



North American Subaru, Inc.

c/o Subaru of America
One Subaru Dr.
Camden, NJ 08103
856-488-8500
856-488-8669 fax

April 30, 2020

Linc Wehrly - Director – Light Duty Compliance
Office of Transportation and Air Quality
U.S. Environmental Protection Agency
2000 Traverwood
Ann Arbor, MI 48105

RE: Application for high efficiency alternator off-cycle GHG credit

This document represents SUBARU's application for high efficiency alternator off-cycle CO2 credit under the alternative methodology outlined in 40 CFR §86.1869-12 (d).

Pursuant to 40 CFR §86.1869-12, car manufacturers can obtain off-cycle credit for the use of GHG reducing technologies that do not fully benefit from federal test procedures and / or highway fuel economy testing. This application for off-cycle credit is filed in accordance with the regulation subsection (d). This allows manufacturers to earn credit by demonstrating that applicable technologies provide GHG reductions.

SUBARU also states that the high-efficiency alternator technology covered by this application is not a safety-related technology and is not subject to the exclusions listed in 40 CFR §86.1869-12 (a). 40 CFR §86.1869-12 (a) was established to achieve compliance with collision avoidance technologies, safety-critical systems, technologies designed to reduce the frequency of vehicle collisions, or vehicle safety standards or regulatory sets. Specifies that off-cycle credit cannot be earned for technology (described in CFR Title 49).

We would be grateful if you could notify us in writing or by email that EPA has received this off-cycle credit application. If there are any questions regarding the material, please contact David Barker at 856-488-8500.

Request for High Efficiency Alternator Credits

1. Introduction and overview

Pursuant to 40 CFR 86.1869-12 (d), SUBARU requests approval of off-cycle greenhouse gas ("GHG") credits for high efficiency alternator technology for 2017 and subsequent model year vehicles.

SUBARU proposes using a scalable GHG credit value of 0.16 grams/mile CO₂ per 1% efficiency improvement above the baseline efficiency level of 67% through the test procedure promulgated by Verband der Automobilindustrie ("VDA"¹).

SUBARU references two methodologies that were approved by the Environmental Protection Agency (EPA) for Ford Motor Company^{2,8} and Toyota Motor Company^{3,7}. Also this request references EPA's technical assessment which contains the Agency's conclusion that the scalable GHG credit value that was already reviewed and approved for other manufacturers "could serve as the basis for a generalized menu credit for high efficiency alternators" ⁴.

2. Description of System

Automotive alternators convert the energy of mechanical systems (generated by the fuel consumption of combustion engines) into electrical energy used in vehicle systems. Improving the conversion efficiency from mechanical energy to electrical energy reduces fuel consumption and CO₂ emissions. The industry standard that characterizes alternator efficiency is the test procedure promulgated by VDA.

The VDA efficiency evaluation procedure weights four different alternator speeds at 50% of the maximum charging current. EPA has accepted that a 67% VDA efficiency rating is a baseline for credit applications. This means that alternators with VDA efficiencies greater than 67% may be eligible for off-cycle greenhouse gas credits. In the GHG Final Regulations ⁵, EPA has indicated that "... 68% VDA seems to be a good starting point" for off-cycle GHG credits for high efficiency alternator technology. SUBARU proposes to use the 68% VDA as a starting point for credit decisions.

3. Methodology to determine the off-cycle benefit of high efficiency alternators

High-efficiency alternators are a well-known technological component to increase the conversion efficiency of vehicle mechanical to electrical energy and reduce greenhouse gas emissions during a two-cycle test. However, due to the increased electrical load on the vehicle in real-life conditions, high-efficiency alternators can generate greater greenhouse gas benefits than represented in FTP and HFET test conditions.

The pre-approved technical menu considered high-efficiency alternators as a possible menu item but was not included due to the limited amount of vehicle data available at the time. As such, high-efficiency alternator technology is not available with the pre-approved technology menu credits. Also, while the five-cycle methodology tends to incorporate a wider range of operating parameters it still does not capture the real world GHG benefits since customers regularly generate high accessory loads in use.

As such, because of higher off-cycle accessory loads in the real world, high-efficiency alternators are more beneficial in on-road operation than the effects demonstrated in a two-cycle or five-cycle test. Several OEMs have already applied and been approved for off-cycle credits under a similar alternative methodology⁹. SUBARU agrees with these decisions.

4. Analysis of electrical load during 2-cycle and on-road driving conditions

Vehicle electrical load is an important parameter for calculating off-cycle credits for high efficiency alternators. EPA accepted the use of Ford's proposed vehicle electrical load data in LDV and LDT models to calculate off-cycle credits for high efficiency alternators.

Ford's data was 588 watts of electrical load and road driving conditions for a 297 watt two-cycle test and that data was used to determine the power savings resulting from the use of a high

efficiency alternator. The unified road savings approved by the EPA is 41 watts, and the unified two-cycle savings approved by the EPA is 21 watts.

