ICCT Comments in Response to the Notice on Alternative Method for Calculating Off- Cycle Credits for Mercedes-Benz Vehicles Under the Light-Duty Greenhouse Gas Emissions Program. FRL-9901-57-OAR.

Docket ID No. EPA–HQ–OAR–2013–0643

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These comments are submitted by the **International Council on Clean Transportation (hereafter, "ICCT").** The ICCT is made up of leading government officials and experts from major countries and regions around the world who participate as individuals based on their experience with air quality and transportation issues. The ICCT promotes best practices and comprehensive solutions to improve vehicle emissions and efficiency, increase fuel quality and sustainability of alternative fuels, reduce pollution from the in-use fleet, and curtail emissions of local air pollutants and greenhouse gases (GHG) from international goods movement.

1. Main Points

How EPA responds to this request from Mercedes-Benz is extremely important, as it establishes a precedent for all subsequent manufacturer requests for off-cycle credits. It is extremely important for EPA to set the proper precedent - which includes making a clean separation between the methods EPA used to arrive at the default off-cycles and the methods allowed for manufacturers to request deviations from the default credits.

The nature of Mercedes-Benz's request will establish a system in which manufacturers will be allowed to cherry-pick the data and methods they want to use for each step in the process, maximizing the calculated credit with each step. Before granting this request, EPA needs to step back and think about the precedents they want to set.

There are two major guiding principles that need to be established. First, EPA needs to set a clear precedent that **any deviations from the default credits must be based upon the amount of operation actually experienced in-use**. In fact, this precedent already exists. EPA has default manual transmission shifts points and default testing requirements for driver-selectable devices. Manufacturers are required to submit data on actual in-use manual transmission shift points and actual in-use amount of operation in each driver-selectable mode, respectively, in order to use alternatives to these default values. The exact same principle needs to be applied to off-cycle credits. For example, in this case any additional stop/start credits should be granted to Mercedes-Benz only with the provision that they be validated with in-use data on actual stop/start operation and, if necessary, retroactively revised. Mercedes-Benz already gathered both engine rpm and vehicle speed data in their existing study. An identical followup study on vehicles with stop/start systems would allow the actual amount of stop/start operation calculate to be directly calculated. **Mercedes-Benz must be required to provide their best engineering estimate of their stop/start system operation and then validate it with actual in-use data,** instead of using the methodology EPA used for default credits in order to artificially

increase their credit**.**

The second guiding principle that needs to be established is whether or not to give "manufacturer specific" credits based upon a manufacturer's data and analysis that says "their products idle more", or some other traffic driven difference, rather than any differences in technology or how the technology is implemented. Granting additional credits for improvements in how technologies work in-use is clearly appropriate. However, **granting additional credits simply based upon where or how a manufacturer's products are used will set a highly undesirable precedent**. In-use usage is far more difficult to determine - and for EPA to monitor - than assessing how technologies work, opening the door to significant gaming of the system. It would also create differential impacts for the same technology between manufacturers, with highly undesirable competitive impacts. Finally, it opens the door to manufacturer demands for equal treatment. For example, manufacturers of pickup trucks may come to EPA demanding additional credits for their cylinder deactivation systems, simply because they are used primarily in rural areas and driven more on the highway. Or a manufacturer who sells their vehicles primarily in the southern states could ask for credits because their vehicles don't spend as much time warming up at cold temperatures.

The most significant factor in Mercedes' calculation of additional off-cycle credits for its start-stop system is the high percentage of idle time that Mercedes claims its vehicles experience. Mercedes' consultant states: "A careful analysis of the MB data demonstrates that this difference [high idle time] is the result of the highly urbanized location and operation of MB vehicles." It may be appropriate in certain circumstances for manufacturers to gain credit for actions they take to ensure that their vehicles are used, or fueled, in such a way as to reduce GHG emissions. In the present case, however, Mercedes offers no evidence that its vehicles have lower emissions as a result of the way they are used, instead claiming only that they idle more and therefore have more to gain from stop-start systems. **In fact, "highly urbanized location and operation" would result in increased GHG emissions for most vehicles**. **Offering off-cycle credits in this situation, where the vehicles will emit more GHG emissions in-use despite more idle-off operation, is clearly inappropriate.**

In the specific case of stop/start systems, extra credits should only be based on a system design that triggers the engine to shut off quicker and stay shut off longer during a typical idle period. Setting a precedent to allow credits simply for where a manufacturer's products are used will severely undermine the effectiveness and credibility of the standards.

