

# Documenting and Mapping the Creation of a Deconstruction and Green Design Hub for the Arts & Cultural Sector

## Sustainability Arts & Green Ecosystem (SAGE) New materials evaluation

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## Disclaimer

This report was produced as part of the UBC Sustainability Scholars Program, a partnership between the University of British Columbia and various local governments and organisations in support of providing graduate students with opportunities to do applied research on projects that advance sustainability and climate action across the region.

This project was conducted under the mentorship of Museum of Vancouver staff. The opinions and recommendations in this report and any errors are those of the author and do not necessarily reflect the views of Museum of Vancouver or the University of British Columbia.

## Territory acknowledgement

The author acknowledges that the work for this project took place on the unceded ancestral lands of ancestral territories of the xʷməθkʷəy̓əm (Musqueam), Skwxwú7mesh (Squamish), and səliłwətał (Tseil-Waututh) Nations.

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- Peter Moonen: Canadian wood council
- Elia Kirby: CEO and director of projects at GNW scene shop, Board president of arts factory society
- Jason Chiu: Managing Director-UBC- Center for advanced wood processing
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# Introduction

The cultural sector has both obligations and opportunities to create public dialogue, education, and systemic change addressing the global climate crisis.

The Museum of Vancouver (MOV) is a founding member of the Coalition of Museums for Climate Justice (Canadian Museum Association), an active participant with Creative Greens Tools (Centre for Sustainable Practice in the Arts), and has a long-standing working relationship with UBC's Sustainability HUB. MOV is an experienced cultural institution that is ready to shift to new models of working, and public programming more sustainability and cross-sectorally.

Having experimented with upcycling and circular economy practices in previous exhibitions, in 2023, the MOV launched the **Sustainable Arts and Green Ecosystems Project (SAGE)** to engage partners in the museum, gallery, and theatre sectors to collaborate on initiatives and solutions to advance the environmental performance, reduce greenhouse gas (GhG) emissions, and design and manage for circular materials use.

The SAGE initiative draws on multiple experts to discuss and ideate on greener ways of working, and that includes the role of a UBC Scholar to contribute to research and guideline development.

SAGE is particularly focused on staged events and exhibitions: the impact of the materials used, and construction and waste management practices. SAGE partner organizations collectively generate thousands of tonnes of waste annually from demolition of their exhibitions. This contributes to GhG emissions and other environmental impacts. Additionally, materials used for staged events and exhibitions have a significant environmental impact. Therefore, the focus of the SAGE project is primarily on three key deliverables:

- (1) SAGE Toolkit –guidelines for planning, design, material selection, construction, and de-construction of staged events;
- (2) SAGE Hub –online repository tracking couple with physical space for arts organizations to store and trade used materials –to reduce waste and keep materials in circulation;
- (3) A demonstration exhibition that will be planned, designed, and constructed following the SAGE Toolkit guidelines. It will serve as a model of circularity and low environmental impact for other exhibitions and staged events.

This UBC Scholar project, ***Documenting and Mapping the Creation of a Deconstruction and Green Design Hub for the Arts & Cultural Sector***, contributes to the SAGE Toolkit. This project focuses on the assessment of materials commonly used in constructing exhibitions and staged events: wood panels, dimensional lumber, and paints. The aim of this project is to collate and assess the environmental and health impacts of these materials and to present the information in a simplified and accessible way. This materials section of the SAGE Toolkit will guide museum and gallery curators, exhibition directors and managers, designers, and builders in making decisions that will reduce or avoid negative environmental and health impacts.

The research drew from published sources and interviews with experts in this arts sector as well as materials experts. Product and materials ratings (and weightings) were determined based on this information and in collaboration between the UBC Scholar and SAGE partners and project mentors.

It is anticipated that the SAGE Toolkit will be a living document (online interactive website) and the content will be updated as new information (such as product EPDs –Environmental Product Declarations) become more widely available.

## Section 1: Wood panels, evaluating MDF and plywood

This section presents four (4) tables and two (2) bar charts, offering a detailed evaluation of two wood panel types frequently used for exhibitions and staged events: MDF (Medium-Density Fiberboard) and plywood.

- Tables 1 and 2 assess the materials based on environmental and greenhouse gas emissions, sustainable forestry certifications, and health impacts and certifications of products of four brands readily available in Metro Vancouver.
- Table 3 and bar chart 1 compare the two materials with each other based on environmental considerations, as well as other materials considerations relevant to their use.
- Table 4 and bar chart 2 compare the two materials with each other based on their durability for reuse (and important consideration for circularity).

*Notes:* The environmental assessments for all the products and materials presented in the following tables (except for Table 9), are based on a volume of one cubic meter of the wooden, steel, aluminum, or other materials.

At the time of research for this project, the Environmental Product Declarations (EPDs) were not available for all brands or products. According to the Canadian Wood Council, we can anticipate greater access to EPDs for wood products and brands by 2025.

## MDF evaluation based on brands

MDF is a commonly used material for staged events and exhibition walls, risers, and other elements.

Brand	Product name	Rating elements																				Total Score	
		Local production			Sustainable forest management practices						Environmental impacts				Health/ Indoor air quality								
MDF	Product name	Available in Metro Vancouver	Manufactured in BC 1		FSC - Forest Stewardship Council certification 2		SFI - Sustainable Forestry Initiative certification 3,4		PEFC 5		6 Units= kg CO2eq		EPD/Water use in production Units=Litre		LEED <sup>7</sup> v4 compliant		CARB 8		HPD 9		Greenguard certification 10		/100
		/15	/15	/5	/5	/5	/5	/20	/10	/10	/10	/10	/10	/10	/10	/10	/10						
West Fraser	Westpine MDF	Yes	Yes	15	Yes <sup>i</sup>	5	Yes	5	Yes	5	759	4	3017	0	No	0	Yes	10	No	0	No	0	<b>44</b>
Columbia Forest Products	MDF	Yes	No	0	Yes <sup>ii</sup>	5	No	0	Yes	5	759	4	3017	0	Yes	10	Yes	10	No	0	No	0	<b>34</b>
Eroko	MDF	Yes	Yes	15	Yes <sup>iii</sup>	5	No	0	No	0	759	4	3017	0	No	0	No	0	No	0	No	0	<b>24</b>
Metrie	MDF	Yes	Yes	15	No	0	No	0	No	0	759	4	3017	0	No	0	No	0	No	0	No	0	<b>19</b>

Table 1

<sup>i</sup> KF-COC-001045 and FSC-C109677

<sup>ii</sup> FSC-C017500

<sup>iii</sup> FSC C134574

## Plywood evaluation based on brands

Plywood is also commonly used material for staged events and exhibition walls, risers, and other elements.

