Background

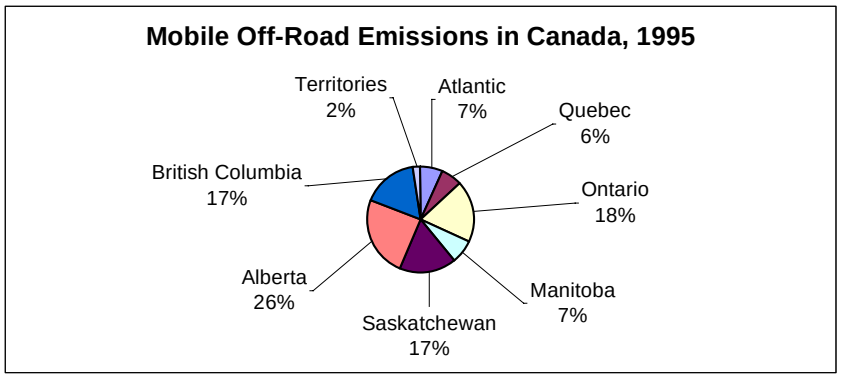
- The off-road sector includes a wide range of engine and equipment types, including lawn and garden, airport service, recreational and recreational marine, industrial, agriculture, logging, construction and mining, and light commercial.

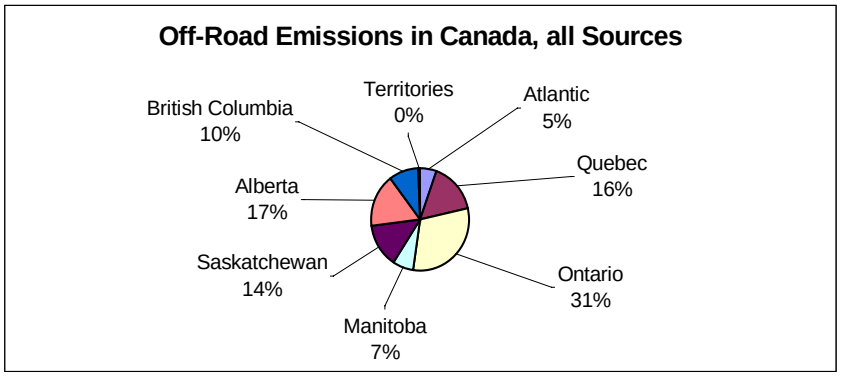
- The diversity of engine and equipment types in this sector and the relative inattention to off-road emissions complicate national and provincial inventories and present considerable challenges in the development of an off-road emissions reduction strategy.

- Estimates of the relative proportion of provincial off-road emissions for Alberta can vary significantly, depending on source information.

Off-Road Emissions

- An estimate of Alberta's relative contribution to off-road emissions in Canada varies according to what emission sources are included in the estimation process. Values from Environment Canada's publication, "Trends in Canada's Greenhouse Gas Emissions, 1990-1995", report that Alberta is responsible for 26 percent of off-road emissions in Canada. This value is based on mobile emissions, and does not include many engine and equipment types that are considered in the off-road sector.





- Alternatively, the work completed by the Off-Road Working Group of the Transportation Table generated strikingly different values for provincial off-road emissions. It estimated that Alberta contributes 17 percent of off-road emissions in Canada. This value represents the range of engine and equipment types that comprise the off-road sector, however the authors acknowledge that information problems persist when attempting to develop an accurate inventory of off-road emissions in Canada.

- The information used in the Environment Canada publication and by the Off-Road Working Group differs, explaining the divergence between the reports of Alberta's off-road emissions. The Off-Road Working Group included stationary sources of off-road emissions (compressors and generators etc.) and likely captures off-road emissions that are "hidden" in other categories in the Environment Canada report, or those that were not recorded whatsoever.

- The following table adapted from the Off-Road Working group lists the various vehicle and equipment types in the off-road sector, suggesting the difficulty inherent in developing an emissions inventory for this sector, and the complications involved in mitigating emissions form these sources.

Off-Road Sector Vehicles and Equipment

Lawn and Garden
Trimmers/Edgers/Brush Cutters
Lawn mowers
Leaf blowers/Vacuums
Rear Engine Riding Mowers
Front Mowers
Chainsaws <4 HP
Shredders <5 HP
Tillers <5 HP
Lawn and Garden Tractors
Wood Splitters
Snowblowers
Chippers/Stump Grinders
Commercial Turf Equipment

Airport Service
Airport Support Equipment
Terminal Tractors

Recreational
All Terrain Vehicles
Minibikes
Off-Road Motorcycles
Golf Carts
Snowmobiles
Specialty Vehicle Carts

Recreational Marine
Vessels w/Inboard Engines
Vessels w/Outboard Engines
Vessels w/Sterndrive Engines
Sailboat Auxiliary Inboard Engines
Sailboat Auxiliary Outboard Engines
Personal Watercraft

