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VKT Study – Part of the CEEI Reporting Initiative

BACKGROUND

The Ministry of Environment is leading a multi-agency initiative – Community Energy and Emissions Inventories or 'CEEI' – mandated to establish a cost-effective, provincially-sponsored data collection, analysis and reporting system that will provide BC local governments with Greenhouse Gas (GHG) inventory baselines, ongoing monitoring and periodic reports in order to help inform community decision making and support broader provincial objectives. The three primary sectors being reported on for each regional district and member municipality in the Province of British Columbia are: buildings, transportation and solid waste.

As part of the work on estimating vehicular GHG baselines, the CEEI required information on the number of kilometres driven by various vehicle types and in order to contribute to this CEEI requirement, BC STATS, the Insurance Corporation of BC (ICBC), and Pacific Analytics Inc. undertook the 'Transfer/Tax Form VKT Analysis' in the fall of 2008. The purpose of the study (outlined herein) was to improve vehicle kilometres travelled ('VKT') estimates for different regions of the Province. Where VKTs have been used by communities in the past, Statistics Canada provincial-level estimates have been drawn upon. While these estimates represent a range of vehicle types, they are generic across the province and therefore do not provide the necessary information at the municipal scale required for CEEI application.

The recent 'Transfer/Tax Form VKT Analysis' study improves VKT accuracy for a small range of vehicle types and ICBC geographical groupings or 'Rating Territories' across the Province. This study is part of a resident-based approach using ICBC data and aligning those vehicles to the appropriate local government jurisdictions around the Province. The Vehicle Transfer/Tax Form VKT project improves the vehicle kilometres driven estimates for ICBC-registered vehicles in various regions of the Province, although, as acknowledged below, there are still additional enhancements needed in the future.

METHODOLOGY

The Community Energy and Emissions Initiative (CEEI) methodology for determining community-level GHG vehicle emissions follows the resident-based (gross resident emissions) recommendation outlined in the report *Assessing Vehicular GHG Emissions: A Comparison of Theoretical Measures and Technical Approaches* undertaken on behalf of the CEEI in November, 2008 by Pacific Analytics Inc.[1]

The methodology determines GHG emissions by resident vehicles in each community based on the basic identity:

[1] The report assessed the theoretical and technical differences between two competing methodologies for determining vehicular GHG emissions: the Gross Resident Emissions (GRE or resident-based) approach which calculates emissions for all vehicles resident in a community respective of where the emissions occur; and the Gross Domestic Emissions (GDE) approach which calculates emissions for all vehicles travelling within the community boundaries, irrespective of whether the vehicle is registered in the community or is commuting or visiting from another region.

GHG Emissions = # of Vehicles X Avg. Fuel Efficiency X Avg. VKT X Unit Emissions

where vehicle types are sub-divided into a number of different categories ranging from small passenger vehicles to light duty trucks to heavy duty trucks to various specialized vehicle classifications.

The community-level data for the # of Vehicles, average Fuel Efficiencies, and Unit Emissions are current and of high accuracy. In contrast, a major limitation of this methodology is the community-level estimates of average Vehicle Kilometres Travelled (VKT).

At present the only accurate estimates of regional VKT for different vehicle types are provided by data collected by AirCare for the Lower Mainland area.[2] An econometric analysis was undertaken relating the number of kilometres driven (the dependent variable) to a number of explanatory (independent or influencing) variables: for the time period 2000 to 2007, the price of fuel (gasoline or diesel), the average per capita real income, and the age of each vehicle in each time period were used.

The results from this AirCare econometric analysis provided the initial estimates of VKT by vehicle type, but since these values are specific to Lower Mainland, the results do not fully account for community-specific characteristics that may be different from the Lower Mainland and that may affect driving characteristics. While it was understood that until there are samples of odometer readings for each community/region it will not be possible to have definitive community-specific VKT estimates (see Recommendation 3 in the *Assessing Vehicular GHG Emissions* report cited earlier), it was concluded, in conjunction with staff at BC STATS, that some regional information could be generated from ICBC's *Vehicle Transfer Forms* that would inform community-specific VKT estimates, and while the resulting VKT estimates would still not be 'definitive', the estimates would be closer to the true values than simply using Lower Mainland estimates.

Vehicle Transfer Form Methodology

When a vehicle is sold in BC (generating a change in registration), ICBC requires that a *Vehicle Transfer Form* be filled out. These VT Forms (or "9Ts") include characteristic data on the vehicle including the model year of the vehicle and the odometer reading as of the date of sale. From this information, it is not possible to determine VKT for a specific year, but it is possible to estimate for each vehicle filling out a VT Form the average annual kilometres driven over the life (to date of sale) of the vehicle. At the same time, it is possible to estimate the average kilometres the vehicle *would have driven* using the econometric coefficients derived from the Lower Mainland AirCare data multiplied by the regional values for each variable (i.e., fuel price, average per capita income, and model age).[3] The difference between what the VT Forms suggest is the actual average annual kilometres driven by a vehicle and the estimate based on AirCare econometric data provides an indication of the influence of differing regional fuel prices, average incomes and average age of the vehicle stock on VKT in each region.

