The AGMA Electric Drive Technology Committee approached 2019 with three goals. The first goal was to assess electric drive motor development in the industrial space to specifically see if any technological advances are resulting in electric motors replacing traditional gear motors in specific applications. The second goal was to gain a real understanding of electric drive developments for vehicles, specifically for possible impacts to the gear industry. And finally, the third goal was to watch for new innovations beyond upgrades to existing technologies that may impact the future gear industry. The committee talked with each other, met with industry experts, attended conferences, brought guest speakers to the AGMA Board and to AGMA events, and read articles and reports to get the information that is contained in this summary report.

ELECTRIC DRIVE TECHNOLOGY — INDUSTRIAL

Electric drives or electric motors are not new to the industrial space. But continuous work is being done in creating more efficient motors. AGMA spoke with several industry experts and did a lot of research over 2019. The conclusion of the Committee is that there are no motor technology changes that would drive a significant shift from gear motors to electric motors. However, we did find instances where more efficient developments in electric motors have started to push into some sectors. The fundamental problem of removing reduction is that the electric motor would have to be significantly larger which can make the motor more expensive to build and more costly to run. Sectors where gears are being eliminated appear to be limited to selected smaller applications where oversizing the motor would not significantly increase the cost or high gear maintenance applications.
New Innovations – Industrial

The committee did find some interesting new innovations of note that we are monitoring.

C-Motive - https://www.c-motive.com/

C-Motive states that it has built “The world’s first commercially viable electrostatic motor.” These motors work on the principles of static electricity and as a result they are lightweight, the torque produces near-zero heat, and is nearly lossless. And there is no requirement for steel, copper, or rare earth minerals. This has the potential to fundamentally change the cost equation for providing torque through electric motors.

This Madison, WI-based start-up received funding in April, 2019 that it touted would be used to “deliver its first product to early customers.”

Infinitum Electric - https://www.infinitumelectric.com/

Infinitum Electric was started in 2016 with a mission to disrupt the way electric machines consume and create electricity. The company began as an application used to reclaim wasted energy from residential HVAC systems and created the PCB stator.

Infinitum Electric boasts the highest power density by cost advantage in the industry.

On the cutting edge

VIDEO: Increased efficiency with magnetized metals

Materials Science & Engineering Professor Michael McHenry explains how his lab creates metal materials that are small and flexible but still strongly magnetic.

ELECTRIC DRIVE TECHNOLOGY – VEHICLE

There has been significant movement toward electric drives in vehicles. That is something that almost anyone paying attention to manufacturing can take away from 2019. However, if you line up some of the top experts in automotive and ask them where this energy will lead, their answers vary widely.

The AGMA Electric Drive Committee not only talked to some of these experts and get their views, but also worked to collect a wide swath of articles on this subject that we posted to the AGMA website, social media, and e-Newsletters in 2019.
Here are some key take-aways from our 2019 work:

- Electric drives are not being developed by the same teams of engineers that develop internal combustion engines.

- There is no one-size-fits-all system configuration for electric drives. We have found a variety of configurations that are being employed across vehicle development including one motor running both axles, one motor on each axle and one configuration that has the motors in each wheel.

- There is no definitive answer on whether this is the future of car buying in America. Best estimates that we found agree within a margin that up to 30% of the market in the U.S. may shift to all-electric with the remainder staying in hybrid with ICE or full internal combustion engine vehicles by 2030. Electric vehicle adoption outside the U.S. tracks at a much higher rate in most future projections. All seem to agree that widespread electrification of vehicles will take several decades in the US.

- The lynchpin is the battery technology. The raw materials needed to build electric drives will increase in price as more of the materials are used. This effects the overall success and price structure of these vehicles. But technological advances, listed below, may provide tectonic shifts in this market in the future.

The same way that the development of the electric cars and trucks is moving at a much faster pace in years past, there has been a fundamental shift in the consumer-pointed demand for these vehicles. In 2020, gone are the tiny efficient “green” cars like the Volt. In their place, car makers are presenting full lines of hybrid and electric SUVs, pick-up trucks, and something new called an SUT – Sport Utility Truck. Car makers see the expense of producing these electric motors and are putting them in vehicles that have the bigger ROI. This is a big shift that started before 2019 but really played out in the last 12 months.

