Sustainability Assessment

TRIO READY-MIX

Concrete Plant at 2800 Bridge St.

Prepared For	Trio Ready-Mix
Name	Stephen Hay
Title	General Manager

Completed By	Heidi Grantner & Jill Doucette
Email	heidi@synergyenterprises.ca
Completed	24/9/2019

synergy

Executive Summary

Trio Ready-Mix is constructing a new concrete plant at 2800 Bridge St. in the Rock Bay neighbourhood of Victoria. Cement, a key component of ready-mix concrete, is responsible for 7% of global man-made greenhouse gas emissions, making it the world's second largest industrial source of carbon dioxide, according to the International Energy Agency. Trio's move to a new site provides an opportunity to rethink and redesign the way ready-mix concrete is produced, and the company is implementing the latest technology that will reduce the environmental impact of their operations and products.

Synergy has conducted a review of operations at both the existing plant and the new, and has calculated the potential impact of the environmental initiatives at the new Trio site. This report summarizes the carbon, fuel, water and waste savings that will be realized each year the new plant is in operation. In total, Trio's new site is estimated to save over 2,000 tonnes of carbon equivalent (tCO_2e). The analysis is broken down into sections that mirror the way ready-mix is produced, first examining changes to raw materials, then fuel and energy savings from more efficient transportation & storage. The impact of an improved layout and new equipment on production has been measured, as well as the material savings from recycling & reusing waste concrete using a reclamation system.

Trio's plant will set the standard for low-impact concrete production, raising the bar and showcasing innovation in the industry.

	Existing	New	Savings	Savings (%)
Embedded Carbon (tCO_2e)	14,029	11,994	**2,034**	**14.5%**
Fuel for Transport (L)	93,243	8,957	**84,286**	**90.4%**
Total Water Use (L)	6,396,000	5,295,943	**1,100,057**	**17.2%**
Waste Concrete (mt)	8,930	857	**8,073**	**90.4%**

Table 1: Summary - Sustainability Assessment

Key Sustainability Features at New Site

- Reduced land footprint through use of silos
- Stormwater capture, treatment & re-use
- Waterfront access reduces ground transportation and associated fuel and emissions
- New reclaimer equipment allows for recycling of waste concrete
- Lower carbon concrete through use of Carbon Cure™ technology
- Shoreline rehabilitation with ECOncrete Blocks (pending approval)

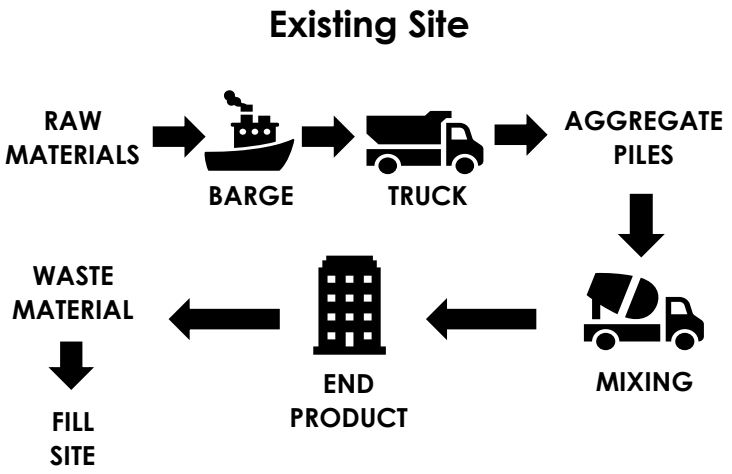
166,020 Sqft Smaller

3,047 Fewer Trips

8,073 Less Waste (mt)

