

## Transformation

# CES Recap: AI everything, everywhere, all at once

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### Key takeaways

- As one of the largest tech events in the world, the 2024 Consumer Electronics Show (CES) made one thing clear: tech is accelerating innovation across all sectors. We highlight key recurring themes observed by BofA Global Research analysts in attendance at this year's show, but in short, and perhaps unsurprisingly: artificial intelligence (AI) continued to dominate discussions - however, such discussions are now moving from concept to commercialization.
- From automotive to agriculture, several tangible products and commercial applications for AI were demonstrated across home, work, heavy industry and mobility, with a combination of advances in simulation, computer vision and sensor fusion as key enablers to commercializing AI beyond digital to include physical applications.
- And don't forget electric and autonomous vehicles - mainstays at CES. This year's show was no exception, highlighting "software defined vehicles," autonomous industrial equipment, and even several "flying" concepts.

### What happened in Vegas... shouldn't stay in Vegas

With over 130,000 attendees and more than 4,000 exhibitors, CES 2024 in Las Vegas remains one of the largest tech events globally. And both the attendees and exhibitors are broadening with more analysts, investors and company management now attending. So, what's new? Converging tech is accelerating innovation across all sectors: healthcare, agriculture, supply chains and heavy industry all featured a range of tech-focused launches and exhibitions. Plus, the usual array of consumer brands showed how innovation is transforming their sectors, and tech companies showcased the next generation of computation that will power this: more capable semiconductors, data and artificial intelligence (AI).

We highlight four key recurring themes observed by BofA Global Research analysts in attendance. In short: AI continued to dominate discussions, but conversations are moving from concept to commercialization, evident in the array of new product launches ranging from embedding AI assistants into devices (and cars!) through to robots and autonomous machinery.

### Rise of generative, immersive, embodied AI...

As we mentioned in [The AI evolution](#), 2023 was the year of breakthroughs in large language models and generative AI (Gen AI) – making AI the dominant theme of CES. But rather than conceptual, several tangible products and commercial applications for AI were demonstrated across home, work, heavy industry and mobility. This is much broader than generative AI, with a combination of advances in simulation, computer vision and sensor fusion as key enablers to commercializing AI beyond digital to include physical applications. Across the array of AI announcements and demonstrations at CES, BofA Global Research saw a few converging themes:

- **AI personal assistants are in everything:** from car dashboards, keyboards, and devices that are more AI agent than application based, to several home appliances integrating Gen AI.
- **Digital to physical:** Gen AI is shifting from digital applications to advance simulation, testing, and training – streamlining product development from years to months.
- **Immersive AI:** The lines between physical and virtual reality (e.g., smart glasses, transparent TVs) are being blurred, with more mixed and extended reality (XR) tech in consumer, corporate and industrial applications (which may create new media/advertising experiences, too).
- **Embodied/autonomous AI:** Rise of the robots! Combining a range of sensors and computer vision with Gen AI for conversational and situational awareness – a range of robots and autonomous machinery were on display.

## Reality check: Immersive AI and experiences are getting nearer

Several immersive devices and experiences were available at CES this year that many defined as “XR” (extended reality) – combining augmented, virtual and mixed reality technologies, whether for personal or business use. Some key conclusions worth noting, include:

- **Compute:** The advancing computational power can enable more content/rendering to be seen through smart glasses, but most VR/AR (virtual reality/augmented reality) products still require external or large compute pads (that are heavy and heat up).
- **Just add AI:** Several exhibitors showcased smart glasses with various features from pictures to streaming, and AI features: think voice commands for AI assistants that can see and hear – useful to identify objects and one’s location to suggest what’s nearby, or even translate text, for example.
- **Immersive entertainment:** Transforming event venues with a range of screens – all of which one can experience at the Sphere, a 20,000 capacity, purpose-built venue that can project video, audio, scents, haptic feedback and wind (up to 120mph!) to produce a more immersive entertainment experience.

### Transforming screens with transparency, holograms, and crystal

On display this year were also several new concepts and developments of screens to visualize content – from new technologies (transparent TVs using LEDs (light-emitting diodes)), new materials (crystal to make content appear floating within luxury cars), and new form factors (holograms displaying digital avatars).

## Rise of the robots: Convergence of AI, sensors and software

Several robots were on display at CES, undertaking a number of tasks. And while robots at CES aren’t new, according to several exhibitors, the advancement of conversational capabilities owing to Gen AI on demand and advancing computational capabilities at a lower cost will bring “embodied AI” closer to reality. This was described to BofA Global Research by a humanoid robot, describing how a combination of these technologies can bring robots/sensory technology closer, accelerated by quantum computing when available.

The rationale, use case and urgency for this technology may vary depending on location and role that its undertaking, but whether for food preparation, hospitality, entertainment, companionship, making cocktails, or tackling home chores such as vacuuming – a range of ideas were shown this year.

## Future mobility: Software defined, electric, autonomous

### Software defined vehicles

Several tech companies and auto suppliers demonstrated “software defined vehicles,” characterized by a range of features that cars can undertake from commerce/payments to better entertainment, autonomous driving and more. To enable this requires a shift from the largely independent electronic control units (ECUs) that control each tech component in most vehicles today, towards a few high-powered computers controlling multiple functions within cars. This shift could allow companies to launch new features and content more quickly (requiring software rather than hardware changes), provide ongoing upgradeability and remote maintenance via over-the-air updates, and in turn, avoid obsolescence, and reduce costs and new product lead times.

