INDIANA UNIVERSITY
SCHOOL OF PUBLIC AND ENVIRONMENTAL AFFAIRS

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Secretary Elaine L. Chao
US Dept of Transportation
1200 New Jersey Avenue, SE
Washington, DC 20590

Administrator Scott Pruitt
Environmental Protection Agency
Mail Code: 1101A
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460

Dear Administrator Pruitt and Secretary Chao:

In March 2017 we released, through Indiana University, "A Macroeconomic Study of Federal and State Automotive Regulations with Recommendations for Analysts, Regulators, and Legislators". We then submitted the study for consideration by EPA, NHTSA and CARB in the ongoing "midterm evaluation" of the 2012 final rulemaking that established fuel-economy and greenhouse-gas standards for light-duty passenger vehicles through model year 2025.

The study was launched in January 2016 with financial support to Indiana University from the Alliance of Automobile Manufacturers but the study was conducted in a sponsored research agreement that ensured that the authors had the freedom to undertake the study independently. The research design and methods used in the report were critiqued by a Project Peer Review Advisory Board comprised of Dr. Joseph Aldy (Kennedy School), Mr. Gurminder Bedi (former VP, Ford), Dr. Rob Carey (Clemson), Dr. Carolyn Fischer (Resources for the Future), Dr. Heather McLean (University of Toronto), and Dr. Edward Montgomery (then Georgetown University, now Central Michigan University). The findings and recommendations, as well as this letter, are solely the work of the authors and do not necessarily represent the views of the Project Peer Review Advisory Board, Indiana University or the Alliance.

With regard to economic impacts, the study used two analytic tools: a general-equilibrium, input-output model of the US economy called REMI, and a total-cost-of-ownership (TCO) model of new vehicle sales. The basic findings of the study were that the 2017-2025 federal standards, coupled with state Zero Emission Vehicle standards for 2018-2025, are likely to exert negative effects on the US economy (employment, GDP, and disposable income) in the near term but much more favorable impacts in the long run. The macroeconomic impacts tend to be somewhat worse when 2012 inputs are replaced with 2016 inputs but still positive in the long run. The study also shows that the economic impacts are likely to vary by region of the country. The TCO modeling of new vehicle demand shows positive effects using 2012 inputs but negative effects using 2016 inputs. The inputs to the analysis are based on information available to the authors as of the fall of 2016.

We are pleased that several stakeholder groups have read the study and offered commentary (praise and criticism) in the public docket for the midterm evaluation. In this letter, we respond to the criticism of the study. We begin with the technical issues and then address the policy issues raised by commenters. We are selective with references in this letter, as a complete set of references are available in Carley et al (2017).

Technical Issues

1. The Costs of Fuel Saving Technologies

The performance standards in the regulations under study are designed to stimulate commercialization of fuel-saving technologies. For the 2012 inputs, we used the estimates of technology costs prepared by EPA and NHTSA and published in the respective Regulatory Impact Analyses (2012). For the 2016 inputs, we made modifications to the cost estimates based primarily on a 2015 report of the National Research Council (NRC) of the National Academies of Sciences. To obtain a more realistic set of cost estimates for the combination of the federal and state programs, we also designed and estimated a bottom-up engineering-economic model called COMET, which is similar to the EPA OMEGA model. Thus, our economic models are run with five sets of cost estimates: NHTSA-2012; EPA-2012; COMET-2016; 2016-High; 2016-Low. The High and Low estimates for 2016 represent different technical viewpoints within the NRC Committee (2015), with the 2016-Low corresponding to 11% higher cost estimates than reported by NHTSA (2012); 2016-High corresponds to 56% higher cost estimates than reported by NHTSA (2012). NRC (2015) did not review the EPA (2012) cost estimates, which were slightly larger than the cost estimates reported by NHTSA (2012).

The International Council on Clean Transportation (ICCT) (2017, 19) and the American Council for an Energy-Efficient Economy (2017, 7) express concerns that the estimates of technology costs in our study are inflated because they do not adequately account for cost savings due to new technologies, innovation, and learning. After our analysis was completed, ICCT released a technical report (Lutsey et al, 2017) finding that the estimated technology costs (e.g., for lightweight materials) used by NHTSA, EPA, and NRC are too large. However, alternative studies prepared by the Center for Automotive Research and others suggest that the estimated technology costs published by the agencies are too small, especially for light trucks (e.g., see Dziczek et al, 2016). We encourage agency analysts to review all of the post-NRC (2015) information and make appropriate adjustments to estimates of technology costs.