Brand	Product name	Rating elements																				Total Score	
		Local production			Sustainable forest management practices						Environmental impacts						Health/ Indoor air quality for workers						
PLYWOOD	Available in Metro Vancouver	Manufactured in BC 1	FSC -Forest Stewardship Council certification 2	SFI - Sustainable Forestry Initiative certification 3,4	PEFC 5	Units= kg CO2eq	EPD/Water use in production	LEED <sup>7</sup> v4 compliant	CARB 8	HPD 9	Greenguard certification 10												
												/15	/5	/5	/5	/20	/10	/10	/10	/10	/10	/10	
West Fraser	Plywood	Yes	Yes	15	Yes <sup>iv</sup>	5	Yes	5	Yes	5	219	16	1080	6	No	0	No	0	No	0	No	0	<b>52</b>
Columbia Forest Products	Purebondplywood (hardwood)	Yes	No	0	Yes <sup>v</sup>	5	No	0	Yes	5	219	16	1080	6	Yes	10	Yes	10	No	0	No	0	<b>52</b>
Tolko	T_PLY	Yes	Yes	15	No	0	Yes	5	Yes	5	219	16	1080	6	No	0	No	0	No	0	No	0	<b>47</b>
Metrie	Plywood	Yes	Yes	15	No	0	No	0	No	0	219	16	1080	6	No	0	No	0	No	0	No	0	<b>37</b>

Table 2

<sup>iv</sup> KF-COC-001045 and FSC-C10967

<sup>v</sup> FSC-C017500

## Comparing wood panels: MDF and plywood

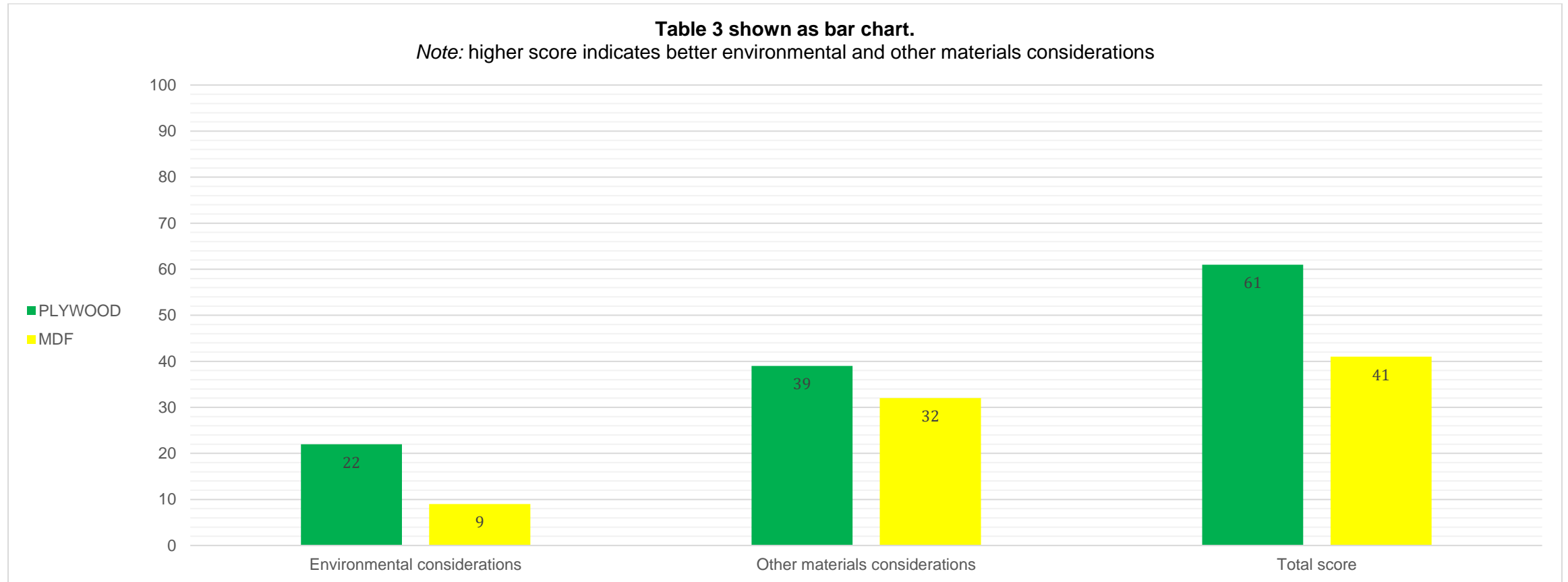
A comparison of MDF and Plywood based on environmental considerations and other materials considerations relevant to use for staged events and exhibitions.