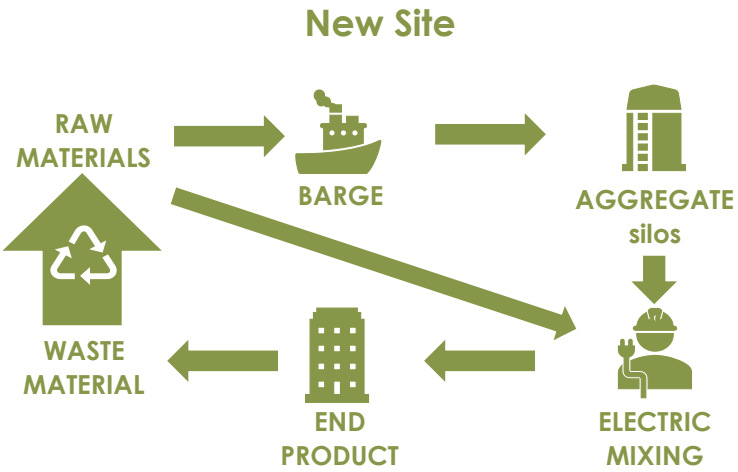
2,348 Less tCO_2e

Process Overview



The existing site, located at 1020 Hallowell Rd in Esquimalt, is a conventional concrete ready-mix plant. Raw materials, including sand, aggregate, cement and fly ash are barged from the mainland and trucked to the site. Raw materials are stored in open-air piles around the site; aggregate is regularly sprayed with water to keep the dust down and the material cool. Batches of concrete are mixed in the drums of concrete trucks running at their max rpm for 15 minutes per batch. When waste concrete is returned from client construction sites, the material is poured into pre-cast blocks or laid on the ground in strips where it hardens before being crushed and used for road fill.

"The entire process will change when we move from the old site to the new. The way we ship our materials, how we use water, the way we deal with waste concrete… It will be totally different."
- Stephen Hay, Trio General Manager



The new site in Rock Bay is located on the Gorge Waterway. The direct barge access avoids shipping raw materials by truck, reducing fuel and associated emissions. Electric pumps and conveyor belts move raw materials from the barge directly into silos, where they are kept cool. A new Central Mixing Unit mixes the concrete more efficiently, and Carbon Cure™ technology reduces the amount of cement in each batch, which in turn reduces embedded emissions. Finally, a reclaimer processes waste concrete and recycles it for use in new batches. This reduces raw materials and saves water.

Raw Materials

Carbon Cure™

The new plant will allow Trio to use different raw materials and newer, more environmentally friendly techniques to make concrete. First, it will use injections of Carbon Cure's™ liquid (recycled) CO_2, which reduces the amount of cement needed per ton of concrete produced. Cement is a crucial ingredient in any concrete mix, acting as the glue that holds it together. It is also the ingredient that has the largest embedded carbon footprint. Making cement requires superheating calcium carbonate, or limestone, which releases carbon dioxide into the atmosphere. Reducing cement use directly reduces emissions.

