EPA Decision Document: Off-Cycle Credits for Toyota Motor North America

United States Environmental Protection Agency

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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 CO_2 credits for technologies that provide CO_2 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 5-cycle test option, and (3) an alternative methodology that includes opportunity for public comment. These are described in more detail in Section II.

Toyota Motor North America, Inc. (Toyota) submitted an application requesting off-cycle credits for use of their Dual-Layer HVAC technology. EPA published a notice in the *Federal Register* on April 1, 2020, announcing a 30-day public comment period for the Dual-Layer HVAC application.[1]

EPA received no adverse comments regarding the methodology presented for determining the credits sought from this technology by Toyota, and is hereby approving the technology, methodology for determining the credit value, and credit value as described in the application from Toyota and in the *Federal Register*.

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 application referenced herein.

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 (CO_2) credits for those off-cycle technologies that achieve CO_2 reductions in the real world but where those reductions are not adequately captured on the test procedure used to determine compliance with the CO_2 standards. The first is a predetermined list of credit values for specific off-cycle technologies that may be used beginning in model year 2014.[2] 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

[1] 85 FR 18227, April 1, 2020.
[2] See 40 CFR 86.1869-12(b).

methodology uses five different testing procedures) to demonstrate and justify off-cycle CO_2 credits.[3] 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 for determining the off-cycle CO_2 credits.[4] 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 CO_2 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.

Further, the regulations specify the following requirements regarding an application for off-cycle CO_2 credits:

- 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 CO_2 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.

[3] See 40 CFR 86.1869-12(c).
[4] See 40 CFR 86.1869-12(d).

- 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.[5] 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. EPA also established caps on technologies that improve the efficiency of air conditioning systems (5 grams/mile for cars and 7.2 grams per mile for trucks). 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 Decision on Off-cycle Credit Application

A. Dual-Layer HVAC

Toyota applied for off-cycle credits using the alternative demonstration methodology pathway for the Dual-Layer HVAC technology. Ventilation and heat transfer losses between the cabin and outside ambient are the key HVAC thermal losses during vehicle warmup. Ventilation losses can be reduced by recirculating the cabin air, but this has the adverse effect of building up cabin humidity, which can then become a safety hazard due to increased windshield fogging. Dual-layer HVAC uses two separate "layers" of airflow within the vehicle and a two-stage fan that can recirculate air through the lower outlets while flowing fresh, low humidity air through the upper ducts (includes the windshield defroster). The module has a door that selects full fresh, full recirculate, or dual-layer mode based on logic parameters. Low humidity air is needed to better defog the windshield and recirculated air improves warmup performance. With the use of recirculated air less engine heat is needed to warm the cabin, and both the cabin and the engine warmup faster. Faster engine warmup improves vehicle efficiency.

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 at

[5] See 40 CFR 86.1869-12(d)(2).

https://www.epa.gov/ve-certification/toyota-motor-north-america-compliance-materials-light-duty-greenhouse-gas-ghg.

EPA did not receive any adverse comments on Toyota's application. EPA received comments from the Alliance of Automotive Innovators that were supportive and recommended timely approval of the methodology for determining off-cycle credits for Toyota's Dual-Layer HVAC technology. Denso also commented on the Toyota Dual-Layer HVAC technology application. Denso recommended EPA approve the off-cycle credit request for the Dual-Layer HVAC technology. EPA also received comments from the Motor and Equipment Manufacturers Association (MEMA). MEMA did not take a position on whether the Dual-Layer HVAC petition should be approved.

EPA staff met numerous times with Toyota staff to discuss the modeling approach, data utilized to generate the model results, and differences between the modeled CO_2 values and the gravimetric fuel consumption results measured during the testing performed to generate the model inputs. The Agency raised concerns with Toyota regarding the differences between the modeled CO_2 results and the gravimetric fuel consumption measurements observed when testing the vehicle to generate the inputs for the model. Toyota addressed the concerns raised by the Agency by performing additional testing which specifically addressed the concerns raised by Agency staff. The additional test results showed reductions in fuel consumption values consistent with the modeled output.

EPA has evaluated the application and finds that the methodologies described therein are sound and appropriate. Therefore, EPA is approving the Dual-Layer HVAC credit application requested by Toyota for the 2016 and later model years. Caps or limits on credits that are specified in the regulations also apply to the credits being approved in this document, as discussed above. As the function of the Dual-Layer HVAC technology is to improve the warm-up performance of the vehicle under cold ambient conditions the A/C efficiency cap does not apply to this technology. All information necessary to determine the total Megagrams of credits must be included in the reporting to EPA, and the total Megagrams for each fleet and model year should be included in a summary of credit averaging, banking, and trading.