

Environmental Product Declaration

Typical Western Red Cedar Bevel Siding “½ x 6” Clear Grade, Painted

Type III environmental declaration developed according to ISO 21930 and 14025 for average cedar siding products manufactured by the members of the Western Red Cedar Lumber Association.

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Manufacturer Information

This EPD addresses products from multiple manufacturers and represents an average for the membership of the Western Red Cedar Lumber Association (WRCLA), a non-profit trade association representing manufacturers of western red cedar products. This average is based on a sample that included two lumber mills in British Columbia (BC), Canada and three remanufacturing mills (two in BC and one in Washington State, USA), which represented 12% and 18% of western red cedar lumber and siding production respectively, in 2007.

Product Description

Wood siding is a board-type weatherproof product applied to a building as a final surfacing for exterior walls. Western red cedar siding is produced in various dimensions and different profiles (shapes) including bevel, board and batten, tongue and groove, and channel. This EPD addresses the following product:

- Cedar siding type: Bevel siding
- Board size: "½ x 6" (12.7 mm x 152.4 mm)
- Grade: Clear
- Product composition (on the basis of 1 m² installed siding with a 50-year service life):
 - Western red cedar lumber: 4.65 kg (oven-dry basis) (0.0141 m³)
 - Coatings
 - Alkyd primer (solvent-based): 0.20 litres
 - Acrylic paint (water-based): 0.93 litres
 - Fasteners (6D 2" galvanized nails): 0.05 kg
- Installed and used according to Western Red Cedar Lumber Association specifications (See http://www.wrcla.org/installation_and_finishing/finishing_siding/default.htm). Information reported here is for a product that is painted on installation and then repainted every 15 years.



Scope: Cradle-to-grave.

Functional unit: 1 m² of siding assumed installed over a wood-frame wall.

Service life: 50 years.

System boundary: Life cycle activities from resource extraction through product use for a 50-year life span inclusive of maintenance, replacement and end-of-life effects. Wood-framed wall substructure is excluded as it is common to other siding types.

Geographic boundary: North America.

