EVs-Mid Fall, 2022

By John Benson

October 2022

1. Introduction

My last EV post was a little over a month ago. This is described and linked below.

EVs Early Fall 2022: *There is a huge amount of new information coming out on the title-vehicles. Thus, I felt it was best to start and schedule this post before this trove requires a multivolume post.*

This paper will cover some additional clarifications to the Inflation Reduction Act tax credits for purchasing EVs, new battery and EV manufacturers building new battery plants in the U.S., some new information on "heavy" EV Manufacturers, puncturing a bogus argument about how charging EVs will impact the grid, the cost of charging various EVs and how do we can reduce that cost. The section on Future EVs focuses on Vans. The final section is on how California codified its future requirement to only sell light EVs after 2035 (vs. light vehicles mainly powered by gasoline or diesel engines).

https://energycentral.com/c/ec/evs-early-fall-2022

In this Post we will continue to look at various future mainstream EVs plus go up-market (to the heavies) and down-market (to the tiny, hyper-efficient EVs). Also, we will look at some early payoff from the Inflation Reduction Act of 2022 (IRA), as EV manufacturers start expanding their U.S. facilities to take advantage of the IRA's tax credits, which will boost their sales. Finally we will look at Tesla's Third Quarter Results and Earnings Call.

2. Dodging & Weaving

When Dodge picked the "Charger" as a model name, they probably thought about knights of yore riding their faithful chargers into battle rather than electric vehicles charging their batteries. Keep in mind that the first generation Chargers were in 1966/67. I suppose Dodge / Chrysler / Stellantis simply lucked out that the name will still be appropriate when this muscle-car evolves to electric power as described below.

Dodge has made a massive marketing push over the past two months to sell several "Last Call" versions of its current-generation Challenger coupe and Charger sedan before they end production next year. The Stellantis brand has said future Chargers and/or Challengers will be only battery-electric on a new platform, certainly creating an incentive for consumers wanting an outgoing model with Hemi power.[1]

But is it really the end of the line for an internal-combustion Charger and/or Challenger?

The marketing plan for these future muscle cars is as clear as mud.

Dodge has communicated very clearly that the "Challenger and Charger, in the current platform and powertrain as we know it, will be built through 2023. In 2024 we're moving

[1] Tom Murphy and Todd Lassa, Autoweek, "Gas-Engine Dodge Charger, Challenger May Yet Come after Last Call," Sep 27, 2022, https://www.autoweek.com/news/industry-news/a41396954/gas-engine-dodge-charger-challenger-after-last-call/

on, and the new Dodge cars will be fully electric," springing from Stellantis' global STLA Large platform.

Previous media reports have indicated that in addition to the battery-electric Challenger and/or Charger, these new vehicles on the new platform will also have a version powered with an internal-combustion engine, perhaps the Hemi V8. In an email to Autoweek, the Dodge PR team has proclaimed those reports to be wrong: "The Hemi-powered Charger and Challenger are going away after 2023." Of course, that leaves the door open to other engines.

While the outdated (but beloved) Hemi might be going away because of emissions hurdles, two reputable forecasting houses—AutoForecast Solutions and LMC Automotive—report there will be an internal-combustion version of the Charger and/or Challenger replacements available through 2027, although the EV versions will go on sale first. The Dodge and Chrysler brands are scheduled to go all-EV by 2028.

Replacing the Hemi in a new Charger and/or Challenger would be the new Hurricane 3.0-liter twin-turbo inline six-cylinder that is debuting now in the Jeep Wagoneer (the standard-output Hurricane makes 420 hp and 468 lb-ft of torque) and Grand Wagoneer (the high-output Hurricane in this model is rated at 510 hp and 500 lb-ft of torque). Those are solid numbers (besting the output of both the 5.7- and 6.4-liter Hemi V8s), and Stellantis executives positioned the Hurricane as a Hemi replacement when the new engine was revealed earlier this year.

