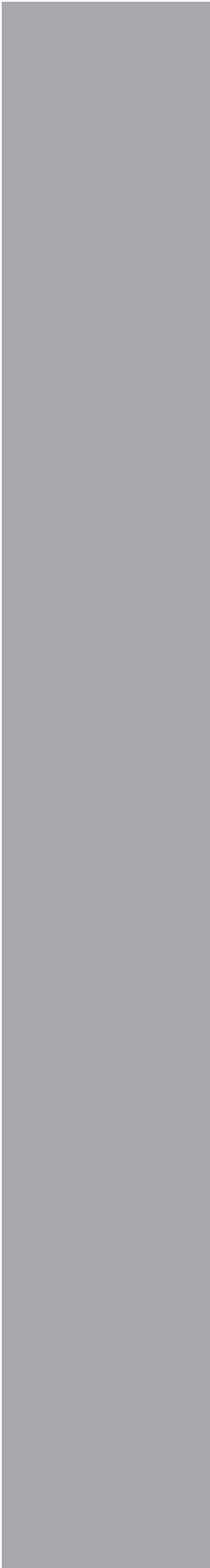


EPA Decision Document:

**Off-Cycle Credits for General Motors
and Toyota Motor Corporation**



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Compliance Division
Office of Transportation and Air Quality
U.S. Environmental Protection Agency

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I. Introduction

EPA's light-duty vehicle greenhouse gas (GHG) rules include opportunities for manufacturers to generate CO₂ credits for technologies that provide CO₂ reductions not captured by the 2-cycle emissions test. There are three pathways by which manufacturers can generate off-cycle credits: (1) a pre-determined "menu" of technologies and credits that is available for 2014 and later model years, (2) a testing based option, and (3) an alternative methodology proposed by the manufacturer that includes opportunity for public comment. These are described in more detail in Section II. Pursuant to those rules, General Motors (GM) and Toyota Motor Corporation (Toyota) submitted applications requesting off-cycle credits for a several technologies and model years.

This decision document evaluates demonstrations for credits made using the public process pathway. GM applied for credits from high-efficiency alternators. EPA requested comment on a similar application from Ford Motor Company in June of 2017,¹ and subsequently approved those credits in December of 2017.² Toyota applied for credits for the Denso air conditioning compressor with variable crankcase suction valve technology. EPA requested comment on a similar application from General Motors (GM) for credits from the Denso device in June of 2015,³ and subsequently approved those credits in September of that year.⁴

EPA published a notice in the *Federal Register* on February 26, 2018 announcing a 30-day public comment period for these applications.⁵ EPA received comments from the Alliance of Automobile Manufacturers (AAM),⁶ Global Automakers,⁷ the Motor & Equipment Manufacturers Association (MEMA), Denso International America, Gentherm Inc., The ITB Group, Valeo North America, and The International Council on Clean Transportation (ICCT).

Section II of this document provides background on EPA's off-cycle credits program. Section III provides EPA's decision. This decision document applies only to the applications referenced herein.

¹ 80 FR 31598, June 3, 2015.

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 80 FR 31598, June 3, 2015.

⁴ "EPA Decision Document: Off-cycle Credits for Fiat Chrysler Automobiles, Ford Motor Company, and General Motors Corporation," EPA-420-R-15-014, September 2015.

⁵ 83 FR 8262, February 26, 2018.

⁶ The Alliance of Automobile Manufacturers is a trade group representing 12 vehicle manufacturers, including BMW and Ford.

⁷ Global Automakers is a trade group representing 12 vehicle manufacturers, including Hyundai.

II. EPA's Off-cycle Credits Program

EPA's light-duty vehicle greenhouse gas (GHG) program provides three pathways by which a manufacturer may accrue off-cycle carbon dioxide (CO₂) credits for those off-cycle technologies that achieve CO₂ reductions in the real world but where those reductions are not adequately captured on the test procedure used to determine compliance with the CO₂ standards. The first is a predetermined list of credit values for specific off-cycle technologies that may be used beginning in model year 2014.⁸ This pathway allows manufacturers to use conservative credit values established by EPA for a wide range of technologies, with minimal data submittal or testing requirements. In cases where additional laboratory testing can demonstrate emission benefits of an off-cycle technology, a second pathway allows manufacturers to use a broader array of emission tests (known as "5-cycle" testing because the methodology uses five different testing procedures) to demonstrate and justify off-cycle CO₂ credits.⁹ The additional emission tests allow emission benefits to be demonstrated over some elements of real-world driving not captured by the GHG compliance tests, including high speeds, hard accelerations, and cold temperatures. Credits determined according to this methodology do not undergo additional public review. The third and last pathway allows manufacturers to seek EPA approval to use an alternative methodology that they propose for determining the off-cycle CO₂ credits.¹⁰ This option is only available if the benefit of the off-cycle technology cannot be adequately demonstrated using the 5-cycle methodology. Manufacturers may also use this option for model years prior to 2014 to demonstrate off-cycle CO₂ reductions for technologies that are on the predetermined list, or to demonstrate reductions that exceed those available via use of the predetermined list.