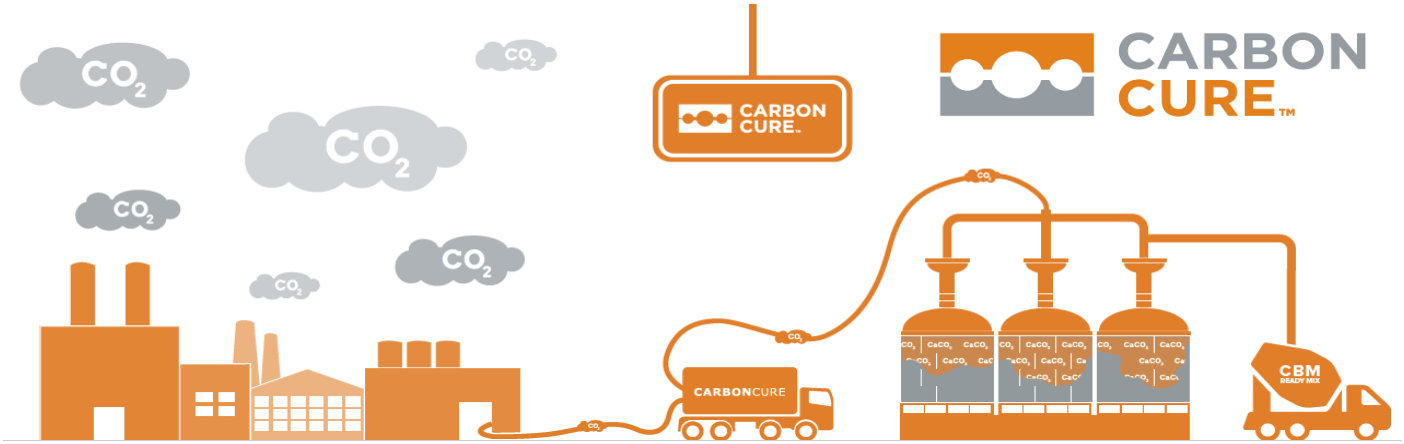


Image courtesy of Carbon Cure ™

	Traditional	With Carbon Cure	Savings
Cement / Yr (mt)	14,924	14,178	746

Portland Limestone Cement

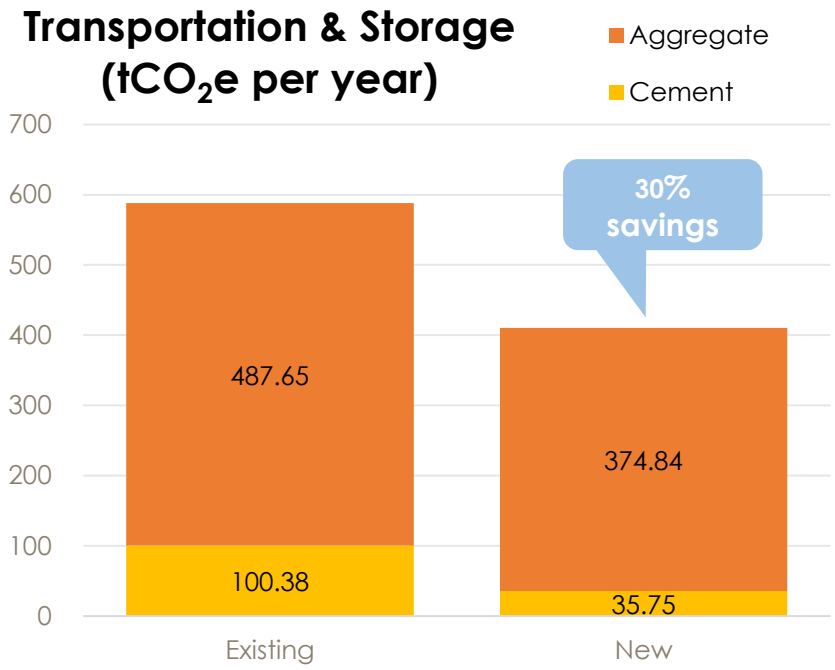
In addition to using less cement, the new Trio plant will use a better kind of cement. The company will transition to General Use Limestone (GUL) cement, which is 10% less carbon intensive than General Use (GU) cement due to added limestone. This change is expected to save 1,403 tonnes of CO_2e per year, based on Trio's yearly volume.

	tCO_2e / ton	tCO_2e / Year
GU Cement	0.94	14,029
GUL Cement	0.85	12,626
Savings	9.4%	1,403

Image courtesy of Canadian Consulting Engineer.com.

-5% less cement	-746 less cement (mt)	-9.4% tCO_2e / ton	tCO_2e Savings/Yr 2,034

Transportation & Storage



The site's waterfront location will allow raw materials such as cement and aggregate to be shipped directly to the site on a barge. This will save on diesel fuel and the resulting carbon emissions from trucking raw materials, which were previously barged to various locations on Vancouver Island and then shipped to Trio in dump trucks and B-trains. Once at the site, the aggregate will be stored in silos rather than open air piles. These improved arrangements will avoid 3,047 dump truck deliveries per year.

The impact of these changes is significant and estimated to save 176 tonnes of CO_2e per year.

Storing aggregates in silos will also eliminate the need to spray aggregate to keep it cool, saving over 1 million litres of water per year.

5,010
Baths / Yr

The new Trio site showing shipments arriving via barge. The large silo on the left will store aggregate and sand.

	Deliveries / Year	Diesel (L) / Year	Water (L) / Year	tCO_2e / Year
Existing Plant	3,047	93,243	1,100,000	588.0
New Plant	0	8,957	0	410.6
Savings	3,047	84,286	1,100,000	177.4

3,047
Fewer Trips

84,286
Less Diesel (L)