The first order of business was to obtain from ICBC a relatively large sample of VT Forms. From an original sample of approximately 20,000 records entered into a database, just over 10,000 usable vehicle records were identified.[4] Because of the relatively small sample size, it was not possible to

[2] All vehicles over 7 years old, registered in the Lower Mainland and weighing less than 5,000 KGs NVW are required to go through AirCare. AirCare registers the odometer reading for each, and this very large sample of vehicles enables a very accurate estimation of the number of kilometres driven per year by vehicle type.

[3] This effectively assumes that drivers are influenced by (say) fuel prices in the exact same way that drivers in the Lower Mainland are, but since the actual (say) fuel price is different, the effect on the number of kilometers driven will differ.

[4] The original 20,000 records included a large number of unusable records: new vehicles with very low odometer readings that were transferred from retailers to new owners; records with invalid VINs; records with model year prior to 1994; vehicles not included in the passenger vehicle classification; etc.

undertake the analysis by Regional District; rather it was necessary to undertake the analysis by ICBC Ratings Territory.

Actual average annual kilometres driven over the life of each vehicle were estimated for each vehicle based on its model year (assumptions being that the vehicle was first driven at the midpoint of its model year and the only three-quarters of the average kilometres driven occurred in 2008). The sample average for each vehicle class (i.e., small cars, large cars, light duty gasoline trucks, and light duty diesel trucks) was then calculated for each ICBC Rating Territory where it was agreed there was a "sufficient" sample size.

In order to estimate kilometres driven based on Lower Mainland driving behaviour for each vehicle, the econometric coefficients derived from Lower Mainland AirCare data were applied to regional specific explanatory variables (i.e., the price of fuel in each time period, the average per capita real income, and the model age of each vehicle). The average for each vehicle class for each Rating Territory was calculated and the percentage difference between actual average and the average based on the Lower Mainland coefficients for vehicle class and Rating Territory calculated. These percentages were used to adjust the estimated Lower Mainland VKT values in order to provide differential Vehicle Kilometres Travelled (VKT) values for different regions of the province which in turn are used in the calculations of annual fuel consumption and annual GHG emissions for each community.

The following table highlights the adjustment factors relative to Lower Mainland VKT (i.e., Lower Mainland VKT is equal to 1.0) that were applied to the estimated VKT values for MetroVan determined using the AirCare data. Note that for a number of ICBC Rating Territories, the sample size was not considered to be large enough to provide reasonably reliable adjustment factors, and therefore the Rating Territories were combined.

Table 1: Adjustment Factors by Rating Territory and Vehicle Class[5]

Rating Territory	Small Car	Large Car	Truck/SUV (gasoline)	Truck/SUV (Diesel)
E + F + G	1.07	0.91	1.15	1.03
H	1.21	1.08	1.13	0.94*
L	1.07	1.09	1.11	1.06
N	1.16	1.02	1.12	1.07
P			1.26	
R			1.10	
S			1.42	
V			1.19	
P + R + S + V	1.28	1.56		1.16
X + Y	1.15	1.06	1.14	0.84*
W	0.96	0.97	0.96*	0.86*

*Sample size is considered small and therefore results should be used with caution

[5] Rating Territory approximate areas: E = Maple Ridge; F = Squamish; G = Hope; H = Abbotsford; L = Kamloops; N = Kootenays; P = Chilcotin; R = Quesnel; S = Smithers; V = Fort Nelson; X = Mid Vancouver Island, W = South Vancouver Island; Y = North Vancouver Island.

In the report *Assessing Vehicular GHG Emissions: A Comparison of Theoretical Measures and Technical Approaches*, a number of recommendations were included for future years for enhancing the quality of regional information derived from the Vehicle Transfer Forms. These include:

1. Increasing the sample size of the VT Forms. This will enable the identification of a finer geographical detail, possibly for all 29 Regional Districts in BC. At the same time, an increased sample size would enable the identification of additional vehicle classes, including possibly heavy vehicles.
2. At present, the estimated VKTs by vehicle class for MetroVan are used as the starting values for each Rating Territory before the adjustment factor is applied. It is recommended that the MetroVan coefficients (derived from the AirCare data) be applied to community level explanatory variables (fuel prices, average per capita incomes, vehicle age) in order to determine the starting values before applying the appropriate adjustment factor.
3. It also is recommended that the CEEI approach ICBC in order to ascertain collectively the feasibility (and the pros and cons) to either require annual odometer readings for all registered vehicles in the Province or to gather a large, representative Province-wide sample of odometer readings at the time of license renewal. While this information would not be usable for a couple of years (one would need two odometer readings to make an estimate of annual VKT by vehicle), the resulting estimates would be highly accurate and would provide detailed information at the community level.
4. A fourth recommendation, not addressed in the earlier report, is to use the AirCare information to calculate detailed VKT estimates by vehicle class for each municipality within the AirCare catchment area. This would provide distinct and better information for (say) Vancouver vs Burnaby vs Abbotsford.

