



CN / CXT Sustainability Assessment



Project Scope:

This project involved information collection and development of recommendations for the sustainable production of concrete ties. Research spanned sustainability, CXT company practices and supply chain, concrete tie production techniques, life cycle analyses, tie disposal through recycling and reuse, and process modeling. The main objectives of the project were to:

- Create a model that tracks the sustainability of CXT Concrete Ties
- Identify applicable and practical performance metrics that can serve as benchmarks
- Calculate the carbon footprint for Spokane, WA CXT production facility
- Compare the sustainability of concrete and wood ties
- Define what sustainability should be for CXT



Tie Disposal Model

Production Emissions (Tons CO₂): 11,493

Inputs: Results (Tons CO₂ Produced)

General Inputs: These values are used in multiple sections to calculate the cost of fuel used in transportation. These values are used in multiple sections.

| Item | Quantity | Unit Price | Total Cost | CO ₂ Produced (Tons/year) | |
|-------------------------|----------|------------|------------|--------------------------------------|-------|
| Cement (Type III) | 30,000 | tons | \$ 12.00 | \$ 360,000 | 2,509 |
| Coarse Sand | 75,000 | tons | \$ 12.25 | \$ 918,750 | 899 |
| Fine Sand | 5,000 | tons | \$ 15.75 | \$ 78,750 | 77 |
| Pea Gravel | 50,000 | tons | \$ 14.25 | \$ 712,500 | 697 |
| 3/4" Gravel | 70,000 | tons | \$ 14.75 | \$ 1,032,500 | 1,030 |
| Admixtures | | | | | |
| Retardant | 123 | gallons | \$ 123.00 | \$ 15,129 | 22 |
| Air Entrainment | 123 | gallons | \$ 123.00 | \$ 15,129 | 22 |
| Water Reducer | 123 | gallons | \$ 123.00 | \$ 15,129 | 22 |
| Steel | | | | | |
| Stressing wire | 123 | tons | \$ 123.00 | \$ 15,129 | 34 |
| Plastic & PVC | | | | | |
| Date plugs | 123 | tons | \$ 123.00 | \$ 15,129 | 8 |
| Form pockets | 63,000 | each | \$ 123.00 | \$ 7,749,000 | 3,946 |
| Other Items used | | | | | |
| Steel casting forms | 123 | tons | \$ 123.00 | \$ 15,129 | 34 |
| Abrasive Cutting Wheels | 650 | each | \$ 123.00 | \$ 79,950 | 35 |
| Form release oil | 123 | gallons | \$ 123.00 | \$ 15,129 | 2 |
| Circulating oil | 123 | gallons | \$ 123.00 | \$ 15,129 | 2 |
| Utilities & Fuel | | | | | |
| Electricity | 1,234 | kW | \$ 123.00 | \$ 151,782 | 1,037 |
| Natural gas | 1,234 | gallons | \$ 123.00 | \$ 151,782 | 2 |
| Water | 1,234 | gallons | \$ 123.00 | \$ 151,782 | 124 |
| Diesel Fuel | 1,234 | gallons | \$ 3.95 | \$ 4,874 | 14 |
| Biodiesel | 1,234 | gallons | \$ 4.00 | \$ 4,936 | 7 |
| Regular gasoline | 1,234 | gallons | \$ 3.50 | \$ 4,319 | 14 |

Carbon Footprint: (Tons CO₂/year) 10,493

Total Costs: (dollars/year) \$ 11,921,957

Number of ties produced last year: 900,000

Emissions per tie: (lbs CO₂/tie) 23.917

Emissions per dollar: (lbs CO₂/dollar) 1.82

Recycling Metrics:

| Item/Material recycled | Quantity | Price | Income | Tons CO ₂ Saved |
|-----------------------------|----------|----------|-----------------|----------------------------|
| Rejected ties | 500 | \$ 15.00 | \$ 7,500 | 5.83 |
| Scrap concrete (tons) | 10 | \$ 5.00 | \$ 50 | 0.05 |
| Scrap stressing wire (tons) | 10 | \$ 3.00 | \$ 30 | 0.06 |
| Total: | | | \$ 7,600 | 5.93 |