Type of materials for paneling	Environmental considerations /impact									Other materials considerations												Total Score		
	EPD factors & data									Surface's smoothness for painting and mudding for 1st time of use	Surface's smoothness for painting and mudding after 1st time of use	Dust when cutting (re healthy work environment) No dust = 5 High dust = 0	Moisture resistance	Disposal challenges	Load-bearing capacity	Potential for repurposing								
	GWP of Raw material supply	GWP of + transport	GWP of production =	EPD/Total GWP Unit=total Kg CO2eq	EPD/ water use Unit=Litre	Pre-consumer recycling																		
				/25	/15	/10	/15	/10	/5	/5	/5	/5	/5	/5	/5	/5	/5	/5	/5	/5	/5	/5	/100	
<b>Plywood</b>	70.03	10.28	139.00	219	16	1080	6	No	0	No	0	Yes	10	Yes	4	Yes	5	Yes	5	Yes	10	Yes	5	<b>61</b>
<b>MDF</b>	319.69	9.44	430.02	759	4	3017	0	Yes	5	Yes	15	Yes	10	No	0	No	0	No	2	No	5	No	0	<b>41</b>

Table 3

## Comparing wood panels: MDF and plywood

A comparison of MDF and Plywood based on environmental considerations and other materials considerations relevant to use for staged events and exhibitions.



Bar Chart 1



## Wood panels: Durability for re-use

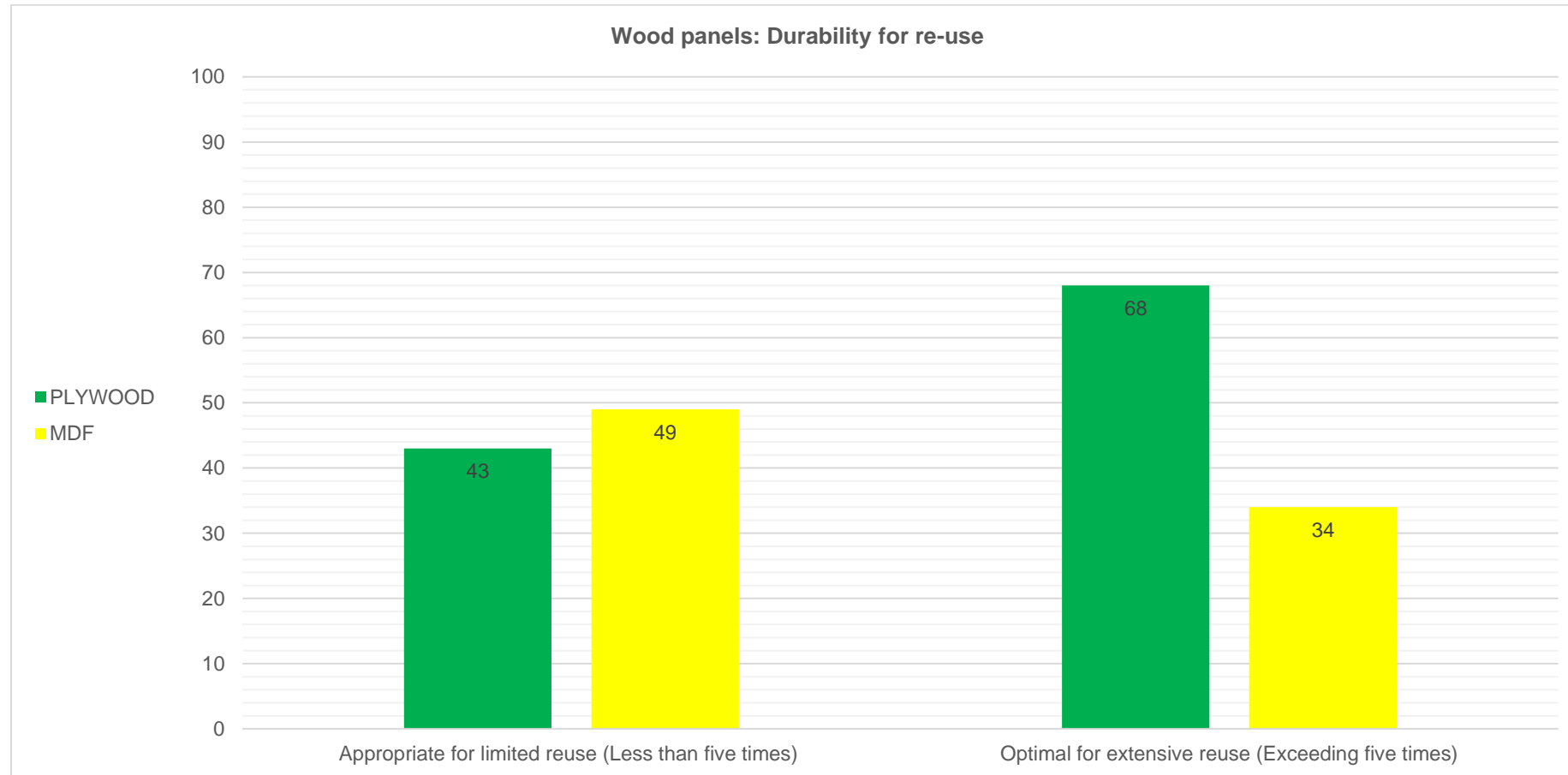
A comparison of the two wood panel materials based on their durability for reuse. Durability of materials is an important consideration for circularity of use (and re-use) of materials.

Durability considerations	Rating elements									
	Modular use opportunities		Potential for multiple disassembles		Load-bearing capacity		Appropriate for limited reuse (Less than five times)		Optimal for extensive reuse (Exceeding five times)	
	/25		/20		/10		/20		/25	
Plywood	Yes	20	No	15	Yes	8	No	0	Yes	25
MDF	Yes	20	Yes	5	No	4	Yes	20	No	5

Table 4

## Wood panels: Durability for re-use

This is a graphical presentation of Table 4 (above) i.e. a comparison of the two wood panel types based on their durability for reuse. Durability of materials is an important consideration for circularity of use (and re-use) of materials.



Bar Chart 2

## **Section 2: Lumber & lumber substitutes**

This section presents four (4) tables and two (2) bar charts, offering a detailed evaluation of material (such as dimensional lumber) that can be used for framing in the exhibitions.

