

The Intelligent Vehicle Is Moving Off-the-Road

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From passenger vehicles to two-wheelers and commercial trucks, all corners of the on-road mobility are following a familiar trajectory: vehicles are becoming more connected, digital and intelligent.

Traditional commercial vehicles are already well into this transformation, with safety requirements accelerating the adoption of cameras, ADAS, digital cockpits, and centralized computing.

Regulations such as UNECE R151 and R159 are also helping drive the shift from traditional mirrors toward camera-based detection and greater awareness around the vehicle. We explored this evolution recently in **How Safety Regulations Are Redefining Truck Architecture**.

However, the same transformation does not stop when the pavement ends.

When the environment changes, vision must change with it

Look beyond the highway and another category of machines is moving from analog visibility to intelligent perception, with agricultural equipment, construction machinery, forklifts, cranes, mining equipment, and off-road trucks giving way to the camera above the mirror.

But going off-road changes the problem.

This new environment can expose cameras to mud, dust, water, snow, vibration, and extreme temperatures. Visibility cannot be an afterthought when a camera is expected to operate in these conditions, and depending on the application, that can mean the need for:

- Self-heating for cold and freezing conditions
- Ultrasonic self-cleaning to maintain lens visibility
- High-dynamic-range imaging
- 360-degree surround view
- Object and pedestrian detection
- Edge AI and intelligent perception
- High-speed digital connectivity
- Radar integration

Off-road also does not necessarily mean on land. Marine applications introduce another demanding environment where exposure to water, salt, and corrosion places additional requirements on camera housing, materials and long-term durability.

The result is a wide range of engineering challenges, but also an estimated \$650 million global addressable market for advanced camera and vision systems, spanning different regions with very different needs.

Europe combines sophisticated applications with demand for advanced technology. North America offers scale and increasing automation. China brings high volumes alongside strong cost pressures. Japan and South Korea emphasize technology and automation, while India combines growth potential with the need for localization and cost optimization.

A natural adjacency for Visteon

For Visteon though, this is not simply a new opportunity in a new market. We are talking about a compelling adjacency to technologies already transforming vehicles on the road.

Camera systems are the entry point. The same progression that took passenger cars from a single rear camera to surround view and AI perception applies off-highway, with a different job to do: visibility around the machine, blind-zone awareness, and, on more advanced sites, perception for assisted or remote operation.

Displays follow the same path. A digital cluster and camera display consolidate onto a cockpit domain controller or high-performance compute platform, then onto a connected architecture that can take software updates and fleet data.

Cameras → surround view → AI perception

Displays → CDC/HPC → connected AI architecture

The opportunity is bigger than the camera.

As off-highway machines become more connected, digital, and intelligent, the technologies that transformed the road are starting to reshape what happens beyond it.

"Advancements in Visteon's camera portfolio are well suited to the requirements of the off-highway market. They also open the door to the rest of the cockpit stack - displays, domain control, and AI perception systems, rather than a camera sale on its own."

— Claudia Larsson, Commercial Vehicles Customer Business Unit Director