Comments on CARB Vision For Clean Air and Vision Model

September 15, 2012
AIR, Inc.

Introduction

On June 27, 2012, CARB released a report entitled "Vision for Clean Air: A Framework for Air Quality and Climate Planning" (VCA). On August 20, 2012, an appendix was released which contained the ARB Vision Model documentation. The Vision model was used extensively in the main report to evaluate the NOx and CO2 impacts of widespread changes in mobile source technologies and fuel types in the South Coast Air Basin (SCAB) and the San Joaquin Valley Air Basin (SJV). The CARB Vision model is a California adaptation of an Argonne model that combines tailpipe emissions from on-road and offroad vehicles with upstream emissions for the different fuels used in these vehicles. AIR reviewed both the model and the documentation for the Truck and Engine Manufacturers Association. The following are our comments on the model.

Comments

1. The Vision model's upstream emission reductions from gasoline and diesel vehicles due to the rollout of zero emission vehicles are overstated because the model presumes that if gasoline and diesel use in California decline, then the upstream emissions will be reduced as well. However, if gasoline/diesel use decline in California, that does not necessarily mean that upstream emissions will be reduced, because gasoline and diesel will likely still be produced in California and exported outside of the state.

2. The VCA evaluates widespread conversion of the onroad and offroad fleet from conventional petroleum to renewables, electricity and hydrogen. The electricity and hydrogen portion will entail significant infrastructure changes. There is no accounting in the Vision model for construction and related emissions to create these new infrastructures. While these may be somewhat temporary in nature, they are probably significant and should be included.

3. For medium heavy-duty on-road vehicles, Scenarios 2 and 3 in the Vision model exhibit vehicle miles traveled in the future that are the opposite of the trends for heavy-duty vehicles. The reasons for this are not clear.

4. The fuel economy trends by calendar and age for MHDs and HHDs appear to be quite different, and reasons for this are not clear.

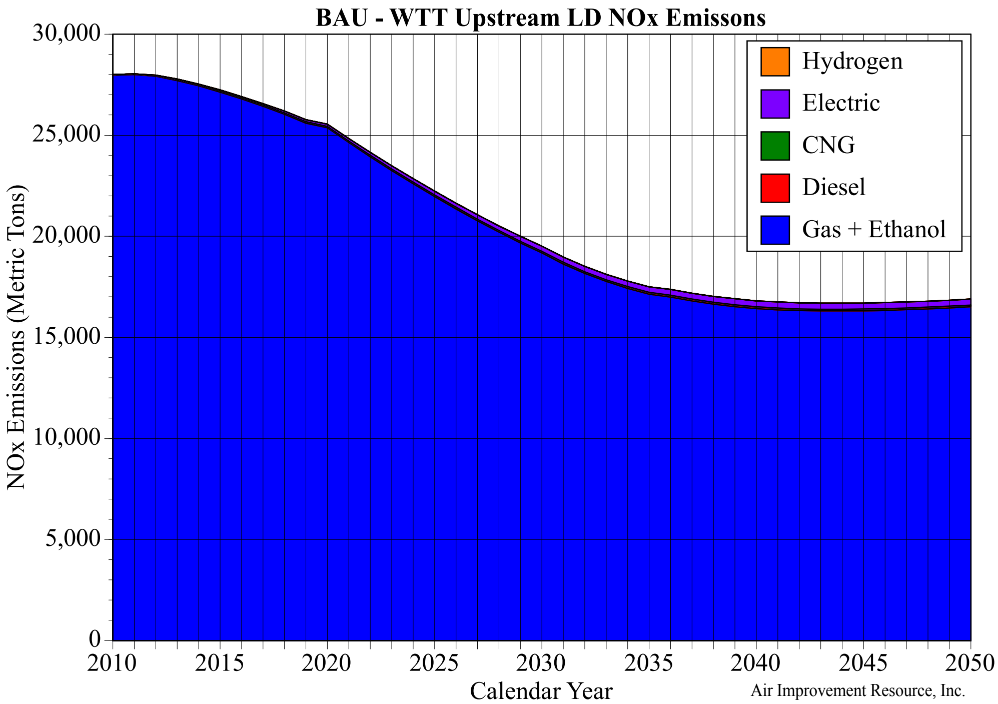
Comment #1: The Vision model's upstream emission reductions from gasoline and diesel vehicles due to the rollout of zero emission vehicles are overstated because the model presumed that if gasoline and diesel use in California decline, then the upstream emissions will be reduced as well. However, if gasoline/diesel use decline in California, that does not necessarily mean that upstream emissions will be reduced, because gasoline and diesel will likely still be produced in California and exported outside of the state.

