To: City of Bend Citywide Transportation Advisory Committee & CTAC Funding Work Group
Attn: Susanna Julber, Karen Swirsky, and Eric King
From: Steve Porter and Michelle Porter
Date: August 8, 2019

Public Comment:

Transportation System Funding: Fuel Tax

Dear Bend Citywide Transportation Advisory Committee & CTAC Funding Work Group:

We would like to thank the Funding Work Group (FWG) for provisionally endorsing a fuel tax to help fund Bend's transportation system. We believe this is a positive decision.

Unfortunately, there appear to be material flaws in the way the FWG has modeled the tax. To remedy these issues, we have produced an amended fuel tax model on which basis we reach two key conclusions:

- First, the fuel tax as identified by the FWG would generate about one-half the revenue that is estimated in the FWG's calculations.
- Second, the beneficial economic consequences of a fuel tax are substantial. One dollar paid in taxes would generate at least $13.81 in returns accruing to Bend's residents primarily as a result of the tax's salutary effects on vehicle miles traveled (VMT), air and noise pollution, road maintenance costs, and Bend resident living standards.

In this comment we describe our amended model and its findings, then we outline three modest alterations to the fuel tax's structure that can improve its demand-side effects while enhancing its revenue potential and social efficiency.

Although this comment is primarily intended to provide assistance to the FWG as it analyzes the fuel tax, we also hope it demonstrates a critical point that has not been sufficiently addressed by the FWG: *how the transportation system is funded affects how the transportation system is used.*

In our fuel tax modeling this notion is captured through demand elasticity, which reflects the economic concept that less of something is consumed as its price increases. The concept applies more broadly to Bend's transportation system than just to the fuel tax; any funding mechanism will have implications for transportation system use, and therefore consequences for how well the transportation system serves Bend. To ignore this effect is to ignore the role of price/cost in decision-making and to therefore potentially subject Bend's transportation system to significant waste. We hope the FWG will more fully consider this fundamental issue in future discussions.

Funding Work Group's Proposed Fuel Tax

The FWG has proposed a fuel tax that would:

- add 1 cent per gallon to fuel purchases during Bend's "off season" (November, December, January, and February);
- add 3 cents per gallon in "shoulder seasons" (March, April, May, and October); and
- add 5 cents per gallon in the "peak season" (June, July, August, and September).[1]

The FWG estimates the tax will generate about $1.83 million in annual revenue. This is predicated on two key economic modeling inputs: first, that 40 million gallons of vehicle fuel are sold in Bend annually; and second, that vehicle fuel demand in Bend is perfectly inelastic with respect to price. We do not agree with these inputs and, because material implications attach to them, we provide an alternative fuel tax analysis.

Alternative Fuel Tax Modeling

Our alternative model of the proposed fuel tax accounts for long-run demand elasticity and reflects what we believe to be more accurate figures for fuel sales in Bend.

Elasticity of Demand

Demand elasticity refers to the linkage between a product's unit price and the quantity demanded of that product; for most products, quantity demanded falls as price increases. Demand elasticity values quantify that relationship. Empirical work shows that vehicle fuel demand is extremely inelastic in the short run, in the range of -0.10 to -0.20.[2] Long-term price elasticity values are much greater, estimated around -0.70, implying that a 10% increase in long-run fuel price corresponds with decrease in fuel consumption of about 7%.[3]

The large difference between short-term and long-term price elasticities for vehicle fuel can be understood intuitively: Over the long-run (i.e., several months to upwards of a year) drivers may switch to more efficient vehicles or change transportation habits by, for instance, moving closer to work in the face of higher fuel costs, options that do not present themselves in the short-run when fuel is needed to make a marginal trip.

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[1] "Initial Funding Assessment" (October 31, 2018). "Funding Work Group #5 Memo" (July 17, 2019).

[2] Schipper, L. and EMBARQ, "Fuel Economy and Car Use Trends," World Resources Institute. Lin, C.and L. Prince, "Gasoline Price Volatility and the Elasticity of Demand for Gasoline," *Energy Economics*, Vol. 38 (July 2013). United States Energy Information Administration.

[3] Long-run elasticity estimates range from about -0.60 to -0.90, with the bulk of empirical evidence placing the value around -0.70. Schipper, L. and EMBARQ, "Fuel Economy and Car Use Trends," World Resources Institute. Lin, C.and L. Prince, "Gasoline Price Volatility and the Elasticity of Demand for Gasoline," *Energy Economics*, Vol. 38 (July 2013). United States Energy Information Administration.

With respect to modeling Bend's prospective fuel tax, we believe it is appropriate to incorporate demand elasticity into the calculations, and we believe long-run demand elasticity is the applicable statistic. One reason is that the fuel tax aims to generate revenue over a period longer than a year; in estimating revenue potential, the relevant time horizon is accordingly the "long term." Additionally, empirical evidence shows consumers' fuel purchase behavior begins to approximate long-run patterns in the span of a few months when price changes occur, implying a relatively brief behavioral transition period in Bend once a higher price is imposed via taxes. Further, local consumers might be expected to adopt long-run fuel purchase behaviors more quickly than evidenced in empirical studies. That is because most studies are based on price changes of uncertain duration whereas the tax's price rise would be permanent and communicated beforehand. Bend's consumers would be able to plan with certainty and would be expected to adjust behaviors comparatively rapidly. For these reasons, we incorporate a -0.70 elasticity value in our fuel tax modeling.

Quantity of Fuel Sales

The FWG fuel tax model estimates 40 million gallons of vehicle fuel are sold annually in Bend. Because fuel sales for Bend are not reported directly, the estimate reflects fuel sales in Oregon cities with a fuel tax, where sales are reported. The FWG converts these cities' gross fuel sales to per capita figures, then applies median per capita sales from Oregon cities with more than 50,000 people to Bend's population. Economic census data also are used to support the 40 million gallon figure using statewide statistics.[4]

In an earlier comment, we calculated annual fuel consumption in Bend of around 28 million gallons on the basis of Bend's annual VMTs. Our analysis converted VMTs to fuel gallons using fleet average fuel efficiency of about 22 miles per gallon (MPG).[5]

While fuel sales and fuel consumption are not necessarily the same, we would anticipate a closer match of values than exhibited by these two sets of figures. Indeed, we are unaware of any effect that would cause Bend fuel purchases to exceed fuel consumption by about 40% on net.[6] Certainly over the long run we would expect net sales and use figures to be substantially similar. This implies that one set of estimates may be inaccurate. To test these competing figures, we conducted three separate analyses as outlined below. The results of our analyses indicate that our estimate of 28 million gallons is approximately correct, and the FWG estimate is inflated.

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[4] "Initial Funding Assessment: An Interim Report to Inform Bend's Transportation Plan" (October 31, 2018).

[5] "Evidence Demonstrating the Efficiency, Safety & Economic Benefits of 20mph Speed Limits" (July 13, 2018).

