

**EPA Decision Document:**  
**Off-Cycle Credits for Nissan North  
America, Inc.**



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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<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, Nissan North America, Inc. ("Nissan") submitted applications requesting off-cycle credits for two types of air conditioning compressor technologies. The application covers 2017 and later model year vehicles.

EPA published a notice in the *Federal Register* on November 12, 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 Nissan, and is hereby approving the technologies, methodologies for determining credits, and credit levels as described in the applications from Nissan 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 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

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<sup>1</sup> 84 FR 61053, Nov. 12, 2019.

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

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 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.
- 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.

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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 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**

#### **A. Denso Air-Conditioning Compressor**

Nissan 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 initially approved credits for General Motors (GM) for the use of the Denso SAS compressor, and has since approved requests for several additional manufacturers.<sup>6</sup>

The credits calculated by Nissan for the Denso SAS compressor would be in addition to the credits of 1.7 grams/mile for variable-displacement A/C compressors already allowed under EPA regulations.

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

<sup>6</sup> "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.

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

Nissan requested an off-cycle GHG credit of 1.1 grams CO<sub>2</sub> per mile for the Denso SAS compressor (the same as was approved for GM in 2015). Nissan cited the bench test modeling analysis referenced in the original GM application, which demonstrated a benefit of 1.1 grams/mile. Like other manufacturers, Nissan also ran vehicle tests using the AC17 test to confirm the benefit of the Denso compressor. Based on these results, Nissan requested a credit of 1.1 grams/mile for all Nissan vehicles equipped with the Denso SAS compressor with variable crankcase suction valve technology, starting with 2017 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 Nissan 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 Nissan. EPA has evaluated the application and finds that the methodologies described therein are sound and appropriate. Therefore, EPA is approving the credits requested by Nissan for the 2017 and later model years for all Nissan vehicles using this technology. Caps or limits on credits that are specified in the regulations also apply to the credits being approved in this document. Credits for the 2017-2019 model years must be reported to EPA not later than May 1, 2020, the date on which reporting of GHG credits for the 2019 model year is due. Nissan must include all information necessary to determine the total Megagrams of credits in the reporting to EPA, and they should also include the total Megagrams for each fleet and model year in a summary of credit averaging, banking, and trading.

## **B. Off-Cycle GHG Credits for Calsonic Kansei A/C Compressor Incorporating Flowpath Resistance Reduction Technology**

Using the alternative methodology approach discussed above, Nissan applied for credits for an air conditioning compressor manufactured by Calsonic Kansei that results in air conditioning efficiency credits beyond those provided in the regulations. This request is for the 2018 and subsequent model years. This compressor (the “Calsonic Kansei CR-Phase 4 compressor”), improves the efficiency of the compressor by changing the contours of the refrigerant flow path, reducing the pressure loss and improving the efficiency relative to previous versions of the system.

The credits calculated by Nissan for the Calsonic Kansei CR-Phase 4 compressor would be in addition to the credits for air conditioning efficiency technologies 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 A/C efficiency regulations and those granted via the off-cycle regulations – must comply with the stated limits.

Nissan requested an off-cycle GHG credit of 1.1 grams CO<sub>2</sub> per mile for the Calsonic Kansei compressor. Nissan cited the bench test modeling analysis conducted by Calsonic Kansei, using the procedures contained in SAE standard J2765, which characterize a system's coefficient of performance. Nissan also ran six vehicle tests comparing compressors on the AC17 test protocol; these tests demonstrated a 1.7 gram/mile benefit. Finally, Calsonic Kansei used the LCCP model to estimate the benefits of the technology, and this modeling also supported a credit value of 1.1 grams/mile. The Nissan 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 Nissan. EPA has evaluated the application and finds that the methodologies described therein are sound and appropriate. Therefore, EPA is approving the credits requested by Nissan for the 2018 and later model years for all Nissan vehicles using this technology. Caps or limits on credits that are specified in the regulations also apply to the credits being approved in this document. Credits for the 2018-2019 model years must be reported to EPA not later than May 1, 2020, the date on which reporting of GHG credits for the 2019 model year is due. Nissan must include all information necessary to determine the total Megagrams of credits in the reporting to EPA, and they should also include the total Megagrams for each fleet and model year in a summary of credit averaging, banking, and trading.