- Tables 5 and 6 assess the materials based on environmental and greenhouse gas emissions, sustainable forestry certifications, and health impacts and certifications of products of four brands readily available in Metro Vancouver.
- Table 7 and bar chart 3 compare the two materials with each other based on environmental considerations, as well as other materials considerations relevant to their use.
- Table 8 and bar chart 4 compare the reused materials with each other based on their durability and other factors.

## Lumber evaluation based on brands

Brand	Product name	Rating elements																				Total Score	
		Local production			Sustainable forest management practices						Environmental impacts					Health/ Indoor air quality for workers							
		Available in Metro Vancouver	Manu- factured in BC 1	FSC -Forest Stewardship Council certification 2		SFI - Sustainable Forestry Initiative 3,4		PEFC 5		6 Units= kg CO2eq		EPD/Water use in production Units=Litre		LEED <sup>7</sup> v4 compliant		CARB 8		HPD 9		Greenguard certification 10			
Dimensional Lumber & CanDo!			/15	/5		/5		/5		/20		/10		/10		/10		/10		/10		/100	
CanDo! <sup>*i</sup>	CanDo!	Yes	Yes	15	N/A (Recycled)	5	N/A (Recycled)	5	N/A (Recycled)	5		18	No	10	No	0	No	0	No	0	Yes	10	68
West Fraser	Dimensional Lumber	Yes	Yes	15	Yes <sup>ii</sup>	5	Yes	5	Yes	5	63	20	440	10	No	0	No	0	No	0	No	0	60
Columbia Forest Products	Dimensional Lumber	Yes	No	0	Yes <sup>iii</sup>	5	No	0	Yes	5	63	20	440	10	Yes	10	Yes	10	No	0	No	0	60
Canfor	Dimensional Lumber	Yes	Yes	15	Yes <sup>iv</sup>	5	No	0	Yes	5	63	20	440	10	No	0	No	0	No	0	No	0	55
Tolko	Dimensional Lumber	Yes	Yes	15	No	0	Yes	5	No	0	63	20	440	10	No	0	No	0	No	0	No	0	50

Table 5

<sup>i</sup> Note: CanDo! is a new product launching in the marketing in Fall 2023: <https://www.cando.earth/>. It is locally manufactured (in Metro Vancouver) by joining together used pieces of dimensional lumber (1x4s and 2x4s –using glue and joinery techniques). Research on the project performance and environmental impacts and attributes were done in part by (or with) researchers at UBC Centre for Advanced Wood Processing. CanDo! lumber does not have Environmental Product Declaration (EPD) because the lumber is used materials (so it earned no points), but we received environmental data sheets on the glues used.

<sup>ii</sup> KF-COC-001045 and FSC-C109677

<sup>iii</sup> FSC-C017500

<sup>iv</sup> FSC-A000520

## LVL evaluation based on brands

Laminated Veneer Lumber (LVL) is a type of engineered wood made from multiple layers of thin wood bonded together. Given British Columbia's strong forestry-based economy, UBC, and other research centers and businesses are exploring the potential of LVL for building construction. Although LVL isn't currently used extensively in the arts sector for exhibitions, possibly due to cost, it holds promise for the future. As LVL becomes more prevalent in the market, it could also find use in other sectors, such as exhibition or staged event wall construction.

Type	Product name	Rating elements																				Total Score	
		Local production			Sustainable forest management practices						Environmental impacts				Health/ Indoor air quality for workers								
LVL	Product name	Available in Metro Vancouver	Manu- factured in BC 1		FSC -Forest Stewardship Council certification 2		SFI - Sustainable Forestry Initiative 3,4		PEFC 5		6 Units= kg CO2eq		EPD/Water use in production Units=Litre		LEED <sup>7</sup> v4 compliant		CARB 8		HPD 9		Greenguard certification <sup>10</sup>		/100
			/15	/5	/5	/5	/5	/20	/10	/10	/10	/10	/10	/10	/10	/10	/10						
West Fraser	LVL	Yes	Yes	15	Yes <sup>i</sup>	5	Yes	5	Yes	5	361	12	1490	4	No	0	No	0	No	0	No	0	<b>46</b>
Metrie	LVL	Yes	Yes	15	No	0	No	0	No	0	361	12	1490	4	No	0	No	0	No	0	No	0	<b>31</b>