Note that Dodge / Stellantis released the concept car shown below *"…as a preview of its first all-electric muscle car, expected in 2024."*

Dodge Charger Daytona SRT concept car

Dodge

3. Hyper-Efficient Tiny EVs

I actually started collecting information on this subject before the last EV Post. I ran out of space for that one, and this subject was delayed. Also, I was too concerned that the leading candidate for this new class was touting too many unproven technologies. I still believe that the vehicle described and pictured in this section is the leading candidate, but with a caveat.

The vehicle is made by Aptera in San Diego. Note that the Aptera is not yet in production, although it appears to be close. Some earlier releases said that they would be in production by 2022, and they still might, but only time will tell when they will actually start shipping vehicles to real customers, how many, and how suited to their intended market these will be.

At this point, I will treat their vehicle as really more of a concept than a production vehicle, and it is a reasonable concept: a very light, hyper-efficient EV. Rather than spending most of the price on a large battery they are spending most of the money making their vehicle as efficient as possible, and thus minimizing the energy their battery needs to store to achieve a reasonable range. Plus, by designing their body to host a large number of PC cells, every day these can add 35 to 45 kWh of energy to the battery without plugging in. (Motor Trend says “20 miles per day”, and PV Magazine says up to 40 miles a day, but Aptera’s largest battery (100 kWh) is said to provide 1000 mile range, so there is a disconnect here). For users like me that rarely drive more than 15 miles per day, and only take a long (≈250 mile) trip every couple of weeks, most of my miles would be directly from the sun. The images below are the best I could find, and mainly come from the Aptera web site.[2]

[2] https://aptera.us/

The first thing that you probably notice is that this is a three-wheel vehicle.

The one thing that's never changed throughout the Aptera (née Accelerated Composites) in its transition to a solar-powered electric car is its extremely light, extremely strong passenger cell comprised of just four composite parts. The fully assembled "body-in-white" weighs less than 800 pounds. Three-wheelers qualify as motorcycles, and enclosed three-wheelers dodge the need for helmets and motorcycle driving licenses, but Aptera swears it's going to meet all 700 NHTSA crash-safety requirements, not just the 38 that apply to cycles.[3]

Technically speaking the Aptera is an Autocycle. That is:

A three-wheeled design with:

- *Steering wheel.*
- *A seat for the driver.*
- *Occasionally, seats for passengers.*[4]

Currently, 31 states have autocycle statutory definitions. All 31 states require that an autocycle have three wheels, and 27 states require an autocycle to have a steering wheel (Colorado, Mississippi, Oklahoma, and Virginia do not require a steering wheel). Below are the other range of requirements commonly seen in autocycle definitions, along with their prevalence among the various state definitions:[5]

- *Nineteen states require autocycles have seatbelts.*
- *Sixteen states require that the driver not sit astride or straddle the seat.*
- *Fifteen states require autocycles be enclosed.*

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[3] Frank Markus, Motor Trend, "2022 Aptera First Look: The Solar-Powered Electric Vehicle," Sep 30, 2021, https://www.motortrend.com/news/2022-aptera-solar-ev-first-look-review/

[4] Steven Lambert and Douglas Shinkle, The National Conference of State Legislatures, "Transportation Review, Autocycles" April 17, 2017, https://www.ncsl.org/research/transportation/transportation-review-autocycles.aspx

[5] The National Conference of State Legislatures, "Transportation Review, Autocycles," May 2017, https://www.ncsl.org/Portals/1/Documents/transportation/TransportReview_Autocycles_Go_31249.pdf

Concerning enclosure requirements, Colorado's statute requires that an autocycle have "a hardtop enclosure that protects occupants from the elements and that supports the vehicle's weight without harming the occupants when the vehicle is resting on the enclosure." The language requiring the autocycle to protect the occupants while "resting on the enclosure" is mirrored in Vermont's statute, which defines "fully enclosed autocycle" as an autocycle that has, among other features, "full top and side enclosures capable of supporting the vehicle's weight and protecting the occupants when the vehicle is resting on the enclosures."

- *Fifteen states require foot pedals to control acceleration, braking, and, if applicable, a clutch.*
- *Eleven states require autocycles meet federal motorcycle safety requirements.*
- *Ten states require the vehicle to have a roll cage or roll bar.*

Concerning roll bar requirements, Louisiana has statutory language defining a "roll cage" or "roll bar" as "supports that will bear the vehicle's weight and are so designed as to protect the occupants when the vehicle is resting on the supports."

