, would end up in mixed paper bale, Ind1. Composting appears to be the most common end of life for food packaging, namely because of where it is used (food courts). Ind4, Ind1, Ind5. Does not make sense to extend life, since it is a single use product that provides an alternative to plastics which persist in the environment. Aca1 Using recycled fibre for uses with food contact can be more complicated than virgin fibre. Aca1 Can help reduce the consumption of plastics, Gov5.	Additional efforts to minimize resource use at the pulp mill, Ind5. CTMP has been used for several years, but applications aiming to replace plastic is relatively recent. There is still room for optimization (less material for equivalent strength). Aca1 Avoid bleaching when not required for functional purposes, Ind1. Better barrier materials that facilitate washing or are compatible with recycling processes can increase recycling rates, Ind5, Ind4. Need to make sure barrier materials are either removable or compatible with composting. Aca1, Ind1.	Allow: Fibre used for food grade packaging is high quality and can be recycled to be used in multiple paper products, including food grade packaging. Aca1 Is compostable, Ind1, so use in food applications well tailored for composting, as it the only fate of food waste. Ind4 Accepted in all recycling facilities (if not soiled), unlike some plastics (color / type), Gov5. Hinder: Food contact, soiled packaging makes recycling more difficult. Aca1 Typical barrier materials (plastics, fluorocarbon based) can hinder recycling and composting, Aca1, Ind5, or persist in the environment and body, Ind1. More difficult to reuse than plastics, cannot be washed, Gov5, Ind5. Can be complicated to use recycled fibre in food grade applications, Ind5. Is assumed compostable, but need to demonstrate the impact of large volumes sent to compositing, Ind5. Lack of infrastructures to properly handle the product at its end of life, Ind4, Gov5. Low density, coupled with long hauls and high investments, results in low returns, Aca1	Design product to use as little pulp as possible, needs to compete with plastics that can be lower weight. Use of CTMP is preferable to chemical pulp to that regard (bulkier). Aca1 Recycling is the preferred option given the quality of the fibre. Requires careful design: barrier material allowing cleaning, Ind5, but that can be removed or is compatible with recycling process. Aca1, Ind4 Composting is the most realistic avenue, given the application, Ind1, Ind5. Recycling or composting required that the right collection equipment is available in public places where a lot of single use food packaging is used or that sorting is done properly at recycling centres. Remains a single-use product, might be preferable to avoid when possible, Ind1, Ind5, even if it replaces a material made from non-renewable resources. Ind4, Gov5. Ultimately, should be informed by LCA, Gov5.