[6] 40 million - 28 million = 12 million. 12 million / 28 million = 42%. The question is whether fuel consumers, on net, would be substantially more likely to purchase fuel in Bend than to burn fuel while driving in Bend. We are unaware of any reason this would be the case. Certainly not all fuel sold in Bend is burned in the city limits; at the same time, some fuel sold outside of Bend is burned in the city. We would expect these factors to offset one another. In any case, statistical evidence shows the overwhelming majority of car trips - and thus total miles driven - are of short distances (under 10 miles), which would occur largely if not completely within city limits. Federal Highway Association 2009 National Household Travel Survey, "Vehicle Trips, Number of Vehicle Trips by Trip Distance Including Trips 2 Miles or Less."

Carbon Dioxide Emissions-Based Estimate of Fuel Consumption

First we used data compiled by Bend's Climate Action Steering Committee (CASC) in its quantification of Bend's transportation sector carbon dioxide (CO2) emissions to verify Bend's vehicle fuel consumption. Summing emissions from passenger cars and light trucks, commercial services, truck freight, and transit, annual CO2 emissions associated with retail fuel usage are about 252,282 metric tons.[7] This carbon emissions figure corresponds with fuel consumption of about 28 million gallons, virtually identical to our earlier-calculated figure.[8] In addition to verifying our 28 million gallon consumption estimate, this analysis also verifies Bend's observed fleet average fuel efficiency at about 22MPG. Our calculations are set forth in Appendix 1.

Per Capita Fuel Sales Analysis

We undertook a second analysis using per capita fuel sales data compiled by the FWG. We wanted to evaluate whether our 28 million gallon consumption figure would yield a reasonable per capita sales amount, assuming it reflected not only fuel consumption but also sales.

The FWG data show that per capita fuel sales in Oregon cities with fuel taxes range from 2,225 per year (Warrenton) to 291 per year (Portland), with a statewide average of 397. Our 28 million gallon figure corresponds with 322 gallons per capita in Bend.[9] This approximates the midpoint between Portland's and Eugene's (377) per capita sales, suggesting Bend's per capita fuel sales are similar to those cities' and on the low end for cities in Oregon.

To evaluate the reasonableness of this finding we considered several factors:

1) Bend has perhaps the highest share of telecommuters in Oregon (9.4%), suggesting daily commute-related fuel needs are low in Bend relative to Oregon as a whole;[10]
2) Bend has a relatively high retired population, indicating that a comparatively small share of Bend's population commutes or is responsible for shuttling children, suggesting low fuel needs;[11]
3) Bend's average travel time to work is significantly below Oregon averages (15.3 minutes in Bend versus 23.5 minutes statewide), implying low daily fuel requirements for those who do commute;[12]

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7 "2016 Community Greenhouse Gas Inventory" (August 2018). "Bend Community Transportation System Background Report" (October 2018).

8 Approximately 20 pounds of CO2 emissions are generated per gallon of gasoline burned. There are 2,204.623 pounds per metric ton.

9 Bend population of 86,765 is used, in accordance with FWG calculations.

10 "Transportation Working Group Bend Community Climate Action Plan," Presentation (October 18, 2018).

11 Mesh, A., "Bend Is Where Old People Go to Retire," *Willamette Week* (November 20, 2016).

12 United States Census Bureau, "QuickFacts: Oregon; Bend city, Oregon; United States," (accessed August 2019).

4) Bend's share of population under age 18 is much higher than state averages (22.7% versus 20.8%), implying a low proportion of drivers and thus relatively low fuel needs;[13]
5) Bend, Eugene, and Portland have similar ratios of workers who either live in-city and work outside it or vice versa, implying that all three cities' fuel uses would be similarly affected by this dynamic;[14] and
6) Bend has a small geographic footprint, at 33 square miles, indicating that driving distances are short and everyday transportation is not fuel intensive (for comparison, Eugene's land area is 44 square miles).[15]

These observations suggest 28 million gallons is a reasonable fuel sales figure for Bend.

Fuel Efficiency Analysis

Finally, we assessed the fleet average MPG value that would have to be observed in Bend to correspond with 40 million gallons of annual fuel usage, given Bend's VMTs. To do this we divided Bend's VMTs by the FWG fuel estimate of 40 million gallons, deriving an implied average fuel efficiency of about 15MPG.[16]

This figure is one-third below national fleet fuel efficiency as well as one-third below Bend's average efficiency implied by our CO2 analysis.[17] Because of this large disparity, we evaluated whether there is reason to believe Bend's average fuel efficiency should be significantly worse than broader averages.

A means of doing this is to consider certain economic factors in Bend that might have implications for its vehicle fleet fuel efficiency. Our evaluation suggests Bend's fleet fuel efficiency should be in line with national averages as the CO2 analysis indicates, if not somewhat higher. This is because MPGs are negatively correlated with vehicle age (i.e., newer vehicles obtain better efficiency), and vehicle age is negatively correlated with income (i.e.,

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[13] Statistics are not reported for persons under age 16, so we use persons 18 or under as a proxy for people below driving age. United States Census Bureau, "QuickFacts: Oregon; Bend city, Oregon; United States," (accessed August 2019).

[14] "Transportation Working Group Bend Community Climate Action Plan," Presentation (October 18, 2018).

[15] United States Census Bureau, "QuickFacts: Oregon; Bend city, Oregon; Eugene, Oregon; United States," (accessed August 2019).

[16] We use the same VMT figure (610.7 million) for this calculation as used in our earlier public comment's estimate of Bend fuel consumption. The VMT figure is estimated for 2018 on the basis of average annual VMT growth in Bend, using 2014 as the base year and a 4% annualized growth rate. For more detail, see: Porter, "Evidence Demonstrating the Efficiency, Safety & Economic Benefits of 20mph Speed Limits," Public Comment (July 13, 2018).

[17] Fuel economy of all U.S. light-duty vehicles (cars, pickup trucks, vans, SUVs) was 21.6MPG as of 2013, with slight annual increases observed. When the entire U.S. vehicle fleet is considered (including freight trucks, buses, etc.), fuel economy was about 18MPG, as of 2013, again with slight observed annual improvements. Due to the observed yearly improvements, we would expect U.S. fleet averages to be somewhat higher than these figures, and in no case lower. Sivak, M., "Effects of Vehicle Fuel Economy, Distance Travelled, and Vehicle Load on the Amount of Fuel Used for Personal Transportation in the U.S.: 1970-2010," University of Michigan Transportation Research Institute, Report No. UMTRI-2013-10 (February 2013). "Gas Mileage of Vehicles on the Road: Little Progress Since Early '90s," University of Michigan, Michigan News (August 2015).

wealthier populations own newer vehicles).[18] Since Bend's median income is well above Oregon and national medians, we would expect Bend's average vehicle age to be relatively young and MPGs to be at or above general averages.[19] Hence, we view the FWG's implied 15MPG value as unlikely and our estimated 22MPG appropriate.

On the basis of these analyses, we believe our initial estimate is approximately correct and the FWG's fuel sales/consumption estimate is inflated by about 12 million gallons per year.[20] While any estimate is subject to some level of uncertainty, for purposes of planning, we are inclined to recommend that the FWG use our lower 28 million gallon figure to avoid overstating fuel tax revenue potential.

Alternative Model

By adjusting fuel sales/consumption to 28 million gallons per year and accounting for fuel demand elasticity, our alternative fuel tax model generates two significant differences from the FWG model.