Under the regulations, a manufacturer seeking to demonstrate off-cycle credits with an alternative methodology (i.e., under the third pathway described above) must describe a methodology that meets the following criteria:

- Use modeling, on-road testing, on-road data collection, or other approved analytical or engineering methods;
- Be robust, verifiable, and capable of demonstrating the real-world emissions benefit with strong statistical significance;
- Result in a demonstration of baseline and controlled emissions over a wide range of driving conditions and number of vehicles such that issues of data uncertainty are minimized;
- Result in data on a model type basis unless the manufacturer demonstrates that another basis is appropriate and adequate.

⁸ 40 CFR 86.1869-12(b).

⁹ 40 CFR 86.1869-12(c).

¹⁰ 40 CFR 86.1869-12(d).

Further, the regulations specify the following requirements regarding an application for off-cycle CO₂ credits using an alternative methodology:

- A manufacturer requesting off-cycle credits must develop a methodology for demonstrating and determining the benefit of the off-cycle technology, and carry out any necessary testing and analysis required to support that methodology.
- A manufacturer requesting off-cycle credits must conduct testing and/or prepare engineering analyses that demonstrate the in-use durability of the technology for the full useful life of the vehicle.
- The application must contain a detailed description of the off-cycle technology and how it functions to reduce CO₂ emissions under conditions not represented on the compliance tests.
- The application must contain a list of the vehicle model(s) which will be equipped with the technology.
- The application must contain a detailed description of the test vehicles selected and an engineering analysis that supports the selection of those vehicles for testing.
- The application must contain all testing and/or simulation data required under the regulations, plus any other data the manufacturer has considered in the analysis.

Finally, the alternative methodology must be approved by EPA prior to the manufacturer using it to generate credits. As part of the review process defined by regulation, the alternative methodology submitted to EPA for consideration must be made available for public comment.¹¹ EPA will consider public comments as part of its final decision to approve or deny the request for off-cycle credits.

Although these credits are requested under regulatory provisions that don't explicitly require limitations, or caps, on credit values, EPA is stipulating here that credits for technologies for which there is a regulatory cap must be held to the applicable regulatory cap, if such credits are approved by EPA. For example, for reasons described in the implementing rulemaking documents and analyses, EPA established caps on thermal technology credits of 3.0 grams/mile for cars and 4.3 grams/mile for trucks. The rationale for these caps is applicable regardless of the off-cycle pathway being used to achieve such credits. Thus, credits approved in this Decision Document are being approved only to the extent that the regulatory caps on credits for certain technologies or categories of technologies are not exceeded.

III. EPA Decisions on Off-cycle Credit Applications

A. General Motors Corporation

1. High-Efficiency Alternator

General Motors Corporation (GM) requested GHG credits for alternators with improved efficiency relative to a baseline alternator, for the 2010 to 2016 model years. Automotive alternators convert

¹¹ 40 CFR 86.1869-12(d)(2).

mechanical energy from a combustion engine into electrical energy that can be used to power a vehicle's electrical systems. Alternators inherently place a load on the engine, which results in increased fuel consumption and CO₂ emissions. High efficiency alternators use new technologies to reduce the overall load on the engine yet continue to meet the electrical demands of the vehicle systems, resulting in lower fuel consumption and lower CO₂ emissions. GM proposed a methodology that would scale credits based on the efficiency of the alternator (as measured using an accepted industry standard procedure). This is essentially the same methodology approved by EPA for Ford Motor Company in December of 2017.¹² Details of the testing and analysis can be found in the manufacturer's application. EPA reviewed the application for completeness and made it available for public review and comment as required by the regulations. The GM off-cycle credit application (with confidential business information redacted) is available in the public docket and on EPA's web site.

EPA did not receive any adverse comments on the application from GM. EPA has evaluated the application and finds that the methodologies described therein are sound and appropriate. Therefore, EPA is approving the credits requested by GM for the 2010 to 2016 model years for all GM vehicles using this technology as described in GM's application. These credits must be reported to EPA not later than May 1, 2019, the date on which reporting of GHG credits for the 2018 model year is due. GM must include all information necessary to determine the total Megagrams of credits, and they should also include the total Megagrams for each fleet and model year in a summary of credit averaging, banking, and trading.

2. Active Climate Control Seats

GM requested GHG credits for the use of active climate control seat technologies, for the 2010-2016 model years. This request is for a larger amount of credit than could be earned by these designs using the pre-defined regulatory "menu" of default off-cycle credits for ventilated seats (1.0 and 1.3 grams/mile for cars and trucks, respectively). The technology used by GM uses a combination of ventilation fans and cooling devices. Active cooling to the seat back is provided by the installation of thermoelectric devices (TED) and a blower which provides positive, temperature controlled airflow pushed towards the occupant. The seat cushion also features a blower operating in a pull mode, drawing the air surrounding the occupant into the seat cushion. The foams in both seating surfaces include a textile spacer fabric that facilitates lateral airflow under occupant load. The seat covers are made of cloth and backed by an additional layer of textile spacer fabric to promote airflow to the occupant.

