

Interim Report on C8 FWD Hybrid

(It will be updated as more info is available- last November 2021)

Early information about a probable FWD C8 Hybrid was in a published February 2019 interview with Andy Pilgrim (pic left) in "Corvette Online" written by Andy Bolig.



And Andy Pilgrim would know. He is currently based in Bowling Green, KY and consults for the National Corvette Museum from conducting driving courses to safety driving habits at schools. Andy's professional racing started in 1996 when he made his 24 Hours of Le Mans debut. He raced for the Chevrolet Corvette factory team from 1999 to 2004. He won the 2001 Petit Le Mans.

He continued racing with General Motors, driving for the winning team at the Daytona 24 in a Doran-Pontiac in 2004 and spending the rest of the season driving for the new Cadillac CTS-V factory team in the Challenge GT Series. The following year Pilgrim won the driver's championship in that series in his CTS-V.

In the interview he discusses the C8 suspension setup saying, it's quite complicated to eliminate oversteer with a rear heavy car. But the Chevy engineers have achieved that objective. The general consensus is it will be a better handling vehicle and have much greater potential for a quick racing vehicle.

He also dropped this statement as an ME benefit, *"Now you've got the room to put alternate power up front."* **Not prompted with a question from the writer; thought did he "drop" that info with the other first C8 details, as requested by GM? They probably approved the interview when there was no official C8 info! Perhaps it was to reduce the negative noise from "FE Vette Forever Crowd!"**

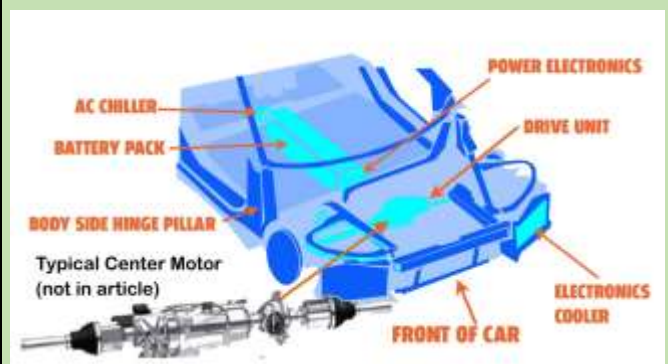
The Hybrid, AWD C8 Corvette

An article written by Bozi Tatarevic in Jalopnik late November 2019 could be a "controlled leak by GM!" It states it's from "official documents" and has very specific details that probably came from someone who knows them- OR was it "leaked" by GM similar to Pilgrim's info? In this case to reduce the negative comments about GM concerning the C8 having *"NO Standard Shift!"* IMO the low hp hybrid divulged with the LT2 engine is there for one main reason - to significantly improve mpg! *Why?* Because although for the past 3 years the EPA planned requirement of having the "Corvette Family" progressively improve and achieve ~40 mpg by 2025 has been on hold - it's not going away. Going from the C8 current ~20 mpg average to anywhere close to the very detailed goals covered in a 1174-page EPA report will be difficult! Even the current Federal administration is talking with California to reach some 50-state compromise since CA has already reached a separate agreement with Ford, Toyota, VW and BMW. This report covers the C8 hybrid article and significantly improving mpg issues.

If you were on the GM Board, would you base your business future on an election result, hoping improved mpg would continue to be on hold??

Photo Sequence

The Jalopnik article defines the C8 FWD having 114 electric hp and being used with the 495 hp LT2. It uses a 16,000-rpm motor that equates to 150 mph max! With an 8:1 gear ratio it produces 880 ft-lbs of torque. They note the power cannot be added directly because of different peak levels but say, “mid to high 500’s can be expected.” A rectangular case battery fits in the center tunnel. It uses a Rechargeable Energy Storage System (RESS – as it’s called.) There are 80 cells with a small 1.94 kWh capacity. Prius for years had a 4.4 kWh battery and was achieving 51 City/48 Highway mpg



Based on Prius battery capacity/weight, the C8 battery should weight <75 lbs. Some 2 kWh batteries weight only ~67 lbs. **Latest: it's two 50hp motors back to back!**



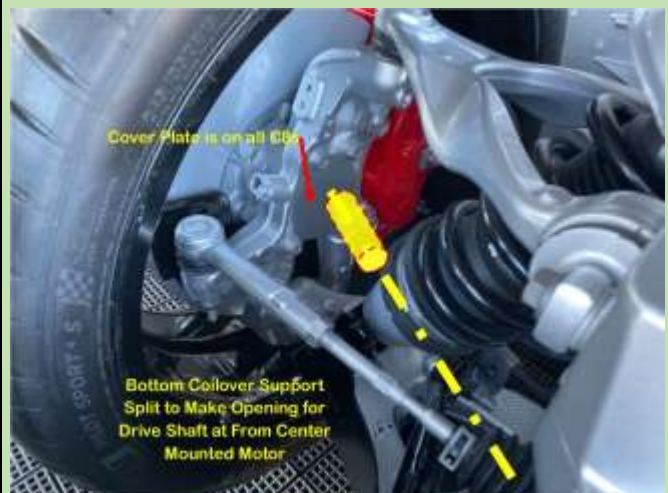
This is a Link to the Jalopnik article: <https://jalopnik.com/what-we-know-about-the-hybrid-all-wheel-drive-c8-corve-1839885240>

Mid to high 500rds total power does NOT make a C8 Z06! The current C7 Z06 has 650 hp, expect at least that high.