Table 6

<sup>i</sup> Certificates KF-COC-001045 and FSC-C109677

## Framing score

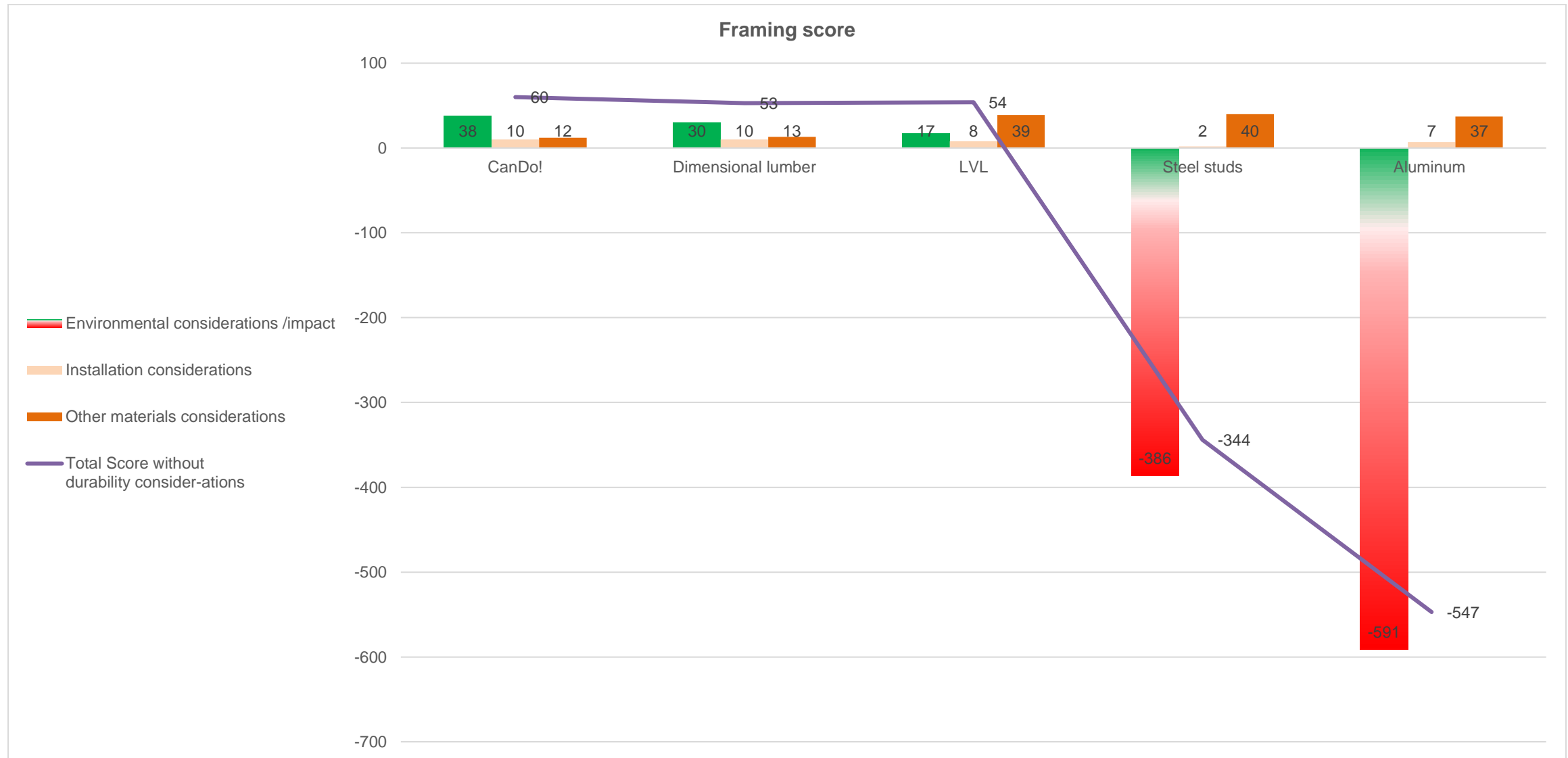
A comparison of dimensional lumber and other framing materials based on environmental considerations and other materials considerations relevant to use for staged events and exhibitions.

Type of materials for framing	Environmental considerations /impact								Installation considerations		Other materials considerations					Total Score (without durability considerations)
	EPD factors & data								Lightweight	Easy cutting	Resilience against warping post-use	Capable of supporting heavy loads	Indoor air quality for workers (glues offgassing)	Moisture Resistance (storage consideration)	Potential for recycling	
	GWP of Raw material supply	GWP of + transport	GWP of + production =	EPD/Total GWP unit= kg CO2eq	EPD/water use Unit=Litre	Re-cycled/ used material	/25	/15								
<b>CanDo!</b>	NA	NA	NA	NA	18	NA	10	10	5	5	3	3	4	2	0	<b>60</b>
<b>Dimensional lumber</b>	10.55	10.01	42.56	63	20	440	10	0	5	5	3	3	5	2	0	<b>53</b>
<b>LVL</b>	167.23	19.84	174.37	361	12	1490	5	0	4	4	15	8	1	5	0	<b>54</b>
<b>Steel studs</b>	NA	NA	NA	19000	-380	20358	-6	0	0	2	15	10	5	5	5	<b>-344</b>
<b>Aluminum</b>	NA	NA	NA	29700	-580	35000	-11	0	4	3	15	7	5	5	5	<b>-547</b>

Table 7

## Framing score<sup>12</sup>

This is the scoring from Table 7 above depicted graphically



Bar Chart 3

## Used framing material score

Table 8 is a comparison of materials that are already used. The SAGE Project recognizes that circular solutions for materials re-use may come from re-using and sharing used materials within the arts sector, and from sourcing used materials from other sectors –such as the building and construction companies. For used materials the environmental performance rating (in previous tables) is not considered –because that impact is assumed at time of purchase of new materials.

For repeated materials re-use, durability is a key factor, as are other performance and use considerations listed below.

