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Automated Vehicle Regulation: An Energy and Emissions Perspective

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Automated Vehicle Policy and Regulation: A State Perspective Workshop

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What does automated vehicles' emissions impact look like?

- Preliminary estimates range from 80% reductions to slight increases in vehicle GHG emissions. (Vimmerstedt 2015).
- These estimates depend on numerous assumptions based on level of automation and adoption, behavioral responses, and vehicle type.
- Understanding these impacts and tracking behaviors could result in measurable emissions reductions and potentially well-designed behavior incentives.

Current Motor Vehicle GHG Emissions Impacts

Table 1. Motor Vehicle GHG Emissions, 2014, by Source Category

(million metric tons, CO_2-equivalent)

Category	Total GHG Emissions	Percent of Motor Vehicle Total
Passenger Cars	762.6	49.6%
Light Duty Trucks	338.2	22.0%
Medium- and Heavy-Duty Trucks	415.1	27.0%
Buses	19.1	1.2%
Motorcycles	3.9	0.3%
Total	**1,538.9**	

Source: U.S. EPA, *DRAFT Inventory of U.S. Greenhouse Gas Emissions and Sinks, 1990-2014*, Table 2-13. Prior to 2014, this report showed passenger cars accounting for about 40% of the total and light duty trucks about 35%. In a footnote to the Inventory report published in 2012, EPA explained that, "In 2011, FHWA changed how vehicles are classified, moving from a system based on body-type to one that is based on wheelbase. This change in methodology in FHWA's VM-1 table resulted in large changes in fuel consumption data by vehicle class, thus leading to a shift in emissions among on-road vehicle classes in the 2007-2010 time period."

NHTSA Levels of Automation

National Highway Traffic Safety Administration 2013 Policy Automation Levels

Function-specific Automation (Level 1): Automation at this level involves **one or more specific control functions.** Examples include electronic stability control or pre-charged brakes, where the vehicle automatically assists with braking to enable the driver to regain control of the vehicle or stop faster than possible by acting alone.

Combined Function Automation (Level 2): This level involves automation of **at least two primary control functions designed to work in unison** to relieve the driver of control of those functions. An example of combined functions enabling a Level 2 system is adaptive cruise control in combination with lane centering.

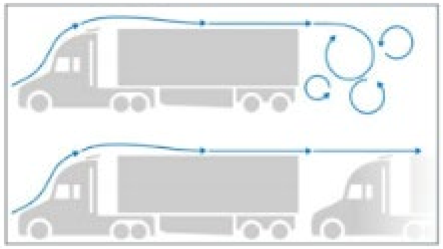
Limited Self-Driving Automation (Level 3): Vehicles at this level of automation **enable the driver to cede full control of all safety-critical functions under certain traffic or environmental conditions** and in those conditions to rely heavily on the vehicle to monitor for changes in those conditions requiring transition back to driver control. The driver is expected to be available for occasional control, but with sufficiently comfortable transition time. The Google car is an example of limited self-driving automation.

Full Self-Driving Automation (Level 4): The vehicle is designed to **perform all safety-critical driving functions and monitor roadway conditions for an entire trip**. Such a design anticipates that the driver will provide destination or navigation input, but is not expected to be available for control at any time during the trip. This includes both occupied and unoccupied vehicles.

Automated Vehicles Could Decrease GHG Emissions

Potential Energy and GHG Emission Reductions

NREL conducted track testing of platooned trucks with 53-ft trailers at the 8.5-mile Uvalde track in San Antonio, Texas. Photo courtesy of Peloton, NREL 31236



Platooning reduces aerodynamic drag by decreasing the driving distance between vehicles. Illustration by Al Hicks, NREL

- Congestion mitigation/efficient routing
  - Fewer accidents, improved flow through routing
- Automated eco-driving
  - Efficient operation, less braking
  - 4-10% improvement in fuel economy from accelerating and decelerating (Anderson 2016)
- Platooning
  - Multiple vehicles following close to one another to reduce aerodynamic draft.
- Automated car/ride sharing with "right-sizing" of vehicles
  - Car service that matches car type to passenger needs
- Lighter Vehicles
  - Full automation may eventually lead to lighter vehicles due to lower accident probabilities
  - Several speculate that it will lead to faster electrification of the fleet.

Do we trust the market to naturally lead toward these benefits, or could policy be aligned to encourage such benefits?

Automated Vehicles Could Increase GHG Emissions

Potential causes of increased energy use and GHG emissions

- Increase in highway speed limits
  - Less concern over human reaction time w/ automation
- Increase in vehicle miles traveled (VMT) and increase in car user groups
  - Longer commutes may become more acceptable
  - The elderly and disabled may have access and opportunity that previously did not exist.
- Increase in automobile features
  - Higher level of comfort, convenience, and electronic devices.

Current Automated Vehicle Policy and Regulation

Current and Proposed Automated Vehicle Regulations

- Largely focused on safety, liability, licensing
- Unique case of the Washington D.C. Bill (B19-0931)

  - Original version required alternative fuel sources for automated vehicles.

  - Goal was to indicate that autonomous vehicles will get above average fuel economy (Committee Report).

Final law (L19-0278) does not include an alternative fuel source requirement.

Future Autonomous Vehicle Policy and Regulation

How could ***state*** policymakers merge current automated vehicle regulations with policies to incentivize emission reductions?

Regulations and policy incentives for eco-driving and platooning potentially reside at the ***federal*** level.

- Regulations requiring V2V & V2I (V2X) communications capabilities for platooning (NHTSA and FCC).
- "Off-cycle" credits for fuel economy/emissions improvements for eco-drive features (EPA).

Eco-driving and Platooning could reduce emissions in the range of 5%-20% each.

- Eco-driving benefits can begin to be achieved starting at automation level 1
- Platooning can be achieved starting at automation level 2

State policy and regulatory options?

1) Monitoring/Reporting

- Require automated vehicles to be equipped with technology to report vehicle GHG emissions (where applicable).
- Enables states to track impacts of autonomous vehicles on emission levels , **as well as implement road use charging**
- Possibly a "Phase 1" policy to gauge the impact of future policies implemented to mitigate emission levels.
- Privacy concerns
  - What type of data is reported?
  - Where is the data stored?
  - Federal regulation?

2) Designated Automated Vehicle Roads

- Maximize the emissions reductions for improved flow
- Allows tighter formation of vehicle fleets

Future Autonomous Vehicle Policy and Regulation

3) Maintain Speed Limits

- Balance convenience and greater safety for autonomous vehicles to travel at higher speeds with energy use and emissions of increasing speed limit.
- A status quo policy of maintaining current speed limits may prevent an increase in GHG emissions

4) Regulation of Commercial Fleets (e.g. Autonomous Taxis, Local Shipping)

- Prohibit access to certain areas if specific requirements are not met (e.g. Uber/Lyft 45 mpg Seattle Airport Requirement).
- Emission caps (Mobile Emissions Reduction Credit [MERC] cap and trade system or carbon tax), alternative fuel requirements could apply to commercial fleets.
  - This could counteract emissions increases from new user groups and incentivize “right-sizing” of vehicles by commercial fleets

Courtesy CityMobil2

References/Resources

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Discussion

Questions, thoughts, insights?

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