They also state it will be “in the standard car.” If not the Z06 than which C8 variant will be the 1st to use the FWD hybrid? From the increase in tire size, suspect it will be the C8 Grand Sport. It will have 275/30R20 front and 345/25R21 rear. To fit the tires extra fender width of ~3-inch wider rear and ~2.5 front will be needed. **Latest: That extra tire size and width reinforced and C8 Z06 body = 3.5 in. wider!**

The detail of the front spindle and coilover was also leak in this pic (less my added axle!)

Quoting the article, “Although it was readily apparent that there was a spot for the axle shafts, it wasn’t clear how they would get there as the coilover/damper was in the way. But based on the document that we saw, Chevy has come up with a solution. The coilover bottom mount has been replaced by what is called a split yoke damper where the single mounting point at the bottom is replaced by a fork with two mounting points that leave a space in the middle. This allows for the axle shaft to pass through the middle of the damper/coilover bottom!





The PDF C8 Owner’s Manual is available. On fuse panel page one shows a Li-ion battery!

244 Vehicle Care

Fuses	Usage
1	Driver memory seat module/Power seat
2	Driver heated seat
3	Passenger memory seat module/Power seat
4	Passenger heated seat
5	Transmission control module
6	Rear park assist
7	Power scanner module/Pedestrian friendly alert function

Fuses	Usage
8	Side blind zone alert
9	Column lock module
10	Engine control module/Air conditioning
11	Lithium ion battery module
13	Active fuel management
14	Beet fan
15	-
16	Exterior lighting module
17	Instrument panel cluster/Shift/Interface board/Transmission control module/Electronic brake control module

The vehicle may not be equipped with all of the fuses, relays, and features shown.

* The U.S. National Highway Traffic Safety Administration by September 2019, required Electric Vehicle Hybrids and EV’s to emit warning sounds at speeds less than 18.6 mph (30 km/h) to alert pedestrians.

Another Fuse Makes It Clear It’s for a Future Hybrid!

It’s fuse #7 for the “Pedestrian Friendly Alert,” for the electrical vehicle warning sounds designed to alert pedestrians to the presence of electric drive vehicles travelling at low speeds.

The U.S. National Highway Traffic Safety Administration by September 2020 requires the device to emit warning sounds at speeds less than 18.6 mph (30 km/h). When going slow forward or backward, the vehicle must make a continuous noise level of at least 56 dBA and a maximum of 75 dBA (within 2 meters of the vehicle)



Despite having 8 gears, shifting at low rpm when in the “automatic mode” (see chart right) and switching to V4 mode where possible, GM says the C8 will provide an EPA mpg of 15 City and 27 Highway. GM released the 2022 EPA ‘average’ mpg as of 16 City, 24 highway and 19 overall.

The issue is the “government” pressure to do much better. A hybrid with the proper size battery capacity mentioned in the should be able to achieve more than the “required” ~40 mpg average outlined in the 2012 government report defined below! If the “No Fossil Fuel” folks stay in control in it will be ONLY zero CO2 emissions EVs or hydrogen etc!

For vehicles with an Electronic Limited-Slip Differential (Z51)		
Upshift Allowed (into gear)	At Approximately	
	km/h	mph
2nd	15	9
3rd	25	16
4th	36	22
5th	47	29
6th	60	37
7th	76	47
8th	92	57
Maximum Downshift Inhibit Speed (into gear)	At Approximately	
	km/h	mph
1st	30	19
2nd	63	39
3rd	104	65
4th	164	102
5th	232	144
6th	304	189
7th	380	236

In addition to significant extra power and FWD the benefit of the C8 hybrid is *significantly improved mpg!*

Prior to 2017, there were very aggressive vehicle mpg goals in place to start that year and progressively get much higher by 2025. All vehicles are covered and placed in "Families." The 2025 goal for the "Corvette Family" was ~40 mpg! You can disagree with the goals, but the method used to define each family requirement, although complex, is very rigorous and logical. The current administration put those improved mpg goals on hold in 2017. But California said they will implement them as they have been allowed in the past for their State. Car manufactures can't afford not to sell cars/trucks in CA or the 5+ other states that follow CA vehicle emissions laws!

U.S. Department of Transportation
National Highway Traffic Safety Administration

Final Regulatory Impact Analysis

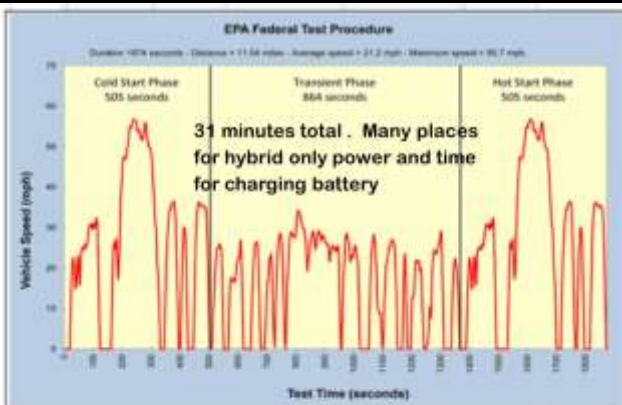
1174 Pages!