The Vision Model currently assumes for gasoline and diesel that all upstream NOx emissions due to crude oil extraction, transport, refining into gasoline and diesel, and transport to service stations occurs in California. But for other fuels, the Vision model assumes ½ of the NOx emissions occur in California. Second, the Vision model only accounts for upstream emissions from vehicles operated in California. If fuel is produced in California (and thus emits NOx in California), and is exported outside of California, these emissions are not accounted for in the model. We are not sure how much gasoline and diesel is produced in California but exported out of California at this time, but if the California fleet turns over to hybrid electric vehicles (HEVs) battery electric vehicles (BEVs) and fuel cell vehicles (FCVs), then much less gasoline will be used in California, and oil companies operating fuel production facilities in California will export much more gasoline (and diesel) outside of California.

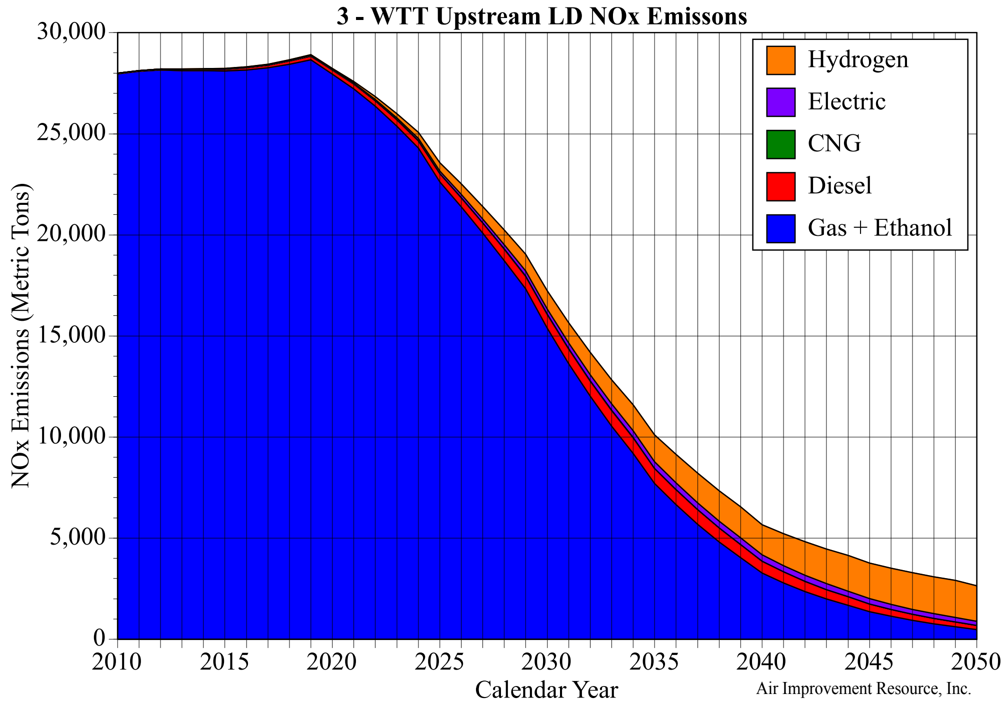
The following four figures show a comparison of NOx emissions for both LDVs and HDVs for the Business as Usual (BAU) case and Scenario 3. In Scenario 3, there are much lower NOx upstream emissions in the future than the BAU case for both vehicle classes. The main reasons for this are the three assumptions mentioned above. If all gasoline and diesel emissions upstream emissions do not occur in California, then the baseline upstream NOx is too high. If more than ½ of alternative fuel NOx emissions occur in California, then the upstream projection would be higher than shown in Scenario 3. If refineries continue to produce gasoline and diesel for vehicles outside of California when the California fleet is more electric and fuel cell vehicles, then again the projected upstream emissions would be higher (unless the state acts to reduce NOx emissions from fuel production in the state by 90% as well).