- *• Eight states require autocycles to have antilock brakes.*
- *• Four states require autocycles to have airbags.*

Probably the most comprehensive autocycle definition is Nebraska's statute, which defines an autocycle as any motor vehicle:

1. *With a seat that does not require the operator to straddle or sit astride it.*
2. *That is designed to travel on three wheels in contact with the ground.*
3. *In which the operator and passenger ride either side by side or in tandem in a seating area that is completely enclosed with a removable or fixed top and is equipped with manufacturer-installed air bags, a manufacturer-installed roll cage, and for each occupant a manufacturer-installed three-point safety belt system.*
4. *That has antilock brakes.*
5. *That is designed to be controlled with a steering wheel and pedals.*

3.1. Reasonable Design Elements

I consider the following reasonable design elements for the Aptera. These are assumed to be beyond the above Nebraska Autocycle Standards.

- Small in-hub motors for either the front two, or (optionally) all three wheels.
- The solar recharging panel that can charge the battery sufficiently for daily in-neighborhood trips.
- Crash safety testing to near automotive standards.
- Extremely good aerodynamics (Drag coefficient of 0.13)
- Very low base price ($25,900)
- Lean design (see below)

Aptera has retained Sandy Munro's Munro and Associates to apply its Lean Design methodology, which will have Aptera outsourcing the production of much of the vehicle. Final assembly will involve the marrying of six major subassemblies with the

composite body: front and rear suspension modules (including motors), the instrument panel, the battery, and the interior.[3]

- Retail sales entirely online
- Distributed final assembly (see below)

CEO Chris Anthony's dream is to one day meet local demand with small local assembly facilities close enough to the customer to enable factory pickup, thus solving one thorny problem: How to transport three-wheel vehicles (the current truck and train car-carriers lack a central rail to support the rear tire.

- Right to repair (see below)

With minimal maintenance required of any electric vehicle, Anthony said his company embraces the Right to Repair movement. This involves manufacturers disclosing all repair and service procedures online to empower owners to service and repair their own vehicles.

Aptera will ship parts to customers worldwide. There will reportedly be a warranty program for getting things fixed, presumably at some established network of automotive service centers.

Author's comment: I believe the local assembly (and stocking of components), the right to repair and being able to ship repair parts overnight will allow existing small auto repair service centers to easily evolve to support a simplified EV design.

3.2. Maybe Not so Reasonable

The one "feature" I am dubious of is Aptera's "Skin-Cooling System." That is, using the vehicle's body surface to radiate any excess heat coming from the drive-train (motors or battery) or passengers (HVAC system). The first rule of engineering is "keep it simple, stupid!" Running some sort of liquid or gas heat-transfer fluid though body panels seems to totally defy this rule.

An aluminum radiator (or radiators) with a thermostatically controlled fan(s) for this function is simple, reasonably light, and can be placed in multiple locations that would access the normal airflow.

4. Heavies

Currently the only heavy semi-tractor being delivered in North America is the Nickola with about 50 units delivered (probably most, if not all delivered for drayage duty in Southern California).

4.1. Volvo and Tesla

In the United States, Volvo Trucks North America announced California-based Performance Team, a unit of Maersk Co., in October took delivery of its first 30 Volvo VNR electric trucks for its Southern California operations, with 16 operating from its Santa Fe Springs location and an additional 14 trucks set to begin operating from its Commerce location.[6]

[6] Roger Gilroy, Transport Topics, "Volvo, Mack, Tesla Show Gains With BEVs," Oct 7, 2022, https://www.ttnews.com/articles/volvo-mack-tesla-show-gains-bevs

In all, Performance ordered 126 Volvo VNR electric heavy-duty trucks to service its short-haul warehouse distribution routes.

Separately, the Tesla Semi truck is in production with the first deliveries scheduled for Dec. 1 and headed to PepsiCo, Tesla founder Elon Musk reported on Twitter Oct. 6.

PepsiCo Inc. ranks No. 1 on the Transport Topics Top 100 list of the largest private carriers in North America.