### EVs: Competition intensifies

Despite the slowing demand for electric vehicles (EVs) (see [Is the EV transition running out of charge?](#)), and lack of consumer and infrastructure readiness for autonomous vehicles, CES reaffirmed that anything that moves is indeed heading in this direction. Cars, trucks, bikes, and even boats and heavy industrial equipment such as mining vehicles, electric and/or self-driving variants were on display, which not only demonstrates the increasing competition from both established vehicle manufacturers and startup entrants, but also the breadth of companies using CES as a platform to launch new concepts, albeit some far from production ready. Highlights include:

- **Beyond sport utility vehicles (SUVs):** Several EVs were shown across multiple segments from a few small city cars to a number of larger crossovers, high performance cars, off-road, and pickup trucks. Every vehicle segment is moving towards electrification.
- **In-car experiences:** As EV launches rise, a shift in emphasis from purely powertrain towards other features such as in-car streaming, gaming, AI assistants, and smart home integration were a focus (e.g., vehicle to grid charging capabilities).
- **Better batteries:** EV battery ranges continue to increase, enabled by next-gen batteries; whether solid state, sodium-ion or swappable – all were mentioned in product launches across the show.

## Video streaming coming to cars

Several car companies and suppliers demonstrated increased screen sizes within vehicles and concepts of what they could be used for, including business (e.g., virtual meetings), gaming (via the ability to access third party apps to use the screens in cars as a games console), and streaming (e.g., in-car streaming and even a large foldaway screen linked to haptic feedback and speakers embedded in the seats).

## Autonomous driving: When, where, and how? Depends on who you ask...

Autonomous cars, trucks, and “robotaxi”/shuttle services were also on display. Key takeaways from across this year’s show include:

- **ADAS first, AVs later:** What’s clear is that most applications for passenger cars are targeting lower levels of autonomy – meaning the driver is still in control of the vehicle – through advanced driver assistance systems (ADAS) (see [Caution: Safety first!](#)), which can be commercialized sooner in larger volume private cars. To achieve fully autonomous vehicles (AVs) and shared mobility applications remains dependent on regulatory and technological uncertainty (e.g., which sensors to use, proven safety, etc.) and cost (of sensors/compute).
- **LiDAR and/or radar?** Notably, a key debate is whether light detection and ranging (LiDAR) sensors are essential in an autonomous driving future, and if so, can the cost be reduced significantly enough to accommodate the profitably in cars/vehicles? This year’s exhibitors were on both sides of the fence – one noting significant cost reductions (average selling price of around \$1,000 per unit, set to half in the next few years as volume ramps up) and demonstrating the impacts of self-driving capabilities with versus without LiDAR (in summary – it didn’t work as well, hitting an object in the vehicle without LiDAR). However, other companies demonstrated how a combination of improved cameras, radar, and software can also achieve self-driving in certain conditions without it (and thus, are cheaper). Ultimately, the key conclusion was that each company/use case has different requirements that can be met by a combination of sensor configurations that need to be optimized with software.
- **Power consumption:** Related to that sensor choice is the impact on the power required to run it; efficiency is becoming more important, especially with EVs to avoid utilizing too much battery range.
- **Driver as a service:** Several truck companies demonstrated autonomous truck technology – targeting a pay-per-mile “driver as a service” business model to sell autonomy as a product to either truck companies or operators directly. The result? Self-driving trucks may come before cars, with autonomous “driver-out” routes starting this year, and commercial operations expected in the next two to three years as the technology matures and the first customers identify routes.
- **Robotaxis/shuttles are here, but its early days:** While there are several companies piloting fully autonomous services already, timelines for robotaxi deployment at scale remain unclear, subject to cost, safety and tech validation on a city-by-city basis. More positively, AI advancements may accelerate the simulation, testing, and on-board capabilities required to achieve it.
- **Accidents/insurance:** The key reason for developing automated driving features in passenger cars is to improve safety, but it is hard to prove to what extent this can be realized at this point, owing to the early stage of deployment. In turn, companies are looking to quantify the on-road performance/safety of vehicles equipped with their own LiDAR to validate accident prevention capabilities, and in turn reduce insurance premiums.

## Techceleration: From cleantech to moonshots

In addition to cars, bikes, trucks, and boats - there were multiple heavy machinery vehicles (think: mining vehicles, military vehicles, road sweepers and agricultural tractors) within the CES event halls showcasing electric and autonomous capabilities – all at varying maturity. Increasingly, CES is used by heavy industrial companies to demonstrate next gen equipment and technology. Notable takeaways include:

- **Autonomy:** Pilot customers are currently testing autonomous tractors with 50,000 paid acres covered autonomously thus far.
- **Precision Ag:** Tech to identify which crops/weeds to spray, saving on the amount of chemicals used and thus, cost, by up to two-thirds. Also, RFID (radio frequency identification) tagging of crops (e.g., cotton bales) to monitor crop yield and quality. See [Feeding the future](#) for more on this topic.

- **Hydrogen comeback:** From mobility to turbines, several companies launched hydrogen fuel cell products as well as industrial equipment. While there were more electrified alternatives by volume in comparison, it underscored that some manufacturers still see the potential role hydrogen can play in decarbonizing a range of solutions.
- **Flying cars:** That’s right - a combination of technologies may bring moonshot innovation closer than originally thought. Several eVTOL concepts (electric vertical take-off and landing aircrafts) were on display targeting “flying cars” before the end of the decade.

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