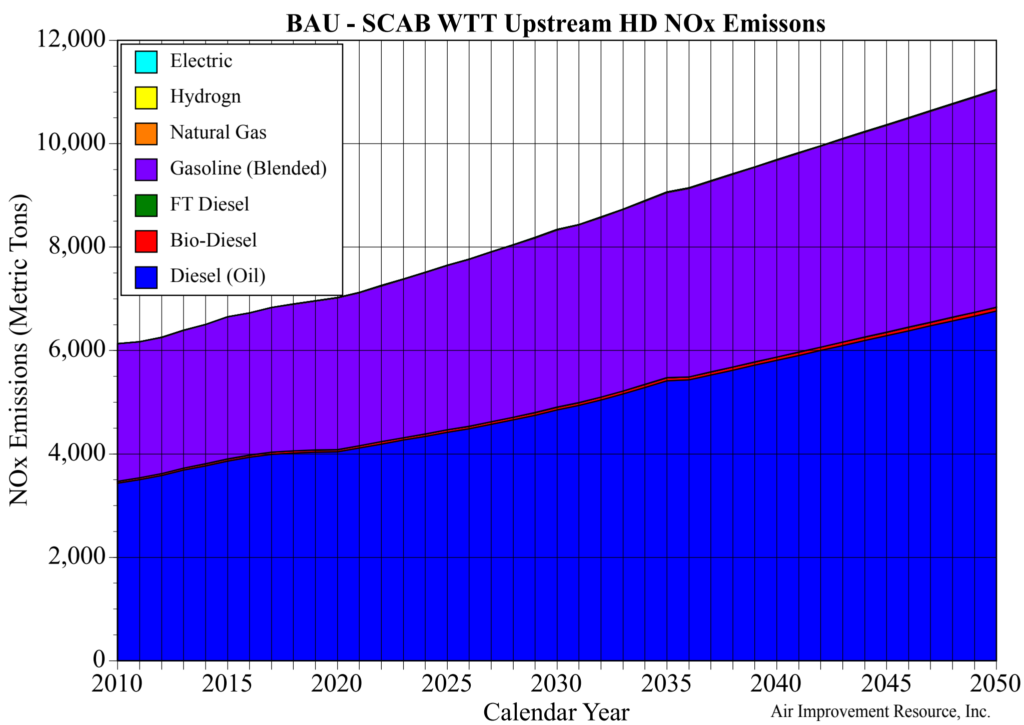
All three assumptions seem to bias the Vision analysis toward too much NOx reduction in California for conversion to HEVs, BEVs, and FCVs from gasoline and diesel vehicles, unless emissions from fuel production facilities are also going to be significantly further reduced along with tailpipe emissions.

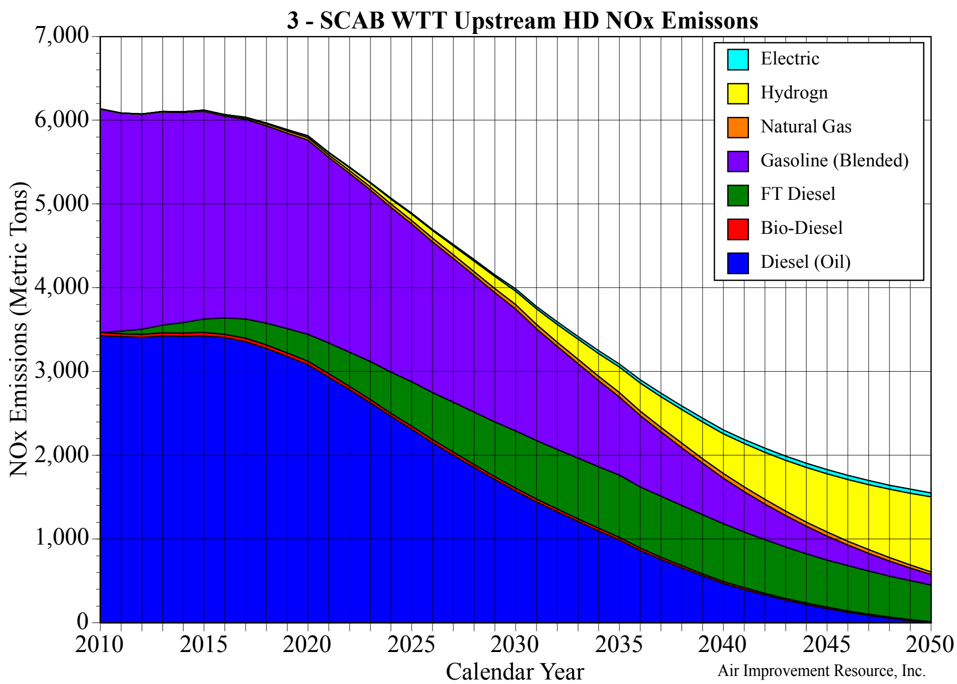
It should not be difficult to determine the percent of NOx emissions from current gasoline and diesel production that is California, based on where the crude oil is coming from, and the emissions from crude extraction and transport versus refining and delivery to service stations. We agree it may be difficult to predict where NOx emissions from alternative fuels may be located, but most of the electricity production should be in California. Finally, the Vision model should assume that upstream emissions from the production of gasoline and diesel fuel should continue even if the California fleet turns over to other technologies. In fact, if these changes are implemented, upstream NOx would probably increase, instead of decrease, with the widespread introduction of alternative on-road technologies. Clearly, the state will need to reduce NOx from all stationary sources producing energy within the state in order to realize significant upstream NOx reductions from on-road transportation sources.