PepsiCo noted it expects to deploy 15 Tesla semi tractors by the end of 2022. It made an initial reservation for 100 of them to be deployed across both its snacks and beverage businesses.

4.2. California Dreamin'

California will probably be home to most of the early class-8 semi tractors. This is mainly because California offers a $120,000 Point-of-Sale Voucher for an electric Class 8 Semi-Tractor. The Federal IRA Tax Credit (Called the Qualified Commercial Clean Vehicle Tax Credit) is $40,000.

See the earlier post linked below for detains on the California Voucher for medium to large trucks and buses.

https://energycentral.com/c/ec/electric-trucks-and-buses-california

There is less information available on the IRA Qualified Commercial Clean Vehicle tax credit, I spent quite a bit of time researching this, and the site linked below seemed to be the clearest statement of the requirements:

https://www.law.cornell.edu/uscode/text/26/45W

5. EV Infrastructure Deployment Plans

For EV owners having more public charge points is never a bad thing. Thus the news in the excerpt below is good.

The Biden-Harris Administration today announced it has approved Electric Vehicle Infrastructure Deployment Plans for all 50 States, the District of Columbia and Puerto Rico ahead of schedule under the National Electric Vehicle Infrastructure (NEVI) Formula Program, established and funded by the Bipartisan Infrastructure Law. With this approval, all states now have access to all FY22 and FY23 NEVI formula funding, totaling more than $1.5 billion to help build EV chargers covering approximately 75,000 miles of highway across the country. The NEVI formula funding under the Bipartisan Infrastructure Law, which makes $5 billion available over five years, will help build a convenient, reliable, and affordable EV charging network across the country...[7]

Thanks to flexibility provided by the Bipartisan Infrastructure Law, State Departments of Transportation (DOTs) were able to leverage technical assistance available through the Joint Office of Energy and Transportation and begin staffing and activities directly related to the development of their plans prior to approval. Now that EV charging plans from all 50 States, the District of Columbia and Puerto Rico have been approved, each State,

[7] U.S. Department of Transportation Press Release, "All Fifty States Plus D.C. and Puerto Rico Greenlit to Move EV Charging Networks Forward, Covering 75,000 Miles of Highway," Sep 27, 2022, https://www.transportation.gov/briefing-room/historic-step-all-fifty-states-plus-dc-and-puerto-rico-greenlit-move-ev-charging

Territory, or District can be reimbursed for those costs and now have a wide range of options to use their NEVI Formula funding for projects directly related to the charging of a vehicle, including:

- *Upgrade of existing and construction of new EV charging infrastructure*
- *Operation and maintenance costs of these charging stations*
- *Installation of on-site electrical service equipment*
- *Community and stakeholder engagement*
- *Workforce development activities*
- *EV charging station signage*
- *Data sharing activities*
- *Related mapping analysis and activities…*

The NEVI Formula program is just one type of funding available to advance our electric vehicle future as part of President Biden's climate and economic agenda. An FHWA guide on federal funding available for EV charging infrastructure is available here.[8]

6. Early IRA Payoff

We are starting to see some of the Inflation Reduction Act of 2022 (IRA) intended results:

The Inflation Reduction Act is the most important climate legislation in United States history, but will it actually generate private investment in new manufacturing?[9]

In a word, absolutely.

Roughly $28 billion in new manufacturing investment has been announced in the weeks following the IRA's signing. These investments have primarily happened in the electric vehicle, battery, and solar manufacturing sectors – but the trend is just getting started.

The economic upside is massive. Energy Innovation modeling projects the IRA will increase GDP nearly 1% in 2030, and the Blue Green Alliance predicts it could add 9 million jobs in the next ten years. But securing the IRA's full economic development potential hinges upon state and utility implementation.

The legislation could become America's most significant investment in clean manufacturing and build a 21st century economy by leveraging tax dollars to generate roughly $1.7 trillion in new investment within a decade, according to Credit Suisse…

While almost every U.S. automaker has announced EV model expansions, the future of consumer uptake was uncertain due to several popular EV automakers reaching the 200,000-vehicle cap on federal EV tax credit eligibility, with several more expected to reach that point as soon as 2023.