Corporate Average Fuel Economy
for MY 2017-MY 2025
Passenger Cars and
Light Trucks

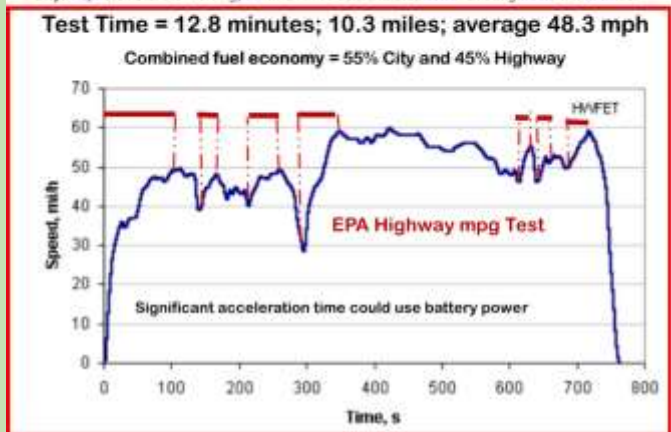
Corvette =
39.83 mpg

Table V-4 - Sample Adjustments for Horsepower to Weight, Cars

Manufacturer	Model	Name Plate	Horsepower	Footprint	GPM	MPG	Adjusted GPM	Adjusted MPG	GFSE % Adjustment
BUICK	BUICK REGAL	REGAL	138	39.2	0.02	49.40	0.0237	49.89	15.0%
TOYOTA	TOYOTA COROLLA	COROLLA	124	42.2	0.02	49.94	0.0237	50.34	9.9%
FORD	FORD FOCUS	FOCUS FWD	140	41.7	0.02	49.94	0.0237	50.34	9.9%
GENERAL MOTORS	CHEVROLET MALIBU	MALIBU	189	48.9	0.02	43.70	0.0220	34.08	-6.7%
BUICK	BUICK ACCORD	ACCORD 4DR	186	46.6	0.02	47.27	0.0219	32.71	3.3%
BUICK	BUICK VERANO	VERANO	138	37.8	0.02	49.40	0.0237	49.89	15.0%
GENERAL MOTORS	CHEVROLET CORVETTE	CORVETTE	490	46.3	0.02	40.84	0.0216	39.83	2.3%
FORD	FORD MUSTANG	MUSTANG	200	46.7	0.02	43.11	0.0218	31.87	-1.3%



City: Represents urban driving, in which a vehicle is started with the engine cold and driven



Note, since 55% of the average mpg is based on the City drive cycle, a major improvement in it, which appears possible, could improve the average with modest Highway mpg! For example, 55% X 45 mpg + 45% X 32 mpg = 39.1 mpg average!

In July 2019, Ford/Toyota/VW/BMW reached a compromise agreement with CA! Those goals are somewhat less aggressive. The administration in 2019 stopped the issue in court. But knowing a 50-state solution is needed for car company planning, it's currently negotiating with CA! All that occurred was an increase (or decrease however you look at the number) in CAFÉ requirements over time.

How could ~40 mpg be achieved? First, the values are based on the EPA drive tests for City and Highway (displayed left.) Most of the City drive cycle can be done with the electric motor hybrid. There are many decelerations, braking times to recharge the battery. Even the highway cycle can benefit. Operating in 4-cylinder mode, instead of switching to V8 mode when moderately accelerating to another speed or going slightly up hill (as is done in the C7,) the hybrid can provide the needed extra power.

When the car stops, the LT2 can shut off and *ONLY Restart* when the car is at about 35 to 40 mph cruising speed. Even accelerating slowly uses a lot of energy compared to driving at a steady speed.



An R&T article by Jason Cammisa had an interesting comment re the brake by-wire assist related to the C8 Hybrid: ***"Once you start thinking about a hybrid Corvette (by-wire assist) really starts to pay dividends. Hybrids use blended brake systems that continually shift braking duties between regenerative braking and conventional friction braking. This leads to inconsistent and unusual pedal feel that a by-wire assist eliminates!"***

I recall F1 drivers having to balance how much friction brake they used for a turn integrating "if" their KERS would be aggressively charging their small battery. Sounds like "by-wire assist" can help compensate for that variability.

In a December 13, 2019 Autoline Afterhours hour interview on the C8, Tadge when asked about an EV Corvette stated, they are part of GM and follow Mary Barra's "000 Goal," which includes zero emissions! He said they follow the World Environmental regulations and have their own desire to help "preserve the planet." Only those "playing ostrich" don't think they were planning on the EPA 2025 ~40 mpg and now just slightly lower CA/Ford, Toyota, VW and BMW agreement! That dictates getting progressively better mpg every year.



Assume a Hybrid with LT2 engine can = ~39 mpg average per above estimates. Then to meet progressively tighter goals to 2026 and first leaving out unknown volumes of Z06 and Zora:

Then: 2020/2021 C8 Average = ~20 mpg

2022 with ~25% GS hybrids @ 39 mpg = ~24 mpg

2024 with 50% GS hybrids @ 39 mpg = ~30 mpg

2025 with 50% GS, 25% Base hybrids = ~34 mpg

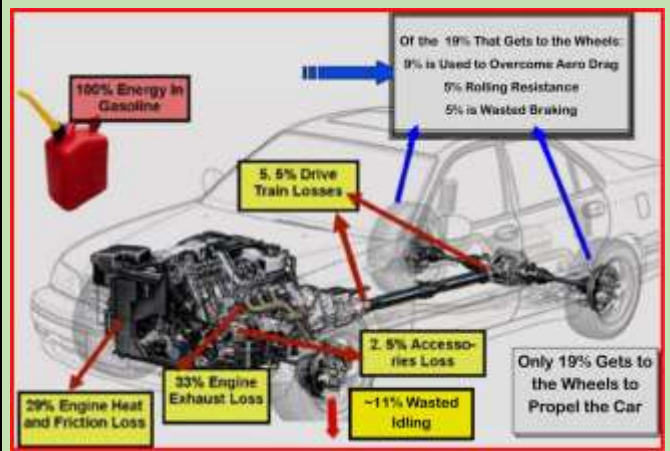
2026 (year per CA/Ford et all agreement) with most LT2 engine C8's being hybrids = 39 mpg.