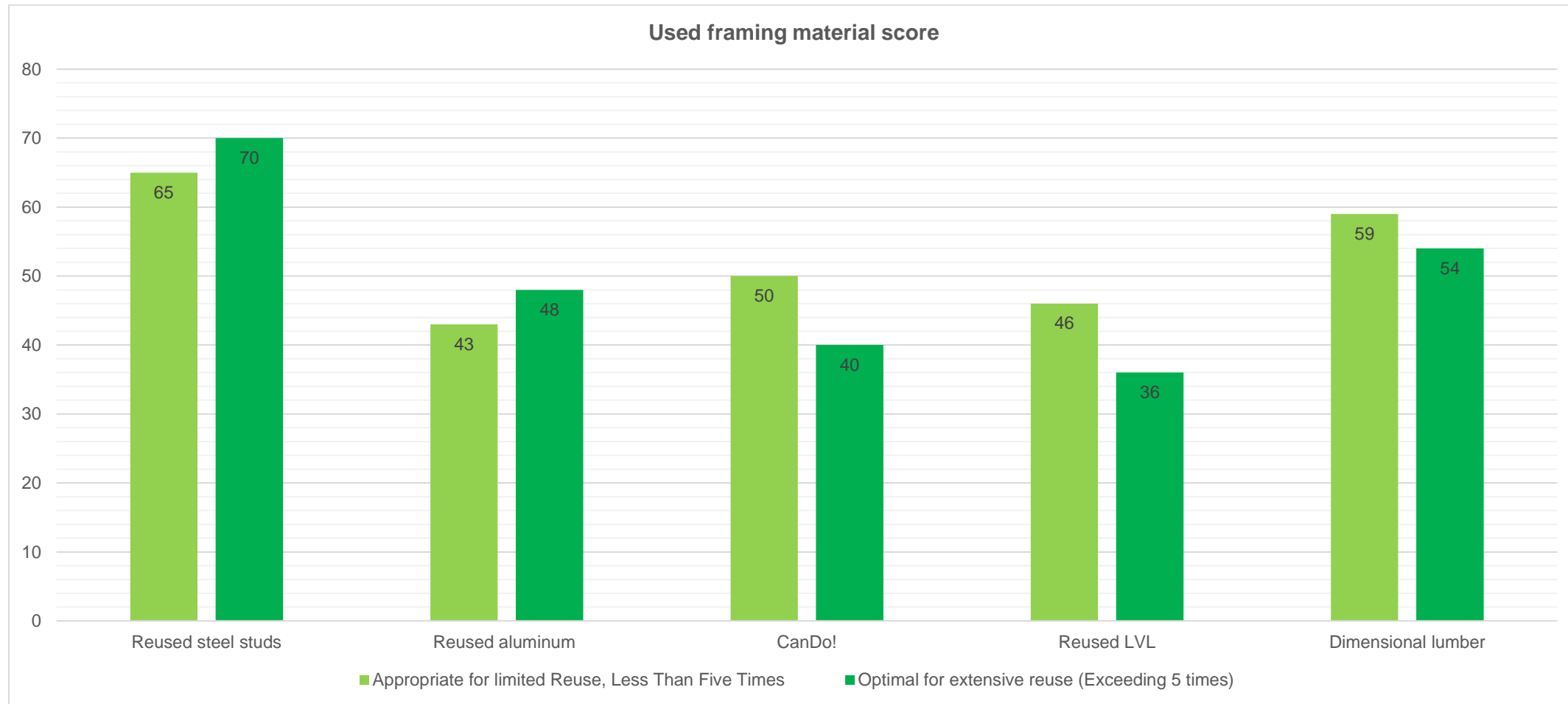
Type of reused materials for framing	Installation considerations		Other materials considerations					Appropriate for limited Reuse, Less Than Five Times	Optimal for extensive reuse (Exceeding 5 times)	
	Lightweight	Easy cutting	Resilience against warping post-use	Capable of supporting heavy loads	Indoor air quality for workers (glues off-gassing)	Moisture resistance	Market presence likelihood			Recyclable
	/5	/5	/10	/5	/5	/5	/10	/10	/20	/25
Reused steel studs	0	2	10	5	5	5	8	10	20	25
Reused aluminum	4	3	10	4	5	5	2	10	20	25
CanDo!	5	5	3	3	5	2	10	7	10	0
Reused LVL	4	4	10	4	2	5	2	0	15	5
Dimensional lumber	5	5	3	3	5	2	10	5	5	0

Table 8



## Used framing material score

This is a graphical depiction of Table 8 (above) i.e. assessment of framing materials that are sourced used.



Bar Chart 4

## **Section 3: Paint**

This section presents four (4) tables and two (2) bar charts, offering a detailed evaluation of materials that can be used for framing in the exhibitions.

- Table 9 assesses GHG emission (GWP -global warming potential) and other environmental considerations, and health impacts of four paint brands available in Metro Vancouver. We focus on products of brands that have their highest environmental claims, as well as two products/brands that are commonly used by SAGE partner organizations.
- Bar chart 5 summarizes the environmental and health scores to compare the paint products with each other in graphical format (bar chart).