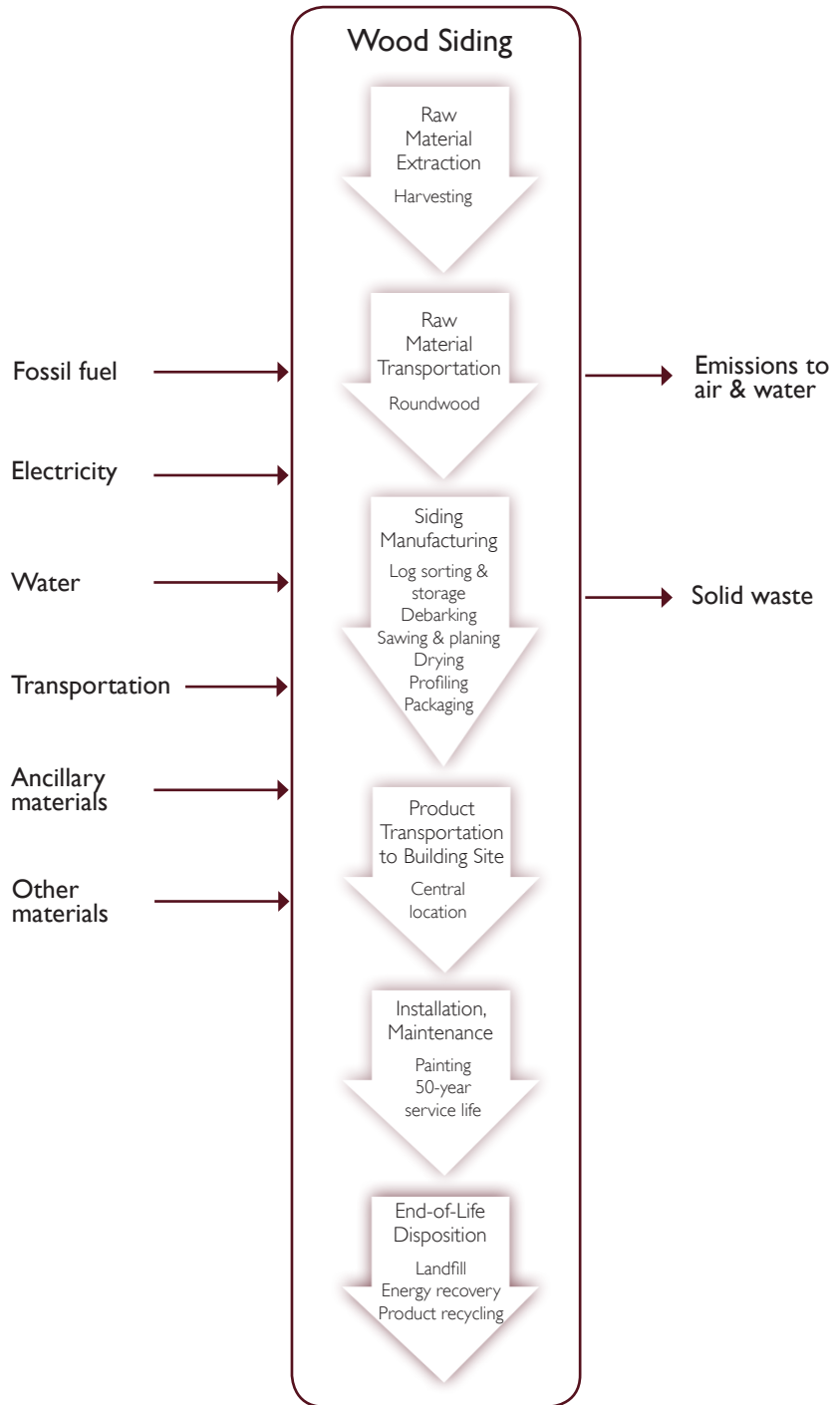
Life Cycle Assessment

Life cycle assessment (LCA) is a rigorous study of inputs and outputs over the entire life of a product or process and the associated environmental impact of those flows to and from nature. The underlying LCA supporting this EPD was performed by FPIInnovations for WRCLA in 2009 and was third-party peer-reviewed by two organizations. The LCA study collected primary data from western red cedar lumber and siding manufacturing operations in 2008 for the production year 2007.

The system boundary includes all the production steps from extraction of raw materials from the earth (the cradle) through to final fate of the product at the end of its service life (the grave). See Figure 1. The boundary includes the transportation of major inputs to, and within, each activity stage including the shipment of products to a hypothetical building site location in North America and eventual transportation to landfill. The city of Minneapolis, USA was chosen as the typical building location, as a central location in North America.

Ancillary materials and other materials such as coatings, fasteners and packaging are included in the boundary unless below the cut-off criteria. Mass or energy flows are excluded if they account for less than 1% of model flows and less than 2% of life cycle impacts in all categories. Human activity and capital equipment are excluded. For the use phase, the consumption of water and cleaning solutions is common to all siding types and is excluded.

Figure 1. System boundary and process flows



Fifty years is the expected life span for cedar siding according to WRCLA. This figure is supported by expert opinion, anecdotal evidence and product warranty claims. A 15-year repainting schedule is used based on manufacturer warranties. According to cedar siding industry standards, an initial flood-coat primer and paint finish is applied with a 15 to 20 year service life. The final painting at year forty-five is fully allocated to the siding as a conservative approach, rather than pro-rated to reflect the remaining life span of the final paint coat at year fifty.



End-of-life assumptions

In the LCA used for this EPD, materials at the end of their service life are assumed to be transported through municipal solid waste collection to inert material landfills, as is estimated by Franklin Associates to be the fate for 70 to 80% of construction and demolition debris (USEPA, 1998). Organic materials in landfills decompose into the greenhouse gases methane and carbon dioxide; the methane portion of which may be captured for heat recovery or flaring. The USEPA (2006) estimates that 59% of landfills are equipped with gas collection systems and 75% of emitted gases are captured; of that, 53% is burned for energy recovery and 47% is flared. The handling of municipal solid waste is modeled with representative process data provided in the ecoinvent database (Doka, 2007), with electricity-fuel breakdown, energy supply chain, and combustion processes substituted with USLCI data. Wood products are known to not completely decompose in landfill (leaving some or most of the carbon essentially in permanent storage); estimates for the proportion of wood that will decompose vary from very low to the most recent estimate of 23% (Skog, 2008). The figures discussed in this paragraph are directly applied in the LCA, along with the assumption that landfill gas is equal parts carbon dioxide and methane.