(WTT = well-to-tank, LD = light duty)


3 - WTT Upstream LD NOx Emissons
NOx Emissions (Metric Tons)
30,000
25,000
20,000
15,000
10,000
5,000
0
2010
2015
2020
2025
2030
2035
2040
2045
2050
Calendar Year
Hydrogen
Electric
CNG
Diesel
Gas + Ethanol
Air Improvement Resource, Inc.


BAU - SCAB WTT Upstream HD NOx Emissons
NOx Emissions (Metric Tons)
12,000
10,000
8,000
6,000
4,000
2,000
0
2010
2015
2020
2025
2030
2035
2040
2045
2050
Calendar Year
Electric
Hydrogn
Natural Gas
Gasoline (Blended)
FT Diesel
Bio-Diesel
Diesel (Oil)
Air Improvement Resource, Inc.

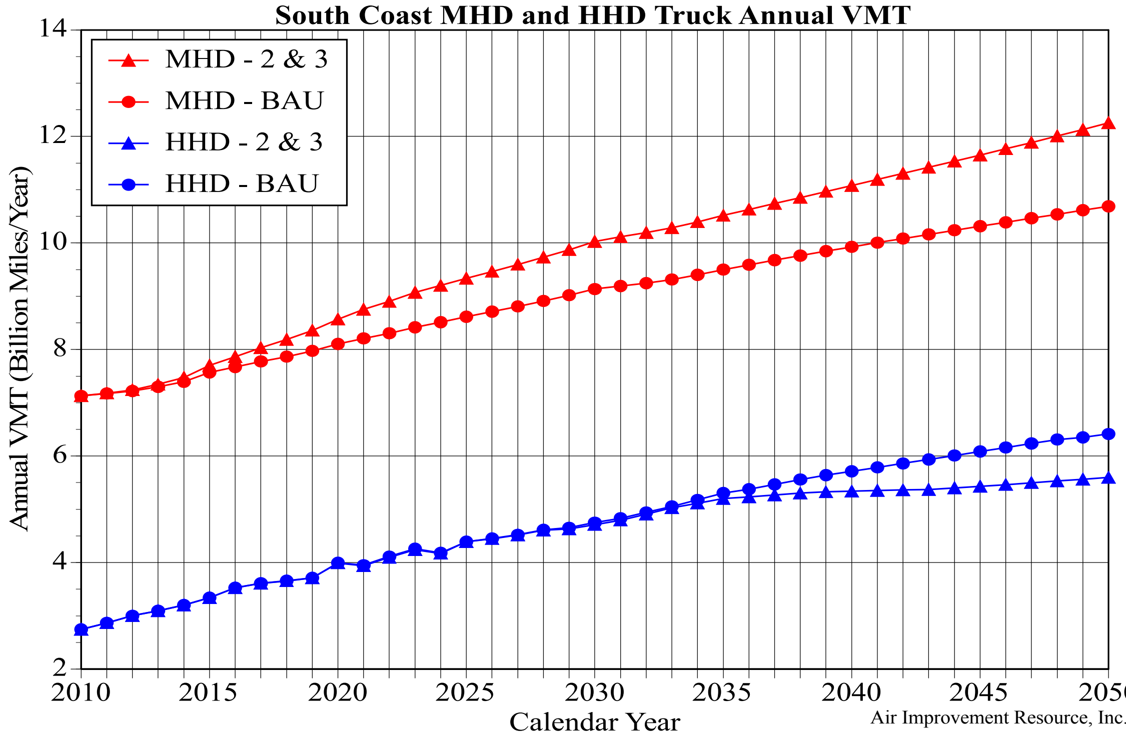


Comment #2: The VCA evaluates widespread conversion of the onroad and offroad fleet from conventional petroleum to renewables, electricity and hydrogen. The electricity and hydrogen portion will entail significant infrastructure changes. There is no accounting in the Vision model for construction and related emissions to create these new infrastructures. While these may be somewhat temporary in nature, they are probably significant and should be included.