Even though most EVs are cheaper than internal combustion engines on a monthly basis from the day they're purchased, those economics depend upon the federal EV tax

[8] https://www.fhwa.dot.gov/environment/alternative_fuel_corridors/resources/ev_funding_report_2022.pdf

[9] Silvio Marcacci, Forbes, "$28 Billion In New Clean Energy Manufacturing Investments Announced Since Inflation Reduction Act Passed," Oct 12, 2022, https://www.forbes.com/sites/energyinnovation/2022/10/12/roughly-28-billion-in-new-clean-energy-manufacturing-investments-announced-since-inflation-reduction-act-passed/

credit, and without them consumers may not choose to drive electric over fossil fuels. The IRA removes that roadblock by extending the credit for ten years and lifting the manufacturer cap.

While the IRS incentives are expected to modestly increase passenger EV sales, adding the new commercial EV incentives could have a powerful impact on that portion of the market. Automakers are already responding.

GM will invest $760 million at its existing Toledo Propulsion Systems plant to expand manufacturing to make drive units for planned EV models – the automaker's first U.S. EV-only powertrain or propulsion facility. It also recently said it will invest $491 million at an existing Indiana stamping plant to make various parts for future vehicles.

Foreign automakers are also focusing on the U.S. Kia announced it will shift some of its EV assembly to the U.S. by 2024 to qualify for IRA incentives. Kia currently holds the second largest market share for U.S. EVs, but only manufactures them in South Korea.

EV investments are also expanding beyond just cars and trucks. ABB announced it will build a new EV charger manufacturing facility in South Carolina, capable of building up to 10,000 chargers per year targeting electric school bus and fleet charging, and creating more than 100 jobs.

But even with new EVs made in America, powering those vehicles on the road is another issue. Battery manufacturing and the associated supply chain is largely concentrated in other countries. Designing incentives to gradually require more and more domestic content alongside the IRA's battery production tax credit will accelerate investments from domestic and international sources eager to power EVs in the world's second largest auto market.

Battery manufacturing investment announcements have quickly surged ahead. Honda and LG Energy Solutions announced a joint venture to build a $4.4 billion battery factory in Ohio where Honda's main U.S. factory is located, aiming for 40 gigawatt-hours annual production capacity – enough to power more than 700,000 vehicles according to the companies. LG's joint venture with Honda is part of its roughly $10 billion investment plan to open four new battery manufacturing plants in North America by 2025 to capture IRA-fueled consumer demand for EVs.

Panasonic, which supplies batteries to Tesla, is in discussions to build a new $4 billion battery plant in the U.S., potentially in Oklahoma. Panasonic already jointly operates a battery factor in Nevada with Tesla, and the new plant is being described as a "twin" plant with another $4 billion EV battery factory Panasonic announced in July for Kansas which could create up to 4,000 direct jobs.

Toyota announced it will more than double a planned EV battery plant in North Carolina, adding $2.5 billion in new investment to a previously announced $1.3 billion plant construction project. The larger plant, which will total $3.8 billion in investment, will create 2,100 new jobs.

Michigan will be home to two new battery manufacturing plants. Local startup Our Next Energy is planning a $1.6 billion cell manufacturing facility that will eventually employ 2,100 people. And Gotion Inc, the U.S. subsidiary of Chinese EV battery manufacturer Guoxuan High-Tech Co., is planning to develop a $3.6 billion manufacturing plant in the

state which will create 2,000 new jobs. That's notable since Chinese companies control most of the world's battery manufacturing.

U.S.-based companies are also expanding. Mining company Piedmont Lithium announced a $600 million lithium processing and manufacturing plant for EV batteries, citing a need to reduce U.S. dependence on Chinese suppliers, creating 120 new jobs, and crediting recent legislation incentivizing the use of domestically sourced critical materials and providing tax credits for U.S. producers.

EV battery recycler Cirba Solutions announced a $200 million expansion of its existing Ohio facility and a new battery recycling facility in Arizona which will create 185 jobs, both part of the company's plan to expand battery recycling 600%.