Landfill Metrics:

| Item | Quantity | Price | Income | Tons CO ₂ Saved |
|--|-----------|-------|-------------------|----------------------------|
| Tons of Material Landfilled per Year | 5,000 | | | |
| Number of Trips to Landfill per Year | 500 | | | |
| Gas Mileage of Truck Full | 6 | | | |
| Gas Mileage of Truck Empty | 8 | | | |
| Average Diesel Fuel Price | \$ 3.50 | | | |
| Miles to Landfill | 1 | | | |
| Landfill Fee (\$/ton) | \$ 103.00 | | | |
| Gasoline of diesel used | 346 | | | |
| Transportation Emissions: (Tons CO ₂ /year) | 444 | | | |
| Total Cost: (dollars) | | | \$ 315,510 | |

Inbound Material Transportation:

| Item | Quantity | Price | Income | Tons CO ₂ Saved |
|--|----------|-------|--------|----------------------------|
| Distance | 1,000 | | | |
| Tons of cargo | 180 | | | |
| Truck Emissions: (Tons CO ₂) | 16.00 | | | |
| Rail Emissions: (Tons CO ₂) | 5.20 | | | |

Outbound Tie Transportation:

| Item | Quantity | Price | Income | Tons CO ₂ Saved |
|--|----------|-------|--------|----------------------------|
| Distance | 1,000 | | | |
| Tons of cargo | 180 | | | |
| Truck Emissions: (Tons CO ₂) | 16.00 | | | |
| Rail Emissions: (Tons CO ₂) | 5.20 | | | |

Values entered are for demonstration purposes only, they do not portray CXT's actual results.

Definition of Sustainability:

Sustainability is meeting current economic needs while promoting social qualities and environmental practice as much as possible from the extraction of materials before production to when the product is discarded after final use. For CXT this means the efficient allocation of material resources to create a quality product, while providing a safe workplace for employees and having an active presence in the community.



LB Foster
CXT Concrete Ties

Social Sustainability Model

Key:

- Input the number
- Input the monetary amount
- Input the percentage (10% would be entered as 10, not 0.1)
- Input yes or no specifically
- Input value directly from the Employee Opinion Survey

Company Demographics:

- Total number of employees
- Number of employees that are African American, Asian, Native American, or Latino
- Number of female employees
- Average number of hours worked per week
- Number of full-time employees who make less than \$22,500/year
- Number of employees hired within the last year
- Number of employees that lost their jobs within the last year

Amounts Given:

- Donations given within the last fiscal year
- Scholarships given within the last fiscal year
- Amount given to Charities within the last fiscal year
- Value of food and/or essentials given to charity within the last fiscal year
- Price of non-product related spending aimed at employee happiness within the last fiscal year
- Yearly cost of maintaining recreation facilities
- Number of hours that employees spent working on volunteer projects
- Average health care coverage for each employee per year (health insurance, dental, etc.) % matching for 401k
- Average wage increase for among all non-management positions within the last year
- Company's DART safety rating
- If DART safety rating is unknown, input number of Days Away, Restricted, or Transferred that employees had due to injuries during the last year here)

Employee Opinion Survey:

- I would like to be working at this organization one year from today
- This organization is effective in welcoming new employees and helping them begin a new job
- The organization makes investments to make me more successful
- The leaders of this organization are committed to making it a great place to work
- At work, my opinions seem to count
- I enjoy doing my work
- My benefits meet my (and my family's) needs well
- Our organization is involved with the community in which it does business

Other:

- Have you been accredited by a 3rd party company on sustainable or social responsibility? If no, have you been attempting to get accredited by a third party?
- Is there a company statement regarding fair labor practices and ethics publicly available?