Assume the reduced goal from the current 3-year-old EPA ~40 mpg for "Corvette Family" will be ~35 mpg. A ~35 average mpg could be possible in normal drive cycle tests including Z06 and Zora somewhat lower mpg, as they will also be hybrids, WITH the ICE starting when the C8 reaches cruising speed powered with only hybrid electric motor and for all slow speed driving.

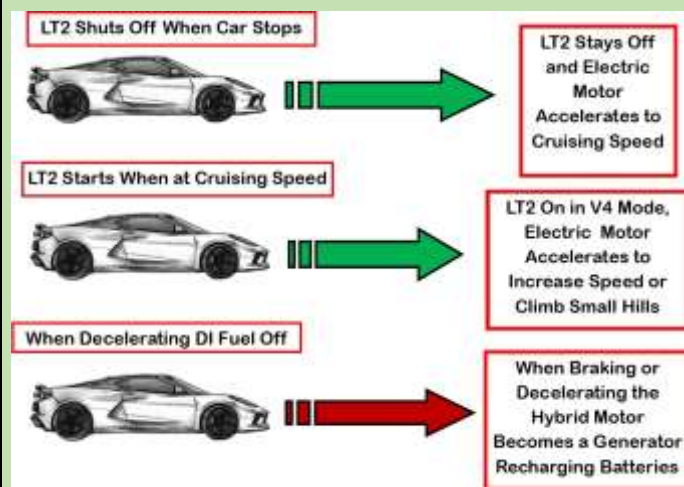
The figure right is made from recent EPA “average” energy use data. Sure, reducing 11% idling energy doesn’t help highway mpg BUT it’s a weighted average of where cars are used! Shutting the LT2 off when the car stops can save some of the ~11% wasted gas energy used, on average.

Braking also consumes about 25% of the 19% energy that gets to the rear wheels to propel the car. Much of that can be captured and stored to recharge the battery.

As seen in the pic right, only 14% of the energy in gasoline is used to propel the car forward! F1 race car rules have been designed to achieve higher efficiency and recover some of that wasted gas. They now are not allowed to refuel and use hybrid and other methods to recover some of that wasted energy!



F1 race cars use about half the fuel energy they did in the past. Refueling is not allowed and overall speeds exceed those in the past on many of the same racetracks! It can be done!



The key to significant C8 mpg improvement is to STOP the LT2 when the car stops or when driving slowly. Then use the Hybrid motor to accelerate the car in “normal driving” to near cruising speed before restating the LT2.

When braking or decelerating the DI shuts fuel off and the Hybrid motor becomes a generator, recharging the hybrid batteries that propel the car. The hybrid battery can operate the water pump and AC etc, as needed.

For the “Standard Shift Forever Folks” the mpg improvement operation sequence needs a computer-controlled transmission to put the car in the proper gear when LT2 is restated. Guess there could be the message (right) in HUD! The computer would also need to select the gear when FWD was engaged in aggressive drive situations.

Some small engine cars in the past used a standard shift and hybrid BUT most did not STOP the Engine eliminating idle energy loss. Hybrid power was used to supplement very small cid low power ICE.

They are no longer in use!





Ferrari is Planning 60% Hybrids in 2022!

Ferrari CEO Camillari says they want 60% of Ferrari's sold in 2022 to be hybrids!

Ferrari's 1st hybrid was introduced in 2013, the LaFerrari. It had a 789 hp V12 with a 161 hp electric hybrid similar to that used for F1 KERS.

Ferrari introduced the SF90 Stradale hybrid in 2019. It's turbocharged 4.0-liter V8 produces 769 horsepower and it has an additional 217 hp electric hybrid drive for a total output to 986 hp. The most powerful road-going Ferrari ever produced.



Plug-in Ferrari Hybrid SF90 Stradale.

There is no mpg data available. Car & Driver stated, "Most buyers won't care about mpg!" True. but Ferrari (to avoid a large government fine including the state of California) sure will!



There have been spy pics of what was called a Ferrari 488 hybrid (shown left.) Perhaps it will use a lower hp, higher mpg, ICE engine with the hybrid to meet EU and other CO₂ emission requirements.



Published Speculation re a Hybrid Ferrari California:

Quoting: "Based on recent Ferrari patent filings, it's testing a different hybrid system than the one on the HY-KERS Concept. The new system uses two electric motors, including a low-capacity front-mounted electric motor to run ancillary systems when the car is operated in electric mode. A rear-mounted drive motor supplies supplementary power to the wheels and is fed from battery cells distributed across the floorplan to retain an ideal center of gravity.

AS REPORTED:

Ferrari's production hybrid system is likely to feature two electric motors. The first is a less powerful model to run ancillary features when the Ferrari is in electric mode."

In addition to reducing carbon dioxide emissions, the hybrid drivetrain gives the California Hybrid superior performance compared to a conventional Ferrari California."