First, fuel taxes provide roughly half as much revenue as the FWG estimates at average per-gallon fuel tax rates of about $0.03.[21] Second, contrary to the FWG model, which ignores any consumption consequences associated with fuel price increases, our analysis shows the tax reduces fuel consumption and accordingly has salutary effects on VMTs and CO2 emissions. Our full alternative model is set forth in Appendix 2.

Table 1, below, summarizes selected findings. At a pre-tax baseline, Bend vehicle fuel usage is associated with about 604.7 million VMTs and 560.0 million pounds of CO2 emissions. We tabulate the impacts of $0.033, $0.050, $0.067, $0.10, $0.20, and $0.30 per-gallon taxes (which correspond with 1.0%, 1.5%, 2.0%, 3.0%, 6.0%, and 9.0% effective tax rates[22]) on fuel tax revenue, VMTs, and CO2 emissions.[23]

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[18] Sivak, M., "Effects of Vehicle Fuel Economy, Distance Travelled, and Vehicle Load on the Amount of Fuel Used for Personal Transportation in the U.S.: 1970-2010," University of Michigan Transportation Research Institute, Report No. UMTRI-2013-10 (February 2013). "Gas Mileage of Vehicles on the Road: Little Progress Since Early '90s," University of Michigan, Michigan News (August 2015).

[19] Bend's median income is $60,563, while the U.S. median is $57,652 and the Oregon median is $56,119. United States Census Bureau, "QuickFacts: Oregon; Bend city, Oregon; United States," (accessed August 2019).

[20] Data relied upon by the FWG are indirect in nature and based upon several assumptions with which the FWG's conclusions exhibit a high degree of sensitivity. For instance, by applying Eugene's per capita fuel sales figure to Bend, the FWG methodology would generate a fuel sales estimate of about 32.7 million gallons, or nearly 20% lower. Similarly, basing the analysis not on per *capita* sales but on average per *driver* sales reduces the estimate for Bend no less than 15%, to 33.6 million gallons. (4,141,100 Oregon population * 79.2% 18-years or older = 3,279,751 estimated drivers. 1,643,472,051 gallons of fuel / 3,279,751 drivers = 501 average gallons/driver in Oregon. 86,765 Bend population * 77.3% 18-years or older = 67,069 Bend drivers. 501 gallons/driver * 67,069 Bend drivers = 33.6 million gallons.)

[21] The FWG's proposed fuel tax corresponds with an approximate monthly weighted average fuel tax of about $0.031 per gallon.

[22] Williams, K., "Oregon Gas Prices Tick Up, Now 4th Most Expensive Nationwide," *Oregonian* (April 16, 2019). The baseline fuel price used is not material to our findings.

[23] The difference between baseline VMTs reported here an in our previous work related to 20mph speed limits derives from the use in this report of a rounded 28 million gallon fuel figure rather than 28.2 as calculated in that earlier comment.

TABLE 1: BEND FUEL TAX RATES, REVENUE, IMPACTS ON VMT & CO2

Fuel Tax ($/Gal.)	$0.000	$0.033	$0.050	$0.067	$0.100	$0.200	$0.300
Fuel Tax Rev. ($000s)	$0.000	$917.5	$1,374.4	$1,831.2	$2,741.4	$5,449.8	$8,126.2
VMTs (millions)	604.7	600.5	598.4	596.3	592.1	579.8	567.7
CO2 (millions lbs.)	560.0	556.1	554.2	552.2	548.3	536.9	525.7

Table 1's summary shows that an average per-gallon fuel tax rate of about $0.067 is needed to generate the FWG's targeted $1.83 million of annual revenue. It also shows that VMTs and CO2 emissions decline substantially as the fuel tax rises. For instance, an increase of the average fuel tax rate from $0.033 to $0.10 corresponds with a VMT reduction of over 8 million miles and a decrease in CO2 emissions of 8 million pounds.[24] These two key findings are useful in evaluating the broader public welfare implications of a fuel tax in Bend.

Fuel Tax Implications

A fuel tax would impact public welfare in Bend through at least the mechanisms of reduced transportation system maintenance costs and improved Bend resident living standards due to reduced particulate matter and noise pollution. While other positive consequences would also be associated with reduced VMTs brought on by a fuel tax, we only quantify these public welfare gains.

Transportation System Maintenance

Our analysis shows that a $0.033 per-gallon fuel tax corresponds with a VMT reduction of over 4 million miles. In an earlier comment we calculated the impact of marginal VMTs on Bend's transportation system maintenance needs, estimating that each 1% reduction in VMTs from baseline is associated with annualized savings in the range of $138,900 to $218,900.[25]

For purposes of estimating implied maintenance cost savings associated with a fuel tax, we take the midpoint of that maintenance savings range ($178,800). Hence, for every $0.033 of fuel tax rate, implied transportation system maintenance costs would decline by approximately $125,200. This calculation is set forth in Appendix 3.

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[24] The high correspondence shown here between VMTs and CO2 emissions is a byproduct of the fact that U.S. fleet emissions averages are about 22 and the conversion factor of a gallon of gas to CO2 emissions is 20; since these figures are similar, variation of VMTs and CO2 emissions over a small range as modeled here will be similar.

[25] Porter, "Evidence Demonstrating the Efficiency, Safety & Economic Benefits of 20mph Speed Limits," Public Comment (July 13, 2018).

Bend Resident Living Standards

In an earlier comment we also showed relationships between VMTs and living standards, calculated via "hedonic price method" on the basis of housing values. We characterized the effects of reduced VMTs as generating an in-kind increase in living standards: the effective value of living in a given place would rise to approximate the living standard associated with more expensive places as VMTs decline. We used housing values as basis for the calculation because they are a market reflection of aggregate living value in Bend and not because the effects would be limited to residents' enjoyment of their homes. There would be a broader manifestation of living standard gains, but housing values provide a useful computational foundation for hedonic price method analysis.

We conduct a similar analysis in connection with fuel taxes. Fuel tax-related living standard gains depend upon particulate matter (PM) pollution and noise pollution, both of which are linked with VMTs. As VMTs fall, so do PM and noise pollution. Combining PM and noise abatement effects, a 1% decline in VMTs is associated with the equivalent of $19.2 million in aggregate living standard improvement in Bend. Hence, for every $0.033 of fuel tax rate (which would reduce VMTs by 0.7%) living standards in Bend would improve by roughly $13.6 million. Our calculations for particulate matter and noise effects are shown in Appendices 4 and 5, respectively.[26]

Public Welfare Returns to Fuel Taxes

Public benefits would not be limited to road maintenance savings and pollution reduction, however. Other empirical research links VMT decreases to enhanced social capital, elevated public safety, increased innovation, improved education attainment, reduced healthcare needs, and augmented local purchasing habits.[27] We accordingly view our modeled effects as directionally indicative rather than comprehensive, and we consider them "floors." We would expect total public returns to exceed the amounts shown here, perhaps by a considerable margin.

