ACEEE Attachment 2
Breakdown of NPRM incremental fatalities (augural fuel economy and existing GHG standards vs proposed standards) by cause

Overview

The tally of fatalities that the NPRM associates with the augural fuel economy and existing GHG standards (the "current standards" when discussed together) reflects several different mechanisms built into the CAFE model. The NPRM breaks down the incremental fatalities from the stronger, current standards into fatalities due to rebound, mass reduction, and "sales impacts," but provides no further breakdown. The "sales impacts," which are the combined effects of the sales response, fleet share, and scrappage components of the CAFE model, account for roughly half of the total incremental fatalities the agencies attribute to the current standards relative to the proposed standards. Hence it is important to investigate the "sales impacts" in greater detail, especially given that these three model components are untested and poorly supported, and yield implausible results. This memo summarizes the results of such an investigation and explains the methodology. It in no way endorses the agencies' fatality results but is simply an attempt to better understand them.

We also report on a second breakdown of the agencies' fatality results. While our first analysis assigns the incremental fatalities to five distinct CAFE model components (rebound and mass reduction, in addition to the three "sales impacts"), it does not directly address the question of how many of the fatalities are due to increases in vehicle miles traveled (VMT) and how many to a decline in average vehicle safety (measured by fatalities per mile). The mass reduction fatalities clearly relate to changes in fatality rate, per the agencies' analysis. Given the agencies' assumption that fatality rates decline with increasing model year, another possible source of fatalities that could be characterized as worsening vehicle safety is an increase in the percentage of total VMT being driven by vehicles with a higher fatality rate, driven by the retention of older vehicles (with higher fatality rates) projected by the scrappage model. Our second analysis investigates this phenomenon in order to evaluate the agencies' claim that current higher standards "keep consumers in older, dirtier, and less safe vehicles" (NPRM at 429930).[1]

Results

The results of our first breakdown of fatality results are shown in Tables 1 and 2 below. For comparison, we have included the NPRM fatality tallies at the bottom of each table.

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[1] The agencies did not explicitly model the effect of a slowdown of vehicle sales on the transition into newer, safer vehicles and on average fleet fatality rates, as the sales model is not connected to the scrappage model. Rather, the scrappage model examines the effect of higher new vehicle prices on vehicle scrappage, under the theory that higher new vehicle prices will make existing vehicles more expensive and slow the rate at which older vehicles are scrapped.

Table 1: Fatality breakdown for CAFE standards, MY 1975-2029, augural vs. proposed, standard-setting run						
	Sales Response	Fleet Share	Scrappage	Rebound	Mass Reduction	Total
Passenger Cars	(793)	(2,229)	5,783	3,208	277	6,246
Light Trucks	(720)	2,300	1,936	3,051	(135)	6,433
Total	(1,512)	71	7,719	6,260	142	12,680
NPRM Table II-74	6,180			6,340	160	12,680

Table 2: Fatality breakdown for CO2 standards, MY 1975-2029, augural vs. proposed						
	Sales response	Fleet Share	Scrappage	Rebound	Mass Reduction	Total
Passenger Cars	(793)	(2,917)	6,662	3,991	562	7,504
Light Trucks	(724)	2,981	2,783	3,224	(123)	8,140
Total	(1,518)	63	9,445	7,215	439	15,644
NPRM Table II-77	7,880			7,300	468	15,648

The results of the second analysis are shown in Table 3.

Table 3: Incremental fatalities induced by total VMT and by average fatality rate			
	Fatalities due to increased VMT	Fatalities due to change in fleet average fatality rate	Total
CAFE standards	12,787	(107)	12,680
CO2 standards	15,574	70	15,644

Especially notable is that the number of fatalities attributable to change in fatality rate is far fewer than the number attributable to mass reduction (142 for CAFE standards and 439 for CO2 standards, as shown in Tables 1 and 2), even though mass reduction fatalities are a subset of those fatalities. In other words, *fatalities due to changes in the various model years' shares of total VMT are negative*. Thus the agencies' own analysis is completely inconsistent with their narrative of the current standards causing additional fatalities by increasing the share of driving done by older vintage, less safe vehicles.

Methodology

The above results are based on two CAFE model output files from the NPRM analysis, both entitled "annual societal effects report"—one for the CAFE program ("standard-setting" run) and one for the CO2 program. For the augural and 0% per year (proposed roll back) scenarios, we used these outputs: fleet size, vehicle miles traveled, and fatalities. The files show values of these parameters for every model year (MY) and calendar year (CY) of the analysis and separate values for passenger car (PC) and light truck (LT).[2]

[2] The data are also shown by fuel type, but we used only totals over all fuels.

Breaking down the fatality numbers by cause involves expressing fatalities as a product, for example:

Total fatalities = Vehicles x Miles per vehicle x Fatalities per mile

1. Breakdown of fatalities by CAFE model mechanism

Taking this decomposition approach a step further, we can express fatalities for a given MY in a given CY for a given vehicle type (here using PC) as follows:

(*) PC fatalities in given MY and CY = Vehicles sold in MY x % PC sold in MY x % PC of MY surviving in CY x Miles per year per PC of given age x Fatalities per mile for PC of given MY

The point of this decomposition is that each term on the right hand side corresponds to one of the five mechanisms shown in the tables above that affect fatalities according to the CAFE model:

- Vehicles sold in MY —Sales response
- % PC sold in MY—Fleet share (cars vs trucks)
- % PC of MY surviving in CY—Scrappage effect
- Miles per year per PC of given age (CY minus MY)--Rebound
- Fatalities per mile for PC of given MY—Mass reduction

Further explanation of these correspondences is provided below.

