The following document is supplemental to *NCHRP WebResource 2: Road Usage Charge Guide* (NCHRP Project 19-18, "Transitioning Fuel Tax Assessments to a Road Usage Charge"). The full WebResource can be found at https://crp.trb.org/nchrpwebresource2/.

Vehicle Impacts by Commercial Vehicle Specific Factors (Size and Weight)

Description:

Road usage charging (RUC) is intended to provide a sustainable replacement of fuel taxes as a source of revenue for road maintenance and investment. By charging vehicles for the distance they travel, it is based on the "user-pays" principle according to the degree to which vehicles use the road network. Although the principle that those that drive the most miles should pay the most is economically sound, the cost imposed by driving is also influenced, not just by distance driven, but also by a range of vehicle-specific factors, including:

- Size, which influences the proportion of road space occupied by a vehicle, reflecting the road capacity it occupies and implicating costs of road network provision;
- Weight, which influences the wear and tear on the road network, and the standard to which roads and bridges must be built to withstand such vehicles;
- Axle and tire numbers per vehicle, with more axles or tires for the same weight reducing the wear and tear generated on the road network relative to vehicles with fewer axles or tires; and
- Vehicle type, which influences vehicle specific infrastructure, such as weigh-bridges, truck parking/stopping facilities, and charging points.

Because various vehicle types have varying impacts on infrastructure, vehicle characteristics may impact how a RUC system is designed, both in terms of rate-setting and how RUC is phased into a jurisdiction. In fact, existing systems to tax and regulate motor vehicles already distinguish between vehicles of varying weights to reflect factors such as impacts on infrastructure and safety.

Data Required:

There has been extensive research on the impacts of axle weights on road wear and tear undertaken by FHWA and other institutions.[1] These provide a general guide as to how vehicle weight influences road maintenance costs. Additional data that would help in establishing the vehicle impacts and costs on the network includes:

- Volumes of traffic by vehicle class (preferably by weight categories) on the road network
- Information on any classification of the road network that reflects the construction standard of any routes/bridges (this will influence the relative impacts of various vehicles on specific parts of the network, and the resulting maintenance costs)
- Local conditions as to the proportion of road maintenance costs attributable to road use compared to environmental conditions (sun, rain, snow, temperature changes).

Furthermore, any special provision of infrastructure for certain classes of vehicles (e.g., truck parking facilities, weigh-bridges, or electric vehicle charging points) that are paid for from fuel taxes would also reflect the indirect impacts of making provision for specific types of vehicles.

To understand more fully what commercial vehicle sectors generate these impacts, it would also help to collect data on the segmentation of the sector by vehicle class, including factors such as for-hire vs. in-house transportation, types of goods (or passengers) hauled and trip patterns for such vehicles.

[1] For one example, see Luskin, D. and Walton, C.M, "Effects of Truck Size and Weights on Highway Infrastructure and Operations: A Synthesis Report," University of Texas at Austin Center for Transporation Research, 2001.

Data Sources:

Likely data sources include:

- Traffic count data, including any data that may identify vehicle classes (including axle counting of heavy-duty vehicles)
- Road network asset inventories
- Historical spending on road maintenance including relative cost differences by road which may reflect difference in volumes/weights of heavy vehicles on different roads
- Survey data on medium and heavy-duty vehicle users by vehicle type, trip patterns and sector

Analysis Steps:

To undertake a comprehensive analysis of impacts requires undertaking a study that disaggregates what is spent on the road network, by types of vehicles and the impacts that vehicle use (distinct from environmental conditions) impose on the road network. Such as study would consider:

1. Costs of maintaining and renewing the road network (which may include deferred maintenance)
2. Traffic volumes by vehicle class (including weight categories)
3. Engineering/economic assessment of what proportions of road maintenance/renewal costs are attributable to heavy, medium, and light-duty vehicles, and what proportions are attributable to external factors
4. Distribution of commercial vehicle road use by sector, vehicle type, trip type.

Considerations/Lessons Learned:

Studies on heavy-vehicle impacts on roadway structures and surfaces have been undertaken by jurisdictions and academics over many years, and may be useful to inform a smaller-scale desktop research study of likely impacts. However, a more extensive highway costs study, similar to that undertaken by Oregon biannually, would help to better understand how different vehicle types, and as a result how various sectors of the commercial vehicle fleet, impact the road network.

Sample Output

Below is a sample output from Oregon's cost-responsibility study for 2019-2021. This illustrates how the costs of various types of road construction activity is recommended to be shared by different categories of vehicles.

Work Type Description	Work Type	Allocator 1	Share 1	Allocator 2	Share 2
Preliminary and Construction Engineering (and etc.)	1	CongestedPCE	0.5595	Other_Construction	0.4405
Right of Way (and Utilities)	2	CongestedPCE	0.7375	Other_Construction	0.2625
Grading and Drainage	3	CongestedPCE	1.0000	None	0.0000
New Pavements-Rigid	4	CongestedPCE	0.0410	Rigid	0.9590
New Pavements-Flexible	5	CongestedPCE	0.0548	Flex	0.9452
New Shoulders-Rigid	6	CongestedPCE	1.0000	None	0.0000
New Shoulders-Flexible	7	CongestedPCE	1.0000	None	0.0000
Pavement and Shoulder Reconstruction-Rigid	8	CongestedPCE	0.0410	Rigid	0.9590
Pavement and Shoulder Reconstruction-Flexible	9	CongestedPCE	0.0548	Flex	0.9452
Pavement and Shoulder Rehab-Rigid	10	All_VMT	0.0410	Rigid	0.9590
Pavement and Shoulder Rehab-Flexible	11	All_VMT	0.0548	Flex	0.9452
Culverts	12	All_VMT	0.8752	Flex	0.1248
New Structures	13	None	1.0000	None	0.0000
Replacement Structures	14	None	1.0000	None	0.0000
Structures Rehabilitation	15	None	1.0000	None	0.0000
Climbing Lanes	16	UphillPCE	1.0000	None	0.0000
Truck Weight/Inspection Facilities	17	Over_26_VMT	1.0000	None	0.0000
Truck Escape Ramps	18	Over_26_VMT	1.0000	None	0.0000