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# An Analysis of the Economics of Recycled Plastic Lumber vs. Tropical Hardwoods vs. Pressure-treated Domestic Softwoods for a Hypothetical Boardwalk Project

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Numerous alternative materials exist for use in waterfront and coastal construction of piers, docks, marinas, boardwalks, bulkheads, ferry terminals and bridges. Each material has economic, social and environmental costs.

Rainforest Relief has analyzed the costs associated with the use of commonly used materials and their alternatives: chemically-treated softwoods (while CCA is being phased out for residential use, at this time the continuing use of CCA for commercial and municipal applications is unclear and in all likelihood, CCA's replacement will cost about the same and last about as long); structural recycled plastic lumber; structural recycled plastic lumber with I-beam construction; a recycled plastic/wood composite; ipê, a tropical hardwood logged in Brazil; black locust, a domestic hardwood from an independently certified operation.

For the analysis, a theoretical boardwalk renovation project was envisioned. The project has two sections, one in which the boardwalk is being entirely rebuilt from the ground up, ultimately utilizing 100,000 board feet of decking (10,715 14'-long 2"x4" beams) as well as the material for the understructure (see figure 1); and another section in which only the 100,000 board feet of decking is being replaced.

The costs associated with renovations to each of the two sections with the various materials was analyzed for eight factors that contribute to costs either immediately or over the life-span of the project: **Materials Purchase Cost, Installation, Durability, Other Maintenance, Additional Personnel Costs, Liability, Disposal Costs,** and **Fires.** For each of the factors the costs or savings were extended based on a life span for the project of 100 years. It is very reasonable to assume that these installations are expected to last that long based on existing projects. New York City's boardwalks were first built in the 1920s; Atlantic City's — the nation's first oceanside boardwalk — was built in the 1890s. No one assumes that any of the other boardwalks having existed for forty years or more or any of the more recent boardwalks, such as Greenport, NY or Yonkers, NY will be dismantled in fifteen years — the typical lifespan of the pressure-treated softwoods typically used for these projects.

While the analysis is based on a theoretical project the costs associated with the purchase, maintenance and other aspects are real, based on research of actual projects and product suppliers as well as interviews with numerous people involved in the installation and maintenance of actual boardwalks in the New York metropolitan region.

For the tropical hardwoods, while greenheart (Guyana), ekki (West Africa) and apitong (Borneo) are all also used for decking, ipê was chosen for the analysis since it has become the most common tropical hardwood used for both municipal and residential decking projects in the U.S.

For recycled plastic lumber, the analysis of costs, durability and maintenance were based on products from two companies, both of whom make a structural recycled plastic lumber suitable for load-bearing decking and structural support members.

Exposing and Challenging Rainforest Consumption

RAINFOREST RELIEF PO Box 298 • Church Street Station • New York, NY 10008 917/543-4064 • info@rainforestrelief.org • www.rainforestrelief. For the CCA, a lifespan of twelve (12) years was used. This is based on numerous published reports as well as ten years of organizational experience and communications with users of the material. Personal communications regarding CCA have quoted lifespans of as little as seven (7) years but as much as fifteen (15) years.

For ipê, a lifespan of twenty-five (25) years was used. While companies typically guarantee the material for twenty (20) years, New York City entirely replaced the ipê on the Coney Island section of the boardwalk after approximately thirty (30) years. By then, the wood was heavily checked, splintered, warped and worn around the fasteners.

For recycled plastic lumber a lifespan of 100 years was used for the analysis. While to our knowledge no recycled plastic lumber has been in use for more than 17 years, accelerated aging tests by the U.S. Army Corps of Engineers as well as tests on 11-year-old material exposed to the weather have shown a reasonable life expectancy exceeding 100 years. The accelerated aging tests by the Army Corps were stopped after a tested fifty (50) years not because the material disintegrated but because the government doesn't amortize anything beyond 50 years. After that long, any product is assumed to have gone beyond any 'break-even' point. In the 50-year test, the material was shown to have had *no significant deterioration*.

Other tests on RPL exposed to the weather have actually shown an *increase* in mechanical properties such as modulus of elasticity and modulus of rupture — that is, the boards became *stiffer and stronger after exposure over time to the elements*. Further, the plastics that make up RPL *have* been in use for over 60 years. In that time, certain products made from those plastics have shown their ability to last at least that long.

# 1. Initial Purchase

• RPL costs approximately \$2.70/bd. ft; tropical hardwoods approximately \$2.20, domestic softwoods approximately \$0.40. This yields \$270,000 for RPL, \$220,000 for hardwoods and \$40,000 for softwoods. Because RPL is more flexible than either of the woods, it is possible, given the use of the boardwalk by trucks and an existing understructure with 24" centers that more understructure would have to be installed. This could add about 20% to the up front cost of the RPL purchase, yielding a total for RPL of \$324,000. Given the lifespan of the materials, repeated purchase over 100 years yields the following.

	Product			<b>Extended Cost Over 100 Years</b>		
	CCA	lpê	RPL	CCA	lpê	RPL
Purchase	\$40,000	\$220,000	\$324,000	\$400,000	\$732 <b>,</b> 600	\$324,000

# 2. Installation

• RPL is easier to install than tropical hardwoods, thus saving substantial labor costs and about the same as domestic softwoods.

A hundred-thousand board-foot boardwalk installation would cost about \$400,000 to install for tropical hardwoods. If we assume 15% less costs for installation of softwoods and RPL, this yields \$340,000 for RPL and softwoods. However, for RPL we can assume an extra 20% installation cost for the added understructure for the first installation.