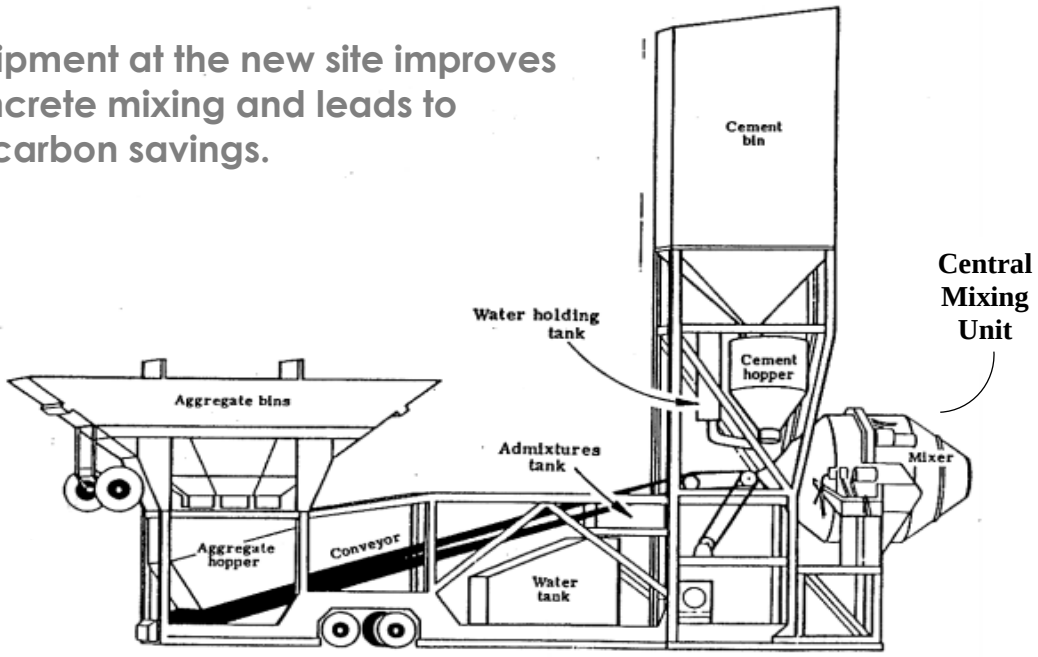
1,100,000
Less Water (L)

tCO_2e Savings/Yr **177.4**

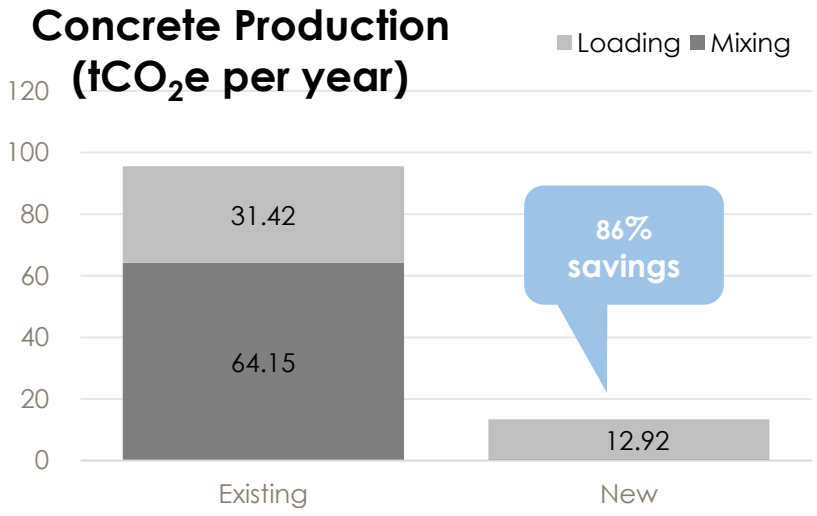
Production

The layout and equipment at the new site improves the precision of concrete mixing and leads to energy, water and carbon savings.

By using a Central Mixing Unit (CMU), Trio avoids having to mix concrete in trucks - savings diesel fuel and associated emissions.



Typical Central Mixing Unit. Image courtesy of State of Minnesota Concrete Manual.



Using conveyor belts instead of diesel-powered loaders will save…

11,617 Diesel (L) / Yr

18.5 tCO_2e / Yr

At the existing site, when a batch of concrete is made, a diesel-powered loader picks up aggregate and sand in its bucket from stockpiles around the site. The ingredients are then funneled into the back of a concrete truck, which revs its engine to full speed to mix the batch. This process is fuel-intensive, because the ingredients are heavy and the loader must make many trips.