Toyota also conducted a two-cycle electrical load test on additional models. The test showed electrical loading under two-cycle test conditions similar to Ford's two-cycle test data. The EPA has accepted that the additional roadside test data can be waived by showing that the electrical load of the additional model's two-cycle test is equivalent to Ford's results. That is, if the electrical loads between two vehicle models on two-cycle testing are similar, then the electrical loads on the road can be considered similar.

Based on these approved submissions and other information, EPA concluded that "... the GHG emissions benefits of the high-efficiency alternator were nearly consistent across manufacturers, conditions, and vehicle types." ⁴

SUBARU also carried out two-cycle test in order to show electrical loading under two-cycle test conditions similar to other approved data.

SUBARU performed two-cycle testing on multiple models equipped with high-efficiency alternator technology. Comparing the data (shown below) with data from several OEMs approved by EPA in a high efficiency alternator application⁹, SUBARU's test result are in between.



5. How to calculate GHG benefits of high efficiency alternator technology

Based on the above data, EPA's conclusion that "off-cycle menu credits in the range of 0.16 grams / mile CO₂% for alternators with efficiency greater than the 67% baseline level are appropriate" ⁴ is also applicable to SUBARU vehicles.

SUBARU used GHG credit calculation methods and tables proposed by other manufacturers and concluded as "adequate" by EPA's technical assessment. ⁴

table 1

VDA efficiency (%)	Credit (g/mile)
67	0.0
68	0.2
69	0.3
70	0.5
71	0.6
72	0.8
73	1.0
74	1.1
75	1.3
76	1.4
77	1.6
78	1.8
79	1.9
80	2.1
81	2.2

The credit calculation method uses a 68% minimum credit threshold VDA according to the EU Technical Guidelines on Eco-Innovation⁶ and EPA's own rulemaking document^{4,5}. Based on the VDA efficiency of the high-efficiency alternator, the effects can be calculated scalably by using the above credit table.

Approving GHG credit values using this table gives the flexibility to implement different supplier alternators with different VDA values without having to create a separate credit request for each component.

5.Durability

The high efficiency alternator technology used by SUBARU has the same durability requirements as other full life components in SUBARU vehicles. Suppliers of high-efficiency alternator technology must demonstrate that the components meet the durability specified in SUBARU and SUBARU uses only alternators that have passed all durability and aging requirements.

SUBARU proves that these high efficiency alternators are expected to meet EPA requirements for in-service-durability over the life of the vehicle on which they are installed. These components are not subject to the reductions associated with deteriorating GHG benefits.

6. Conclusion

Based on

- 40 CFR 86.1869-12 requirements,
- Data, analysis, and information contained in this document,
- EPA's previous approval of similar requirements by Ford Motor Company,
- EPA's previous approval of the request by Toyota Motor Corporation
- EPA survey results and EPA docket submission materials.

SUBARU requests approval for the following items:

- Credit calculation using 67% VDA as industry average baseline alternator efficiency.
- Grant of an off-cycle greenhouse gas credit value of 0.16 grams / mile of CO₂ per 1% efficiency improvement to high efficiency alternators at all 68% VDA efficiency levels since 2017 MY.

References

1. Verband der Automobilindustrie efficiency, the internationally accepted industry standard for measuring alternator efficiency.
2. "EPA Decision Document: Off-Cycle Credits for BMW Group, Ford Motor Company, and Hyundai Motor Company" EPA-420-R-17-010, December 2017
3. "EPA Decision Document: Off-Cycle Credits for Fiat Automobiles and Toyota Motor Corporation" EPA-420-R-18-015, June 2018
4. EPA-OTAQ memorandum to docket EPA-HQ-OAR-2018-0283 entitled "Potential Off-Cycle Credit Levels for High Efficiency Alternators..." dated August 1, 2018.
5. Joint Technical Support Document: Final Rulemaking for 2017-2025 Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards Page 5-66, EPA-420-R-12-901, August 2012
6. European Commission Implementing Decision (EU) 2016/588, April 14, 2016
7. "Toyota Motor Corporation Application for High Efficiency Alternator Off-Cycle GHG Credit", EPA-HQOAR-2018-0168-002, September 22, 2017
8. "Ford Motor Company Application for High-Efficiency Alternator Off-Cycle GHG Credit", EPA-HQ-OAR-2017-0189-006, June 21, 2016
9. See "EPA Decision Document: Off-Cycle Credits for General Motors and Toyota Motor Corporation," EPA-420-R-18-014, June 2018; "EPA Decision Document: Off-Cycle Credits for Fiat Chrysler Automobiles and Toyota Motor Corporation," EPA-420-R-18-015, June 2018; "EPA Decision Document: Off-Cycle Credits for BMW Group, Ford Motor Company, and Hyundai Motor Company," EPA-420-R-17-010, Dec. 2017; "EPA Decision Document: Off-Cycle Credits for American Honda Motor Company, Ford Motor Company, and Nissan North America, Inc." EPA-420-R-20-007, April 2020.