GM performed a series of simulations on three vehicle platforms. The analysis also accounted for emissions associated with the power consumption of the ventilated seat technology. Based on GM's

¹² "EPA Decision Document: Off-cycle Credits for BMW Group, Ford Motor Company, and Hyundai Motor Company," EPA-420-R-17-010, December 2017.

analysis, they are requesting credits equal to 2.3 grams per mile for passenger cars and 2.9 grams per mile for trucks on all models that use these seats in both front seating locations.

EPA did not receive any adverse comments on the application from GM. EPA has evaluated the application and finds that the methodologies described therein are sound and appropriate. Therefore, EPA is approving the credits requested by GM for the 2010 to 2016 model years for all GM vehicles using this technology as described in GM's application. These credits must be reported to EPA not later than May 1, 2019, the date on which reporting of GHG credits for the 2018 model year is due. GM must include all information necessary to determine the total Megagrams of credits, and they should also include the total Megagrams for each fleet and model year in a summary of credit averaging, banking, and trading.

B. Toyota Motor North American

1. Denso Air-Conditioning Compressor

Toyota Motor North America (Toyota) applied for off-cycle credits for an air conditioning compressor manufactured by Denso that has been shown to result in efficiency improvements warranting air conditioning efficiency credits beyond those provided in the regulations. This compressor, known as the Denso SAS compressor, improves the internal valve system within the variable-displacement compressor to reduce the internal refrigerant flow necessary throughout the range of displacements that the compressor may use during its operating cycle. The addition of a variable crankcase suction valve allows a larger mass flow under maximum capacity and compressor start-up conditions (when high flow is ideal), and then it can reduce to smaller openings with reduced mass flow in mid- or low-capacity conditions. The refrigerant exiting the crankcase is thus optimized across the range of operating conditions, reducing the overall energy consumption of the air conditioning system. EPA previously approved credits for the use of the Denso SAS compressor for BMW, Ford, GM and Hyundai.^{13 14}

The credits calculated by Toyota for the Denso SAS compressor would be in addition to the credits for variable-displacement A/C compressors already allowed under EPA regulations. However, it is important to note that EPA regulations place a limit on the cumulative credits that can be claimed for improving the efficiency of A/C systems. The rationale for this limit is that the additional fuel consumption of A/C systems can never be reduced to zero, and the limits established by regulation reflect the maximum possible reduction in fuel consumption projected by EPA. These limits, or caps, on credits for A/C efficiency, must also be applied to A/C efficiency credits granted under the off-cycle credit approval process. In other words, cumulative A/C efficiency credits for an A/C system – from the

¹³ “EPA Decision Document: Off-cycle Credits for Fiat Chrysler Automobiles, Ford Motor Company, and General Motors Corporation.” Compliance Division, Office of Transportation and Air Quality, U.S. Environmental Protection Agency. EPA-420-R-15-014, September 2015.

¹⁴ “EPA Decision Document: Off-cycle Credits for BMW Group, Ford Motor Company, and Hyundai Motor Company,” EPA-420-R-17-010, December 2017.

A/C efficiency regulations and those granted via the off-cycle regulations – must comply with the stated limits.

Toyota requested an off-cycle GHG credit of 1.1 grams CO₂ per mile for the Denso SAS compressor (the same as has been approved for some other manufacturers). Toyota cited the bench test modeling analysis referenced in the original GM application, which demonstrated a benefit of 1.1 grams/mile. Like other manufacturers, Toyota also ran vehicle tests using the AC17 test. Six tests were conducted on a Toyota Corolla, resulting in a calculated benefit of 1.4 grams/mile, thus substantiating the bench test results. Based on these results, Toyota requested a credit of 1.1 grams/mile for all Toyota vehicles equipped with the Denso SAS compressor with variable crankcase suction valve technology, starting with 2013 model year vehicles. Details of the testing and analysis can be found in the manufacturer's application. EPA reviewed the application for completeness and made it available for public review and comment as required by the regulations. The Toyota off-cycle credit application (with confidential business information redacted) is available in the public docket and on EPA's web site.

EPA did not receive any adverse comments on the application from Toyota. EPA has evaluated the application and finds that the methodologies described therein are sound and appropriate. Therefore, EPA is approving the credits requested by Toyota for the 2013 and later model years for all Toyota vehicles using this technology as described in Toyota's application. Caps or limits on credits that are specified in the regulations also apply to the credits being approved in this document. Credits for the 2013-2017 model years must be reported to EPA not later than May 1, 2019, the date on which reporting of GHG credits for the 2018 model year is due. Toyota must include all information necessary to determine the total Megagrams of credits, and they should also include the total Megagrams for each fleet and model year in a summary of credit averaging, banking, and trading.