ENVIRONMENTAL LIFE - CYCLE ASSESSMENT

GETTING AWAY FROM IT ALL

WORKSPACE BY SEBASTIAN COX WITH TERENCE CONRAN

MADE IN AMERICAN RED OAK AND CHERRY

THE·WISH·LIST

SUMMARY

The workspace is composed primarily of two American hardwoods – Cherry and Red oak – which are abundant and under-utilised. The US resource of both hardwoods is large and expanding. Use of these timbers, combined with strong craftsmanship skills – with their emphasis on efficient material and energy use - contribute to a strong environmental profile. The carbon footprint of the workspace is extraordinarily low for such a large and striking piece. Much of the energy input into material production derives from renewables. The waste wood produced during manufacturing and at End Of Life can be used for energy production, thereby offsetting use of fossil fuels.

Of course it would be a shame for such workmanship to be sent to the incinerator too soon. Such an outcome seems unlikely - the quality, beauty and durability of the design suggest the workspace will remain in use and act as a carbon store for many years. Such longevity also reduces the need for replacement, mitigating the significant acidification and POCP environmental impacts of material supply and manufacturing.

WOOD RESOURCE

The wood content of the workspace comprises about one third cherry and two thirds red oak. Red oak is the most abundant hardwood in the U.S. forest accounting for 19% of wood volume. U.S. cherry accounts for 2.7% of U.S. hardwood growing stock. U.S. government forest inventory data[1] shows that U.S. red oak is growing 51.9 million m^3 per year while the harvest is 32.4 million m^3 per year. U.S. cherry is growing 8.6 million m^3 per year while the harvest is 3.5 million m^3 per year. After harvesting, an additional 19.5 million m^3 of red oak and 5.1 million m^3 of cherry accumulate in U.S. forests every year. It takes less than five seconds for new growth in the U.S. forest to replace the hardwood required for the workspace.

CARBON FOOTPRINT

On a cradle to grave basis, the carbon footprint of the workspace is 53 kilograms of CO_2 equivalent. That's roughly equivalent to the carbon emissions of driving 240 miles (380 km) by the average UK car[2].

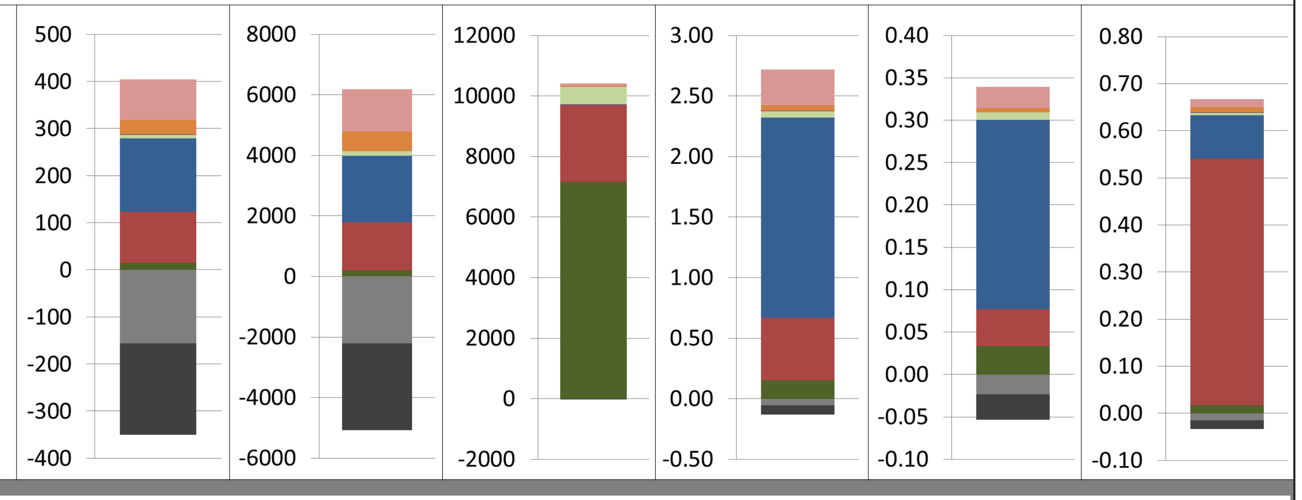
Carbon emissions during all stages of material extraction and processing, product manufacturing, and transport are 404 kilograms of CO_2 equivalent. Of these emissions, 279 kilograms of CO_2 equivalent are associated with processing and supply of American red oak and ash to the UK. However these are offset by 351 kilograms of avoided carbon emissions resulting from substitution of fossil fuels through reuse of wood waste.

Only 86 kilograms of carbon emissions are due to the electrical energy used at Benchmark – a testament to the efficiency of the manufacturing process. An additional 30 kilograms of carbon emissions are due to the glues. Use of other non-wood materials is negligible. Efficient utilisation of material means that there is relatively little manufacturing waste associated with this product. The credits received for energy production from wood waste during manufacturing are about equivalent to those received from final disposal at End of Life.

