MEMO

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SUBJECT: Health benefits for ARFVTP: Preliminary Analysis Results

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Introduction

The Benefits Guidance Report for ARFVTP was prepared by NREL for CEC with estimates of petroleum fuel use reductions, carbon emission reductions, and criteria emission reductions. Though not considered within scope for this initial version of the report, each of these benefits can be expressed in terms of monetized social benefits. This memo provides preliminary quantifications of monetized social benefits for reductions in fine particulate tailpipe emissions (tons of PM 2.5), carbon emissions (MMTCO2e), and energy security benefits of imported oil reductions (million gallons). These estimates have been developed for use in the upcoming IEPR document, can be refined for future benefits analysis, and will be incorporated into the final version of the Benefits Report.

Summary of Results

Projects supported through the ARFVTP result in significant reductions in vehicle tailpipe emissions, GHGs, and petroleum fuel use. These reductions result in social and environmental benefits, some of which can monetized to allow for comparisons to program costs or comparable benefits achieved through other efforts. In particular, the health benefits of reduced PM2.5 emissions can be monetized based upon reduced premature deaths and other health impacts, GHG reductions can be monetized in terms of a Social Cost of Carbon metric, and petroleum fuel import reductions can be monetized in terms of the economic costs of price spikes and pressure on global market demand (or monopsony premium, see Hogan 1981). Several other benefits may accrue due to ARFVTP projects, such as water use reductions or boosts to local and regional economies. Monetized benefits from reductions in PM2.5 tailpipe emissions, GHGs, and petroleum fuel use are estimated here using quantitative methods that are more established and less uncertain compared to the monetization estimation methods proposed for other types of benefits.

The PM2.5 reductions represent an estimate for only some of the vehicles and fuels supported by ARFVTP, particularly electric-drive vehicles, while the carbon reduction and petroleum fuel reduction benefits are estimated for all projects included in the 2014 Benefits Report. All three benefit types are estimated for both Expected and Market Transformation benefits, as categorized in the Benefits Report. Table 1 summarizes the results from estimating the monetized value of these benefits, along with the total reductions and the per unit monetized benefit. These benefits would begin to accrue and increase over time as ARFVTP projects are implemented and market transformation impacts take effect. In aggregate, total benefits for all three benefit types range from $715 to $288 million per year by 2025. Cumulative benefits accrued from 2015 through 2025 may be on the order of 5-7 times greater, depending upon the rate at which projects are implemented and vehicles and fuels deployed. This rough estimate would result in a range of $1.4 to $5.0 billion in total accrued benefits by 2025. Though a more detailed benefit cost analysis would be required to develop more precise and complete estimates across the program, these aggregate results suggests that even the low end of the social benefits are significantly greater than the total $426 million invested into the projects analyzed to date. In addition to the other social benefits mentioned above, this comparison does not take into account direct private household fuel savings that are likely to occur for many projects.

Reductions in PM2.5 emissions are estimated for electric-drive vehicles, primarily light-duty PHEVs, BEVs and FCEVs, as well as some medium-duty PHEVs and BEVs. The health benefits from reduced PM2.5 tailpipe emissions are primarily due to reduced premature deaths. These benefits range from $297 to $184 million per year, contribute to about 41-64% of the total annual social benefits by 2025. These PM2.5 reduction benefits are based damage costs derived from extensive studies of emissions and air quality dynamics resulting adverse health impacts (Fann et al. 2009; Fann et al. 2013; EPA 2013). For this analysis, unit damage costs results by county, expressed in $ per ton of PM2.5 vehicle tailpipe, break wear, and tire wear emissions, have been used based upon EPA modeling data (Mikulin 2014). Given this geographic resolution, it is possible to estimate the value of reducing PM2.5 with respect to project location and likely vehicle operating areas, taking into account factors such as population density, demographics, and general ambient air quality. Though more sophisticated methods are available for detailed project-level assessments in specific air basins, this approach is an improvement over using statewide damage cost estimates for PM2.5 (cf. Fann et al. 2009). Variations in the results of this analysis by county are indicated in Figure 1, with Los Angeles, Orange, and San Francisco counties having the highest total health benefits due to ZEV deployments resulting from ARFVTP projects. Total PM2.5 benefits from all ARFVTP projects funded to date are probably higher than these estimates, given that many other non-ZEV projects can also result in PM2.5 reductions.

The benefits associated with GHG reductions are due to a wide range of impacts associated with climate change. The corresponding social benefits are estimated by multiplying the GHG reductions from the Benefits Report by a high and low range of $75 and $15 per tonne of carbon dioxide equivalent emissions. This is only one possible range that can be used to reflect GHG reduction benefits, and is taken from a range of values reported by the multi-agency Social Cost of Carbon report (EPA 2013). The social benefits estimated for petroleum fuel use reductions are based upon estimates of the national economic benefits of reducing petroleum fuel imports. These include reductions in market disruptions resulting from oil price shocks and the monopsony premium due to increased pressure on global oil markets due to the size of U.S. demand. Spikes in the price of oil, which is determined by global markets, translate into increased domestic fuel costs. While California has a unique supply of oil, foreign sources still contribute to a large fraction of total supply. The impact on the economy has been estimated as an *oil security premium*, the additional economic energy security costs incurred that are not reflected in prices paid for petroleum fuel products. Oil security premium estimates used for this analysis are the same as those used in developing the national 2017-2025 LDV fuel economy and GHG regulations (Leiby 2013). Though domestic oil production is projected to increase, petroleum is traded on a global market, and the geographic concentration of supply from major exporters in sensitive regions (OPEC members and Russia) results in a significant probability of supply disruptions and price shocks. Assuming that 40% of petroleum used in California originates from foreign sources in 2025, we estimate this premium at $0.22 per gallon of fuel demand reduced. About 51% of petroleum was imported in 2013.

Table 1. Summary of Monetized Health Benefits

Health Benefits	Annual Benefit by 2025 ($ millions/year)	Reduction amount	(units)	Benefit per Unit Reduction	Units
PM2.5 Reductions (High)	$297	177	tons	$1.7	$M/ton
PM2.5 Reductions (Low)	$184	108	tons	$1.7	$M/ton
Carbon Reductions (High)	$314	4,248	1000 tonnes	$74	$/tonne
Carbon Reductions (Low)	$42	2,809	1000 tonnes	$15	$/tonne
Petrol Reductions (High)	$104	566.2	million gal	$0.18	$/gal
Petrol Reductions (Low)	$62	338.6	million gal	$0.18	$/gal

Combined (High)	$715
Combine (Low)	$288

1 References

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