Environmental Performance

The U.S. Environmental Protection Agency's TRACI (Tool for the Reduction and Assessment of Chemical and other Environmental Impacts) life cycle impact assessment methodology is used to characterize the flows to and from the environment. Energy and material resource consumption, waste and impacts per functional unit of cedar siding are shown in Table 1. Impact measures shown are global warming potential (GWP), acidification potential, eutrophication potential, smog potential, and ozone depletion potential. The LCA model tracks overall life cycle carbon emissions, including those from biomass combustion. Carbon emissions are addressed in the GWP measure, which reports all carbon fluxes, including the carbon stored in the product and all carbon emissions throughout the product life cycle. A carbon balance at each life cycle stage is also shown on page 8. Landfilling is the assumed end-of-life fate. Landfill gas emissions and management are modeled per a USA average (see page 3). Water consumption does not include the amount of water consumed for maintenance (periodic washing) during use, as it is difficult to estimate and common to all siding types.

Allocation of environmental burdens to cedar siding and its co-products is done according to economic allocation principles. Environmental burdens are allocated entirely to cedar siding due to the low value of co-products relative to ½" cedar bevel siding (95% of the revenue flows are associated with the main product).

Table 1. Environmental performance, base case

Impact category	Unit	Per 1 m ² of siding	Per 100 ft ² of siding
Total primary energy:	MJ	280.08	2601.96
Non-renewable, fossil	MJ	138.84	1289.80
Non-renewable, nuclear	MJ	8.28	76.89
Renewable (SWHG)	MJ	17.00	157.97
Renewable, biomass	MJ	4.50	41.81
Feedstock, non-renewable fossil	MJ	6.46	60.00
Feedstock, renewable biomass	MJ	105.00	975.49
Renewable material consumption (wood)	kg	4.65	43.24
Non-renewable material consumption (nails, paint)	kg	0.37	3.42
Fresh water use	L	1.01	9.40
Total waste	kg	5.02	46.66
Hazardous	kg	0.00	0.00
Non-hazardous	kg	5.02	46.66
Global warming potential (GWP)	kg CO ₂ eq	4.64	43.11
Acidification potential	H+ moles eq	4.15	38.59
Eutrophication potential	kg N eq	6.71E-03	6.23E-02
Smog potential	kg NO _x eq	6.17E-02	5.73E-01
Ozone depletion potential	kg CFC-11 eq	3.20E-07	2.97E-06
SWHG: Solar, wind, hydroelectric and geothermal Note: GWP includes all biogenic carbon sinks and sources throughout the product system boundary.			





About 60% of energy use associated with 1/2" cedar bevel siding over its lifetime is attributed to harvesting and manufacturing of the product. Another 32% of the lifetime energy consumption occurs during installation and use, largely due to periodic repainting of the siding. Only 8% of total energy use is due to transportation of the product to a building site. Energy used during disposal at end-of-life is negligible, at about 0.1% (Figure 2).

The types of energy used in the life cycle of 1/2" cedar bevel siding are shown in Figure 3. Fossil fuels are the predominant source at 82%. Biomass (wood fuels, typically from recovered waste within the facility itself) comprises only 3% of the energy.

Coatings (primer and paint) are a significant contributor to the environmental profile of painted cedar siding (Table 2). Impacts for cedar siding are reduced if the siding is left uncoated, or if coating products are improved for reduced environmental impact.