Fuel purchasers in Bend would pay for these public benefits with the modeled fuel taxes, which means that, at a $0.033 per-gallon fuel tax, a dollar paid in tax generates at least $13.81 in net public economic returns in Bend. We summarize these returns in Table 2 below.

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[26] Our elasticity calculation assumes that all fuel use reductions derive from changed driving behaviors and not from vehicle substitution. Some elasticity estimates indicate about one-third of fuel use reductions derive from migration to more fuel-efficient vehicles. Were this to occur in Bend our estimates would overstate VMT decreases, while CO2 decreases would remain accurate. We use VMT reduction estimates to evaluate fuel tax impacts on road maintenance costs, particulate matter, and noise pollution. This usage may cause us to marginally overstate road maintenance cost savings. However, we believe particulate matter and noise pollution impacts are approximately correct regardless of vehicle substitution rates. This is because vehicle substitution would tend to be from larger, heavier vehicles to smaller, lighter ones that provide superior fuel efficiency. Both particulate matter and noise pollution derive from vehicle mass, tire wear, brake wear, and wind dispersion. Hence, the relationship between particulate matter/noise and vehicle size/weight is at least as strong as with VMTs. Regarding road maintenance, the primary generator of depreciation is VMTs, but vehicle weight plays an important role: heavier vehicles do more damage. We allow that our maintenance estimates may be somewhat high, but we believe the overstatement is minimal. On net, we view our public gain estimates as generally accurate but consider them "indicative" estimates subject to some uncertainty.

[27] An overview of empirical research outlining these effects is discussed in the following book: Speck, J., *Walkable City*, North Point Press (2012).

TABLE 2: BEND FUEL TAX RATES, REVENUE, PUBLIC GAINS

Fuel Tax ($/Gal.)	Fuel Tax Revenue ($000s)	Implied Maint. Svgs. ($000s)	Living Standard Gain ($000s)	Maintenance Svgs. & Living Std. Gain ($000s)	Gains in Excess of Tax Revenue ($000s)	Public Return/Tax Dollar
$0.033	$917.5	$125.2	$13,463.1	$13,588.3	$12,670.8	$13.81
$0.050	$1,374.4	$187.8	$20,194.7	$20,382.5	$19,008.1	$13.83
$0.067	$1,831.2	$250.4	$26,926.2	$27,176.6	$25,345.4	$13.84
$0.100	$2,741.4	$375.6	$40,389.3	$40,764.9	$38,023.5	$13.87
$0.200	$5,449.8	$751.3	$80,778.5	$81,529.8	$76,080.0	$13.96
$0.300	$8,126.2	$1,126.9	$121,167.8	$122,294.7	$114,168.5	$14.05

Since gains from the tax exceed the tax revenue for every rate shown on Table 2, it may be stated that a fuel tax in Bend is corrective rather than distortionary. It is sometimes assumed that all taxes cause economic efficiency loss. This is incorrect. In instances when arm's length market transactions result in negative externalities (i.e., when costs associated with a transaction are borne by people not party to the exchange), taxes can serve to redress this market failure. Air/noise pollution effects and road maintenance costs may be characterized as negative externalities of fuel consumption/VMTs and therefore subject to efficiency-enhancing correction via targeted taxes.

Table 2 also illustrates that, contrary to the FWG's apparent assumption that transportation system usage is independent of how the system is funded, funding tools have important consequences for the system's use. Funding approaches influence how well the transportation network serves Bend's larger community needs and the extent to which the transportation network generates positive or negative externalities associated with different types of aggregate transportation habits.

Suggested Alterations to the Proposed Fuel Tax

We suggest three modest amendments to the FWG's proposed fuel tax that are aimed at improving total revenue prospects, increasing social efficiency, and taking advantage of the tax's beneficial demand effects. These amendments are: 1) increasing the average fuel tax rate; 2) altering the seasonal designations and increasing the rate differential between peak and non-peak seasons; and 3) tiering fuel tax rates on the basis of fuel type and grade. We discuss each in turn.

Raised Average Fuel Tax Rate

Our first suggestion derives from a recognition that the fuel tax has strong effects as a demand management tool. Economic gains associated with higher per-gallon fuel taxes are substantial, and it is difficult to justify not increasing the fuel tax's average rates to capitalize on the tax's observed positive returns profile.

A $0.033 per gallon fuel tax generates net public gains of at least $12.7 million. But at a $0.20 average tax rate, the gains rise to more than $76.0 million. That is, the fuel tax generates increasing returns to scale (i.e, the percent increase in gains is greater than the percent increase in the per-gallon tax rate).

We suggest that the FWG should raise its targeted average per-gallon tax rate from $0.03 to not less than $0.10, and perhaps higher, to take advantage of the tax's positive returns to scale and to maximize public benefit.

We recognize that Bend previously voted against imposition of a $0.05 per gallon fuel tax and, as such, the FWG has concluded that its outlined $0.01 to $0.05 per gallon seasonal tax is the maximum that is politically feasible.[28] We believe this view is not fully considered.

For one, political conditions are not static across time. Simply because a vote went one way in the past does not mean the result is foreordained to always repeat in the future. Indeed, many cities in Oregon required multiple votes to pass local gas taxes. Moreover, conditions surrounding the 2016 vote itself were contentious since one argument against the fuel tax at the time was that it should not have been placed on a special ballot that some viewed as wasteful of public funds. Voter outreach and education also were essentially nonexistent. These issues would stand to be remedied in any future vote.

Perhaps more importantly, evidence had not been developed in 2016 that showed a clear and positive link between imposition of a fuel tax and improved living standards for Bend's residents. That has been established in this comment.

Finally, the FWG has provisionally signaled its intentions to request that voters support a $100 million bond through property tax increases that would add an average $300 in annual household living costs. We view it as logically inconsistent to contend that an average fuel tax rate above $0.03 per gallon (around $10 yearly per capita) is politically impractical while a property tax that escalates annual average housing costs $300 somehow is. In addition, the bond measure would not impart the beneficial demand-side effects of a fuel tax, indicating that money paid in bond-related property taxes likely would not generate positive economic returns but negative ones.

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[28] "Initial Funding Assessment: An Interim Report to Inform Bend's Transportation Plan" (October 31, 2018).

Altered Seasonal Designations and Rate Differentials

We also suggest the FWG reconsider its seasonal tax rates. If the intention is to capture greater revenue from tourist activity in Bend, the FWG should make use of the large difference between short-run and long-run demand elasticity effects observed with respect to fuel.

Over the long-run, fuel price increases do meaningfully reduce quantity demanded. But over the short-run, demand is much less elastic. For tourists whose visits to Bend comprise some relatively small number of days, we would consider their local fuel consumption patterns to be essentially insensitive to fuel price. Unless Bend's fuel tax were so large as to begin to affect tourism rates and behaviors (something that would not occur with fuel tax rates measured in nickels and dimes), we would expect tourist fuel purchases to be unaffected by Bend's fuel tax.

In order to take advantage of this differential elasticity, we suggest a much greater "peak season" fuel tax rate than $0.05, and a greater fuel tax rate differential from non-peak seasons than the FWG proposes.