Porsche Says No Manual Box for Hybrid:

In an article published a few years ago: *“Porsche VP and engineer in charge of a hybrid model, Dr. Gernot Döllner, said hybrid and/or electric cars from the brand would only make sense with automatic (or PDK) gearboxes. According to Döllner, they can only be efficient with an advanced automatic gearbox. In a hybrid 911's case, the PDK wouldn't be there to decrease track times, but to increase efficiency.”*

That does not address what might, IMO, be a bigger issue with the independent C8 FWD hybrid even when driving in an aggressive non-gas-saving mode! When you apply WOT, say after a corner apex, and the computer defines the DCT downshift gear based on car speed etc. It must also consider the rear wheel torque and integrate the FWD power application based on that rear wheel power that lower gear is providing. This would assure the correct power to each wheel for the proper, safe car balance!

Note: In February 2020, a forum poster quoted engineers at Porsche's Tech Center saying they planned 50% EV's in 2025. That could offset non-hybrid models.

Porsche had an early race car powered by my favorite fun hybrid, which used “Flywheel Energy” storage, the 911 GT3R.

Rather than a battery, that system is based on a flywheel, mounted where the passenger seat would normally sit and spinning at speeds up to 40,000 rpm, to capture energy reclaimed from braking.

At the press of a button, the flywheel releases its kinetic energy to power a generator that provides up to eight seconds of electricity to two 80 hp electric motors in the front wheel hubs. The boost serves to maximize exit speed from a corner or to pass another car.

The rear wheels are driven by Porsche's traditional flat-six gasoline engine, in this case a 4.0-liter version developing 480 horsepower.



Porsche 911 GT3R Race Car



103 lb flywheel with support



The 2013-2015 \$875,000 Porsche 918 Spyder mid-engine plug-in hybrid used a NA 4.6 Liter 599 hp @ 8700 rpm V8, and two electric motors delivering an additional 282 hp. The 6.8 kWh lithium-ion battery pack delivers an all-electric range 12 miles. All 300 planned, were sold.

The 2015 model EPA energy consumption equivalent had a combined city/highway fuel economy 67 mpg. With the gasoline engine, combined city/highway fuel economy was only 22 mpg

IMO some of the "Marketing Speak" i.e., why no C8 "standard shift," provided by GM, Tadge and his folks is just that, a "cover story!" It has some reality, but it's provided so they did not have to divulge the real reason- *designing the C8 to achieve significantly improved mpg using a FWD hybrid- when dictated!* Corvette enthusiasts are not looking for a hybrid system that shuts the LT2 off when stopped and ONLY restarts it close to cruising speed in "normal driving." Tremec is well aware of that plan and neither they or GM will invest for one or two years when a Manual Transmission would be usable.

"Clutch pedal room," "Not cutting a hole in center beam for a shift mechanism," "Imprecise cable shifter," are IMO mostly "Marketing Speak." GM may not divulge the needed C8 efficiency improvement reason until the "Government" dictates improved mpg is "required." Corvette folks "don't want to hear about mpg!" They want performance. **Sorry, that is not the real world. If you were on the GM Board would you base your business future on the results of an election?**



Expect GM to talk about the performance features of the extra 114 hp electric FWD and added traction when accelerating to 60 mph or when Tracking, leaving an apex in a turn.

Yep when driving aggressively the EPA test doesn't measure mpg since "on average" most driving is NOT done with large throttle openings! When driving aggressively, you get the benefit of both the LT2 and hybrid electric motor power and AWD traction!

I encountered another incidence of "Marketing Speak;" GM's reluctance to divulge the real reason for no center air dam in my 2014 Z51. Below explains how that took ~2 years to get the real reason! Having a center air dam on the C6 Z51 was curious as to why, although one was shipped to my very knowledge Vette dealer with my early, September 2013 built C7 Z51, they just had a memo that said, don't install:

Why No Center Air Dam on Some C7 Models

- 1) John Bednarchik, the Chief GM Aerodynamicist, in an October 2, 2013 published article said it was removed for high speed stability. I read that article when it was published, as I get that car mag. He gave no details of what "high speed stability meant!"
- 2) A GM engineer said in 2014 it was to get more air to the rear brakes. That didn't match with Bednarchik said and that engineer made a different statement, with no detail to the forum member who posted the comment. *Sounded like "marketing speak" to me!*
- 3) Tadge at the April 2014 Bash said the center air dam on the Z51 was deleted to balance the lift characteristics. Interesting, similar to Bednarchik's statement but again no details.
- 4) Tadge in a 2015 Z06 intro video said it was not used because it was causing high speed oversteer and they require some understeer. *(Now that sounded like the real reason! Since I had a modified '67 Corvair, knew all about high speed oversteer and how the average driver did NOT know how to properly steer to counter a high-speed skid!)*
- 5) Tadge in a 2016 forum post said they carefully control "pitch moment" to provide neutral handling biased to understeer.
- 6) A 2017 GM Bulletin shows the base models of the Grand Sport (*not my Stage 2 Aero Option that doesn't*) and Z06 now have center air dams, minimizing the reason being extra cooling *if that was every more than "marketing speak!"* (GM, must have good CFM (Computational Fluid Dynamic Computer Models) proving it OK for those C7 variants!)

Some still *"Playing Ostrich"* don't except my higher mpg, hybrid postulate and insist the reason for no standard shift C8's are the GM Bean Counters. This fun ~2013 *hypothetical* conversation between a tough GM CFO and Tadge show there are bigger cost issues he was no doubt questioned about than adding a standard shift option.

