

Transportation Carbon Accounting Module (TCAM)

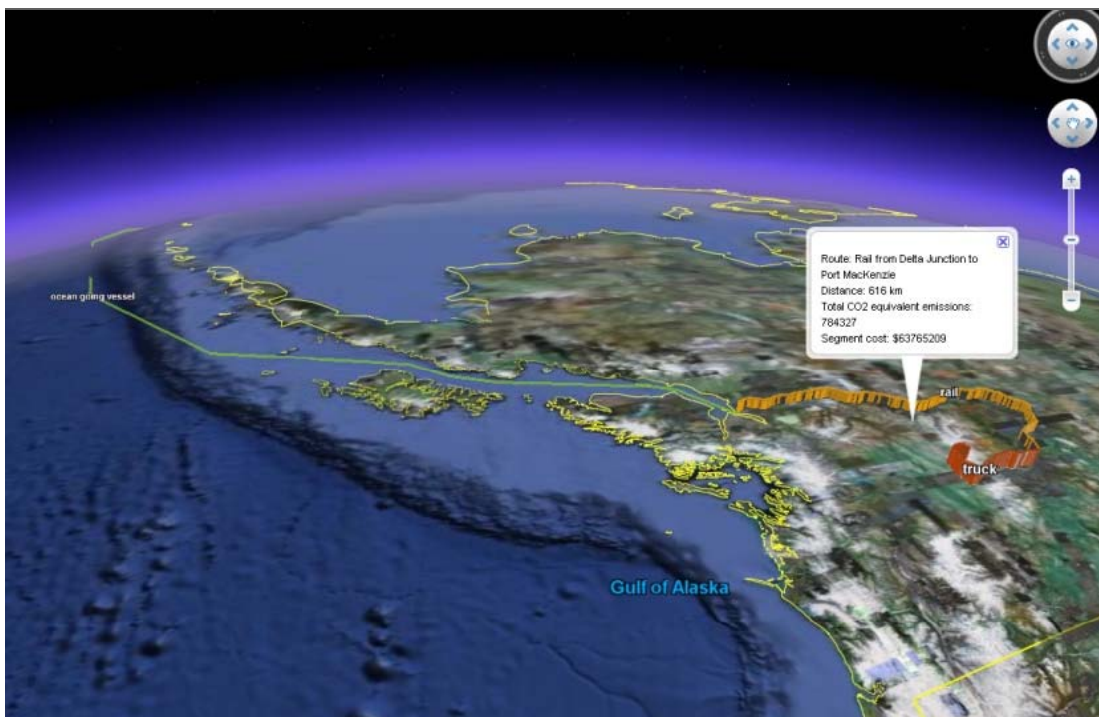
A cooperative project between the **University of Alaska – Fairbanks (UAF)** and the **Michigan Tech Research Institute (MTRI)**

Carbon emissions represent a transportation impact that has not been traditionally included in cost equations. However, accounting for them is increasingly relevant with recent national policy initiatives to enact cap-and-trade and related legislation. The ability to dynamically account for carbon emissions from freight transportation based on mode, distance, and cargo will help to prepare and inform logistics industries, including mining. Additionally, emissions tracking will enable logistics companies to better serve environmentally-minded clients who are interested in minimizing emissions as a factor in transmodal shipping scenarios.



TCAM for the Mineral Occurrence Revenue Estimation and Visualization (MOREV) Tool

MTRI has developed multimodal carbon modeling tools for several of its current research projects. In cooperation with the University of Alaska – Fairbanks (UAF), one of these projects involves modeling commodity revenue and cost of mine operations for the proposed Alaska-Canada Rail Link (ACRL) and other transportation projects in Alaska.



Google Earth visualization of a freight route calculated by MTRI's MOREV tool with route color and height representing carbon emissions for a particular leg as calculated by TCAM.

A significant portion of mining costs goes into the transportation of commodities from the mines to mills, smelters, or other processing facilities. Because of this, understanding the costs and characteristics of transporting mine commodities for all major transportation modes is essential.

Mainland transportation options for bulk hauling of these commodities include truck, rail, and barge. In addition, understanding of ocean-going-vessel logistics is necessary since commodities are frequently shipped overseas as raw material for industries in China and other rapidly developing countries.