CRADLE TO GRAVE ENVIRONMENTAL IMPACT OF WORKSPACE

Impact category	Global Warming Potential	Primary energy demand (resources)	Primary energy demand (renewable)	Acidification Potential	Eutrophication Potential	Photochemical Ozone Creation Potential
Unit	kg CO2-Equiv.	MJ	MJ	kg SO2-Equiv.	kg Phosphate-Equiv.	kg Ethene-Equiv.
Total	53	1112	10398	2.59	0.29	0.63

Data by process steps



Key ■ Forestry ■ US processing ■ Transport ■ Other wood ■ Other Materials ■ Glues & Coatings ■ UK processing ■ Process waste ■ End of Life

OTHER IMPACTS

The total eutrophication potential of the workspace is 0.29 kg of phosphate equivalent about the same as caused each year by conventional farming of 130 square meters of land for wheat in the UK[3].

Nearly all eutrophication potential of the workspace is due to nitrate emissions during burning of fuels for transport and processing of materials. Hardly any eutrophication potential is linked to growth of U.S. hardwoods which thrive under natural conditions and very rarely require fertilisers.

Given the low impact across other categories, the workspace's acidification potential of 2.59 kg of SO_2 equivalent is relatively more significant. Much of the acidification potential results from emissions during shipping of hardwoods from the U.S. to the UK and is due to the relatively high sulphur content of marine fuels.

The workspace has a POCP of 0.63 kg of Ethene equivalent. The processing of U.S. hardwood is the main contributor to this environmental impact due to the presence of terpenes, naturally occurring VOCs, in wood resin. Although terpenes are released naturally as trees grow, processes in which wood is heated lead to more significant emissions.

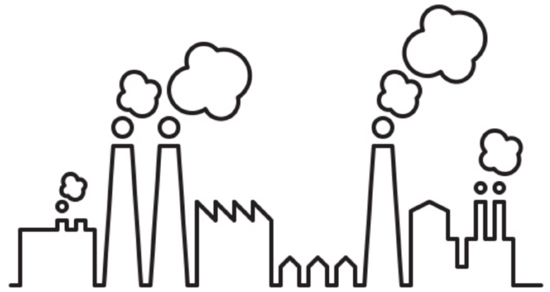
The large apparent input of renewable energy – 10398 megajoules – is due partly to the high proportion of thermal energy derived from burning of wood waste during the hardwood kiln drying process. At least 90% of all thermal energy used for kiln drying in the U.S. hardwood sector is derived from biomass.

The high proportion of renewable energy attributed to the forestry stage is a peculiarity of life cycle inventory rules for wood products and has nothing to do with the energy used during forestry operations. It is the solar energy that is absorbed by the tree during growth and converted into chemical energy within the wood itself. In other words it is the energy that would have been released if the wood were burnt immediately after harvest.

MATERIALS USED FOR THE WORKSPACE

Wood materials	Use	Volume (m^3)
American cherry sawn 25mm	Main structure	0.38
American cherry sawn 50mm	Main structure	0.024
American cherry veneer	Main structure	0.00115
American red oak sawn 25mm	Screen	0.135
American red oak sawn 50mm	Screen	0.72
Spruce plywood	Reusable moulds	0.005784
Birch plywood	Reusable moulds	0.0427
Other materials	**Use**	**Quantity**
Screws	Bonding	96g
Glue	Bonding	3673g
Dominoes	Jointing	72g
Osmo white oil	Finish	400ml

ENVIRONMENTAL IMPACT CATEGORIES

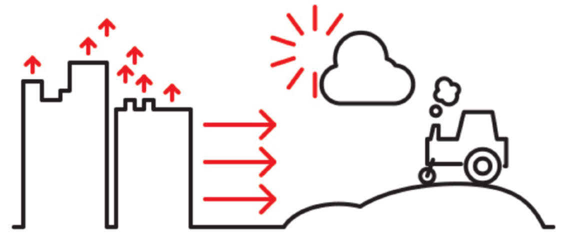


1 PRIMARY ENERGY DEMAND (NON-RENEWABLE RESOURCES)

This is a measure of the total demand of primary energy that comes from non-renewable resources, such as oil and natural gas. Measured in gigajoules (GJ), the primary energy demand takes into account the conversion efficiencies from the primary energy to, for example, electricity. The generation of carbon dioxide from the production of energy is one of the major causes of global warming.