And not to be overlooked, Germany-based Bosch announced it will invest $200 million to expand existing South Carolina facilities to produce hydrogen fuel cell stacks to power electric heavy-duty vehicles, creating at least 350 new jobs along the way.

7. Tesla Third Quarter 2022 Results, Call

7.1. Tesla Q3 2022 Financial Results

Just after the market close today, Tesla released its financial results and confirmed that it managed to meet expectations on earnings, but it was down on revenue.[10]

The automaker reported revenues of $21.5 billion (about $500 million less than Wall Street expected) and earnings per share of $1.05 (Non-GAAP versus $1.00 expected by Wall Street).

Tesla's stock (TSLA) is down 5% in after-hour trading seemingly because of the miss on revenue expectations, but Tesla technically delivered record revenue, operating profits and free cash flow.

The automaker had an operating free cash flow of $3.3 billion last quarter and increased its cash balance to a record $21 billion.

One of the most important metrics is Tesla's automotive gross margin, which is the percentage of profit on sales of new vehicles. It stayed at 27.9% this quarter, which is high for the auto industry.

7.2. Q3 2022 Earnings Call

Good afternoon, everyone, and welcome to Tesla's third quarter 2022 Q&A webcast. My name is Martin Viecha, VP of investor relations, and I'm joined today by Elon Musk, Zachary Kirkhorn, and a number of other executives...[11]

7.2.1. Prepared Remarks:

Author's comment: The Motley Fool did a good job of transcribing the call, but there was much trivia and chit-chat (as there is in most earning calls). I tried to delete most of

[10] Fred Lambert, Electrek, "Tesla (TSLA) releases Q3 2022 results: miss on revenue but delivers on earnings," Oct 19, 2022, https://electrek.co/2022/10/19/tesla-tsla-q3-2022-results/

[11] The Motley Fool via MSN, "Tesla (TSLA) Q3 2022 Earnings Call Transcript," Oct 19, 2022, 5:30 p.m. ET, https://www.msn.com/en-us/money/companies/tesla-tsla-q3-2022-earnings-call-transcript/ar-AA13alpD

this and retain the meaningful content per my understanding of Tesla's direction and goals. If you want to see the full text, go through the link in reference 11.

Elon Musk -- Chief Executive Officer and Product Architect

Thank you, Martin. So just to do a Q3 recap. Q3 was another record quarter on many levels. We had our industry-leading operating margin reach of 17%.

And our free cash flow surpassed $3 billion in Q3 and approached $9 billion in the past 12 months. As our factories ramp, we're looking forward to a record-breaking Q4. So, it really, knock on wood, it looks like we'll have an epic end of year. So, Q4 is looking extremely good.

On the production ramp, Giga Berlin achieved another milestone of 2,000 cars made in a week with very good quality and is ramping rapidly. Giga Austin or Giga Texas should reach this milestone very soon. And in fact, just yesterday, we extrapolated yesterday's hold rate, it would be 2,000. Our production of 4680 cells has tripled in Q3 compared to the previous quarter.

We are finally gaining rapid traction on the 4680 cell. And its output is growing rapidly, and we expect it to start incorporating in cars and having it be a significant portion of our production here in Texas in the coming months. We also have our second generation of manufacturing equipment for 4680 cells in Texas, which continues to show great progress along with our original pilot line in Fremont. The Fremont factory team once again reached record production in Q3…

We've debated the buyback idea extensively at the board level. The board generally thinks that it makes sense to do a buyback. But we want to work through the right process to do a buyback, but it's certainly possible for us to do a buyback on the order of $5 billion to $10 billion. Even in the downside scenario next year, even if next year is -- was a very difficult year, we still have the ability to do a $5 billion to $10 billion buyback.

We're building a Cybertruck line here at Giga Texas [Inaudible] and making a lot of progress in the robotaxi platform design. And then with respect to batteries, we're moving as fast as possible to have -- to achieve 1,000 gigawatt hours a year of production capacity in the United States vertically integrated. And our cathode Tesla refining, we're moving a ton of speed to do that. So, I think it's an incredibly exciting future and really an unprecedented future.