## Paints evaluation based on brands

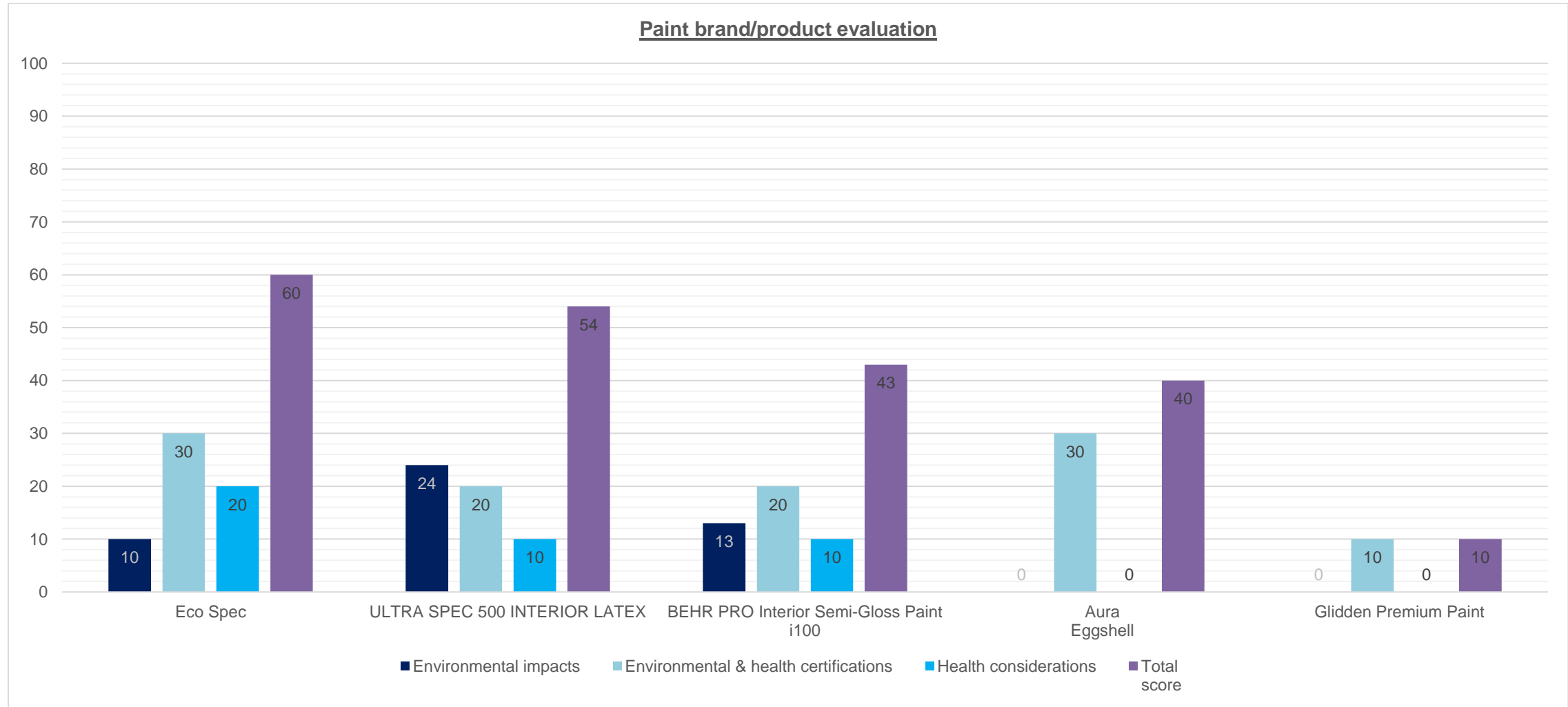
Type	Product name	Available in Metro Vancouver	Rating elements																	Total Score /100	
			Environmental impacts				Environmental & health certifications						Health considerations								
Paints (Latex)	Product name	Available in Metro Vancouver	EPD/Total GWP unit= kg CO2eq		EPD/ water use Unit=Litre		GREENGUARD Certification		Green Seal		MPI 11 Master painter institute extreme green performance		HPD		Formaldehyde Free - Claim Validation <sup>i</sup>		Zero VOCs and zero emissions		Asthma and allergy friendly		Total Score /100
			/20	/10	/10	/10	/10	/10	/10	/15	/10	/10	/10	/10	/5						
Benjamin Moore	Eco Spec	Yes	1.12	10	108	0	No	0	Yes	10	Yes	10	Yes	10	No	0	Yes	10	Yes	10	60
Benjamin Moore	ULTRA SPEC 500 INTERIOR LATEX	Yes	0.789	15	14.4	9	No	0	No	0	Yes	10	Yes	10	No	0	Yes	10	No	0	54
Behr	BEHR PRO Interior Semi-Gloss Paint i100	Yes	2.01	5	17.1	8	Yes	10	No	0	Yes	10	No	0	Yes	10	No	0	No	0	43
Benjamin Moore	Aura Eggshell	Yes	NA	0	NA	0	No	0	Yes	10	Yes	10	Yes	10	No	0	Yes	10	No	0	40
Glidden	Glidden Premium Paint	Yes	NA	0	NA	0	Yes	10	No	0	No	0	No	0	NO	0	No	0	No	0	10

Table 9

*Note:* The environmental assessments for all the materials presented in Table 9 are based on a volume of one kilogram of all paint products. At the time of this research project, only a limited number of paint brands and their products had Environmental Product Declarations (EPDs).

<sup>i</sup> "Formaldehyde-Free - Claim Validation" refers to the confirmation or validation process carried out by a third-party, such as Underwriters Laboratories (UL), to authenticate a product's claim of being free of formaldehyde. Founded in 1894, UL is a trusted third-party certification company based in Chicago, which dedicates itself to the safety and integrity of consumer products.

## Paint brand/product evaluation



Bar Chart 5

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## **Glossary of Terms:**

**Notes and definitions/explanations of certifications, declarations and other terms used in this report**



## 1. **Manufactured in BC**

It is beneficial for the wood products to be sourced locally in British Columbia (BC) for several reasons:

- Boosts Local Economy: Supports local businesses and jobs in forestry.
- Environmentally Friendly: Less transportation reduces carbon emissions.
- Sustainable Forestry: BC has a high percentage of certified, responsibly managed forests.
- Regulated Practices: Strict local regulations ensure sustainable harvesting.
- High Quality: Less transport time can result in fresher, higher-quality wood.
- Community Bond: Builds connection with the local environment and community.
- Green Energy Use: BC's hydroelectric-based grid powers wood processing, reducing carbon footprint.

## 2. **FSC -Forest Stewardship Council**

The Forest Stewardship Council (FSC) certification is an international system that guarantees a product comes from responsibly managed forests that provide environmental, social, and economic benefits. It promotes sustainable forestry practices, including biodiversity protection, worker safety, and community engagement. Products with FSC certification, like timber or paper, ensure consumers that they are supporting responsible forest management.

## 3. **SFI -Sustainable Forestry Initiative**

The Sustainable Forestry Initiative (SFI) certification is a standard that ensures forest management practices are sustainable, environmentally responsible, and socially beneficial. It covers key values such as the protection of biodiversity, wildlife habitat, and water quality, and encourages community involvement and adherence to local laws. Products with SFI certification, like timber and paper, assure consumers that they come from responsibly managed forests.

## 4. **Differences between FSC (Forest Stewardship Council) and SFI (Sustainable Forestry Initiative)**

There are certain differences between FSC (Forest Stewardship Council) and SFI (Sustainable Forestry Initiative) as follows:

- Origin and Recognition: FSC is an internationally-recognized organization with standards developed by a global consortium of stakeholders. On the contrary, SFI originated and is mainly recognized within North America, and its standards were primarily formed by forestry industry professionals.
- Chain of Custody: The chain of custody system in FSC is typically considered more stringent, requiring each company in the supply chain to have certification. In contrast, SFI permits a "fiber sourcing" certification where non-certified wood can be mixed in if it fulfills SFI's sourcing standards.
- Scale: FSC certification is generally seen more in tropical countries and smaller forest lands, whereas SFI certification is more prevalent in North America and on extensive forest lands.
- Certification Process: FSC certifications are conducted by independent third-party auditors, while SFI permits self-assessments in conjunction with third-party reviews.