We also suggest eliminating the "off" season and lumping the months of November, December, January, and February in with the shoulder season months. This suggestion is a means of aligning public and private interests since it has been observed that VMTs in the winter are relatively costly from a road maintenance perspective.[29]

Tiered Fuel Tax Rates by Fuel Grades and Types

Our third suggestion is to more closely align fuel tax rates with fuel purchaser income levels and with fuel consumption externalities by tiering fuel tax rates with fuel grades and types.

Fuel Grades: Market Segmentation

We begin with income considerations through the lens of fuel grade purchases. Retail gasoline is marketed in three tiers, "regular," "midgrade," and "premium," which relate to the products' fuel octane levels. Fuel purchasers tend to buy regular gasoline unless at least one of two conditions is met. First, certain vehicle manufacturers (generally luxury brands) specify that high octane levels are required in order for the vehicle engines to operate optimally. Drivers of such vehicles often purchase midgrade or premium fuel for this reason. Second, some fuel buyers believe that higher-octane fuels improve vehicle performance regardless of whether the higher octane rating is required, and so purchase midgrade or premium fuel on that basis. About 81% of all gasoline sold nationally is regular grade, while 7% is midgrade and 12% is premium.[30]

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[29] "Funding Work Group #5" Memorandum (July 17, 2019).

[30] U.S. Energy Information Administration Website "Growing Octane Needs Widen the Price Difference Between Premium and Regular Gasoline" (June 21, 2017). Reardon, P., "Who the Heck Buys Midgrade Gasoline?" *Chicago Tribune* (September 21, 2005). Sullivan, P., "In Sales of Luxuries, Geography Matters," *New York Times* (November 18, 2014).

Purchases of midgrade and premium fuels are correlated with luxury vehicle ownership, which is positively correlated with income.[31] This suggests the consumer market for fuel purchases may be segmented across household income on the basis of fuel octane purchase habits. Thus, fuel tax revenue may be optimized and social efficiency enhanced by linking tax rates with fuel octane ratings. If a $0.10 tax rate is targeted for regular fuel, then a $0.11 and $0.12 tax rate may be indicated for midgrade and premium octane fuels, respectively.

Targeting market segments in this way improves the tax's revenue and social efficiency results by imposing higher per-gallon tax rates on those with luxury vehicles/higher incomes. This implies that the fuel tax's VMT-reduction effects would be efficiently realized by taxing at a relatively low rate price-sensitive fuel buyers who are prone to beneficial behavior changes with modest price increases. At the same time, added revenue would be realized by taxing at higher rates those with greater income and/or other reasons for fuel price insensitivity.

Fuel Types: Externality Differences

We also suggest differential per-gallon fuel tax rates on the basis of fuel type - that is, gasoline versus diesel. "On-highway diesel" fuel consumption accounts nationally for about 20% of all motor vehicle fuel consumption.[32] Diesel fuel consumption is associated with higher levels of harmful nitrous oxide pollution, particulate matter pollution (unless diesel particulate filter-equipped), and, particularly when used in trucks and SUVs, noise pollution.[33]

As means of accounting for the larger negative externalities associated with diesel consumption, we propose higher per-gallon fuel tax rates be applied to diesel. To harmonize diesel taxes with octane-related taxes described above, we suggest the per-gallon diesel tax be set $0.01 greater than the tax applied to premium gasoline.

Suggested Monthly Fuel Tax Schedule

In Table 3 we organize our suggestions into a monthly tax rate schedule by fuel type and grade.

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[31] In 2014, the U.S. median income was $61,600, while the median income of those who owned a luxury vehicle (i.e, Acura, Audi, BMW, Infiniti, Jaguar, Lexus, Mercedes, or Porsche) was $99,400. Sullivan, P., "In Sales of Luxuries, Geography Matters," *New York Times* (November 18, 2014).

[32] U.S. Department of Transportation Federal Highway Administration, Policy of Governmental Affairs, Office of Highway Policy Website "Highway Finance Data Collection: Our Nation's Highways: 2011, 5. Motor Fuel" (accessed August 2019).

[33] Platt, S.M, et al., "Gasoline Cars Produce More Carbonaceous Particulate Matter than Modern Filter-equipped Diesel Cars," *Scientific Reports*, Vol. 7 (2017). Patel, N., "Noise Is the Next Great Public Health Crisis," *Futurism* (December 19, 2017). A passing diesel truck generates about 85 decibels of noise, whereas light traffic generates about 50 decibels.

TABLE 3: SUGGESTED MONTHLY FUEL TAX SCHEDULE BY FUEL TYPE & GRADE

Month	Regular Gasoline	Midgrade Gasoline	Premium Gasoline	Diesel
January	$0.10	$0.11	$0.12	$0.13
February	$0.10	$0.11	$0.12	$0.13
March	$0.10	$0.11	$0.12	$0.13
April	$0.10	$0.11	$0.12	$0.13
May	$0.10	$0.11	$0.12	$0.13
June	$0.20	$0.21	$0.22	$0.23
July	$0.20	$0.21	$0.22	$0.23
August	$0.20	$0.21	$0.22	$0.23
September	$0.20	$0.21	$0.22	$0.23
October	$0.10	$0.11	$0.12	$0.13
November	$0.10	$0.11	$0.12	$0.13
December	$0.10	$0.11	$0.12	$0.13

Table 4 uses Table 3's fuel tax schedule to estimate fuel tax revenue, VMT and CO2 reductions, maintenance savings, and Bend living standard improvements. Full calculations are set forth in Appendices 6, 7, and 7.1.

TABLE 4: SUGGESTED FUEL TAX RESULTS SUMMARY

Wtd. Avg. Fuel Tax ($/Gal.)	Fuel Tax Revenue ($000s)	VMT Reduction (Miles)	CO2 Reduction (Pounds)	Implied Maint. Svgs. ($000s)	Living Std. Gain ($000s)	Public Return/ Tax Dollar ($)
$0.144	**$3,917.2**	**17,998.8**	**16,667.6**	**$550.9**	**$59,237.6**	**$15.26**

Concluding Observations

In closing, we address four points. First, there is a limit to a local fuel tax's capacity to generate positive social welfare, and one should not expect increasing, or even positive, returns to scale to continue indefinitely with rising fuel tax rates. We have modeled an average local fuel tax rate of up to $0.30, which represents a narrow tax rate range from 0% through 9%. Since this is a narrow range, it is reasonable to expect fairly consistent social returns throughout it, and we believe it is appropriate to model things "linearly" across this range as we have done.

Second, at a certain level of fuel tax, one would expect geographic substitution for fuel purchases to set in; that is, Bend consumers might drive to other areas to make fuel purchases as means of avoiding the tax. This is why fuel taxes improve in potency as the geography they cover expands. For the rates modeled in this comment, particularly our favored $0.144 weighted average fuel tax rate, geographic substitution would not be expected to arise in any meaningful quantity. In part this is due to Bend's geographic orientation and the relatively long distances between Bend and areas housing gas stations that would not be subject to Bend's local fuel tax. If geographic substitution requires a 10 mile drive in each direction, that drive would consume roughly one gallon of fuel at fleet average standards. At a $0.144 tax rate, more than 20 gallons of fuel would have to be purchased to approximately break even, not accounting for the time and vehicle maintenance/depreciation costs associated with driving 20 miles. Even at a $0.30 rate, we would expect such behavior to be minimal.