MTRI Logistics CO2 Emissions Calculator

PLG Transmodal Scenario: PUD-COMM-PUD Item Weight(lbs): 2000 Scenario 1 Scenario 2

Leg	Transportation Mode	Distance (mi)	Vehicle Type	Exclusive use?	Max Payload Capacity (lbs)	% of Max Payload	Percent Load Attributed to Item (%)	Total CO2 Emissions (lbs)	CO2 Emissions Attributed to Item (lbs)
Leg 1	Road	16	Straight Truck (12-14)	<input checked="" type="checkbox"/>	4665	42.9	100	28.7	28.7
Leg 2	Air	180	Boeing 737 Freighter	<input type="checkbox"/>	44500	4.5	4.5	24,240.5	1,090.8
Leg 3	Road	14	Straight Truck (12-14)	<input checked="" type="checkbox"/>	4665	42.9	100	25.1	25.1
Leg 4	NA	0		<input type="checkbox"/>	0	0	0	0	0
Leg 5	NA	0		<input type="checkbox"/>	0	0	0	0	0

TOTAL CO2 Emissions Attributed to Item: 1,145

Above: TCAM's GUI interface for carbon emissions for the logistics industry.

Right: TCAM's mode-specific carbon emissions calculators

Subsequently, MTRI has researched and developed carbon emissions calculation software for each of three modes of transportation (truck, rail, water) with varying complexity based on vehicle capacity, size, fuel usage and type, commodity, and distance traveled (among others). This module is incorporated into MTRI's MOREV tool with the additional option for users to input a carbon offset price per ton of carbon dioxide, thus informing both environmental and economic impacts.

TCAM for the Logistics Industry

MTRI has demonstrated to logistics companies a carbon accounting module to integrate with existing logistics software as a potential factor for clients in shipping prioritization.

For this project, we developed an additional carbon emissions model for airfreight using the best scientific data available. Thus, MTRI currently has working carbon dioxide emissions accounting modules for all four major modes of transportation (road, rail, water, air) and is currently extending our tools to calculate emissions from modal transition nodes → e.g. the emissions from cranes operating at ports to load/unload cargo vessels.

Rail Freight Emissions Calculator

Distance (km): 10

Train type: Freight - Medium

Train weight information

Weight/car (mt): 11

Number of cars: 1

Total trailing weight (mt): 9,040

Consumption/emissions parameters

CO2 / L diesel (kg): 3.00

Fuel consumption / 1000 tonne-km (L): 5

Total CO2 eq. emissions CO2 / tonne-km (g): 1

Total tonne-km: 9,040,000

Total CO2 eq. (kg): 160,008

Water Freight Emissions Calculator

External Inputs

Distance (km): 1000

Ship Type: Container Ship

Ship Size (name): Panamax

Ship Size (dwt): 52,250

Engines

Engine Type	Number	Type	Fuel Type	Power (kW/engine)
Main Propulsion Engine	1	SSD	RO	36,450
Auxiliary Engine	3.6	MSD	MD	1899

Operating Modes

Mode	Hotelling	Maneuvering	Reduced-Speed Zone	Cruise
Average Speed (km/hr):	0.0	9.3	32.9	43.8
Time in mode (hr):	40	1	2	2
Loading Factors				
Main Engine:	0	0.15	0.3	
Aux. Engine(s):	0.17	0.5	0.25	
Total kWh				
Main Engine:	0	5,468	21,87	
Aux. Engine(s):	12,845	945	94	
CO2 eq. Emissions Rate (g/kWh)				
Main Engine:	0	682	620	
Aux. Engine(s):	690	717	652	
Total CO2 eq. Emissions (kg)				
Main Engine:	0	3,729	13,558	
Aux. Engine(s):	8,863	678	616	
Totals				
Main Propulsion Engine				
Total CO2 eq. Emissions, all modes (kg)		398,760	13,535	

Road Freight Emissions Calculator

Truck type: 48' Tractor Trailer

Tonne-kilometer calculation

Distance (km): 1000.0

Vehicle weight (mT): 25,628

Total tonne-km: 25,628

Consumption/emissions parameters

CO2 / L diesel (kg): 2.668

Fuel consumption (km/L): 2.636

CO2 / tonne-km (g): 39.6

Total: 1,014.87

Collaborators:

MTRI - Dr. Robert Shuchman, Colin Brooks, Michael Billmire, Helen Kourous-Harrigan, Eric Keefauver

UAF - Dr. Paul Metz, Mark Taylor, P.E.

Project Consultant – Leon Van Wyhe

Michigan Tech Research Institute

3600 Green Ct., Ste. 100 • Ann Arbor, MI 48105 • USA • 734.913.6840 (p) • 734.913.6880 (f) • www.mtri.org



Colin Brooks
Research Scientist, MTRI
(734)913-6858
colin.brooks@mtu.edu

Dr. Robert Shuchman
MTRI Co-Director
(734) 913-6860
shuchman@mtu.edu

Michael Billmire
Research Scientist
(734)913-6853
mgbillmi@mtu.edu



For more information visit • www.mtri.org and <http://www.mtri.org/mineraloccurrence.html>