At the new site, conveyor belts powered by electric motors will deliver the ingredients from the silo to a Central Mixing Unit (CMU). Also powered by electricity, this piece of equipment improves the efficiency and precision of each concrete mix. In total, the new plant will save 121 tCO_2e and 23,700 litres of diesel in the production process.

500 Fewer Hours	35,336 Less Diesel (L)	-86% Less tCO_2e	tCO_2e Savings/Yr **82.2**

Recycle & Reuse

When Trio's clients order ready-mix, they often purchase a little extra to avoid the risk of running out. This means that approximately 9,000 metric tonnes of concrete is returned to Trio every year. At the existing site, Trio pours this waste into pre-cast concrete blocks, which are then sold. Any remaining concrete is laid on the ground in strips; once the strips harden, they are crushed and sent to be used as road base.

At the new site, Trio will be able to recycle the waste concrete into new batches, savings the fuel and emissions from operating the crusher and transporting waste concrete to the road base fill site.

The reclaimer, the new piece of equipment that recycles the concrete, uses a series of paddles and augers to remove aggregate and sand from the returned concrete. These raw materials can then be used as inputs in new batches. The process water that is left over is funneled into a tank, where it is agitated to keep the remaining solids in suspension until it can be re-used. If too many solids accumulate in this water, the liquid is fed through a filter press to remove the excess.

By re-using waste, Trio avoids having to purchase as many raw materials and saves fuel and associated carbon emissions from transporting them.

Trio is estimated to save diesel fuel and carbon emissions from not having to crush and transport waste concrete strips.

14,201 Diesel (L) / Yr

38 tCO_2e / Yr

Re-using recycled concrete will reduce the amount of raw materials purchased, saving fuel and carbon from shipping.

422 Diesel (L) / Yr

16 tCO_2e / Yr

The reclaimer will save 96% of all returned concrete by weight, including 100% of the aggregate, 99% of the sand, and 100% of the water.

	Aggregate	Sand	Cement	Fly Ash	Water
Waste (tonnes)	4,180	3,040	1,064	114	57
Recycled (tonnes)	4,180	3,010	798	86	57
Savings (%)	100%	99%	75%	75%	100%

8,073 Less Waste (mt)

14,623 Less Diesel (L)

96% Reclaimed

tCO_2e Savings/Yr **53.9**

Estimates & Assumptions

- Estimated 45 nautical miles between Delta & Bamberton (cement shipping distance) & 100 nautical miles from Sechelt to VMD on Bay St.
- 2015 MACK Granite with an MP8 engine gets 5 gal/mile (manufacturer specs, supported by historical fuel use from Trio).

Emissions References

1. 2016/17 B.C. Best Practices Methodology for Quantifying Greenhouse Gas Emissions
http://www2.gov.bc.ca/gov/content/environment/climate-change/policy-legislation-programs/carbon-neutral-government/measure

2. Environment Canada's National Inventory Report (1990-2015); Part 2 & 3.
http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/zip/can-2017-nir-13apr17.zip

3. Intergovernmental Panel on Climate Change (Global Warming Potentials)
http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html

4. Cement Association of Canada Environmental Product Declaration
http://www.stmaryscement.com/Documents/Canada/CAC%20EPD%20(GU,%20GUL).pdf

5. Smart Freight Centre, GHG Emissions Factors for IWT (2018)
https://www.smartfreightcentre.org/pdf/GLEC-report-on-GHG-Emission-Factors-for-Inland-Waterways-Transport-SFC2018.pdf

Glossary of Terms

Term	Description
GHG	**Greenhouse Gas (emissions):** Atmospheric gasses contributing to the greenhouse effect, including Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O), etc.
tCO_2e	**Tonnes of Carbon Dioxide Equivalent**: GHGs have different warming potentials, measured collectively as CO_2 equivalent (hence "e")
kWh	**Kilowatt-Hour**: Common unit for measuring electrical consumption
m^3	**Cubic Meter**: Unit of measurement equal to 1,000 Litres
mt	**Metric Ton**
CMU	**Central Mixing Unit:** Electric-powered drum that mixes concrete in batches
GU	**General Use (cement)**
GUL	**General Use Limestone (cement)**
t-km	**Tonne-kilometer**: A unit of measurement used in shipping

Verified By	Heidi Grantner & Jill Doucette
Email	heidi@synergyenterprises.ca
Completed	24/9/2019

synergy