We emphasize that the High and Low 2016 Cost estimates already incorporate an assumption that technology costs decline from 2025 to 2030 at an annual rate of 0.186% for cars and 0.146% for trucks, based on EPA figures. Thereafter, technology costs are flat through 2035, on the assumption that the technologies are mature.

The future costs of battery technology are uncertain, and will have a significant impact on the technology costs of the ZEV regulation. For the 2016 High Cost estimates, we used data from

EPA (TAR, 2016) on battery costs, which decline steadily through 2025. For the 2016 Low Cost estimates, we use a US Department of Energy goal (target) of $125/kwh in 2022, which is tantamount to a breakthrough in lithium ion battery technology. DOE did not make projections for 2022 to 2025, and we assume breakthrough costs are constant in those years. The 2016 Low Cost Estimates are significantly smaller than the 2016 High Cost estimates throughout the 2017-2025 period. For the 2026-2035 period, we assume that the costs of plug-in electric vehicles decline at the same annual rate that they declined from 2017 to 2025, which was a 4% annual decline for the 2016 High Cost estimate and a 7% annual decline for the 2016 Low Cost Estimate.

The Institute for Policy Integrity (2017, 15) is concerned that the flat cost assumption for batteries after 2022 will overestimate costs due to continued learning and innovation in battery production. However, our 2016 perspectives do assume a continued annual rate of decline in battery costs from 2026 to 2035, as explained. Further analysis of this issue is certainly warranted.

We would also like to emphasize that the 2022 DOE target is quite ambitious and there is growing concern in the battery industry that the prices of raw-material inputs for lithium ion batteries will rise significantly in the 2020-2035 period, as it will take a substantial period of time for the supply of raw material inputs to catch up with the growing rate of demand for batteries from the automotive and non-automotive sectors. The Chinese government is mandating a rapid increase in electric vehicle production for 2019 and 2020 (and presumably thereafter) but the industrial plans for expanding supplies of lithium, cobalt, and other raw materials are at an early stage of development (Martinez, 2017; Scott, 2017; Yang and Mukherji, 2016). Given future market conditions, we doubt that the prices of automotive-grade lithium ion batteries will fall significantly after 2022. IEA (2016) has already reported a recent halt in the rapid rate of decline in battery prices.

Based on our understanding of the technology-cost issues, we urge agency analysts to give priority to the following issues: (1) technology costs for light trucks, since consumer demand for light trucks is increasing rapidly; (2) technology costs for lightweight materials, since the range of viewpoints among stakeholders is quite large and lightweight materials are an important compliance strategy; (3) the fuel-saving effectiveness and costs of multiple technologies in the same vehicle, since multiple technologies will be necessary for compliance and there are subtle issues of interaction that may require further consideration, and (4) the forecasted prices of automotive-grade lithium ion batteries, including their material inputs, as growing demand from China will likely bid up prices for battery cells in the US and European markets.

2. Pass Through of Costs to Consumers

Like the 2012 RIAs, our modeling assumes that vehicle manufacturers will pass 100% of the technology costs to consumers in the form of higher vehicle prices. The Institute for Policy Integrity (2017, 14) questions the assumption of full pass through but does not propose an alternative assumption for analytic purposes. There is a substantial stream of peer-reviewed economics literature supporting the premise that vehicle manufacturers tend to pass through their input costs, even in the era when the US auto industry was structured differently than it is today (e.g., see Gron and Swenson, 2002 and references therein). The industry has become much less concentrated and more competitive in the last 15 years, which gives more credence to a high pass-through assumption. Moreover, the footprint modification of the CAFÉ standards, and the ZEV requirements, have had the effect of spreading technology costs more widely across vehicle manufacturers, and theory suggests that more pass-through pricing occurs when most or all firms in an industry are impacted (on the distributional impact of attribute-based standards, see Ito and Sallee, 2017). We recommend retention of the 100% pass-through assumption, even though it is a simplification of a more complex reality.