This comment does not require further elaboration.

Comment #3: For medium heavy-duty on-road vehicles, Scenarios 2 and 3 in the Vision model exhibit vehicle miles traveled in the future that are the opposite of the trends for heavy-duty vehicles. The reasons for this are not clear.

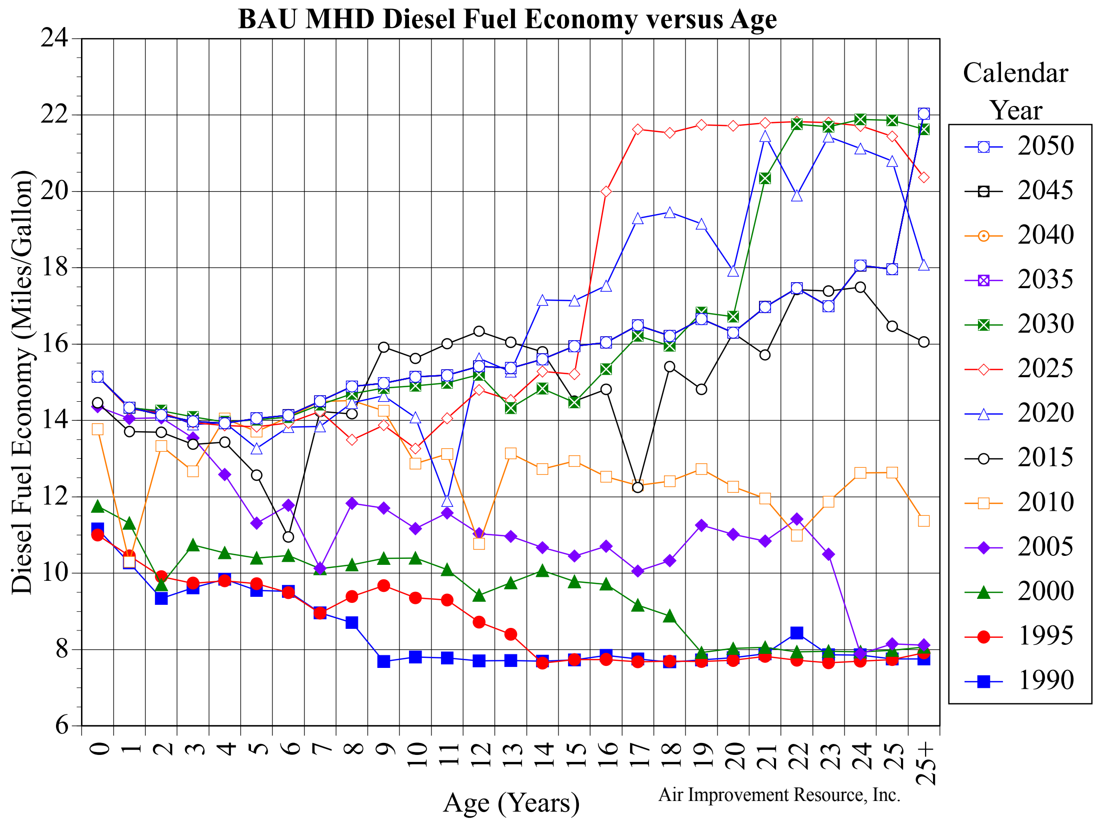
We examined both vehicle miles traveled by calendar year for MHD and HDD from the Vision model for both BAU and Scenarios 2 and 3. The Appendix describing scenario assumptions indicates that Scenario 3 incorporated a 20% reduction in truck activity versus Scenario 2, phased in linearly between 2010 and 2050. Our plot of VMT for heavy-duty vehicles is shown in the following figure. For HHDVs, both Scenarios 2 and 3 seem to show a drop in VMT in the future from the BAU case, not just Scenario 3. In addition, it does not appear to be phase-in from 2010. For MHDs, both Scenarios 2 and 3 seem to show and increase in VMT versus the BAU case, which is in the opposite direction to the documentation (and it does appear to be on the order of 20%). This does appear to be phased-in since 2010.