Zachary Kirkhorn -- Chief Financial Officer

Just to continue on Elon's theme, I just want to thank and congratulate the Tesla team for achieving record vehicle deliveries, production, and storage deployments in the third quarter. On automotive profitability, our GAAP operating margin was 17.2%, with automotive gross margin at 27.9%.

Operating margin is one of our best yet, with improvements in operating leverage. However, Austin and Berlin ramp costs weighed on our margins, particularly if you compare it to Q1. Removing regulatory credits and Austin and Berlin, our operating margins would have been our strongest yet and auto gross margin would have been nearly 30%. Note that while small and growing, each car we build in Austin and Berlin is contributing positively to profitability.

We also continue to experience margin headwinds associated with macroeconomic conditions, as we've discussed at length on prior calls. In particular, raw materials, logistics, and foreign exchange was a big part of this past quarter. On energy profitability, we achieved our strongest gross profit yet for this business, driven primarily by record volumes of our Megapack and Powerwall products. Our free cash flows were also a record despite an increase in cars in transit at the end of the quarter, which has a negative impact on working capital.

Specifically on cars in transit, as noted in our press release on October 2, we've started to experience limits on outbound logistics capacity which we didn't anticipate. This issue is particularly present for ships from Shanghai to Europe and local trucking within certain parts of the U.S. and Europe. Our historical operating pattern of batch building by delivery region leads to extreme concentrations of outbound logistics needs in the final weeks of each quarter.

Just to put this in perspective, roughly two-thirds of our Q3 deliveries occurred in September and one-third in the final two weeks. As a result, we have begun to smooth the regional builds throughout the quarter to reduce our peak needs for outbound logistics. We expect this to simplify our operations, reduce costs, and improve the experience of our customers. As we look ahead, our plans show that we're on track for the 50% annual growth in production this year, although we are tracking supply chain risks which are beyond our control.

On the delivery side, we do expect to be just under 50% growth due to an increase in the cars in transit at the end of the year, as noted, just above. This means that, again, you should expect a gap between production and deliveries in Q4, and those cars in transit will be delivered shortly to their customers upon arrival to their destination in Q1. Boston and Berlin ramp costs will continue to weigh on margins, although we expect the impact to be less than what we saw in Q3. And as Elon mentioned, we are continuing to build as many cars as possible while also maintaining strong operating margins.

7.2.2. Shareholder Questions

Martin Viecha

Thank you very much. And let's go first to the shareholder questions. The first shareholder question is given the stringent battery content and assembly requirements for consumer tax credit eligibility under the Inflation Reduction Act, can you speak to Tesla's ability to meet those thresholds in each of 2023, 2024, and 2025 through your existing and planned supply chain?

Elon Musk -- Chief Executive Officer and Product Architect

Well, yeah, I mean I think just at a high level, I'd say, we do expect to fully meet the IRA's requirements. Do you want to add?

Zachary Kirkhorn -- Chief Financial Officer

Yeah. We view that passing of the Inflation Reduction Act, there's a significant boost toward accelerating automation, while also scaling the battery supply chain at large in the United States. We expect Treasury to publish detailed guidance by the end of the year. Until such time, it's difficult to fully determine the eligibility criteria, but we believe Tesla is very well-positioned to capture a significant share of that for solar storage and also electric vehicles.

Elon Musk -- Chief Executive Officer and Product Architect

Yeah, I'd like to say, we're -- like I said earlier, we're going to go basically pedal to the metal as fast as humanly possible to get to 1,000 gigawatt hours a year of production in the U.S. vertically integrated.

Martin Viecha

The next question is, do you still expect 50% annualized growth for the foreseeable future? Is this also true specifically for the Chinese domestic market? Do you expect to need to cut vehicle prices or offer incentives in any market to sustain a demand? Or has demand remained stable? Or is it even rising? There are three questions there.

Elon Musk -- Chief Executive Officer and Product Architect

Well, like I said, we want to sort of focus on a high level on what we think is possible here. We -- to the best of our knowledge, we believe that Tesla will continue to grow deliveries and revenue production at a 50% or greater compound annual growth rate. It might occasionally be a year that is a little less, and then some years would be maybe a little more or a lot more. In some of our out-year planning, we see potential annual growth rates that are in excess of 50%.