Figure 2. Proportional consumption of primary energy by life cycle stage

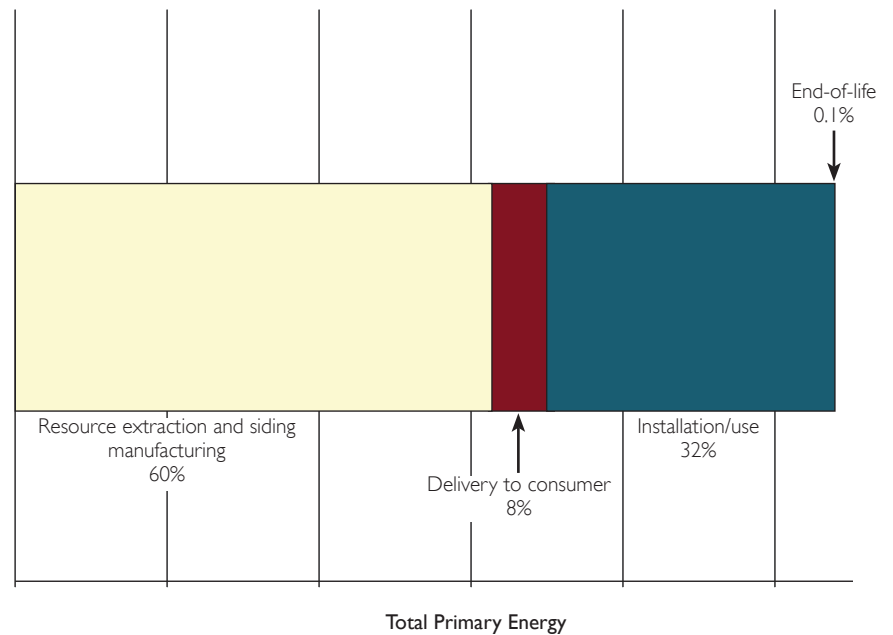


Figure 3. Total primary energy, proportional by source

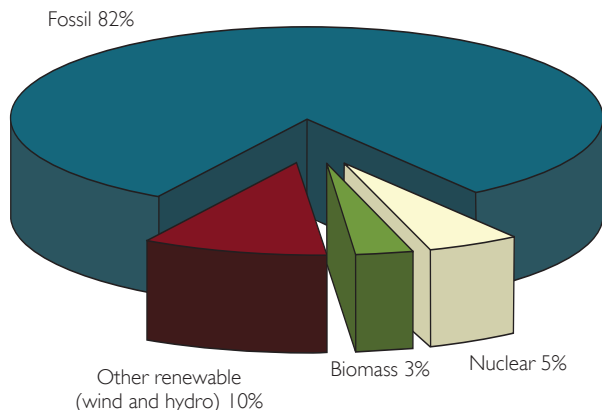


Table 2. Contribution by material, from cradle to end-of-use phase

Impact category	Total	Percent contribution by material			
		Cedar boards	Nails	Alkyd primer	Acrylic paint
Fossil energy use	100%	44.03	1.62	18.39	35.96
Global warming potential	100%	53.82	3.19	10.85	32.14
Acidification potential	100%	73.15	1.39	8.20	17.27
Eutrophication potential	100%	18.01	5.98	46.98	29.03
Smog potential	100%	86.05	0.56	4.21	9.18
Ozone potential	100%	0.67	0.15	33.61	65.57

Note: GWP includes biomass combustion CO₂.

Glossary

Primary Energy Consumption

Primary energy is the total energy consumed by a process including energy production and delivery losses. Energy is reported in megajoules (MJ).

Global Warming Potential

This impact category refers to the potential change in the earth's climate due to accumulation of greenhouse gases and subsequent trapping of heat from reflected sunlight that would otherwise have passed out of the earth's atmosphere. Greenhouse gas refers to several different gases including carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). For global warming potential, these gas emissions are tracked and their potencies reported in terms of equivalent units of CO₂.

Acidification Potential

Acidification refers to processes that increase the acidity of water and soil systems as measured by hydrogen ion concentrations (H⁺) and are often manifested as acid rain. Damage to plant and animal ecosystems can result, as well as corrosive effects on buildings, monuments and historical artifacts. Atmospheric emissions of nitrogen oxides (NO_x) and sulphur dioxide (SO₂) are the main agents affecting these processes. Acidification potential is reported in terms of H⁺ mole equivalent per kilogram of emission.

Eutrophication Potential

Eutrophication is the fertilization of surface waters by nutrients that were previously scarce, leading to a proliferation of aquatic photosynthetic plant life which may then lead to further consequences including foul odor or taste, loss of aquatic life, or production of toxins. Eutrophication is caused by excessive emissions to water of phosphorus (P) and nitrogen (N). This impact category is reported in units of N equivalent.