Some tech details are from Tadge's recent over 1 hour interview on Autoline Afterhours including where he mentioned the C8 design was being finalized when the C7 was being introduced, the chassis must be very ridged so it doesn't act like an "undamped spring," and the Pratt & Miller study that defined the need for 60% rear weight:

GM CFO: OK Tadge you finally convinced Mary and the Board with that Pratt & Miller info what Zora tried to do for years that we need an ME and 60% rear weight to stay competitive. But I see a number of higher cost items in the design, like why are you eliminating the low cost composite spring arrangement we have used for years that, using coilovers, which require a higher, heavier frame structure?

TADGE: In the rear, the engine and trans need to sit low to get a low center of gravity, no room for a flat horizontal spring . **And you know the government is setting a mph goal for sports cars of about 40-mpg in 2025, which is not long after we will launch the C8. A hybrid is really the only solution as Corvette folks won't buy enough EVs to get that 40-mpg average for the Corvette Family. We are also in no position to build a high performance EV by then. So as the plan shows, we're going to put a center electric motor FWD low in the front so no room for the flat composite spring there.**

GM CFO: OK but why the heck to we have to invest in the tooling for unproven, huge. hollow, thin wall cast aluminum frames and make them ourselves in Bedford! Did you not get a clue that it is risky when you could not get a Tier 1 supplier to quote. Those fools take big risks and are often being sold because they lose money! Why don't you just use the method of a welded frame you convinced us to invest in at Bowling Green for the C7. Heck I was happy buying the C7 frame from Dana like we did the C6!

TADGE: We have looked carefully at that option as you'd expect. We have examined many Porsches over the years to see how they get around the "Oversteer" problem with a rear heavy car. They had the same Oversteer issue we did with the Corvair. We found we need a very rigid frame to have the careful suspension design work as planned and the chassis not behave like an undamped spring and cause unintended suspension variations. It took Porsche decades to solve the issue and we don't have their ridged unibody design. We have to get it right first time and our calculations and tests show this cast frame approach will provide what's needed. My Dad owned an early Porsche which he drove to the limit. I know all about Oversteer issues, it's one of my biggest concerns and this cast frame will provide what we need!

Also Porsche announced last year (2012) they are producing the 918 Spider hybrid that gets 65+ mpg! Appears they are planning hybrids and EV's. We believe that Ferrari announced no standard shifts even in their FE models for the same planned hybrid reason. They have the same reduced CO2 emissions issues in Europe. We'll also need a computer-controlled transmission to make a high mileage hybrid viable.

GM CFO: Guess we'll have to go with your team's ideas BUT why the hell can't you use the joint venture 10 speed transmission we got talked into funding with Ford? Have them build it into a transaxle instead of an expensive, heavy DCT we have to get from a supplier!

TADGE: We need a DCT for Corvette enthusiasts and NOT that 10 speed "slushbox" we developed with Ford that some of your bean counters said we should use!

Don't confuse my discussing improved mpg technology with me being a "Tree Hugger!" Frankly, I'm not! My '34 ProStreet Rod with its 502 cid engine gets ~10 mpg! BUT I'm all for using technology so as not to waste energy.



I feel like Andy Cowell, managing director of Mercedes High Performance Powertrains, who said about F1 planning to eliminate MGU-H (Motor Generator Unit, Heat, the energy saving function that used otherwise wasted turbo energy when boost was not needed.) He said HGU-H provided 60% of the electric energy used to power their F1 cars and contributed 5% of the current engine's thermal efficiency.

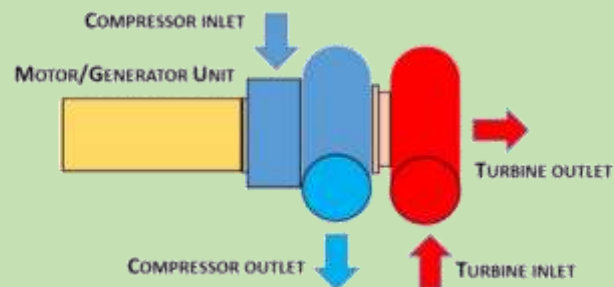
Quoting;

- MGU-H (Motor Generator Unit, Heat, (HGU-H, the energy recover system that uses turbo power

when engine air pressure boost is not needed to operate a generator and can also power the turbine compressor with an electric motor) provides 60% of the electric energy used to power the other part of the energy recovery system and contributes 5% of the current engine's thermal efficiency.



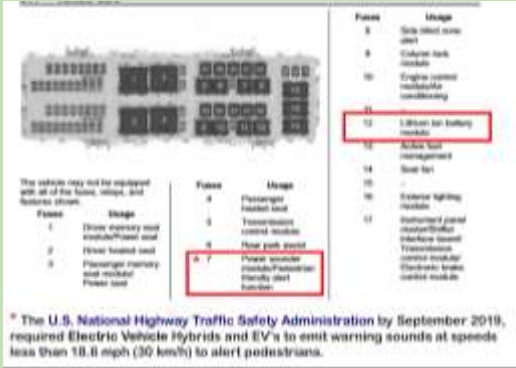
When "Turbo Boost" is not needed for the engine, turbine power is diverted to a generator to charge the battery as AND as a motor it can also power the compressor before the turbine spools up!



- We'll have to come up (*in 2021 F1 when it's banned, because of complexity of managing for smaller teams and the really "stupid" but understandable reason - it reduces engine sound*) with various systems and devices and that will probably involve burning some fuel through the exhaust, *which doesn't feel the most honorable thing to do as an engineer.*

I feel similar to Andy Cowell. IMO it's better to improve the ICE efficiency, best as possible, before being forced to go to EVs!

