

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

Nissan North America, Inc. (Nissan) submitted an application requesting off-cycle credits for use of their Low-Power-Consumption Compressor Clutch technology. EPA published a notice in the *Federal Register* on February 8, 2021, announcing a 30-day public comment period for the Low-Power-Compressor Clutch application.<sup>1</sup>

EPA received comments regarding the methodology used for determining the credits sought for this technology by Nissan. EPA's responses to the comments received can be found in Section III. EPA is approving the technology, the methodology for determining the credit value, and credit value as described in the updated application from Nissan published on EPA's Compliance Information for Light-Duty Greenhouse Gas (GHG) Standards, <https://www.epa.gov/ve-certification/nissan-motor-corporation-compliance-materials-light-duty-greenhouse-gas-ghg>.

Section II of this document provides background on EPA's off-cycle credits program. Section III provides EPA's decision and response to the comments received. 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<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> 86 FR 8631, February 8, 2021.

<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 Decision on Off-cycle Credit Application**

#### **A. Low-Power-Consumption Compressor Clutch**

Nissan applied for off-cycle credits using the alternative demonstration methodology pathway for their Low-Power-Compressor Clutch technology. The compressor clutch is an electro-mechanical device powered by the vehicle's electrical system which activates by applying current through a coil. When the air conditioning system commands cooling, the clutch is activated by energizing the coil. When energized, the coil causes a friction plate to connect the compressor drive belt pulley to the compressor shaft allowing torque to be transmitted from the serpentine belt of the engine to operate the compressor. The compressor then compresses the gas-phase refrigerant and pumps it through the air conditioning system. The Low-Power-Compressor Clutch reduces the load of the vehicle's electrical system during compressor operation.

EPA reviewed the application for completeness and made it available for public review and comment as required by the regulations. The initial Nissan off-cycle credit application (with confidential business information redacted) is available in the public docket and on EPA's web site at

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

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

EPA received comments from the Alliance for Automotive Innovation (the Alliance) and the Union of Concerned Scientists (UCS). The Alliance commented that Nissan's choice to perform an engineering analysis and modeling was appropriate for this technology. The Alliance also commented on the strengths and weaknesses of the AC17 test procedure and noted that it results in an estimate of the air conditioning system performance under a single set of ambient conditions. The Alliance also noted that the AC17 test is not intended for evaluating the impact of incremental changes to an A/C system like reducing the electrical load of the compressor clutch.

UCS commented that the Denso compressor should be considered as an efficiency improvement to the air-conditioning system, not as a credit under electrical load reduction and the A/C efficiency caps should apply to this technology. EPA concurs with UCS regarding this technology being an A/C efficiency technology and as noted in Section II above the A/C efficiency caps do apply to this technology.

UCS commented that the Agency has established the AC17 test procedure specifically to evaluate technologies which improve A/C efficiency and Nissan should use this test to determine the CO<sub>2</sub> benefit for the lower-power-consumption compressor clutch. The AC17 test was designed to evaluate changes to both the vehicle and the A/C system as manufacturers upgrade the efficiency of the vehicle cabin and the performance of the A/C system during major vehicle redesigns. The Agency concurs with the Alliance position that the AC17 test is not an appropriate test procedure to measure the GHG reduction of a 13-watt reduction in load due to improvements in the compressor clutch.

UCS commented that the high fraction of A/C compressor utilization as claimed by Nissan is significantly higher than the utilization found by EPA based on prior studies and is also higher than was assumed by EPA in the 2017 through 2025 rulemaking. EPA staff had similar concerns regarding compressor clutch utilization and requested Nissan provide additional data. Nissan proposed and gathered in-use compressor usage data from their Nissan Rogue and Maxima models with Auto A/C. The data from the Rogue and Maxima were used to determine A/C compressor clutch usage rates. The results of this data gathering determined the A/C compressor clutch operation was greater than the LCCP modelled data for Auto A/C systems.

Most vehicles now have automatic air conditioning systems where the owner sets the desired ambient temperature, and the vehicle controls the A/C operation as opposed to manual systems where the vehicle operator would manually turn on air conditioning. In addition, variable displacement A/C compressors are in use now and the compressor is set so that it provides the appropriate amount of cooling which does not result in the A/C clutch being turned off to maintain the appropriate temperature at the heat exchanger as was done with fixed displacement compressors. Both the adoption of automatic controls and the proliferation of variable displacement A/C compressors have led to increases in the time the A/C compressor is engaged compared to the technology in use when EPA surveyed A/C operation in Phoenix, Arizona in 1994.

UCS commented that the Nissan application, unless Nissan had noted in their pre-model year reports for prior model years, should be eligible for credits beginning in the 2020 model year. Prior to May 1, 2020, EPA had been allowing manufacturers to submit applications for retroactive alternative method off-cycle GHG requests. EPA ended the practice of accepting retroactive credit requests for all alternative method off-cycle GHG applications after May 1, 2020. Nissan submitted their initial application for the lower-power-consumption compressor clutch prior to the May 1, 2020, cut-off date and therefore the Agency has agreed to allow Nissan to claim credits starting in the 20217 MY for this technology.

EPA has evaluated the application and finds that the methodologies described therein are sound and appropriate. Therefore, EPA is approving the low-power-consumption compressor clutch off-cycle credit application requested by Nissan for the 2017 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 low-power-consumption compressor clutch is to improve the efficiency of the A/C system the A/C efficiency cap does 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.