Given the lifespan of the materials, repeated installation over 100 years yields the following.

	Product			<b>Extended Cost Over 100 Years</b>		
	CCA	lpê	RPL	ССА	lpê	RPL
Purchase	\$40,000	<b>\$220,000</b>	\$324,000	\$400,000	\$7 <b>32,</b> 600	\$324,000
Installation	\$340,000	\$400,000	\$400,000	\$3,400,000	\$1,332,000	\$400 <b>,</b> 000

#### 3. Maintenance

#### • True RPL lasts far longer than any wood.

When exposed to the elements, the mechanical properties of wood fall dramatically. This leads to a percentage of the boards needing to be replaced board-by-board prior to the entire deck replacement. This totals about 10% of the decking boards by the time the deck has reached the point of total replacement. This yields an additional purchase cost (reflected in the purchase cost, above) but also additional labor costs. Average annual board replacement over the life of the wood deck can be assumed to be around \$10,000 for softwoods and hardwoods.

	Product			<b>Extended Cost Over 100 Years</b>		
	ССА	lpê	RPL	ССА	lpê	RPL
Purchase	\$40,000	\$220,000	\$324,000	\$400,000	\$7 <b>32,6</b> 00	\$324,000
Installation	\$340,000	\$400 <b>,</b> 000	\$400,000	\$3,400,000	\$1,332,000	\$400 <b>,</b> 000
Annual Maintenance	\$10,000	\$10,000	\$0	\$1,000,000	\$1,000,000	\$100,000

#### Liability

One of the biggest costs associated with wood boardwalks is lawsuits associated with splintering.
RPL does not splinter and therefore splinter lawsuits are eliminated.

• Newly-installed tropical timber is slippery and there are slip-and-fall lawsuits.

No numbers for liability were available for this summary.

#### **Additional Personnel Costs**

• Every time a wood installation is replaced, staff time is required to assess, order, design, engineer, deliver and supervise the purchase, receipt and installation of the materials.

In a typical city we can assume these costs are around \$10,000.

Given the lifespan of the products over 100 years this would yield the following.

	Product			<b>Extended Cost Over 100 Years</b>		
	CCA	lpê	RPL	ССА	lpê	RPL
Purchase	\$40,000	\$220,000	\$324,000	\$400,000	<b>\$732,6</b> 00	\$324,000
Installation	\$340,000	<b>\$400,000</b>	\$400,000	\$3,400,000	\$1,332,000	<b>\$400,000</b>
Annual Maintenance	\$10,000	\$10,000	\$10,000	\$1,000,000	\$330,000	\$100,000
Additional Personnel Costs	\$10,000	\$10,000	\$10,000	\$100,000	\$33,000	\$0

### **Disposal Costs**

• Every time a wood installation is replaced, the old wood needs to be disposed of.

In New York City, tipping fees at Fresh Kills Landfill are about \$100 per ton. Since Fresh Kills is now closing, disposal costs for debris are escalating.

This cost arises every time a wood installation is replaced, which, for tropical hardwoods, could occur up to five times over the life of a single RPL installation.

- Even if RPL needed to be disposed of, it would only happen once compared to five times for wood. But RPL can be re-recycled, thus eliminated disposal completely [would this be at the cost of the supplier -- that is, do companies pick up their used RPL (if not yet, this is certainly something to talk to them about)];
- For chemically-treated wood, disposal costs are subsidized, since arsenic-containing materials have been classified as a hazardous waste. But until now, pressure-treated wood has been exempted from this classification. This exemption (which is purely a subsidy to the industry, since the downstream costs of this toxic substance will be borne by society rather than the producer) is sure to end soon.
- Hardwoods weigh about one ton per 4,000 board feet. Softwoods weigh about one ton per 8,000 board feet. Given the deterioration and loss of moisture of wood exposed to the elements, we can assume a 20% reduction in weight at time of disposal, yielding one ton per 3,200 board feet for hardwoods and one ton per 6,400 board feet for softwoods.
- Further, the cost to truck the materials to the landfill or back to the factor add to disposal costs. We assume \$40/ton of material. RPL weighs approximately the same as hardwoods.

Given the lifespan of the materials, disposal over 100 years (at current costs) would yield the following.

	Product			Extended	<b>Extended Cost Over 100 Years</b>		
	ССА	lpê	RPL	ССА	lpê	RPL	
Purchase	\$40,000	\$220,000	\$324,000	\$400,000	<b>\$732,6</b> 00	\$324,000	
Installation	\$340,000	\$400,000	\$400,000	\$3,400,000	\$1,332,000	\$400,000	
Annual Maintenance	\$10,000	\$10,000	\$10,000	\$1,000,000	\$330,000	\$100,000	
Additional Personnel Costs	\$10,000	\$10,000	\$10,000	\$100,000	\$33,000	<b>\$</b> 0	
Disposal (Tipping)	\$1,562.50	\$3,125	<b>\$</b> 0	\$15,625	\$10,406.25	\$0	
Disposal (Trucking)	\$625	<b>\$1,25</b> 0	<b>\$1,25</b> 0	\$6,250	\$4,162.50	<b>\$1,25</b> 0	
Total	\$402 <b>,</b> 187.50	\$1,046,562.5 0	\$1,791,812.5 0	\$4,921,875	\$3,267,382.7 5	<b>\$825,25</b> 0	

This analysis reveals that total costs over 100 years for a one-hundred-thousand-board-foot boardwalk made of CCA would be approximately \$4,921,875; of tropical hardwoods would be approximately \$3,267,383 and of RPL would be \$825,250.