Third, simply because fuel taxes add to the cost of driving and therefore discourage VMTs does not mean those VMT reductions would be invulnerable to other factors. Were the fuel tax revenue used to build ever-larger vehicle-oriented infrastructure, Bend could fully offset the tax-related VMT reductions with supply-induced demand effects and hence eliminate any living standard gains. Were this to occur, the fuel tax would generate deadweight losses. In order to forestall this possibility and to add further social welfare gains to the fuel tax tally, revenue should be used to make additional VMT reductions by facilitating non-automotive travel within Bend.

Fourth, a fuel tax is moderately regressive. However, a fuel tax is less regressive than the funding tools currently used to fund Bend's transportation system. Were further reductions in the tax's regressiveness desired we would recommend allowing households to qualify for prepaid fuel cards on the basis of income qualification. Upon qualification, a household would be issued a prepaid fuel card up to the amount of the average annual fuel tax burden, given the household's number of people and assuming fleet average fuel efficiency and mileage. A public-private partnership opportunity thus presents itself: a handful of fueling stations might find it advantageous to be the preferred fuel suppliers of residents with the prepaid cards and therefore be willing to help subsidize the cards in exchange for certain marketing rights. At a $0.144 average rate, the annual per capita burden would be approximately $46.44.

Summary

1. The Funding Work Group's fuel tax model depends upon faulty inputs and assumptions that cause it to overstate the endorsed tax's revenue potential.

2. In order to obtain the FWG's targeted $1.83 million in annual revenue, average fuel tax rates would have to be approximately $0.067 per gallon.

3. Contrary to the Funding Work Group's assumptions, imposition of a fuel tax generates significant social welfare gains. For each dollar paid in fuel tax, at least $13.81 in net economic benefits are generated for Bend's residents primarily via enhanced living standards. These gains occur as a result of the tax's salutary effects on VMTs, pollution, and road maintenance costs.

4. In order to optimize revenue and social gains from the fuel tax, we recommend three adjustments to its structure, as shown in Table 3:
   a. Increase the fuel tax to a monthly weighted average rate of $0.144.
   b. Change the seasonal designations from "peak," "shoulder," and "off" to simply "peak" and "non-peak." Amend the seasonal rate differentials to better reflect tourist demand elasticity for fuel and wintertime VMT costs.
   c. Charge different rates on the basis of fuel type and grade in order to capture premium and midgrade fuel buyers' greater willingness to pay and to reflect the greater negative externalities associated with diesel consumption.

5. Incorporating our proposed amendments to the fuel tax would lead to annual revenue of about $3.9 million and generate net social welfare gains of $59.2 million, implying that each dollar paid in fuel tax would result in $15.26 of net public welfare increases.

6. In order to secure these welfare gains, funds from the fuel tax should not be used to build infrastructure that generates supply-induced vehicle travel demand and should instead be used to facilitate non-automotive transportation that causes further VMT reductions.

Thank you for your consideration.

Steve Porter

Michelle Porter

ABOUT THE AUTHORS

Steve Porter

Steve is a recognized authority on economic analysis and valuation. He has provided expert testimony in high-stakes commercial litigation on topics including economics, valuation, statistics, econometrics, market definition, consumer choice, business strategy, and pricing, among others. He has consulted with Fortune 500 corporations on intellectual property licensing, asset transactions, and valuation issues, and he has conducted economic impact analyses, including work performed on behalf of the Los Angeles Superior Court. His articles have published in the *Journal of Legal Economics*, *les Nouvelles*, the *Patent, Trademark & Copyright Journal*, the *Journal of the Patent and Trademark Office Society*, and *Intellectual Asset Management*, among others. He also is co-author of *IP Strategy, Valuation, and Damages* (LexisNexis), a treatise on intellectual property economics. Some of his work has been cited as authoritative in filings submitted to the Supreme Court and the Federal Trade Commission, and he has been quoted by and featured in the editorials section of the *Wall Street Journal*. He has been an invited speaker before the Chicago Bar Association, the Attorney General's Office of the State of Arizona, and various law firms and corporations, where he has lectured on topics ranging from economic analysis and valuation to econometrics and game theory. He is a recipient of the William J. McKinstry Award in economics, the *Wall Street Journal* Scholar Award, the Micronomics Economic Research Award, and the IE Fund Leadership Scholar Award. He served as a teaching assistant in economics at the Dolibois European Center in Luxembourg, an ad hoc referee for the *Journal of Forensic Economics*, and as Co-Chair and an Executive Committee Member of Young Professionals Advisory Council at the Farmer School of Business. He graduated *summa cum laude* and with University Honors from Miami University in Oxford, Ohio, completing dual majors in economics and marketing. He received his MBA, with honors conferred by the Dean and Board of Academic Affairs, from IE Business School in Madrid, Spain, graduating 5th in a class of more than 400. He holds the Series 65 securities license.

Michelle Porter

Michelle is an expert in valuation, economic analysis, and quantitative methods. She has been engaged by Fortune 500 companies, SMEs, U.S. and international government entities, and leading law firms to provide expertise in high-stakes commercial litigations, negotiations, and asset transactions. Her consulting work has encompassed advisory roles in industries including pharmaceuticals, medical devices, banking, telecommunications, consumer goods, software, and transportation technologies, among many others. Michelle is co-author of the book entitled *IP Strategy, Valuation, and Damages* (LexisNexis). Her articles have appeared in *les Nouvelles*, *Intellectual Asset Management*, *Intellectual Property Magazine*, *Smart Business, Los Angeles Daily Journal*, *The Recorder,* and *China Intellectual Property*, and she has been quoted by *Forbes*. Michelle has spoken before such groups as the Intellectual Property Law Committee of the Chicago Bar Association, Google, and Motorola Mobility. Her work has been recognized with the Accenture International Consulting Competition Top Honors Award, the IE Women Leaders Scholarship Award, the *les Nouvelles* Best Article Award, and the Micronomics Economic Research Award. In addition, Michelle has served as an advisor to the Forte Foundation's MBALaunch for Women, President of the IE Business School Southern California Alumni Association, Co-Chair and Executive Committee Member of Young Professionals Advisory Council at the Farmer School of Business, and an instructor in microeconomics. Michelle graduated *cum laude* from Miami University in Oxford, Ohio, majoring in economics. She received her MBA from IE Business School in Madrid, Spain.

Appendix 1
Bend Transportation System Fuel Usage Verification
Conversion of CASC Bend Transportation Annual CO2 Metric Tons to Gallons of Fuel Usage

Bend Transportation Category, Retail Fuel	Bend CO2 Metric Tons	Conversion Factor: Pounds Per Metric Ton	Vehicle Fuel CO2 Pounds	Conversion Factor: CO2 Pounds Per Fuel Gallon	Bend Vehicle Fuel Gallons
	[A]	[B]	[C] = [A] * [B]	[D]	[E] = [C] * [D]
Passenger Travel	212,380				
Commercial Services	20,967				
Truck Freight	18,201				
Transit	734				
Total	252,282	2,204.623	556,186,700	20	**27,809,335**

Original Estimate (Per 20MPH Public Comment)	**28,295,991**
Difference (%)	**1.7%**
Midpoint: Original Estimate and CO2-based Estimate	**28,052,663**
Midpoint Rounded	**28,000,000**

Source: City of Bend "2016 Community Greenhouse Gas Inventory," Good Company (August 2018).
Porter, "Evidence Demonstrating the Efficiency, Safety & Economic Benefits of 20mph Speed Limits," Public Comment (July 13, 2018).

