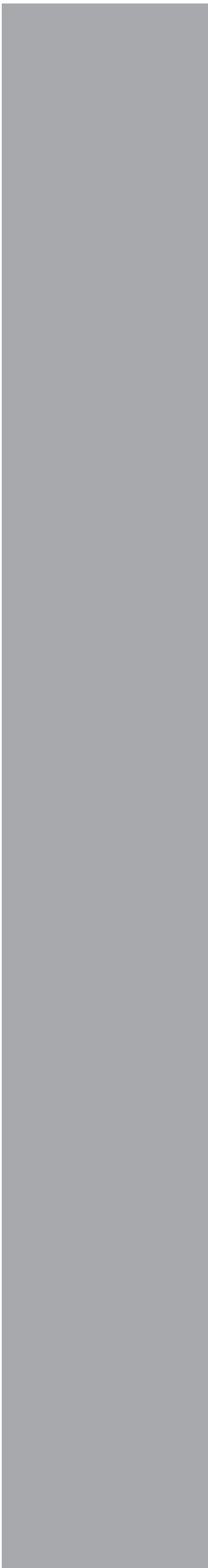


**EPA Decision Document:**  
**Off-Cycle Credits for Toyota Motor  
North America**

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

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

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

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## I. Introduction

EPA's light-duty vehicle greenhouse gas (GHG) rules include opportunities for manufacturers to generate CO<sub>2</sub> credits for technologies that provide CO<sub>2</sub> 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 that includes opportunity for public comment. These are described in more detail in Section II.

Pursuant to those rules, Toyota Motor North America, Inc. (Toyota) submitted applications requesting off-cycle credits for an occupant-based, targeted cooling system (the "S-Flow" system), which reduces the thermal load on the air conditioning system through targeted cooling of only the occupied cabin areas, and for a pulse width modulated brushless motor power controller used in the HVAC system, which improves the efficiency of the HVAC system. The application covers 2013 and later model year vehicles.

EPA published a notice in the *Federal Register* on June 20, 2019 announcing a 30-day public comment period for these applications.<sup>1</sup> EPA received no adverse comments regarding the methodologies presented for determining the credits sought from these technologies by Toyota, and is hereby approving the technologies, methodologies for determining credits, and credit levels as described in the applications 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 applications 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<sub>2</sub>) credits for those off-cycle technologies that achieve CO<sub>2</sub> reductions in the real world but where those reductions are not adequately captured on the test procedure used to determine compliance with the CO<sub>2</sub> standards. The first is a predetermined list of credit values for specific off-cycle technologies that may be used beginning in model year 2014.<sup>2</sup> This pathway allows manufacturers to use conservative credit values established by EPA for a wide range of

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<sup>1</sup> 84 FR 28811, June 20, 2019.

<sup>2</sup> See 40 CFR 86.1869-12(b).

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 CO<sub>2</sub> credits.<sup>3</sup> 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<sub>2</sub> credits.<sup>4</sup> 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<sub>2</sub> 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<sub>2</sub> 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<sub>2</sub> emissions under conditions not represented on the compliance tests.

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<sup>3</sup> See 40 CFR 86.1869-12(c).

<sup>4</sup> See 40 CFR 86.1869-12(d).

- 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.<sup>5</sup> 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 Decisions on Off-cycle Credit Applications**

#### **Toyota Motor North America**

Toyota Motor North America, Inc. (Toyota) applied for off-cycle credits using the alternative demonstration methodology pathway for an occupant-based, targeted cooling system (the "S-Flow" system), which reduces the thermal load on the air conditioning system through targeted cooling of only the occupied cabin areas, and for a pulse width modulated brushless motor power controller used in the HVAC system, which improves the efficiency of the HVAC system. The application covers 2013 and later model year vehicles.

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

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<sup>5</sup> See 40 CFR 86.1869-12(d)(2).

EPA did not receive any adverse comments on the application from Toyota. EPA received comments from the Alliance of Automobile Manufacturers (AAM) that were supportive and recommended timely approval of the methodologies for determining off-cycle credits.<sup>6</sup> AAM also recommended that these technologies not be subject to the cap on air conditioning credits in the regulations or under the existing cap for thermal load reduction technologies. AAM advanced several arguments for why the S-Flow system should not be categorized as a thermal load reduction technology. These comments and EPA's responses are shown below.

**S-FLOW does not reduce the cooling load in the cabin (as do thermal load reduction technologies). It simply selects the area that needs to be cooled and supplies the amount of cooling needed for the selected area.**

EPA understands the point that the S-Flow system isn't reducing the amount of heat in or entering the cabin (such as paint or glass technologies), but it doesn't follow from this that it is not a thermal load reduction technology. Ventilated seats are categorized as a thermal load reduction technology, and EPA sees the S-Flow system as generally similar, in that both reduce the thermal load on the air conditioning system.

**S-FLOW is a GHG and energy saving technology even if all thermal load reduction technologies are additionally included on a vehicle.**

The same argument could be made for several – maybe all – of the technologies in the thermal load reduction category, and, applied in such a way, is nonsensical. Whether this statement is true or not, it is not a reasonable argument for excluding something from being categorized as a thermal load reduction technology.