Even if EPA decides to allow manufacturer-specific credits based upon differences in how their vehicles are used in-use, another concern specific to this case is that Mercedes-Benz solicited participants only from urban areas and only examined registration distributions across the country for their new vehicle purchasers. While adjustments for more rural customers may not be large in Mercedes-Benz's case, it is completely inappropriate to just ignore them.

Other problems with the Mercedes-Benz petition include:

- Mercedes-Benz's reported idle times are far higher than found in the SFTP study, the MOVES estimate, data collected for development of the WLTC, and the Fiat EcoDrive study.
- Mercedes-Benz did not define how they determined when "idle" was occurring.
- Mercedes-Benz ignored the need for air conditioning to cool down the vehicle cabin after soak periods.
- Mercedes-Benz used supplemental electric devices to maintain cabin heat and cooling and extend stop/start operation, but ignored the drain on the battery and the additional loads on the engine to recharge the battery.
- Mercedes-Benz's stop/start system can be deactivated simply by pushing a button. The amount of deactivation was demonstrated only by preliminary data from a small sample of vehicles in Europe and is highly unlikely to be representative of US market and drivers.

These points are addressed in more detail, below.

Finally, the methodology EPA used to generate the default off-cycle stop/start credit contains significant errors that overstate the amount of stop/start operation in the real world. These errors are also discussed in detail, below. Mercedes-Benz should be required to provide their best engineering judgment on the amount of stop/start enablement in-use, instead of cherry-picking parts of EPA's default methodology that artificially boost their credit.

EPA needs to establish precedents that off-cycle credits must be based upon (a) actual in-use operation and (b) differences in technology operation, not upon manufacturer-specific estimated differences in how their vehicles are used. If EPA decides to allow off-cycle credits based only on how vehicles are used, it needs to establish a precedent that **off-cycle credits must only be granted if overall GHG emissions are lower due to the in-use operation**.

In addition, in this particular case, (a) Mercedes-Benz must be required to submit their best engineering judgment of the amount of stop/start enablement in-use and agree to verify this with direct calculations of stop/start operation after the technology is in production; (b) Mercedes-Benz must be required to specify how they determined an idle period; (c) the fuel needed to recharge the battery pack must be accounted for; (d) operator disablement of the stop/start system must be based upon U.S. drivers and idle-off must be demonstrated to be the "predominant" mode before any credits are given; and (e) the amount of stop/start operation must use the default, industry-wide value of 13.76%, or at least be adjusted downward from Mercedes-Benz's calculation to account for the bias in the recruitment of participants.

2. Lack of data from vehicles in rural areas

Statements by Robert Crawford Rincon Ranch Consulting, [1]

> "Because the study vehicles were recruited from among the 100 top selling dealerships in the US, the sample is targeted (by design) to the metropolitan areas where the large majority of MB vehicles are sold and operated."
>
> "The section also considers the sample's representativeness with respect to urban traffic characteristics (traffic density and congestion, specifically) and shows that it is representative of where the fleet of MB vehicles is operated today."
>
> "With regard to the States not sampled by the Study, representing approximately one third of MB US sales, one can infer that the idle fraction cannot be much different from the idle fraction in the 8 States covered in the MB Study."
>
> "Additionally, MB is aware of no data that would indicate the idle time of their vehicles in the remaining States is materially different than in the eight states covered in the study."