Appendix 2
Bend Fuel Tax Analysis: Indicative Long-Run Tax Revenue, VMT, and CO2 Estimates
Applied Demand Elasticity Value of -0.70

Fuel Tax Rate (%)	Tax/Gallon ($)	Fuel Price/Gallon ($)	Fuel Usage (Gallons)	Fuel Spending ($)	VMTs (Miles)	Tax Revenue ($)	CO2 (Pounds)	VMT Reduction (Miles)	VMT Change (%)	CO2 Reduction (Pounds)
[A]	[B]	[C]	[D]	[E] = [C] * [D]	[F] = [D] * 21.5973	[G] = [B] * [D]	[H] = [D] * 20	[I]	[J]	[K]
Baseline	$0.000	$3.300	28,000,000	$92,400,000	604,724,400		560,000,000			
1%	**$0.033**	**$3.333**	**27,804,000**	**$92,670,732**	**600,491,329**	**$917,532**	**556,080,000**	**4,233,071**	**-0.7%**	**3,920,000**
2%	**$0.066**	**$3.366**	**27,609,372**	**$92,942,257**	**596,287,890**	**$1,831,330**	**552,187,440**	**8,436,510**	**-1.4%**	**7,812,560**
3%	**$0.100**	**$3.400**	**27,416,106**	**$93,214,578**	**592,113,875**	**$2,741,427**	**548,322,128**	**12,610,525**	**-2.1%**	**11,677,872**
4%	$0.134	$3.434	27,224,194	$93,487,697	587,969,078	$3,647,858	544,483,873	16,755,322	-2.8%	15,516,127
5%	$0.168	$3.468	27,033,624	$93,761,616	583,853,294	$4,550,656	540,672,486	20,871,106	-3.5%	19,327,514
6%	**$0.203**	**$3.503**	**26,844,389**	**$94,036,337**	**579,766,321**	**$5,449,854**	**536,887,779**	**24,958,079**	**-4.1%**	**23,112,221**
7%	$0.238	$3.538	26,656,478	$94,311,864	575,707,957	$6,345,486	533,129,564	29,016,443	-4.8%	26,870,436
8%	$0.273	$3.573	26,469,883	$94,588,197	571,678,001	$7,237,584	529,397,657	33,046,399	-5.5%	30,602,343
9%	**$0.309**	**$3.609**	**26,284,594**	**$94,865,341**	**567,676,255**	**$8,126,182**	**525,691,874**	**37,048,145**	**-6.1%**	**34,308,126**

Appendix 3
Bend Estimated Fiscal Savings with Fuel Taxes
Transportation System Annual Maintenance Savings

		Low Estimate	High Estimate	Average
Annual Bend Street Maintenance Savings Per 1% VMT Reduction	[A]	$138,878	$218,878	$178,878
Estimated VMT % Reduction Rate Per 1% Tax Fuel Rate (0.7% / 1.0%)	[B] = 0.7 / 1.0	0.7	0.7	0.7
Estimated Annual Street Maintenance Savings Per 1% Fuel Tax Rate	**[C] = [A] * [B]**	**$97,214**	**$153,214**	**$125,214**
Estimated Annual Street Maintenance Savings at Suggested Tax Rate (4.4%)	**[D] = [C] * 4.4**	**$427,744**	**$674,144**	**$550,944**

Source: For further information on Bend Street Maintenance Savings and the relationship between VMTs and maintenance costs, see:
Porter, "Evidence Demonstrating the Efficiency, Safety & Economic Benefits of 20mph Speed Limits," Public Comment (July 13, 2018).

Appendix 4
Bend Estimated Hedonic Gains Associated with Fuel Taxes
Particulate Matter (PM) Pollution Abatement

Estimated Bend Housing Stock Value	[A]	$16,797,360,000
Hedonic Gain Rate Per 1% PM Reduction	[B]	0.10%
Estimated Hedonic Gain Per 1% PM Reduction	[C] = [A] * [B]	$16,797,360
Estimated PM % Reduction Rate Per 1% Tax Fuel Rate (0.7% / 1.0%)	[D] = 0.7 / 1.0	0.70
Estimated PM-Related Hedonic Gain Per 1% Fuel Tax Rate	**[E] = [C] * [D]**	**$11,758,152**
Estimated PM-Related Hedonic Gain at Suggested Tax Rate (4.4%)	**[F] = [E] * 4.4**	**$51,735,869**

Note: PM-related hedonic gains are tethered to housing values for computational convenience.
Hedonic gains would manifest more generally in Bend living standards regardless of PM dispersion patterns.

Source: For further information on estimated Bend housing stock value and the relationship between hedonic gains and particulate matter pollution, see: Porter, "Evidence Demonstrating the Efficiency, Safety & Economic Benefits of 20mph Speed Limits," Public Comment (July 13, 2018).

Appendix 5
Bend Estimated Hedonic Gains Associated with Fuel Taxes
Noise Pollution Abatement

Estimated Bend Housing Stock Value	[A]	$16,797,360,000
Hedonic Gain Rate Per 1 Decibel (dB) Noise Reduction	[B]	0.29%
Estimated Hedonic Gain Per 1 dB Noise Reduction	[C] = [A] * [B]	$48,712,344
Estimated dB Reduction Per 1% VMT Reduction (0.25 dB / 5% VMT)	[D] = 0.25 / 5.0	0.05
Estimated Hedonic Gain Per 1% VMT Reduction	[E] = [C] * [D]	$2,435,617
Estimated VMT % Reduction Rate Per 1% Tax Fuel Rate (0.7% / 1.0%)	[F] = .07 / 1.0	0.70
Estimated Noise-Related Hedonic Gain Per 1% Fuel Tax Rate	**[G] = [E] * [F]**	**$1,704,932**
Estimated Noise-Related Hedonic Gain at Suggested Tax Rate (4.4%)	**[H] = [G] * 4.4**	**$7,501,701**

Note: Noise-related hedonic gains are tethered to housing values for computational convenience.
Hedonic gains would manifest more generally in Bend living standards regardless of noise dispersion patterns.

Source: For further information on estimated Bend housing stock value and the relationship between hedonic gains and noise pollution, see: Porter, "Evidence Demonstrating the Efficiency, Safety & Economic Benefits of 20mph Speed Limits," Public Comment (July 13, 2018).