Smog Potential

Photochemical smog is the chemical reaction of sunlight, nitrogen oxides (NO_x) and volatile organic compounds (VOCs) in the atmosphere. Ground-level ozone is an indicator, and NO_x emissions are a key driver in the creation of ground-level ozone. This impact indicator is reported in units of NO_x equivalent.

Ozone Depletion Potential

This impact category addresses the reduction of protective ozone within the atmosphere caused by emissions of ozone-depleting substances such as chlorofluorocarbons (CFCs). Reduction in ozone in the stratosphere leads to increased ultraviolet-B radiation reaching earth, which can have human health impacts as well as damage crops, materials and marine life. Ozone depletion potential is reported in units of equivalent CFC-11.

Source: Bare et al, 2003.



Additional Environmental Information

Improved performance with alternate end-of-life scenario

Western red cedar siding has an improved life cycle environmental footprint if at least some of the product is diverted from landfill at end-of-life and used for energy recovery and/or product reuse. An alternate scenario for end-of-life disposition is shown in Table 3. In this case, at the end of its service life, 50% of the cedar siding is recovered for bioenergy (replacing fossil fuel consumption), 25% is reused, and 25% is landfilled. This improves GWP by lengthening product life (25% remains in service) and reducing landfill greenhouse gas emissions. GWP further improves when taking into account the avoided fossil fuel use and associated reduction in greenhouse gas emissions from recycling discarded siding boards for bioenergy. In this scenario, the product becomes a net carbon retainer (a pool) rather than a minor greenhouse gas contributor as in the base case landfilling scenario.

Table 3. Environmental performance, alternate end-of-life scenario

Impact category	Unit	Per 1 m ² of siding	Per 100 ft ² of siding
Total primary energy:	MJ	247.10	2295.57
Non-renewable, fossil	MJ	83.87	779.18
Non-renewable, nuclear	MJ	8.08	75.03
Renewable (SWHG)	MJ	16.95	157.44
Renewable, biomass	MJ	26.74	248.43
Feedstock, non-renewable fossil	MJ	6.46	60.00
Feedstock, renewable biomass	MJ	105.00	975.49
Renewable material consumption (wood)	kg	4.65	43.24
Non-renewable material consumption (nails, paint)	kg	0.37	3.42
Fresh water use	L	1.01	9.40
Total waste	kg	5.02	46.66
Hazardous	kg	0.00	0.00
Non-hazardous	kg	5.02	46.66
Global warming potential (GWP)	kg CO ₂ eq	-2.28	-21.19
Acidification potential	H+ moles eq	2.86	26.55
Eutrophication potential	kg N eq	6.50E-03	6.10E-02
Smog potential	kg NO _x eq	5.96E-02	5.54E-01
Ozone depletion potential	kg CFC-11 eq	3.20E-07	2.97E-06
SWHG: Solar, wind, hydroelectric and geothermal			
Note: GWP includes all biogenic carbon sinks and sources throughout the product system boundary.			

Carbon balance

The carbon that is part of the molecular composition of wood is derived from carbon dioxide removed from the atmosphere by the growing tree that produced the wood; this carbon is often a consideration in greenhouse gas calculations and carbon footprints for wood products. At the manufacturing gate, wood products are typically carbon-negative; that is, more carbon is stored in the product than was emitted during harvesting and manufacturing. Emissions from transportation to a building site, product maintenance such as repainting, transportation to landfill, and decomposition in landfill can render wood products into net carbon emitters at the end of the full life cycle. See Tables 4 and 5 for the carbon balance at each life cycle stage, that is, the net carbon footprint per functional unit considering the carbon contained in the wood (a negative number) and the life cycle carbon emissions (a positive number). A negative number indicates a net climate change benefit (a greenhouse gas removal); a positive number is a net greenhouse gas emission. One square meter of 1/2" cedar bevel siding stores the equivalent of 8.53 kilograms of CO₂. The sum of the greenhouse gas emissions during harvesting, manufacturing, transportation, installation and maintenance are less than 8.53 kg CO₂eq, meaning at the end-of-use phase, cedar siding is still net carbon negative (i.e., a carbon pool). However, at the complete end-of-life (end of landfill decomposition and product/energy recovery processes), under the landfill assumptions in the underlying LCA for cedar, cedar siding is ultimately a minor source of greenhouse gas emissions.