Martin Viecha

Thank you. The next question is, we keep hearing of dire energy crisis in Germany this winter. What are Tesla's plans to combat power cuts? And will there be any delays in ramp-up in production from Giga Berlin because of this?

Zachary Kirkhorn -- Chief Financial Officer

I think two points on this question. The first is that based upon everything that we know, we don't see this as a large risk to the company. Even if production did go down for a period of time, this is on near term, it doesn't have any impact on the long term of the company.

And we put in place backup plans, and we're working through the supply chain as well. Nearly all of our suppliers are prepared as well. So, we'll see how this plays out, but it's not something that we're terribly worried about.

The next question is, how is production planning going for the Cybertruck? What is the initial phase 1 production target? When can we expect an update on pricing and final design?

Yeah. I mean, as Elon said earlier, we'd be on facilities preparations here in Giga Texas for Cybertruck. We're still on track to enter early production in the middle of next year. We started our beta builds of all of the battery body in the existing --

Elon Musk -- Chief Executive Officer and Product Architect

When should I drop my beta?

In a few weeks. That's going well, and we continue ramping up through the end of next year and into 2023.

Elon Musk -- Chief Executive Officer and Product Architect

There's Tesla Semi, of course. So, we'll be handing over our first production Tesla Semis to Pepsi on December 1. I'll be there in person.

Yeah, 500 miles with the cargo on level ground. Yeah, sure. Not up. It's excellent.

But the point is it's a long-range truck and even with heavy cargo. And the number of times people talk about you can't -- it's impossible to make a long-range heavy-duty Class A truck. And they'll ask, "Well, what are your assumptions about watt-hour per kilogram and watt-hours per mile," and they look at me with a blank stare and then say hydrogen. I'm like, "No, that's not the answer," but I was looking for numbers literally.

It's not a number. It's [Inaudible] table. You obviously don't need hydrogen for heavy trucking [Inaudible]. And we'll be ramping up Semi production through next year.

As I think everyone knows at this point, it takes about a year to ramp up production. So, we expect to see significant -- we're tentatively aiming for 50,000 units in 2024 for Tesla Semi in North America. And obviously, we'll expand beyond North America. And these would sell -- I don't want to say the exact prices, but they're much more than a passenger vehicle.

The next question is, what is the progress of the 4680 cell ramp? And what factors determine whether vehicles get 2170s versus 4680 cells? And how will that change in the next year?

Zachary Kirkhorn -- Chief Financial Officer

Yeah, ramp is going well, as Elon said. Total output is up 3x quarter over quarter, and production is tracking to exceed 1,000 car cells per week this quarter as we said last quarter. Our focus is now shifting from 100% ramp to cost and further expanding production capacity in North America, as Elon also mentioned. On the 2170 versus 4680, in our factories, we really attempt to minimize factory complexity and product changeover while still making sure we get enough new product into the field to learn how it is performing.

And that sort of mix is going to shift as 4680 scales here and the overall factory ramp proceeds in Texas.

Elon Musk -- Chief Executive Officer and Product Architect

Right. Basically, production of 4680 ramp is growing exponentially. And yeah, it's going well.

Yeah. And like I said, we're -- our goal is to strive toward 1,000 gigawatt hours a year of annualized production in United States alone by Tesla.

Yes, there's roughly -- to transition to sustainable energy, our calculation for both stationary and vehicles is 300,000 to 400,000 gigawatt hours or 300 to 400 terawatt hours.

Yeah. And on the cathode side, we think will probably be iron and most of the iron -- iron can scale to very, very high tonnage and then some nickel. The exact percentages are hard to figure out, but it's probably be twice as much iron cathodes as they [Inaudible]. And then there's the manganese wildcard as well [Inaudible]

Can you talk about how Tesla could adjust if we were to enter a prolonged recession, including new product prioritization, investment flexibility, new factory versus factory expansion, service support infrastructure, productivity cost measures, and demand stimulation alternatives?

Elon Musk -- Chief Executive Officer and Product Architect

Well, to be frank, we're very pedal to the metal come rain or shine. So, we are not reducing our production in any meaningful way, recession or no recession.