2 PRIMARY ENERGY DEMAND (RENEWABLE RESOURCES)

Like the primary energy demand from non-renewable resources, this is a measure of the total amount of primary energy, but in this case, derived from renewable sources such as hydropower and wind energy. Again, it takes conversion efficiencies into account where appropriate. Total primary energy demand can be measured by adding the figures for energy from non-renewable and renewable resources

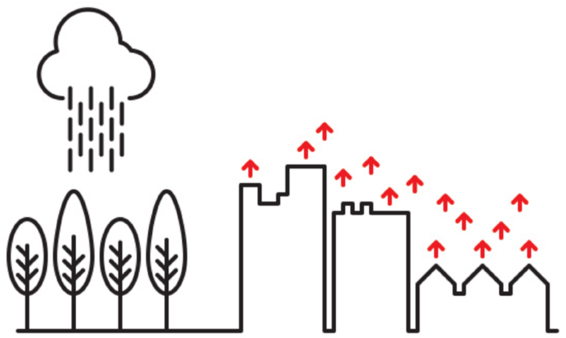


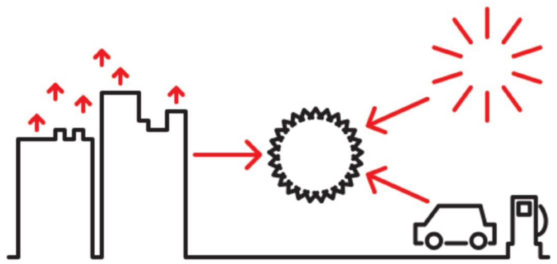
3 GLOBAL WARMING POTENTIAL (GWP)

Global warming is usually regarded as one of the most significant environmental issues. Global Warming Potential, measured in kg CO2 equivalent, is also a good marker for other environmental impacts. It is calculated from the volumes of greenhouse gases, such as carbon dioxide and methane, emitted during a process.

4 ACIDIFICATION POTENTIAL (AP)

This is a measure of the emissions that cause acidifying effects to the environment, which can cause imbalances and the death of species. Emissions of sulphur dioxide and nitrous oxide result in acid rain which can fall some way from the place where the emissions occur. Acidification potential is measured in kg of sulphur dioxide equivalent.





5 EUTROPHICATION POTENTIAL (EP)

Eutrophication is the process by which water receives an excessive amount of nutrients, particularly phosphates and nitrates. These nutrients, which typically come from run-off from fertilisers, lead to algal blooms which, in turn, deprive the water of oxygen and lead to imbalances and deaths in the aquatic populations. Eutrophication is measured in terms of kg of phosphate equivalent, and kg of nitrogen equivalent.

6 PHOTOCHEMICAL OZONE CREATION POTENTIAL (POCP)

This is a measure of emissions or precursors that contribute to low-level smog. It is measured in kg of ethene equivalent. Ozone layer depletion potential (ODP) is also part of the i-report but is not included in the charts because the effect is negligible. There may seem to be a contradiction between these two impacts but, put simply, high-level ozone is good and should be protected, whereas ozone at ground level is a pollutant.

NOTES

1. Figures based on 2011/2012 data from the U.S. Forest Service Forest Inventory and Analysis (FIA) program at http://www.fia.fs.fed.us/
2. Assumes average CO_2 emissions of 139g/km for all the UK's major new cars calculated by Carpages at http://www.carpages.co.uk/co2/
3. Based on Williams *et al* 2010 at Cranfield Natural Resources Management Institute who for 1 tonne of bread wheat from conventional farming in the UK assessed Eutrophication Potential of 3.1 kg of phosphate equivalent and average occupation of 0.14 hectares of Grade 3a agricultural land.

ENVIRONMENTAL LIFE-CYCLE ASSESSMENT

Environmental life-cycle assessment (LCA) involves the collection and evaluation of quantitative data on all the inputs and outputs of material, energy and waste flows associated with a product over its entire life cycle so that the environmental impacts can be determined. LCA quantifies environmental effects against a range of impact categories (see page 3). LCA may also provide qualitative assessment of other environmental impacts such as on biodiversity and land-use that are less easy to quantify.

The LCA of The Wish List builds on a two-year study, commissioned by AHEC and undertaken by PE International, to assess environmental impacts associated with delivery of US hardwood material into world markets[a]. This involved a wide-ranging independent assessment of hardwood forestry practices and a survey of the hundreds of US companies engaged in the processing and export of hardwood products.

Life cycle inventory data from the LCA of US hardwoods was combined with data gathered during product manufacture at Benchmark in the UK.

It was also combined with PE's existing life-cycle inventory database which covers an expanding range of non-wood materials and product groups.

Using PE's Gabi software for LCA, the data was analysed to quantify environmental impacts.

To model the cradle-to-grave impact of the workspace, the following assumptions are made about waste disposal during manufacture at Benchmark and at the end of the product's life.

- 80% of hardwood waste is used as a fuel for biomass boilers, substituting for light fuel oil.
- The remaining 20% of hardwood waste is re-used for other products (no benefits have been modelled for this option).
- 50% of the plywood for the jig is discarded and sent for waste incineration with electricity and thermal energy recovery. This is reported in the 'process waste' stage.
- The final disposal of the plywood (the remaining 50%) occurs in the same way but is reported in the 'End of Life' stage
- Other parts (including glues, coatings, fittings, etc.) are incinerated with electricity and thermal energy recovery using appropriate datasets.

These assumptions are based on information gathered from Benchmark about its standard procedures for use of waste and from secondary sources about waste-disposal practices in the UK.

a. The PE LCA study of US sawn hardwood is available at http://www.americanhardwood.org/fileadmin/docs/sustainability/Final_LCA_Lumber_report.pdf