## 5. **PEFC -Program for the Endorsement of Forest Certification**

The Program for the Endorsement of Forest Certification (PEFC) is an international non-profit, non-governmental organization dedicated to promoting sustainable forest management. A significant component of the PEFC certification system is the Chain of Custody which provides a mechanism for tracking certified material from the forest to the final product. It is a process of documenting and verifying that each step of the supply chain - from harvesting, through processing, manufacturing, and distribution - maintains the integrity of the certified status of forest-based materials.

It is of immense importance as it provides assurances to customers, consumers, and stakeholders about the origins of the forest-based material, ensuring they originate from responsibly-managed forests. It helps in validating sustainability claims and supports businesses in sourcing responsibly, thereby enhancing consumer trust in products and the brands behind them.

#### **6. EPDs -Environmental Product Declarations**

Environmental Product Declarations (EPDs) are standardized documents that communicate the environmental impact of a product or system. They provide transparent, verified, and comparable information about the lifecycle environmental impact of products, including data on a product's carbon footprint, water use, etc.

The most important metric published in an EPD is the product/product type's Global Warming Potential (GWP). With an increasing focus on embodied carbon, the GWP is what the industry uses to assess the extent to which the life of a product impacts the environment.

For wood products, the Global Warming Potential (GWP) indicates the quantity of CO<sub>2</sub> emissions released into the environment per cubic meter of the product, during the 'cradle to gate' process. The 'cradle to gate' process includes all stages from raw material acquisition to the point the product leaves the factory gate, but before it is transported to the user or consumer.

#### **7. LEED -Leadership in Energy and Environmental Design**

LEED is used in the building and real estate development sector to guide green building practices. LEED provides a framework for healthy, efficient, carbon and cost-saving green buildings. It addresses materials as well as building design and construction. LEED certification is a globally recognized symbol of sustainability achievement, and it is backed by an entire industry of committed organizations and individuals paving the way for market transformation. LEED certification of buildings (or urban developments) is done by a 3<sup>rd</sup> party and while planning and design may follow LEED guidelines and specifications, the LEED governing body awards the certification to qualifying buildings only after completion of construction.

#### **8. CARB -California Air Resources Board**

The California Air Resources Board (CARB) certification refers to a set of air quality standards set by the state of California, often regarded as the most stringent in the United States (and valued for their high environmental standards here in Canada as well). CARB certification primarily targets the emission levels of volatile organic compounds (VOCs) and formaldehyde from composite wood products.

Key points about CARB certification include:

- Air Quality Standards: CARB certification ensures that composite wood products meet stringent air quality standards.
- Formaldehyde Emission Control: The certification mandates that formaldehyde emissions from composite wood products stay below set levels, reducing the risk of exposure.
- Product Scope: The certification applies to a range of products, including hardwood plywood, particleboard, and medium-density fiberboard (MDF).
- Market Requirement: For many products, obtaining CARB certification is necessary to access the Californian and, in many cases, the wider U.S. market.
- Health Protection: By limiting harmful emissions, CARB certification helps protect public health.
- LEED Compliance: The Leadership in Energy and Environmental Design (LEED v4) standards for sustainable building, specifically under the materials section, recognize and encourage compliance with CARB certification. This means that using CARB-certified materials can contribute to earning LEED points, helping projects achieve higher levels of LEED certification.

## 9. HPDs -Health Product Declarations

HPDs are standardized reports that provide detailed information about the materials (chemicals, etc.) and health effects associated with products used in the built environment. HPDs are used as a tool for architects, designers, and consumers to make informed decisions about the products they select for their projects.

Key points about HPDs include:

- Transparency: HPDs provide transparency about the ingredients in building products, helping stakeholders understand the potential health impacts.
- Material Health: They provide data on the health effects of the materials in a product, which can guide safer product selections.
- Standardization: The HPD Open Standard provides a consistent format for reporting product content and associated health information.
- Third-Party Verification: Products with HPDs have been independently verified, adding credibility to their health claims.
- LEED Points: HPDs can contribute to achieving Material Ingredient reporting credits under the LEED v4 and v4.1 rating systems.

Unlike industries such as paints, the development of HPDs for wood products is still ongoing. As such, they are less common but are becoming increasingly important for transparency in the building materials industry.

## 10. GREENGUARD Certification

GREENGUARD Certification is part of the UL (Underwriters Laboratories) Environment's family of marks. It provides third-party certification for products and materials that have low chemical emissions, improving the quality of the air in which the products are used.

Key points about GREENGUARD Certification include:

- Air Quality: Products that are GREENGUARD certified to contribute to healthier indoor air by limiting their chemical emissions.
- Chemical Emission Standards: The certification ensures that products meet some of the world's most rigorous chemical emissions standards, reducing exposure to chemicals and pollutants.
- Product Scope: The certification applies to a variety of product categories, including building materials, furnishings, electronics, cleaning and maintenance products, and more.
- Third-Party Verification: It provides third-party verification that products have been tested for their chemical emissions performance.

## 11. The Master Painters Institute (MPI)

The Master Painters Institute (MPI) is an organization that sets standards for the painting and coatings industry. MPI's Green Performance is a certification program that categorizes paint and coatings based on their environmental friendliness and sustainability.

## 12. Building lifecycle vs. exhibition lifecycle

The life cycle of buildings in the construction industry often extends beyond a century. Therefore, it may be reasonable to use high greenhouse gas (GHG) emitting materials like steel or aluminum if you consider their durability and longevity for use over many decades. However, this logic does not hold for exhibition construction, which typically lasts less than a year. While the SAGE project encourages materials re-use, we do not anticipate such long-term use due to the high turnover of exhibitions which will require constant materials manipulation (assembly, disassembly, painting, cutting, etc.). Therefore, choosing to use new materials with high GHG emissions associated with their sourcing and manufacture does not make sense for arts sector exhibitions and staged events that are seeking to reduce their environmental impact. However, if there are used versions of these materials available (that perhaps may otherwise go to waste), these used materials may be an appropriate choice. For example, purchasing (or acquiring) used steel or aluminum studs for reuse.