Appendix 6
Bend Monthly Fuel Usage Estimate By Fuel Type and Grade
Fuel Type and Grade Estimates Based on U.S. National Averages

	Montly % of Total Fuel	Annual Total Fuel (Gallons)	Gasoline			Diesel
			Regular	Midgrade	Premium	On-Highway
Total	**100.00%**	**28,000,000**	**64.50%**	**5.80%**	**9.40%**	**20.30%**
January	7.76%	2,172,530	1,401,282	126,007	204,218	441,024
February	7.03%	1,968,602	1,269,749	114,179	185,049	399,626
March	8.14%	2,278,836	1,469,849	132,172	214,211	462,604
April	8.03%	2,248,349	1,450,185	130,404	211,345	456,415
May	8.76%	2,451,651	1,581,315	142,196	230,455	497,685
June	8.82%	2,470,961	1,593,770	143,316	232,270	501,605
July	9.30%	2,604,577	1,679,952	151,065	244,830	528,729
August	9.44%	2,644,103	1,705,447	153,358	248,546	536,753
September	8.23%	2,305,424	1,486,999	133,715	216,710	468,001
October	8.35%	2,338,156	1,508,111	135,613	219,787	474,646
November	8.10%	2,266,783	1,462,075	131,473	213,078	460,157
December	8.04%	2,250,028	1,451,268	130,502	211,503	456,756

Source: Bend Transportation Plan Funding Work Group Initial Funding Assessment (October 31, 2018), p. 99.

Appendix 7
Bend Fuel Tax Analysis: Fuel Gallons and Tax Revenue By Fuel Type and Grade
Assuming $0.144 Weighted Average Fuel Tax Rate

	Monthly Fuel Share (%)	Total Fuel (Gallons)	Gasoline Regular	Gasoline Midgrade	Gasoline Premium	Diesel On Highway	
Annual Totals		**28,000,000**	**64.50%**	**5.80%**	**9.40%**	**20.30%**	
Fuel Gallons Breakdown by Month and Fuel Type/Grade							
Gallons @ $0.144 Tax Rate		**27,166,620**					
January	7.76%	2,107,868	1,359,575	122,256	198,140	427,897	
February	7.03%	1,910,010	1,231,956	110,781	179,541	387,732	
March	8.14%	2,211,010	1,426,101	128,239	207,835	448,835	
April	8.03%	2,181,430	1,407,022	126,523	205,054	442,830	
May	8.76%	2,378,681	1,534,249	137,963	223,596	482,872	
June	8.82%	2,397,416	1,546,333	139,050	225,357	486,676	
July	9.30%	2,527,055	1,629,951	146,569	237,543	512,992	
August	9.44%	2,565,405	1,654,686	148,794	241,148	520,777	
September	8.23%	2,236,806	1,442,740	129,735	210,260	454,072	
October	8.35%	2,268,564	1,463,224	131,577	213,245	460,518	
November	8.10%	2,199,316	1,418,559	127,560	206,736	446,461	
December	8.04%	2,183,059	1,408,073	126,617	205,208	443,161	
Monthly Fuel Tax Schedule by Fuel Type and Grade							
January			$0.100	$0.110	$0.120	$0.130	
February			$0.100	$0.110	$0.120	$0.130	
March			$0.100	$0.110	$0.120	$0.130	
April			$0.100	$0.110	$0.120	$0.130	
May			$0.100	$0.110	$0.120	$0.130	
June			$0.200	$0.210	$0.220	$0.230	
July			$0.200	$0.210	$0.220	$0.230	
August			$0.200	$0.210	$0.220	$0.230	
September			$0.200	$0.210	$0.220	$0.230	
October			$0.100	$0.110	$0.120	$0.130	
November			$0.100	$0.110	$0.120	$0.130	
December			$0.100	$0.110	$0.120	$0.130	
Monthly Fuel Tax Revenue by Fuel Type and Grade							
January			$135,957	$13,448	$23,777	$55,627	
February			$123,196	$12,186	$21,545	$50,405	
March			$142,610	$14,106	$24,940	$58,349	
April			$140,702	$13,918	$24,607	$57,568	
May			$153,425	$15,176	$26,832	$62,773	
June			$309,267	$29,201	$49,579	$111,935	
July			$325,990	$30,780	$52,259	$117,988	
August			$330,937	$31,247	$53,053	$119,779	
September			$288,548	$27,244	$46,257	$104,436	
October			$146,322	$14,473	$25,589	$59,867	
November			$141,856	$14,032	$24,808	$58,040	
December			$140,807	$13,928	$24,625	$57,611	
Total (Rounded)			**$2,380,000**	**$230,000**	**$400,000**	**$910,000**	**$3,920,000**
Weighted Average Fuel Tax Rate Per Gallon							**$0.144**

Appendix 7.1
Iterative Fuel Tax Rate & Fuel Consumption Analysis Work Table
Applied Demand Elasticity Value of -0.70

Fuel Tax Rate (%)	Tax/Gallon ($)	Fuel Price/Gallon ($)	Fuel Usage (Gallons)	Fuel Spending ($)	VMTs (Miles)	Tax Revenue ($)	CO2 (Pounds)	VMT Reduction (Miles)	VMT Change (%)	CO2 Reduction (Pounds)
[A]	[B]	[C]	[D]	[E] = [C] * [D]	[F] = [D] * 21.5973	[G] = [B] * [D]	[H] = [D] * 20	[I]	[J]	[K]
Baseline	$0.000	$3.300	28,000,000	$92,400,000	604,724,400		560,000,000			
1%	**$0.033**	**$3.333**	**27,804,000**	**$92,670,732**	**600,491,329**	**$917,532**	**556,080,000**	**4,233,071**	**-0.7%**	**3,920,000**
2%	**$0.066**	**$3.366**	**27,609,372**	**$92,942,257**	**596,287,890**	**$1,831,330**	**552,187,440**	**8,436,510**	**-1.4%**	**7,812,560**
3%	**$0.100**	**$3.400**	**27,416,106**	**$93,214,578**	**592,113,875**	**$2,741,427**	**548,322,128**	**12,610,525**	**-2.1%**	**11,677,872**
4%	$0.134	$3.434	27,224,194	$93,487,697	587,969,078	$3,647,858	544,483,873	16,755,322	-2.8%	15,516,127
4.4%	**$0.144**	**$3.444**	**27,166,620**	**$93,567,088**	**586,725,638**	**$3,917,242**	**543,332,397**	**17,998,762**	**-3.0%**	**16,667,603**
5%	$0.168	$3.468	27,033,624	$93,761,616	583,853,294	$4,550,656	540,672,486	20,871,106	-3.5%	19,327,514
6%	**$0.203**	**$3.503**	**26,844,389**	**$94,036,337**	**579,766,321**	**$5,449,854**	**536,887,779**	**24,958,079**	**-4.1%**	**23,112,221**
7%	$0.238	$3.538	26,656,478	$94,311,864	575,707,957	$6,345,486	533,129,564	29,016,443	-4.8%	26,870,436
8%	$0.273	$3.573	26,469,883	$94,588,197	571,678,001	$7,237,584	529,397,657	33,046,399	-5.5%	30,602,343
9%	**$0.309**	**$3.609**	**26,284,594**	**$94,865,341**	**567,676,255**	**$8,126,182**	**525,691,874**	**37,048,145**	**-6.1%**	**34,308,126**