3. Price Elasticity of Demand for New Vehicles

The REMI model presumes that the price elasticity of demand for new vehicles in the consumer retail sector is -1.65. Fleet buyers, which account for roughly 20% of annual sales, are assumed to be completely price inelastic within REMI.

Synapse Energy Economics Inc. (2017, 3-4) and ICCT (2017, 19) express a concern that the -1.65 value is much larger than the -1.0 figure used by the agencies and used in our TCO modeling. Synapse Energy Economics Inc. (2017, 3) cites a report by Fujita (2015) for the proposition that the range of automotive elasticity values supported by the literature is -0.30 to -1.28. Note that the -1.65 value used by REMI is close to the upper end of that range if one adjusts for the fact that -1.65 applies only to the individual retail sales (fleet sales in REMI are assumed to be inelastic). More importantly, a close examination of Fujita (2015) suggests that a different interpretation of the literature is more supportable.

The studies reporting low elasticity values tend to be outdated (published from the 1950s to the 1970s), before the advent of modern econometric methods. The most recent paper by Klier and Linn (2012) uses modern instrumental-variable methods to estimate elasticities for sales from the 1975-2007 period. They show that the valid elasticity estimates (-1.28 and -1.86), which used instrumental variable estimation, are larger than the estimates based on traditional modeling (-0.30). Obviously, the REMI value is comfortably in the IV-method range. Fujita (2015) omits consideration of another recent paper on CAFÉ in the economics literature that addresses new vehicle demand. Jacobson (2013, 16) reports an elasticity estimate close to -2.0 using modern econometric methods.

Our inclination is that the price-elasticity assumption does not influence the aggregate REMI results as much as the commenters may think. The bigger factor is REMI's consumer reallocation mechanism, as REMI envisions regulation forcing consumers, who are living on constrained incomes, to spend more money on motor vehicles and less money on other goods and services in the economy. If the REMI price-elasticity estimate is reduced, then the consumer reallocation mechanism is enlarged, and more expenditures will be lost in other sectors such as housing, recreation, clothing and so forth. Thus, a smaller price elasticity of demand for new vehicles does not necessarily generate more favorable economy-wide impacts in the REMI modeling.

We believe it would nonetheless be worthwhile for agency analysts to look carefully at recent price elasticity estimates in the literature and determine whether the -1.0 elasticity assumption should be modified. See the analytic recommendation in Carley et al (2017, 147). New vehicle demand needs to be estimated correctly in this rulemaking for several reasons that are unrelated to macroeconomics. Changes in new vehicle demand will influence prices faced by used car buyers, the extent of fuel savings and environmental benefits, and the societal cost-benefit analysis (e.g., see Carley et al, 2017, 17-18).

4. Financing of New Vehicle Purchases

The REMI model does not incorporate any explicit mechanism for consumer financing of new vehicle purchases, even though we report that roughly 70% of new vehicle sales are supported by loans. The price increases induced by regulation are assumed in REMI to have an immediate adverse effect on the US economy. This seemingly unrealistic assumption arises from a constraint that is built into the structure of REMI: overall levels of savings and debt in the U.S. economy are assumed to be constant.

Synapse Energy Economics Inc. (2017, 3) and the American Council for an Energy-Efficient Economy (2017, 6) argue that the fuel-economy and greenhouse-gas regulations can be financed with higher rates of automotive consumer debt, thereby smoothing out the near-term effects of the price increases on new vehicles. This is a plausible criticism of the REMI modeling but we are not convinced that greater levels of automotive debt will be as feasible in the next decade as they have been during the previous one.

Total levels of household debt (housing, student loan, automotive, etc.) have steadily increased for the past decade, and are now approaching the peak levels of the third quarter of 2008, the height of the financial crisis (Gray, 2017). Automotive debt has been a significant contributor to the rise of overall household debt, as underwriting standards in the automotive sector have been liberalized during the same period that interest rates on car loans have hit historical lows. Consumers with poor credit ratings now account for slightly more than 20% of new vehicle sales (Sullivan, 2016).

About half of car loans are issued by banks and credit unions; the other half by auto finance companies linked to dealers and/or manufacturers (Haughwout et al, 2016). But, the interest rates are not the same for all vehicle purchasers. In late 2015, for example, the average interest rate was 2.7% for those with excellent credit records, 10.36% for subprime loans, and 13.31% for "deep" subprime loans. The average amount financed on a new vehicle in late 2015 was $29,551 (a record high), only slightly lower than the average transactions price for a new vehicle (Sullivan, 2016).