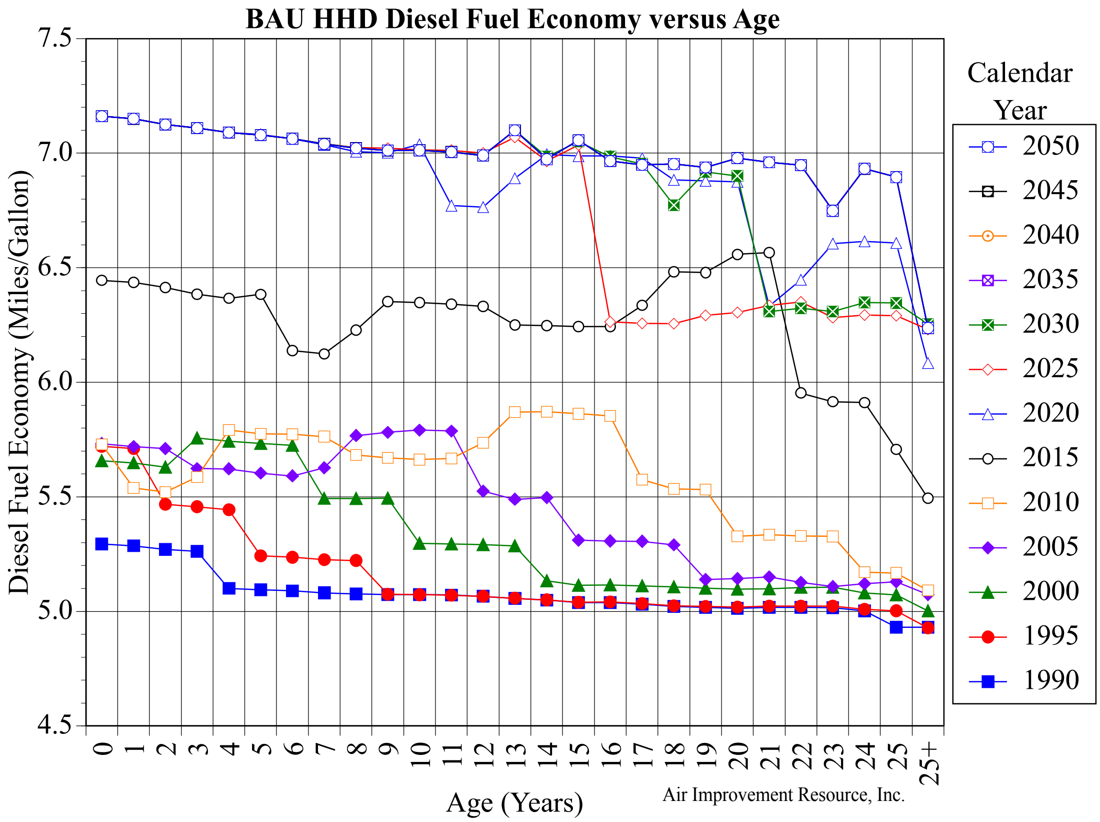
Comment #4: The fuel economy trends by calendar and age for MHDs and HHDs appear to be quite different, and reasons for this are not clear.

We have shown MHD and HHD fuel economy in mpg for a number of different calendar years and ages for the BAU case in the following figures. Fuel economy was increased for 2017 and later vehicles by the heavy-duty fuel economy regulations promulgated by the EPA. For MHDs, for 2010 and earlier calendar years, fuel economy in the Vision model declines somewhat versus age. For example, for the 2005 calendar year, model year 2005 vehicle fuel economy is at 14 mpg. Seventeen year-old vehicles in that calendar year (1988 model year vehicles) have fuel economy around 10 mpg.

After the 2015 calendar year, the trends are quite different. For example, for the 2020 calendar year, model year 2020 fuel economy is about 15 mpg. However, 20 year-old vehicles (2000 model year) are estimated to be above 16 mpg. The later calendar years show similar trends.



The following figure shows HHD vehicle fuel economy patterns by calendar year and model year. These show a more normal increase in fuel economy with increasing calendar year, but decreasing fuel economy within a calendar year with age.


BAU HHD Diesel Fuel Economy versus Age
Diesel Fuel Economy (Miles/Gallon)
Age (Years)
Air Improvement Resource, Inc.
Calendar Year
2050
2045
2040
2035
2030
2025
2020
2015
2010
2005
2000
1995
1990