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APPENDIX

Vehicle Class	Rating Territory	Sample Size	VT Form Kilometres	Coefficient-Derived Kilometres	Adjustment Factor	Region	Fuel Type
SMALL	E	33	3,644,858	4,305,606	0.930	Maple Ridge	G
LARGE	E	15	1,146,317	1,413,652	0.869		G
TRUCK	E	45	5,405,567	4,478,761	1.054		G
TRUCK	E	4	637,741	636,901	0.800		D
SMALL	F	17	1,614,395	1,364,334	1.299	Squamish	G
LARGE	F	8	859,678	1,040,329	0.885		G
TRUCK	F	16	2,888,364	1,954,124	1.291		G
TRUCK	F	4	322,028	272,381	0.944		D
SMALL	G	11	2,021,615	1,800,502	1.233	Hope	G
LARGE	G	2	273,347	249,455	1.175		G
TRUCK	G	13	1,744,585	1,210,912	1.259		G
TRUCK	G	2	378,829	130,126	2.325		D
SMALL	H	230	30,331,121	27,549,694	1.209	Abbotsford	G
LARGE	H	96	10,222,203	10,108,050	1.084		G
TRUCK	H	222	24,740,291	19,158,049	1.128		G
TRUCK	H	37	3,616,046	3,067,407	0.942		D
SMALL	L	523	57,559,368	59,001,620	1.071	Kamloops	G
LARGE	L	315	34,304,981	33,777,765	1.089		G
TRUCK	L	819	104,716,194	82,359,704	1.110		G
TRUCK	L	89	13,082,971	9,873,676	1.058		D
SMALL	N	119	14,520,238	13,697,072	1.164	Kootenays	G
LARGE	N	73	6,702,389	7,022,969	1.023		G
TRUCK	N	240	31,337,054	24,455,006	1.119		G
TRUCK	N	26	2,664,067	1,985,807	1.072		D
SMALL	P	42	5,177,382	4,446,664	1.278	Chilcotin	G
LARGE	P	14	1,718,095	1,773,696	1.039		G
TRUCK	P	89	11,591,026	8,020,720	1.262		G
TRUCK	P	12	2,061,328	1,091,057	1.509		D
SMALL	R	76	9,772,262	7,986,270	1.344	Quesnel	G
LARGE	R	60	13,158,703	7,634,379	1.848		G
TRUCK	R	174	19,755,316	15,684,898	1.100		G
TRUCK	R	28	5,035,734	3,834,992	1.049		D

SMALL	S	45	5,909,548	4,674,415	1.387	Smithers	G
LARGE	S	14	1,219,522	1,289,737	1.014		G
TRUCK	S	81	11,867,541	7,260,235	1.428		G
TRUCK	S	11	1,679,063	1,369,262	0.979		D
SMALL	V	25	2,416,273	2,792,597	0.950	Fort Nelson	G
LARGE	V	14	1,749,074	1,590,151	1.179		G
TRUCK	V	110	13,816,994	10,158,598	1.188		G
TRUCK	V	21	3,412,802	2,119,890	1.286		D
SMALL	X	352	40,297,088	38,412,738	1.151	Mid Van Isl.	G
LARGE	X	187	19,065,816	18,815,883	1.086		G
TRUCK	X	474	61,413,059	46,382,233	1.156		G
TRUCK	X	41	4,211,044	3,912,659	0.859		D
SMALL	W	287	30,749,489	35,354,032	0.955	South Van Isl.	G
LARGE	W	157	14,705,189	16,235,845	0.971		G
TRUCK	W	357	40,382,714	36,797,310	0.958		G
TRUCK	W	15	1,597,236	1,483,805	0.859		D
SMALL	Y	23	2,980,183	2,938,201	1.113	N. Van Isl.	G
LARGE	Y	10	605,325	1,044,569	0.621		G
TRUCK	Y	55	6,658,119	5,704,888	1.019		G
TRUCK	Y	6	871,891	933,590	0.746		D
SMALL	E+F+G	61	7,280,868	7,470,442	1.070		G
LARGE	E+F+G	25	2,279,342	2,703,436	0.904		G
TRUCK	E+F+G	74	10,038,516	7,643,797	1.147		G
TRUCK	E+F+G	10	1,338,598	1,039,408	1.029		D
SMALL	P+R+S+V	188	23,275,465	19,899,946	1.284		G
LARGE	P+R+S+V	102	17,845,394	12,287,963	1.557		G
TRUCK	P+R+S+V	454	57,030,877	41,124,451	1.211		G
TRUCK	P+R+S+V	72	12,188,927	8,415,201	1.157		D
SMALL	X+Y	375	43,277,271	41,350,939	1.149		G
LARGE	X+Y	197	19,671,141	19,860,452	1.062		G
TRUCK	X+Y	529	68,071,178	52,087,121	1.141		G
TRUCK	X+Y	47	5,082,935	4,846,249	0.838		D