The C8 Owner's Manual showed a location for a Lithium Battery fuse location



Thought the presence of a Lithium battery would have some accept the C8 hybrid was planned. Some rationalized it was probably from another Chevy! For sure the April 23, 2020 article by Motor Trend with leaked GM info reinforcing the leaked info published November 2019 would do it- BUT NO!

<https://www.motortrend.com/news/c8-chevrolet-corvette-zora-1000-hp-hybrid-leak-info/>

Perhaps this published article will help some of those “*Playing Ortrige*” understand what was going to be LAW in 2017 and why GM had to plan on ~23 mpg when the C8 Corvette was to be released and ~40 mpg by 2025 (*BTW, so did Ferrari, Porsche etc*):

<https://obamawhitehouse.archives.gov/the-press-office/2012/08/28/obama-administration-finalizes-historic-545-MPG-fuel-efficiency-standard> This is the Article Title:

Obama Administration Finalizes Historic 54.5 MPG Fuel Efficiency Standards

BTW, Sports Cars have the lowest mpg requirement, some small sedans were to require 60 mpg! Here are some clips from the article! It's filled with propaganda stating automakers applaud the concept! They expected some gullible folks to buy that BS. That's until they saw the implications and didn't like the result! Especially most sports car folks!

“Last year, 13 major automakers, which together account for more than 90 percent of all vehicles sold in the United States, announced their support for the new standards. ...

“Simply put, this groundbreaking program will result in vehicles that use less gas, travel farther, and provide more efficiency for consumers than ever before—all while protecting the air we breathe and giving automakers the regulatory certainty to build the cars of the future here in America,” ...

“The fuel efficiency standards the administration finalized today are another example of how we protect the environment and strengthen the economy at the same time,” said EPA Administrator Lisa P. Jackson. Innovation and economic growth are already reinvigorating the auto industry and the thousands of businesses that supply automakers as they create and produce the efficient vehicles of tomorrow. Clean, efficient vehicles are also cutting pollution and saving drivers money at the pump.”

Note: Some said the C8 hybrid could not achieve that high mpg with that small battery.

Some key points from a June 2020 article about the new Toyota RAV4 Prime plug-in hybrid with an even smaller 1.6 kWh battery versus the leaked C8 Hybrid 1.92 kWh:

The RAV4 Prim will have an estimated “battery-only” range of 42 miles. It will also be the quickest RAV4, with 302 horsepower and a zero-to-60-mph time of 5.7 seconds. It uses a 2.5-liter inline-four engine mated to a pair of electric motors (one driving the front wheels and another one driving the rear wheels). The electric motors draw energy from a 1.6-kWh nickel-metal hydride battery mounted under the rear seats. Cargo capacity is not affected. Combine that powerplant with the Prime's electric motors, you get a combined 302 horsepower. Not bad for a “green” SUV.

The plug-in RAV4 will have all-wheel drive as standard, and the automaker is estimating that it will achieve 94 MPGe combined.



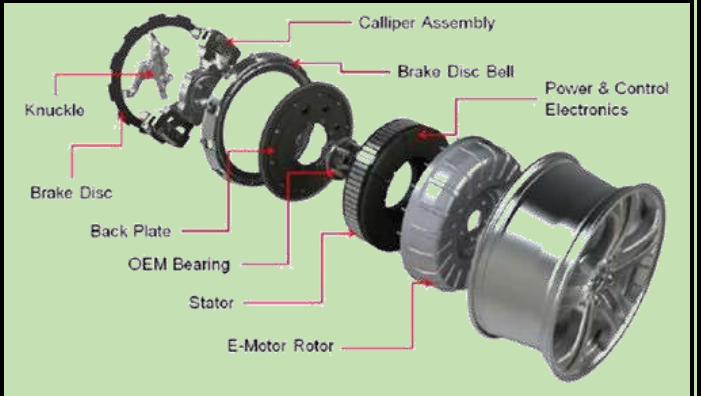
The recent: 1) thought by a Forum poster that the new C9 Vette could look futuristic (top pic) 2) GM announcement of spending 2.3 billion with South Korean LG Chem on a new battery plant for new higher capacity battery design and 3) the recently introduced Lordstown all Electric Endurance Truck (bottom pic) using 4 Elaphe wheel Hub motors are an alternative for the C9 Corvette.

Perhaps, like Porsche, they can have half the Corvettes be EV's and allow others to be hybrids and a few gas guzzlers!

The Endurance Truck specs and simplicity are interesting.

Using wheel hub motors means no gears or axle shafts etc. Leves room for batteries etc. Perhaps like the new Ferrari SF90 Stradale hybrid, it would use a small electric motor driven generator to provide electrical power needed for AC, and other electronics.

The Endurance can generate 600 peak hp, has a range of 250 miles and the equivalent of 75 MPGe!



GM is investing over 35 Billion dollars in combination with LG Chem to produce a new technology LiNiCoAlO_2 battery. Not brand-new technology but they believe they can reduce or eliminate the costly, limited supply Cobalt that will reduce costs. There is a safety concern, and their solution has not been discussed.

With Mary Barra's commitment to zero emissions assume Gm engineers are working on an EV Corvette. Probably the next, C9, IMO

With many Corvettes' spending much time in a garage and used for short trips on weekends, a small capacity battery option could be used for a "Low Cost Base Model." Pay more and get a longer range, bigger battery C9. Or pay even more and get an ICE and electric FWD Hybrid power Grand Sport, Z06 or Zora!