Score: ###

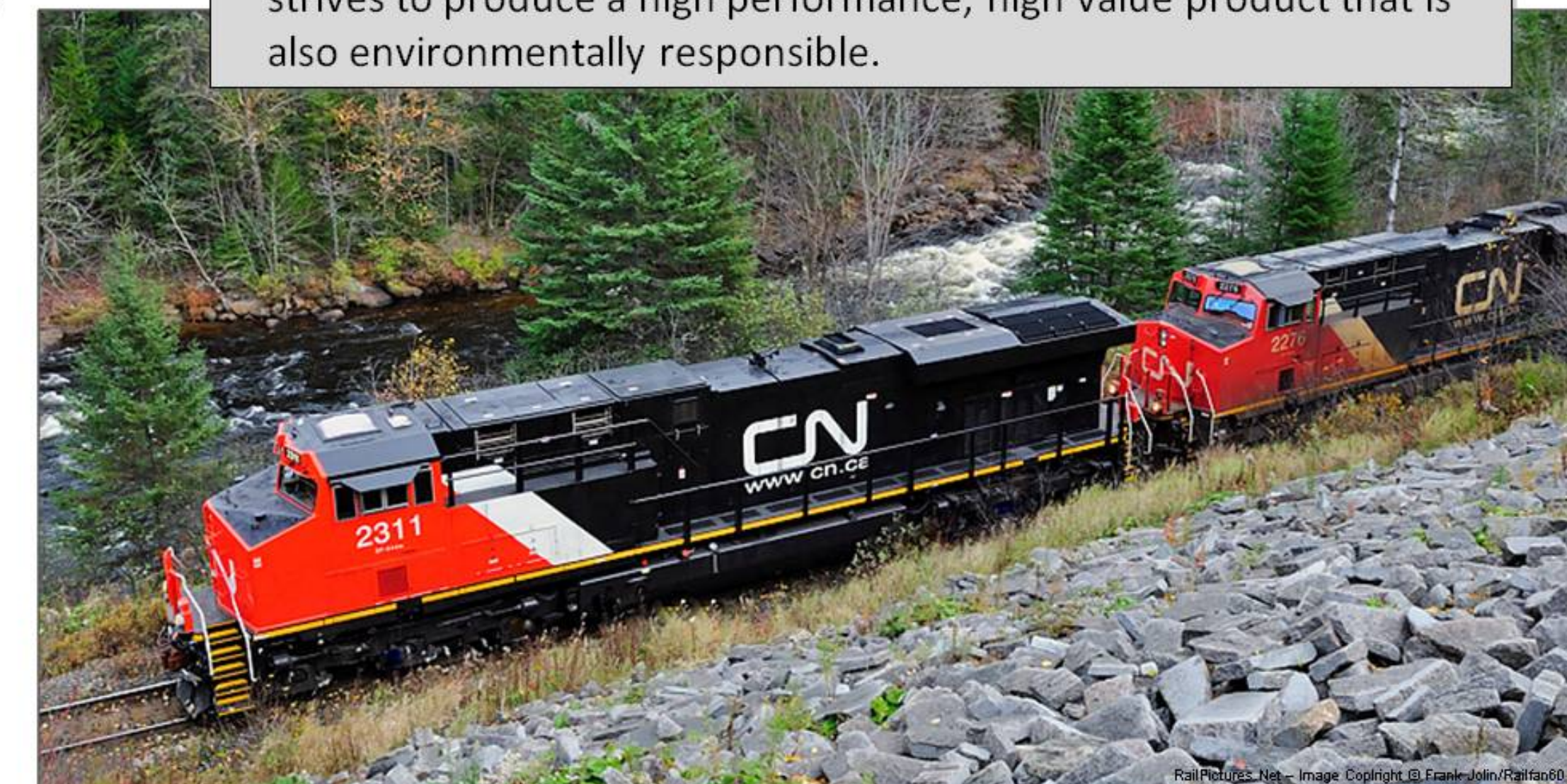
Project Results:

Through research and numerous meetings with industry sponsors, CN and CXT, and university professors, we were able to define sustainability in respect to CXT's manufacturing processes and develop models to track CXT's sustainability over time. Our final deliverables were:

- Model that tracks CXT's production emissions based on fuel consumption, as well as energy and material usage
- Model that evaluates CXT's social sustainability based on employee satisfaction, demographics, and safety, as well as benefits provided to employees and the community
- Model to evaluate various tie disposal options, both by emissions and potential profit
- Literature review comparing lifetime CO₂ emissions of concrete and wood ties
- Definition of sustainability as applied to CXT

Clients:

- As the widest reaching railroad in North America, CN is committed to protecting the environment and ensuring the health and safety of their employees and the public.
- As the largest supplier of concrete ties in North America, CXT strives to produce a high performance, high value product that is also environmentally responsible.



Transportation Enterprise

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