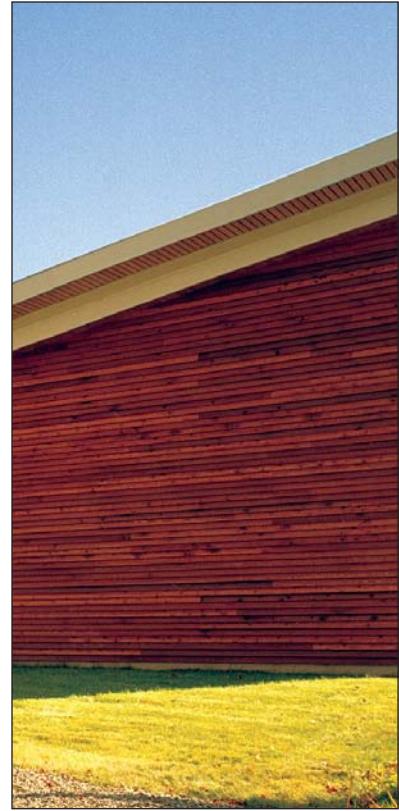


Table 4. Carbon balance per 1m² of cedar siding

	kg CO ₂ eq	
	Base case end-of-life scenario 100% landfill	Alternate end-of-life scenario 50% energy recovery, 25% reuse, 25% landfill
Forest carbon uptake	-8.53	-8.53
GWP harvesting and manufacturing	4.77	4.77
Net carbon balance cradle-to-gate	-3.77	-3.77
GWP transportation to customer	0.96	0.96
Net carbon balance cradle-to-site	-2.80	-2.80
GWP installation and use	2.30	2.30
Net carbon balance cradle-to-end-of-use	-0.50	-0.50
GWP end-of-life processes	5.14	-1.78
Net carbon balance cradle-to-grave	4.64	-2.28

GWP: Global Warming Potential
Note: GWP includes all biogenic carbon sinks and sources throughout the product system boundary.



Table 5. Carbon balance per 100 ft² of cedar siding

	kg CO ₂ eq	
	Base case end-of-life scenario 100% landfill	Alternate end-of-life scenario 50% energy recovery, 25% reuse, 25% landfill
Forest carbon uptake	-79.27	-79.27
GWP harvesting and manufacturing	44.28	44.28
Net carbon balance cradle-to-gate	-34.99	-34.99
GWP transportation to customer	8.95	8.95
Net carbon balance cradle-to-site	-26.04	-26.04
GWP installation and use	21.36	21.36
Net carbon balance cradle-to-end-of-use	-4.68	-4.68
GWP end-of-life processes	47.79	-16.51
Net carbon balance cradle-to-grave	43.11	-21.19

GWP: Global Warming Potential
 Note: GWP includes all biogenic carbon sinks and sources throughout the product system boundary.

Alternate allocation method

In a production process where more than one product is generated, it is necessary to allocate the environmental impacts from manufacturing in some proportional manner to the various products. This is most typically done based on mass of the co-products. However, if a co-product has far less economic value than the main product, it may be more appropriate to allocate proportionally by value. In such cases, a conservative approach is to allocate 100% of the environmental burdens to the main product. For many wood products, a co-product (or by-product) is wood chips, which typically have market value as feedstock for other forest products, as mulch, or as fuel. In the LCA study underlying this EPD, the value of this by-product was found to be very low, hence 100% allocation to the main product was used. Had that study reported LCA results using allocation by mass, the numbers shown in Tables 1 and 3 would be reduced by two-thirds.

Sustainable forestry

Western red cedar products from WRCLA members come from forests that are independently certified as legal and sustainable.

References

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About this EPD

PCR:

North American Structural and Architectural Wood Products. April 2011. Prepared by FPIInnovations and available at www.fpinnovations.ca. PCR panel chaired by Wayne Trusty.

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Cradle-to-grave LCA results can be used for comparison between different EPDs provided products and systems have been assessed on the basis of the same function, quantified by the same functional unit in the form of their service life reference flows. EPDs from different programs may not be comparable.

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EPDs do not address all issues of relevance to sustainability.

