CARBON FOOTPRINTING

Most climatologists agree the main cause of the current global warming trend is human expansion of the "greenhouse effect[1]. The greenhouse effect is caused by an increase in greenhouse gas (GHG) emissions, which traps the sun's heat in the lower atmosphere, causing the surface to warm. GHG emissions are produced and released into the atmosphere from the burning of fossil fuels. The largest contributor to GHG emissions in the U.S. is for transportation, electricity, and heating needs. The most common GHG emissions are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_20) and fluorinated gasses.[2] The transportation sector (e.g., cars, trucks, airplanes and trains) accounts for 27 percent of all GHG emissions. Furthermore, carbon footprinting is typically measured by the burning of fossil fuels in units of carbon dioxide. Specific LRTP goals, objectives, and performance measures pertaining to the reduction in carbon emissions include:

- Goal 4: Environment/Energy/QOL:
    - Objective: Reduce carbon emissions and other air pollutants associated with motorized vehicles to improve air quality.
    - Performance Measure: By 2040, reduce transportation-related CO_2 emissions by 40 percent below 2009 levels.
    - Performance Measure: By 2040, ensure zero percent population exposure to at-risk levels of air pollution.
    - Performance Measure: Reduce outdoor levels of ozone, nitrogen dioxide, carbon monoxide and particulate matter as a percent of national Ambient Air Quality Standards.

- Goal 5: Integration and Connectivity
    - Objective: Reduce carbon emissions and other air pollutants associated with motorized vehicles to improve air quality.
    - Performance Measure By 2040, reduce vehicle miles traveled per person by 10 percent compared to 2010.

In essence, carbon footprinting is a means to determine the impact human activity has on the environment. Human activity is influenced by the built environment, which includes different types of settings. The built environment may include elements such as housing developments, industrial areas, transportation networks, schools, hospitals, and airports. A meaningful carbon footprint assessment evaluates each component to determine the human impact on the environment. This method provides an overall carbon footprint for the entire community. However, as prescribed by the MPO, the LRTP solely focuses on carbon footprinting for the transportation network. Therefore,

[1] *IPCC Fourth Assessment Report, 2007: http://www.ipcc.ch/publications_and_data/ar4/syr/en/contents.html*

[2] *2010 GHG Emissions: http://epa.gov/climatechange/ghgemissions/sources.html*

findings from this report should complement the City of Grand Forks and the University of North Dakota's studies and should promote unified and coordinated efforts in reducing greenhouse gas emissions in the metro area.

LRTP Carbon Footprint Measurement

A pound of $C0_2$ we emit today by driving a car may still be in the atmosphere decades to hundreds of years from now. Therefore, measuring GHGs associated with transportation systems is closely linked to CO_2. However, this level of assessment can be difficult to measure, considering data availability and scale. The measurement used for the LRTP estimated the tons of CO_2 emissions produced in the metro area by evaluating the number of vehicle miles traveled (VMT) for passenger cars and light trucks. The LRTP's methodology is documented in Appendix X.

The assessment examined 2006 and 2010 VMT data for the Grand Forks – East Grand Forks metro area. The total VMT was linked to GHG estimates to determine the total amount of CO_2 emissions (See Table 1). As a result, the assessment determined there has been a reduction in VMT between 2006 and 2010. It is important to note that the reduction in VMT for this five year period may or may not forecast a long-term trend throughout the Grand Forks – East Grand Forks metro area. This short-term trend may merely reflect a change in travel behavior due to the economic downturn in 2008 and an increase in fuel costs. Therefore, VMT should be closely monitored to determine if travel behaviors are changing within the region. Monitoring VMT will help determine travel patterns and if roadway's are reaching their capacity. More importantly, VMT serves as a benchmark for evaluating carbon.

Regardless of the short-term trend, there was a reduction in VMT, which equates to a reduction in carbon emissions over the five year period. This data documents that GHG emissions can be affected by changing transportation behaviors. This reduction is quantified into measurable outcomes using the Environmental Protection Agency's (EPA) Greenhouse Gas Equivalent Calculator (See Table 2). For example, the documented reduction in VMT and $C0_2$ equates to the removal of 371 passenger vehicles from the transportation network over the five year period. The end result, from an environmental perspective is a reduction in the region's carbon footprint, which should serve as a benchmark for the region.

Mitigating for GHGs

A reduction in VMT and carbon emissions can also produce positive outcomes from financial and public health perspectives. For instance, increasing GHGs not only impacts climate change, but it can cost money. For example, repeated natural disasters as a result of early winter thaws have caused major flooding along the Red River. These events inflate the cost of homeowner's insurance and significantly damage infrastructure (e.g., bridges and roads). Furthermore, the fluctuation in the annual freeze-thaw cycle can also cost money in roadway and bridge maintenance repairs. The LRTP's Transit Element also encourages the use of transit, and non-motorized transportation modes, such as biking or walking instead of driving, which increases physical activity and improves air quality. These measures reduce health care costs associated with chronic and respiratory diseases.

Table 1. Carbon Footprint for Vehicle Miles Traveled

Year	Total Vehicle-Miles Traveled by Year by Passenger Cars and Light Trucks[3]	Average Miles of Travel per Gallon of Fuel Consumed[4]	Gallons of Fuel Consumed by Year By Passenger Cars and Light Trucks	Metric Tons of Carbon Dioxide or CO_2 Equivalent
2010[5]	265,428,000	20.04	13,244,910	117,747
2006[6]	269,698,500	20.04	13,458,009	119,642
Difference	- 4,270,500	0	- 213,099	- 1,895

Table 2. Carbon Footprint Equivalence

Equivalent	Five Year Carbon Footprint from Passenger Cars and Light Trucks
-371	Annual CO_2 emissions from the number of passenger vehicles.
-21,383	CO_2 emissions from the number of gallons of gasoline consumed.
-4,406	CO_2 emissions from the number of barrels of oil consumed.
-25	CO_2 from the number of tanker truck's worth of gasoline.
-10	CO_2 emissions from burning of the number of railcars' worth of coal.

3 Passenger cars and light trucks account for approximately 80% to 90% of vehicles on Grand Forks-East Grand Forks roads. Greenhouse Gas Emissions Inventory for the City of Grand Forks, North Dakota, prepared by Dr. Gopal Bandyopadhyay (September 2008).

4 In 2007, the weighted average combined fuel economy of cars and light trucks combined was 20.4 miles per gallon (FHWA 2008) - http://www.epa.gov/cleanenergy/energy-resources/refs.html

5 *FHWA Highway Statistics for Urbanized Areas (2010)*

6 *FHWA Highway Statistics for Urbanized Areas (2006)*