It is clear that both Mercedes-Benz and their consultant only considered driving in metropolitan areas and ignored driving in rural areas. Further, they only considered the impact of "States not sampled by the Study" and ignored the impact of rural areas not included, both for states sampled and states not sampled by the study.

The data submitted by Mercedes-Benz indicates that the large majority of their vehicles are purchased in urban areas and, thus, the error from not including rural vehicles is not likely to be large - at least for new vehicles. But this does not mean that vehicles sold in rural areas should be ignored, as was done by Mercedes-Benz.

Further, the benefits of stop/start are not just on new vehicles, but will be accrued throughout their useful life. When resold to subsequent owners, do the vehicles remain almost entirely in urban areas, or do they spread out to more rural areas? Mercedes-Benz ignored this issue, which suggests that subsequent owners of Mercedes's vehicles may have lower stop/start usage rates.

3. Idle duration

MB calculated idle times that were substantially higher than idle times estimated from MOVES, calculated from the SFTP program, found during development of the Worldwide harmonized Light vehicles Test Cycle (WLTC), or calculated from the Fiat EcoDrive study.

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[1] STATISTICAL ASSESSMENT OF IDLE TIME FRACTION CALCULATION IN MERCEDES-BENZ VEHICLES

Note that the results of the SFTP program were misstated in the 2017-25 final TSD. The TSD stated that the SFTP program found 22% idle time. In reality, only vehicles recruited at the Baltimore-Exeter central I/M station, in downtown Baltimore, had idle rates this high. Idle rates from vehicles recruited from central I/M programs in Baltimore-Rossville, a suburban location, Spokane, and Atlanta all ranged from 17.4% to 18.3%.

	Baltimore - Exeter	Baltimore - Rossville	Spokane	Atlanta
Percent idle	23.9	18.3	17.9	17.4

Federal Test Procedure Review Project: Preliminary Technical Report May 1993. EPA 420-R-93-007

The idle rates reported by Mercedes-Benz, 23.6%, are almost exactly the same as for Baltimore-Exeter, which is a high population density location that is not representative of even suburban locations. Even the Baltimore-Rossville, Spokane, and Atlanta data are likely to significantly overstate the national average amount of idle time, as they are suburban locations that do not include much rural driving. This is supported by EPA's calculation of national average idle time of 13.76% from the MOVES model.

The new WLTC was designed on the basis of in-use driving databases provided by Europe, India, Japan, Korea and USA, which were combined into a Unified database.[2] A comparison between the Unified and the European database demonstrated a high level of correlation for the most important parameters, such as speed distribution, acceleration distribution, and speed*acceleration.[3] In all countries, a high share of urban driving means low speeds and high idle shares. Results include:

- The new WLTC-EU drive cycle proposed for Europe was validated using only European drive data and includes 13.4% idle at 46.5 km/h average speed.
- The Unified WLTC database average for all countries had idle times similar to the WLTC-EU drive cycle proposed for Europe.
- The 'Fiat Ecodrive' study was based on data from many European countries and resulted in 14.8% idle and 40.4 km/h speed average.
- For comparison, the average speed on the US cycles is 26.75 mph (harmonic average of city at 19.6 mph and highway at 48.3 mph, weighted 55/45), or 43 kph. Idle time at 43 kph would fall between the Unified, WLTC-EU, and EcoDrive results and, thus, would be between 13.4% and 14.8%.
- Idle fractions of more than 20% were found only very rarely in the Unified database, under very specific conditions.