There are several reasons for believing that the currently high level of automotive debt will fall (or at least stop increasing) in the decade ahead. First, the New York Fed reports signs of significant stress in the car-loan market, especially among subprime borrowers (Haughwout et al, 2016). In late 2016, more than one million US consumers were more than 60 days late with their car loan payment (the highest rate of delinquency since 2009). Among subprime buyers, the delinquency rate grew 25% from 2012 to 2016 (Haughwout et al, 2016; Guilford, 2017). And official delinquency rates are artificially low because repossession can occur quite rapidly (as repossession of the car removes a case from the delinquency rate). Repossession rates are also increasing rapidly (Center for Responsible Lending, 2015). Second, federal and state regulators are beginning to express increasing concern about conditions in the automotive lending market (Tracy, 2015; Egan, 2016). In 2015 the federal Consumer Financial Protection Bureau began for the first time to supervise nonbank lenders of automotive loans (Gray, 2017). The federal Office of the Comptroller of Currency is warning lenders of growing risks from liberalized automotive lending. As returns to lenders on automotive debt look more risky, some subprime car lenders are withdrawing from the market (Gray, 2017). The new nominee for OCC reported at his confirmation hearing that the auto loan market, once "overcooked," is "pulling back" (Goldstein, 2017) Finally, the use of car loans has been inflated recently by the low rates of interest charged by lenders for low-risk borrowers compared to the surprisingly high average returns realized in equity and real-estate markets. As interest rates rise in the decade ahead, as planned by the Federal Reserve Board, more consumers with excellent credit records may choose to pay cash while subprime borrowers will hit their loan limits more quickly, even without the extra price burdens of regulation. Real household income since 2007-2009 has been growing quite slowly (Census, 2017), with few analysts projecting for large rates of income growth. Income constraints only underscore the impracticality of more household debt between now and 2025. For all of these reasons, the "constant debt" assumption in REMI may in fact be more realistic for the next decade than it was for the previous decade in the US economy.

Even if the extra price burdens of regulation could be financed with higher levels of automotive debt, it is not obvious that higher levels of household debt would boost the performance of the US economy, as elevated debt levels impact the psychology of consumers and other actors in the market in ways that are difficult to model in REMI or other packages. In a recent report by the International Monetary Fund, rising short-term household debt levels in advanced economies was seen as a net negative for macroeconomic performance (Valakx, 2017). Certainly, any administration policy decision to further expand household debt levels in the US economy should be reviewed with care.

5. Consumer Demand for Fuel Economy

The REMI model shows that gasoline savings have a strong net positive impact on the US economy, especially in the long run, even though the REMI model does not incorporate any consumer demand for fuel economy into the estimates of new vehicle demand. REMI presumes that new vehicle demand is affected by the gross vehicle price increases, which is typical of macroeconomic models (see Carley et al, 2017, 124-6).

Synapse Energy Economics Inc. (2017, 3), ACEEE (2017, 6) and ICCT (2017, 19) are concerned that the REMI modeling of economic impacts exaggerates adverse economic impacts by failing to account for consumer demand for fuel economy. They argue that the REMI modeling should be redone using net prices rather than gross prices, similar to the way we performed the TCO modeling.

The suggestion of the commenters is conceptually reasonable and we considered this analytic direction for our own modeling. However, there are complications that render this approach analytically unattractive, assuming that REMI is the model of choice. If we assume that consumers allocate some or all of the gasoline savings to new vehicle demand, then the consumer reallocation mechanism in REMI needs to be restructured. The REMI model already assumes, in its input-output structure for reallocations that 100% of the savings in gasoline expenditures are reallocated to consumer expenditures in other sectors of the economy, using historical data over many years. It would be double counting to assume that the same fuel savings can also be dedicated to boosting consumer demand for new vehicles. While a fraction of the expenditure allocation in REMI does go to the auto sector, most of the reallocations boost demand for housing, recreation, clothing and other goods and services.