September 9, 2020, Published Report by Zane Merva (condensed):

Electric All-Wheel-Drive Hybrid Coming to the C8 Corvette

It's reported documents have been seen indicating electric all-wheel-drive (eAWD) will be an option on the Stingray coupe and convertible versions as soon as the 2023 model year. The Corvette with eAWD would be a hybrid. ***"That's not how Chevy will market it. The feature will most certainly be performance-oriented."***

(My Note: That is exactly how I said it would be done by GM, Ferrari etc. until a "government" dictates it will not start the ICE until in "normal driving" the electric motor brings the car to cruising speeds by making higher mpg or lower CO₂/km in Europe a legal requirement! As outlined above, that was going to happen in the US in January 2017 if the 2016 election had gone to the Dems. If the 2020 election goes that way it will again or worse! AOC and her followers won't allow "rich" Corvette, Ferrari etc., owners have any cars above a certain minimum mpg! It will be sold to the public as saving the World!)

"We're unsure how eAWD fits into an all-electric C8 Corvette, Speculation has been rampant for years that the C8 Corvette would feature an electric version."

Either way, this is a game-changing move for the mid-engine Corvette, which is already capable of 0-60 times under 3 seconds. Imagine the added torque that would be provided by one or two electric motors providing juice to the front wheels.

"It's entirely possible the eAWD Corvette could move independently of the rear wheels and V8 engine... and in theory travel silently. They could be different cars entirely...or the same feature described by many people."

It speculates it will use GM's Ultium Battery system and would have a plug-in cord for recharging.

In March 2021 a very reputable Automotive Journalist, Don Sherman, wrote an article for SAE International that detailed more info of what GM will call the E-Ray. Essentially the same configuration as outlined in the 2019 leaked article with the electric motor being two mounted side by side, operating independently.

He said *"electrification is expected to improve fuel economy by giving the engine a break during cruising. Propelled solely by its electric motors, the hybrid Corvette will be eligible for access to city centers where combustion engines alone are forbidden."*

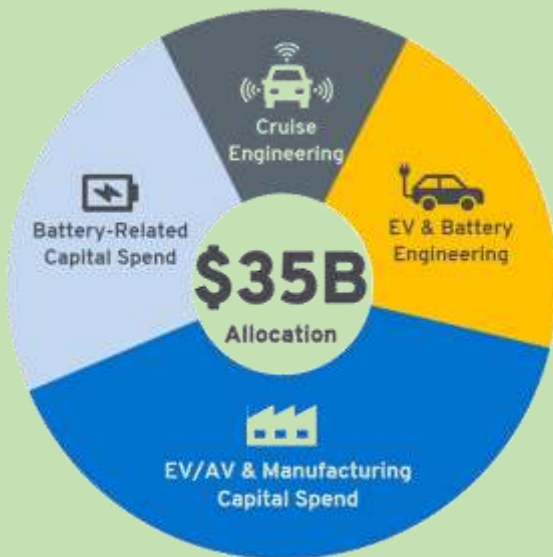
He said the expected base price will be well less than \$100,000. So like Ferrari it won't be cheap or light! Manufacturers will wait for a government to dictate by law the need to "save the world" with low CO₂ emissions before they mention the reason.



Sherman alluded to it possibly being a plug in hybrid and a YouTube video mentioning what he said showed this pic of two prototype C8's with plugs. They are similar plugs used to charge electric forklifts! So, in addition to braking recharging, it's batteries owners may be able to recharge at home etc and run mostly on electric power.

The C8 Z06 has been announced:
These are some key specs:

- LT6 Engine: 5.5 Liters DOHC; Flat Crank
- 670 hp @ 8400 rpm; 460 ft-lbs @ 6300 rpm
- Titanium Connecting Rods
- Very Low Height, Light Pistons
- Dry Sump Uses 6 Oil Scavenge Pumps
- Crank/Rods Operate in ~11 psi Vacuum
- Volumetric Efficiency Over 1
- Small Block, '55- 2023, Bore Spacing 4.4"
- LT6 Weights 1kg over LT2 for 175 more hp
- Final Drive (~dif) = 5.56:1 vs 5.17:1 C8 Z51
- 275/30/20 Front; 345/25/21 Rear Tires
- 345 tires = 3.6" wider body than C8 = 79.7"
- Brakes: 14.6/15.0 steel vs 13.8/13.3 C8 Z51
- Carbon Ceramic Brake Option 15.7/15.4
- Dry Weight 3434 lb; Reported C8 3366 lbs
- eLSD Standard



Mary Barra Announced GM Will Be Spending 35 Billion Through 2025 on Mostly EV and Battery Car and Battery Development and Production.

Next Corvette Model, the C9, will be an EV, IMO. Flagship Promoting EV's to Public

Mary Barra announced GM is accelerating its engineering and capital investments in electric vehicles (EVs) and self-driving technology (AVs) to \$35 billion between 2021 and 2025.

GM will focus on zero-emission, battery-electric vehicles (with some share of hydrogen fuel cell vehicles), *instead of "partial solutions" like hybrids/* "electrified" ICE vehicles.

"With our engineering and capital investments, we are executing the industry's most comprehensive and fully integrated EV and AV strategy, underpinned by the Ultium Platform, along with revenue growth opportunities like connected services, HYDROTEC and Super Cruise."

Most of the investments will fall on vehicle plants and four battery plants in the US.