The WLTC data and the Fiat Ecodrive data are very similar to the idle time estimated from

[2] http://bookshop.europa.eu/en/europe-centric-light-duty-test-cycle-and-differences-with-respect-to-the-wltp-cycle-pbLDNA25345/
https://www2.unece.org/wiki/pages/viewpage.action?pageId=2523179

[3] Steven, H., "Analysis of Fiat Ecodrive data". Presentation to the UNECE WLTP subgroup on the Development of the Harmonized driving Cycle (DHC), on behalf of the European Automobile Manufacturers' Association (ACEA) and Fiat AG. Sept 5th, 2013.

the MOVES data. The idle time reported by Mercedes-Benz is roughly 65% higher than any of these data sources and is roughly 30% higher than the idle time for only suburban areas found in the SFTP study. Given these substantial disparities, **EPA must investigate why Mercedes-Benz's reported idle times are so high**. As a minimum, **EPA must ask Mercedes-Benz how they defined an idle period**. No where in the public version of their request does Mercedes-Benz discuss or define how idle was determined. They do state that both vehicle speed and throttle position was monitored and reported. Did Mercedes-Benz include some non-zero speeds with a closed throttle in their calculation of idle time?

4. **AC cooldown.**

Mercedes-Benz only addressed the ability of the vehicle to maintain cool cabin temperatures over the FTP and when the cabin was already cool:

> "MB conducted an FTP test with an outside temperature of 95°F and an interior temperature of 72°F. The results indicate that the energy management system for all electronic components, including cooling fans and air recirculation, caused the stop-start system to operate 88% of the time under hot climate conditions compared to an FTP under normal test conditions."

Mercedes-Benz did not address the ability of the vehicle to maintain cool cabin temperatures in the real world (although they have the data to do this). More importantly, they did not address the issue of cabin heat up during vehicle soaks and the need to turn the engine on to operate the air conditioner to cool down the vehicle. Thus, their assessment that stop/start can engage 88% of the time at ambient temperatures above 80°F is grossly overstated. Again, Mercedes-Benz is cherry-picking methods, instead of simply presenting their in-use data on actual stop/start operation.

5. **Change in Battery SOC**

Mercedes-Benz is using supplemental electric devices to extend the range of idle-off operation, such as electric heater circulation pumps and cabin fans to maintain air flow during both heating and cooling with the engine off. This electric power consumption has to be replaced by charging during normal driving, with higher engine loads causing additional fuel consumption and CO2 emissions. This is improperly ignored by the credit system. **The stop/start credit must incorporate estimates of the additional fuel consumption and CO2 emissions to recharge the battery.**

6. **Operator Deactivation of Stop/Start System**

Mercedes-Benz's stop/start system allows the operation to deactivate the system simply by pressing a button. The amount of operation deactivation was demonstrated only using preliminary data from a European survey with a low number of vehicles tested. These results are highly unlikely to be representative for the US market and drivers, especially given recent reports of U.S. driver dissatisfaction with stop/start systems. **Mercedes-Benz must be required to monitor U.S. drivers, especially during the winter months, to**

properly account for the amount of operator deactivation.

In fact, given the extremely small sample size and lack of data on American drivers, the data is not sufficient to even determine that the idle-stop behavior is the predominant mode. According to the final rule, "*Off-cycle engine start-stop credits will only be allowed for a vehicle if the Administrator has made a determination under the testing and calculation provisions in 40 CFR Part 600 that engine start-stop is the predominant operating mode for that vehicle*" (77 FR 63172). So, even if Mercedes-Benz's calculations of stop/start enablement are correct it's not clear they should be allowed any credits, as the driver can disable the start-stop system and there is no reliable data to suggest they aren't doing so.

7. Problems with EPA Methodology for Determining Default Stop/Start Credits

There are a number of fundamental errors in the method EPA used to calculate the amount of in-use idle time that is eligible for stop/start operation. Following is a discussion of the various errors in the methodology. In support, **note that Mercedes-Benz did not provide their best engineering judgment of the amount of stop/start enablement and, instead, cherry-picked pieces of EPA's methodology.**