**New Innovations – Vehicle**

The committee did find some interesting new innovations of note that we are monitoring.

VIDEO: Aluminum-air battery promises 1,500 miles of range from a charge – BBC Autoblog, October, 2019.

VIDEO: 5 Motors you have to see to believe – Tech Planet, April, 2019

VIDEO: Why the future of cards is Electric – BMW’s outlook on electric as of August, 2019.

VIDEO: Siemens eHighway animation port application

VIDEO: It’s Electric! Meritor looks toward the future of electrification of vehicles – Meritor, May, 2019

**COMMITTEE – OTHER IMPORTANT HIGHLIGHTS FROM THE YEAR**
The Committee brought three powerhouse speakers to the MPT Conference this past October:

**John Bennett**, VP and Chief Technology Officer for Meritor discussed their plan for electrification in small and big trucks. He believes that trucks will stay with 2-4 speed transmissions. He voiced concern that the national grid cannot support a full switch to EV. He outlined the payback differential for ICE vs. EV with the payback longer for diesel which gets attractive by 2030. And he sees no real change in gear requirements on the truck side – motors run 5000 RPM max (where gears in cars need to handle faster speeds at high quality and low NVH)

**Jeff Hemphill**, Chief Technology Officer at Schaeffler talked about their multiple projects into electric for automobiles and smaller motorized vehicles. He stated that electric vehicle growth could be 26% by 2030 with slower growth in the U.S. He discussed their new technology for plug-in hybrid module. And stated that the biggest issues for EV specific to gears are the durability and noise. He cited that gears now need to get to speeds of 20,000 RPM currently and may be pushed to 50,000 RPM in the near future.

**Casey Selecman**, a veteran automotive analyst for IHS Markit came to deliver an honest and very informative talk on the nuts and bolts of the numbers for automotive. He provided information on a variety of vehicles:

- Start/stop ICE
- Hybrid electric vehicles
- Battery electric vehicles
- Cited current development for gears for speeds 16,000-20,000 RPM
- Use of new materials in EV R&D

He made the controversial case that automotive manufacturers do not see Battery EV as viable as he doesn’t see how they will bring down the price of the batteries and ultimately cars over time. He specifically cited the pricing of lithium and cobalt – There are limited amounts of these elements and as they are used over time the price will not come down but most likely increase. His forecast says batteries will not get to $100/kWh which is a key assumption in many current forecasts of electrification.

He pointed to a prediction that automaker strategy on emissions standards will focus on hybrids and start-stop technology and that they will fail to meet the standards. Despite these projections, all automakers are putting a lot of time and money in EV development. And he stated that we all must continue to monitor the influence of the oil lobby.

**Tech Deck Articles**

Throughout the year we posted articles to the weekly Teck Deck on this topic. Some of the top read articles include:
• Meritor launches slew of electrification programs with global OEMs – Meritor, January 2019.
• DOE announces $59M accelerate advanced vehicles technologies research – Green Car Congress, April 2019
• Electric cars still face a major roadblock – The Atlantic, June 2019.
• The coming electric vehicle transformation – Science, October 2019.

COMMITTEE GOALS FOR 2020

In 2020, the committee will work to continue to provide top articles, and reports to the AGMA membership. The focus for 2020 will be on the vehicle side of electric. We will be meeting with electric drive manufacturers to interview them to get the latest information. We hope to continue to provide high-level information to the AGMA membership.

The committee will have a minimum of 4 meetings in 2020:

• Thursday, February 20, 2020 – 2:00 pm EST
• Friday April 17, 2020 – 2:00 pm EST
• Friday July 10, 2020 – 2:00 pm EST
• Friday October 16, 2020 – 2:00 pm EST

HOW CAN YOU PARTICIPATE? Join a committee – Emerging Technology Committee participation is open to all employees of member companies. You do not have to be an expert in the technology – you just have to have a desire to learn more and engage with experts. We also encourage experts in the field to meet with us. Contact Mary Ellen Doran, Director – Emerging Technology at doran@agma.org for complete information.