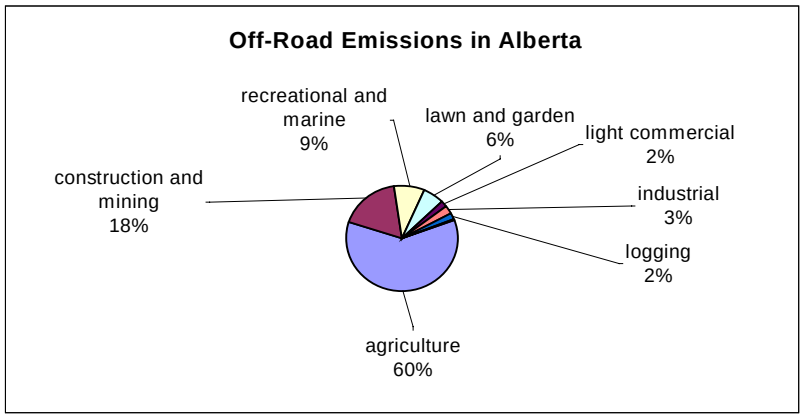
Light Commercial
Generator Sets <50 HP
Pumps <50 HP
Air Compressors <50 HP
Gas Compressors <50 Hp
Welders <50 Hp
Pressure Washers <50 HP

Industrial
Aerial Lifts
Forklifts
Sweepers/Scrubbers
Other General Industrial Equipment
Other Material Industrial Equipment

Agriculture
2-Wheel Tractors
Agricultural Tractors
Agricultural Mowers
Combines
Sprayers
Balers
Tillers >5 HP
Swathers
Hydro-Power Units
Other Agricultural Equipment

Logging
Chainsaws >4 HP
Shredders >5 HP
Skidders
Fellers/Bunchers

Construction and Mining
Asphalt Pavers
Tampers/Rammers
Plate Compactors
Concrete Pavers
Rollers
Scrapers
Paving Equipment
Surfacing Equipment
Signal Boards
Trenchers
Bore/Drill Rigs
Excavators
Concrete/Industrial Saws
Cement and Mortar Mixers
Cranes
Graders
Off-Highway Trucks
Crushing/Processing Equipment
Rough Terrain Forklifts
Rubber Tired Loaders
Rubber Tires Dozers
Tractors/Loaders/Backhoes
Crawler Tractors
Skid Steer Loaders
Off-Highway Tractors
Dumpers/Tenders
Other Construction Equipment



- Based on these categories, Alberta's off-road emissions are predominantly from agriculture, then construction and mining, and recreation.

- 85 percent of off-road emissions in Alberta are from diesel combustion, with the remaining 15 percent from combustion of gasoline.

Off-Road Working Group

- The Transportation Table's Working Group on off-road vehicle and equipment emissions had as it's goals to consider and recommend measures to reduce emissions of GHG and promote more fuel efficient off-road technologies, and to strengthen the capacity to estimate off-road sector GHG emissions.

- The report prepared by the Working Group is unique; no such effort to produce an inventory of off-road emissions and develop policy options for emissions reductions has been undertaken previously by other jurisdictions. This points to the data problems and uncertainty facing analysis of this sector.

- The consultant, ICF Kaiser, developed a GHG database that would enable a "bottom-up" estimation of off-road emissions, which could be updated and modified when better information becomes available. The ICF Kaiser model was also calibrated/normalized to fuel consumption estimates from NRCan's Canada's Energy Outlook.

- In developing the database the consultant was required to estimate vehicle and equipment populations, and fuel use by engine type. Information sources for vehicle and equipment populations are identified; some data is available via Canadian sources such as Statistics Canada, while other data is estimated based on specific methodologies or surrogate data from the United States. Whenever more appropriate data becomes available, it should replace existing data.

- Fuel use for most engine types was calculated with the following activity variables:

  Fuel use = population * hours of use (average) * power (average) * load factor (average) * brake specific fuel consumption (average).

- These activity data variables were scaled from U.S. sources to the Canadian population. The consultants state that should Canadian consumption factors become available, they should replace current defaults.

- A list of policy options to mitigate GHG emissions from the off-road sector was evaluated and three broad options underwent further analysis: (1) a fuel efficiency regulation, (2) a voluntary memorandum of understanding, and (3) a public awareness campaign. This analysis involved three different engine classes: (1) a recreational engine, (2) construction and mining equipment, and (3) agricultural equipment.

- The consultant suggests that fuel efficiency regulations would have significant effects on improving fuel efficiency. Advancement in on-road diesel engine technology likely has applications for construction, mining, and agricultural engines. A sufficient phase-in period would be necessary.

- A voluntary memorandum of understanding could produce benefits, however a number of elements need to be in place for voluntary agreements to be effective. The consultant notes this uncertainty.

- A well-executed public awareness campaign could produce real benefits.

- ICF Kaiser's analysis did not produce cost per tonne figures, however a cost-effectiveness matrix was developed for comparative analysis of the three policy options. Additional qualitative assessment of the social, economic, health, and environmental benefits and impacts is provided.

- Generally, the consultant suggests that the most effective measure would be a regulatory measure for fuel efficiency, followed by a voluntary memorandum of understanding and a public awareness campaign.

- There may be barriers to implementing policy measures (i.e. heavy-duty equipment tends to have a long service life, slowing the rate of turnover to new technology; and, personal versus commercial purchasing).

- The consultant strongly recommends that more data be gathered, including GHG emission factors, cost data based on engine and equipment type, and the real price of technology change. They also stress the importance of improving the accuracy of population and activity data, and encourage primary data collection efforts to minimize the need for U.S. surrogate data.

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