We use (*) as follows. Starting with the agencies' fatality total for a given MY, CY, and vehicle type in the augural scenario, we adjust that total stepwise. Each step in effect replaces the augural scenario value by the 0% scenario value for one term on the right hand side of (*). The change in fatalities resulting from that step is the number of fatalities attributable to the corresponding mechanism.

For example, under the augural CAFE standards, MY 2025 cars have 1,084 fatalities in CY 2030. Total vehicle sales in MY 2025 are 17,714,225 in the augural scenario and 17,941,282 in the 0% scenario. The effect of sales response on fatalities is then calculated as:

$$1{,}084 - 1{,}084 * (17{,}941{,}282 / 17{,}714{,}225) = -9.6$$

In other words the augural standards eliminate 9.6 fatalities due to sales response for MY 2025 cars in CY 2030.

Only at the end of this stepwise process is the data summed across vehicle type, CY, and/or MY to generate a fatality decomposition at the desired level of aggregation.

Notes on the fatality factor-CAFE model mechanism correspondence shown above follow.

a) Vehicles sold in MY and % PC sold in MY: Expressing the number of PCs sold in MY as the product of total vehicle sales and % PCs allows the separation of fatalities associated with the agencies' sales response model (which projects only total vehicle sales) and their dynamic fleet share model. The sales response model projects that slightly fewer vehicles will be sold under the augural standards and as a result reduces fatalities, because the smaller number of new vehicles reduces the number of vehicle miles traveled and thus the number of fatalities. For PCs, the fleet share model would also show fewer fatalities, though these are more than offset by the increase in fatalities for LTs (see Tables 1 and 2) due to the higher lifetime miles the CAFE model assumes for LTs.

b) % PC of MY surviving in CY and miles per year per PC of given age. The difference in survival rates of PCs in a given year between the augural and 0% scenarios captures the effect of the agencies' scrappage model. While delayed scrappage has the effect of increasing average vehicle lifetime miles, miles per year is completely determined by the rebound effect.

c) Fatalities per mile for PC of given MY. The only determinants of fatality rate in the CAFE model are MY and application of mass reduction as a fuel economy and GHG emission reduction strategy. Hence for a given MY, any difference in fatality rates between the augural and 0% scenarios is due entirely to mass reduction.

2. Breakdown of fatalities by VMT vs fatality rate

Alternatively, the difference in fatalities between the augural and the rollback scenarios can be separated into those associated with the difference in total VMT and those associated with the difference the overall, average fleet fatality rate. To understand the scale of the effect of VMT changes on fatalities under the augural scenario as compared to the rollback, we isolate the effect of VMT by taking the change in the average fleet fatality rate out of the picture. To do so we calculate, in effect, what the total number of fatalities would be if the vehicle fleet modeled under the rollback (with the average fleet fatality rate of the rollback fleet) drove the same number of miles as the fleet does in the augural scenario. This increase in fatalities is directly attributable to VMT changes. The difference between total fatalities and the number of "VMT fatalities" is the number of fatalities caused by the change in the average fleet fatality rate.

In contrast to the first analysis, the breakdown of incremental fatalities into those attributable to the change in miles driven and those attributable to the change in fatality rate was done at the most aggregate level. Using the same output files as above, we summed VMT and fatalities for all vehicles of affected MYs (through 2029) in all affected CYs (2016-2068) in the augural and 0% scenarios. We then wrote fatalities in the augural scenario as:

$$\text{Total fatalities} = \text{Total miles driven} \times \text{Fatalities per mile}$$

As in the analysis above, we then calculated incremental fatalities in the CAFE program due to VMT using the ratio of total VMT in the 0% and augural scenarios:

514,149 – 514,149 * (57,539,943,702,077 / 59,007,465,770,564) = 12,787

(Augural fatalities – augural fatalities * (total 0% VMT / total augural VMT) = Fatalities due to VMT)

Since total incremental fatalities between augural and 0% scenarios are 12,680, there are -107 fatalities due to change in fatality rates, as shown in Table 3. That is, the augural standards reduced fatalities per mile averaged over all travel in the entire period.[3] The fatality rate declined from 8.715 per billion miles to 8.713 per billion miles. For CO_2 standards, average fatality rate rose slightly under the augural standards from 8.712 to 8.713; but this is lower than the increase in fatality rate driven by mass reduction alone. This indicates that if fatalities projected from mass reduction are set aside, the fleet average fatality rate for the CO_2 standards is lower than the fleet average fatality rate under the rollback.

[3] Note that in the disaggregate analysis above, changes in fatality rates reflect only mass reduction impacts, because fatalities per mile within a MY are otherwise fixed according to the CAFE model. That is not the case in this analysis, where fatality rate represents an average across MYs.