<u>Discussion of current EPA methodology</u>

- MOVES estimated idle time: 13.76%. This appears to be reasonable.
- 10.7% idle time on FTP/hwy was reduced to 10.0% eligible for stop/start operation, due to exclusion of first two idle periods before coolant reached 90% of max coolant temperature (324 seconds at 75°F). This is proper.
    - However, **similar exclusion of the in-use initial idle time was only done for ambient temperatures below 40°F. It is an error to exclude in-use starts for ambient temperatures above 40°F, as they need the same initial idle to bring the engine and catalyst to operating temperature as is needed on the FTP.**
    - **It is also an error to exclude starts above 80°F, as engine operation is needed to power the AC system and cool down the vehicle** (vehicles siting in the sun can easily exceed 120°F inside the cabin).
- The warmup time of 5-minutes used to exclude the first two idle periods from stop/start operation on the FTP at 75°F was also used for ambient temperatures below 40°F. **This is improper, as engine warmup times are much longer at colder temperatures.**
- Even at ambient temperatures below 40°F, the 5-minute warmup time (which is already too short) was only applied to trips of less than 5-minute duration. **The methodology implicitly assumes that stop/start operation can start immediately for trips of more than 5-minutes, even below 40°F.**
- In-use trip lengths are much shorter than the weighted FTP/highway results. **No adjustment was made for shorter in-use trip lengths in the EPA methodology,** which implicitly assumed in-use trip lengths would be the same as the FTP/highway.

The proper methodology is as follows:

- Temperature splits. EPA's analyses are fine, i.e.:
  - >80°F = 9.69% of VMT
  - 40°F-80°F = 68.75% of VMT
  - <40°F = 21.95% of VMT
- The 1993 EPA Preliminary Technical Report contains a detailed description of the number of seconds the vehicle was operated with an engine coolant temperature of less than 140°F at an ambient temperature of 75°F (average of all starts, cold, warm, and hot). This data should be used directly to assess the amount of time that stop/start cannot be engaged at 75°F due to engine warmup. Note that this approach is conservative, as 140°F is significantly less than the 90% of maximum coolant temperature that EPA used to determine stop/start disablement on the FTP.
  - **Average time to 140°F engine coolant per tip was 79.7 seconds.**
    - Preliminary Technical Report, Appendix E, Table E-1
  - **Average trip time was 12.03 minutes**
    - Preliminary Technical Report, Table 6-1
  - **Percent time at engine warmup < 140°F = 11.0%**
    - If <10 second and >990 second times to warm up engine coolant to 140°F are excluded, percent time at engine warmup < 140°F = **10.0%**
- Colder ambient temperature cools the engine faster during soak periods, plus it takes longer to warm up. Both increase the amount of time with cold coolant temperatures
  - Chapter 5 of the 1993 EPA Preliminary Technical report (and Figure 6-14) presents an equation for engine cooldown time. This was used to calculate the length of time it takes to cool down the engine to 140°F and 90°F for different ambient temperatures in the table below. Table D-1 in the Appendices to the report presents the proportion of starts after different amounts of soak time. These data, together, yield the following % of starts with engine coolant temperature below 140°F and 90°F:

Ambient temperature	Soak time (minutes) to engine coolant temp. of		Percentage of starts with coolant temp. below:	
	140°F	90°F	140°F	90°F
75°F	100	375	36%	21%
40°F	64	157	42%	30%
10°F	46	107	47%	35%

  - Even within the 40°F to 80°F temperature range, there are substantially more starts with cold engines than the 11% or 10% calculated in the previous step for 75°F ambient temperature. In addition, the table does not include the longer time it takes for the engine to warm up at colder ambient temperatures.
    - Given the additional engine warmup time between 40°F and 75°F and the longer engine warmup time, **a conservative assumption is to double the 10% stop/start disablement time for operation below 40°F ambient temperature.**
- Proportion of trips that need AC cooling.