Moreover, proper implementation of the suggestion of commenters would not necessarily lead to the results they expect: a more favorable story concerning the economy-wide impact of the regulations. Analytic steps that weaken the role of gasoline savings in boosting other sectors of the economy could nullify or overwhelm the attenuated adverse impacts on the motor vehicle sector. As we have shown, the consumer expenditure-reallocation mechanism in REMI, when triggered by gasoline savings, exerts a powerful positive effect on the US economy. Given how much surgery would be required of REMI to pursue this analytic path, and given the uncertain impact on overall results, we believe that our decision to proceed as we did is analytically reasonable.

6. Constant Import Ratios in REMI Modeling

Like all available input-output models of the US economy, the results of the REMI modeling are sensitive to assumptions about the extent of imported inputs in the supply chains of the affected economic subsectors. Supply chains with high import ratios have relatively low multipliers compared to supply chains with low import ratios. We assume that the import ratios embedded in REMI are constant for the time horizon of interest (2017-2035). That means, for example, that shares of imported parts for cars and shares of imported crude oil for gasoline refining are constant. See Carley et al (2017, 106-110) for our discussion of the related uncertainties.

The Institute for Policy Integrity (2017, 15) questions the constant import assumption on the grounds that regulation may stimulate US companies to develop a stronger domestic position in electric-vehicle production due to expanded R&D investments in the US and more patents obtained by US companies. This is an important point that merits further analysis in light of the currently dominant positions of China, Japan, and South Korea in production of battery cells for plug-in electric vehicles. Some efforts were made by the Obama administration, through the Recovery Act, to nourish a domestic supply chain for plug-in electric vehicles. Those subsidies and loan guarantees reinforced the investment incentives created by the state Zero Emission Vehicle programs in 10 states that comprise about 30% of new vehicle demand. Unfortunately, the REMI model does not contain a module for the electric vehicle industry because there is no NAICS code for electric vehicles and REMI relies on NAICS codes.

We make the optimistic assumption in our REMI modeling that the US position in production of plug-in electric vehicles and components will equal, for the 2017-2035 period, the current US position in gasoline vehicles and components. For reasons that we explain in Carley (2017, 60-63), our REMI assumptions may overestimate the ability of US firms to compete globally in production of plug-in electric vehicles and components. Nonetheless, we agree with the commenter that more analysis of this important issue would be worthwhile.

7. Interest Rates and Discount Rates in Economic Modeling

In the REMI modeling, the prices of vehicles are conservative because we assumed zero financing costs. We also did not discount future fuel savings, which tends to accentuate the beneficial impact of fuel savings in the macroeconomic modeling. The commenters on the REMI modeling see potential biases only in the direction of negative economic results (e.g., see Synapse Energy Economics Inc., 2017, 3 and ICCT, 2017, 9) but these assumptions (zero financing costs and zero discounting of future fuel savings) are not biased against the 2017-2025 standards. Moreover, the REMI modeling assumes that cash outflows to pay for oil imports and imported car parts are never recycled back into the US economy. Those assumptions are certainly not biased against the 2017-2025 federal regulations (see Carley et al, 2017, 109-110).

In the TCO modeling, regulatory impacts on new vehicle demand are a key question of interest. We incorporate financing costs, which requires an interest rate on car loans, and consumer demand for fuel economy, which requires a consumer discount rate on future fuel savings. The 2012 perspectives adopt the NHTSA assumption of a 5% real interest rate on car loans and a 5% discount rate on future fuel savings until the vehicle is resold, when the original consumer is assumed to capture roughly 35% of the price of fuel-saving technology at resale. For the 2016 perspectives, we assumed the long-term average interest rate of 7% for the 2017-2025 period as well as a 7% discount rate on future fuel savings. More importantly, we assume that the original purchaser has a limited time horizon for fuel savings (e.g., three years) and captures only a fraction (55%) of the present value of fuel-saving technology at resale.

Synapse Energy Economics Inc. (2017, 5) questions the use of a 7% rate for interest and discounting because interest rates on car loans have actually declined from about 5% in 2012 to 4.5% in 2016. However, the relevant question is not what the rates are in 2016 but what the 2016 forecasts of future rates are through 2025. Given that car-loan rates are at historical lows and that the Federal Reserve Board is signaling a sustained yet gradual rise in interest rates, we felt the most defensible assumption is the long-term average real interest rate on car loans, which is about 7% in the US. Our sensitivity analysis showed that the differences in results between 5% and 7% are not meaningful in the context of the TCO modeling. We also present some analytical results with rates as low as 3% and as high as 15% so that the reader has a feel for the degree of sensitivity in our TCO results. The low-end of 3% corresponds to rates now given to borrowers with excellent credit records; the high end corresponds to interest rates on credit card debt and interest rates on loans to borrowers with very poor credit histories. Synapse Energy Economics (2017, 6) claims that interest rates on credit card debt have been below 15% since 2010 but the original source that they cite reports that interest rates on credit card debt (assessed accounts) rose from roughly 13% to 15% from 2014 to 2016. There is certainly no reason to expect that interest rates on credit card debt will decline over the next decade or so.