**S-FLOW is not related to any of the predefined technologies eligible for air conditioning efficiency technology credits. The technology reduces the duty cycle of the air conditioning system, it does not improve the operating efficiency of an individual component of the system.**

EPA does not disagree with these statements and is not categorizing the S-Flow system as an air conditioning efficiency technology subject to the caps applicable to such technologies. Rather, EPA believes that the S-Flow system is appropriately categorized as a thermal load reduction technology.

**S-FLOW technology is not related to any of the predefined off-cycle technologies eligible for credit under 40 C.F.R. § 86.1869-12(b).**

EPA finds that the phrase "is not related to" is ambiguous, and likely incorrect. Toyota's application itself likens the technology, and its GHG reduction impact, to "existing off-cycle

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<sup>6</sup> The Alliance of Automobile Manufacturers is a trade group representing 12 vehicle manufacturers, including BMW, Ford, GM, and VW,

menu credits like active or passive cabin ventilation.” Further, Toyota’s application recognizes that S-Flow is a thermal load reduction technology, contrary to the position advanced by AAM.<sup>7</sup>

EPA disagrees with the suggestion that these technologies should not be subject to existing regulatory caps. Thermal control technologies are all predicated on achieving one thing: reducing the amount of work that has to be done by the air conditioning system, generally by reducing the heat transfer into the vehicle (glass and paint technologies), by moving heated air out of the vehicle (active or passive ventilation), or by targeting cooling to occupants so the A/C system doesn’t need to cool the entirety of the vehicle interior (seat ventilation). These methods and technologies noted above are classified by EPA regulations as thermal control technologies, and credits from this group are capped at 3 grams/mile for cars and 4.3 grams/mile for trucks. EPA finds that Toyota’s S-Flow system is likewise a thermal control technology that must be subject to these caps, applied on a per-vehicle basis. The S-Flow system is much like seat ventilation (which is subject to the regulatory caps) in that both apply targeted air flow to cool occupants in a more direct fashion than broadly cooling the whole vehicle interior.

EPA also disagrees with AAM that the BLM technology should not be subject to regulatory caps and finds that AAM’s arguments are without merit. Toyota’s application describes the credits appropriately: “For time when the AC is “ON” the AC cap should be applied to the AC usage portion of the total saving.” AAM presented five reasons for why BLM technology should be viewed as a unique off-cycle technology not subject to any caps. These comments and EPA’s responses are shown below.

**“BLM technology reduces the amount of power used to produce airflow in the HVAC unit, resulting in reduced electrical energy requirements that are similar in nature to what EPA already approved with the high efficiency alternator applications.”**

Suggesting that similarity to another technology that is not capped has the effect of removing the need to apply a cap is, in EPA’s view, a misplaced argument. There is a difference between making electricity more efficiently (an alternator) and using electricity more efficiently (a fan).

**“BLM technology is an electrical efficiency improvement in addition to the predefined air conditioning efficiency technology ‘Blower motor controls which limit wasted electrical energy’ and uses a blower motor control which is more efficient than a PWM control.”**

It’s not clear to EPA what AAM’s intent is with this remark, other than to say that BLM improves the efficiency of the A/C system beyond the technologies listed in the A/C credit “menu. EPA does not disagree with this statement.

**“BLM technology is not limited to only the HVAC system; it is an option wherever brushed motors are used such as in engine cooling fans.”**

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<sup>7</sup> “This thermal load reduction technology...” and “This technology reduces the thermal load...”, Toyota Motor Corporation, “Request for GHG Off-Cycle Credit for Energy Saving Air Flow Control System (S-FLOW) HVAC Technology,” February 26, 2019, p. 1.

This may be true, but Toyota applied for credits using the technology as an element that is integral to the HVAC system. Thus, consideration of benefits outside the HVAC system, such as for engine cooling fans, is outside the scope of both the application and this Decision Document.

**“BLM technology offers real world energy savings and GHG improvements independent of HVAC system operation.”**

As in the above statement, Toyota’s application is specific to HVAC system operation, thus, in the context of the Toyota application and this Decision Document, this comment is not relevant.

**“BLM technology is not related to any of the predefined off-cycle technologies eligible for credit under 40 C.F.R. § 86.1869-12(b).”**

EPA generally agrees with this statement but finds that this does not offer a valid rationale to exclude BLM technology from regulatory caps. As the application acknowledges, BLM technology is related to predefined air conditioning efficiency credits, and it is the cap on these credits that EPA is requiring be applied to the BLM technology credits for A/C operation. Further, although EPA regulations use separate sections in the regulations for A/C efficiency and off-cycle credits, A/C efficiency credits are, in fact, a category of off-cycle credits, and closely related to some of the technologies described in the off-cycle credit regulations (e.g., the thermal technology category).

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. Caps or limits on credits that are specified in the regulations also apply to the credits being approved in this document, as discussed above. Specifically, the S-Flow technology is found to be a thermal load reduction technology that must be subject to the applicable regulatory caps for such technologies (3 grams/mile per vehicle for cars and 4.3 grams/mile per vehicle for trucks), and the BLM technology is found to be an air conditioning efficiency technology and must be subject to the applicable regulatory caps for credits claimed for A/C operation (5.7 grams/mile per vehicle through model year 2016, and 5 grams/mile for cars and 7.2 grams/mile for trucks for later model years). As described in the application, BLM technology credits for period when the A/C is not operating shall not be subject to any regulatory caps. 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.