    - For ambient temperatures above 70°F, engine operation will frequently be needed to cool off the cabin. This is true even after short soak periods where the engine is still warm, as the cabin will heat up quickly in the sun.
    - Some trips between 70°F and 80°F will need engine operation to cool down the cabin, due to sun load. Some trips above 80°F will not need immediate engine operation or will need just a brief amount of engine operation, if they occur after a short soak period and the vehicle is not parked in the sun.
    - **A reasonable assumption is that these factors are offsetting, i.e. all time above 80°F disables stop/start.**
- If the proportion of idle time changes with trip length, an appropriate adjustment needs to be made to the numerator to adjust for the much shorter average trip length in-use compared with the FTP.
    - Figure 6-16 in the 1993 EPA Preliminary Technical Report suggests that idle time for each of the first three 80-second phases of in-use driving is similar to the average idle time for driving after the first 240 seconds. Thus, it is reasonable to assume that idle time, on average, does not change significantly for longer trips.
- **Total stop/start disablement**
    - >80°F = 9.69% of VMT x 100% = **9.69%**
    - 40°F-80°F = 68.75% of VMT x 10% = **6.88%**
    - <40°F = 21.95% of VMT x 20% = **4.39%**
    - **Total disablement = 20.96%**
    - **In-use stop/start operation = 13.76% idle time x (1-20.96%) = 10.9%**
- By comparison, **EPA's methodology** gives a stop/start enablement of 87.75%, **or disablement of only 12.25% and in-use stop/start operation of 12.1%.**
    - **Compared with the FTP stop/start operation of 10.0%, EPA's methodology more than doubles the appropriate off-cycle credit,** even compared to the conservatively derived in-use stop/start disablement of 20.96%.

8. Conclusions

EPA's methodology to assess the amount of stop/start activity in the real world is far too optimistic. It did not reduce in-use stop/start enablement for temperatures between 40°F and 80°F for engine warmup after cold starts - to make this worse, it did reduce stop/start disablement on the FTP. It applied engine warmup times derived at 75°F to ambient temperatures below 40°F, whereas engine warmup times are much longer at cold temperature. Much worse, it only reduces stop/start disablement for trips that last less than 5-minutes and implicitly assumes that stop/start operation can begin immediately for trips greater than 5-minutes, even below 40°F. Finally, it did not make any adjustment for the shorter average in-use trip length, compared to the FTP.

ICCT's calculation of 20.96% stop/start disablement, above, using the SFTP data and consistent assumptions, is very conservative, as it used 140°F for stop/start enablement instead of 90% of maximum coolant temperature and made a conservative adjustment for the faster engine cooldown and slower engine warmup at ambient temperatures below

75°F. This means that the real amount of in-use stop/start disablement is likely about twice the 12.25% derived using EPA's methodology. This also means that the off-cycle credit given by EPA's methodology is over twice what it should be. In fact, more appropriate adjustments for the faster engine cooldown and longer engine warmup at temperatures below 75°F might completely eliminate the off-cycle credit for stop/start systems.

Manufacturers must not be allowed to use methods developed for default credits. This is improper even in theory. Any derivation from default credits must be based upon actual in-use operation, as has already been established for manual transmission shift points and driver-selectable devices.

In the case of stop/start credits, it is even more important to prevent manufacturers from cherry-picking their assumptions each step of the way. In addition to using every assumption in EPA's methodology that favored them, Mercedes-Benz also ignored rural operation, operation of their vehicles after being resold, additional loads to recharge the battery, U.S. driver deactivation of the system, and air conditioning operation to cool down the vehicle cabin after soaks.

EPA needs to require Mercedes-Benz to submit their best engineering judgment on their stop/start system enablement and agree to validate this estimate with data on actual stop/start operation after the technology goes into production.

EPA also needs to require all manufacturers to use industry-wide assumptions of in-use vehicle operation. In this case, it means that Mercedes-Benz should apply their best engineering judgment of stop/start enablement to the industry-wide idle usage rate of 13.76%.

If EPA decides to allow manufacturer-specific credits based upon how their vehicles are used and not any differences in technology, off-cycle credits should not be awarded unless overall in-use emissions are lower, plus appropriate adjustments still need to be made for rural operation and operation of subsequent owners. EPA also needs to validate how Mercedes-Benz determined an idle period and why their idle estimates are so much higher than multiple other sources of idle time.