One of our key findings from the TCO modeling of new vehicle demand is that regulatory impacts are positive with 2012 inputs but negative with the 2016 inputs. ACEEE (2017, 7) uses our TCO modeling structure to estimate impacts on new car demand but the modeling inputs are changed in several ways. They omit the upward adjustments to costs recommended by NRC (2015); they exclude the costs of the ZEV regulation; and they generously assume that consumers will value four years of fuel savings at the time of purchase. With those and other inputs, they find that the impacts on new vehicle demand are positive rather than negative. Our response is that each of the input adjustments they have made is less supportable than our inputs, and the combination of inputs they use is particularly implausible, as they have strung together several questionable inputs that are all favorable to new vehicle demand.

Policy Issues

1. Ramifications for Federal and State Regulatory Programs

A variety of commenters (e.g., Synapse Energy Economics, 2017, 2; Environmental Defense Fund, 2017, 42) express concern that our results may be used to justify a roll-back or weakening of the federal and state regulations. While the concerns are understandable, the commenters gloss over the nuanced conclusions in our study concerning public policy. With regard to the Joint National Program for fuel economy and greenhouse gas control, our results provide no support for rescission of the Program, as Carley (2017) has highlighted in a recent op-ed piece. Our recommendations address policy options aimed at refining the federal programs to enhance cost-effectiveness (i.e., capture most or all of the benefits projected in 2012 but at a lower near-term cost to the economy). We raise "deeper" questions about the state Zero Emission Vehicle Regulations, and call for a concerted effort to better coordinate those state regulations with the federal programs and with fiscal policies at the state and federal levels.

2. Relative Size and Timing of Near-Term Losses and Long-Term Gains

Several commenters (e.g., Synapse Energy Economics Inc., 2017, 2) noted, as we did, that the long-term gains from fuel savings in our REMI modeling are much larger than the short-term losses from higher prices on new vehicles. However, those commenters do not fully appreciate how long it will take for the accumulated negative impacts to be offset by the accumulated positive impacts. When the 2012 inputs are used, it takes less than a decade for the accumulated positive impacts to overwhelm the accumulated negative impacts (see Carley et al, 2017, Table 8.1, 105). While the net GDP impact is slightly negative in 2025, the impact is strongly positive by 2035. Use of the 2016 inputs, coupled with incorporation of the market shift from cars to light trucks, makes the results more worrisome. The 2016-Low and 2016-High scenarios achieve positive results for GDP prior to 2025, but those scenarios do not account for the market shifts from cars to light trucks and do not fully account for the impact of the ZEV regulations. Using the COMET-2016 perspective, which accounts for the light-truck growth and the ZEV regulations, the accumulated results for GDP remain negative through 2035. Moreover, our REMI results assume no tightening of these regulations or other auto safety or tailpipe regulations between 2025 and 2035. In contrast to that no-regulation assumption, ICCT (2017, 22) calls for consideration of an even stricter pattern of fuel-economy regulations from 2026 to 2030 (a 5% annual tightening of fuel economy standards and a 13-23% rate of penetration of plug-in electric vehicles). Thus, the long-term macroeconomic benefits of the federal program, while quite large, may take a considerable period of time to materialize.

It is the responsibility of policy makers, not analysts, to make the judgments as to whether the large long-term gains occur fast enough to compensate for an extended period of modestly adverse economic impacts. Fortunately, our report discusses a wide variety of policy options – some involving regulation, others involving fiscal policy -- that might lessen the near-term burdens without losing much or any of the long-term gains. We emphasize that each of our policy options requires careful policy analysis, including an assessment of benefits and costs, prior to enactment.

Sincerely,

John D. Graham, Ph.D.
Dean

APPENDIX: REFERENCES

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