LeddarTech®

WHITE PAPER

From Hype to Highway: Today's Opportunities in Automated Driving

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Abstract

With a nod to the tempered expectations surrounding autonomous vehicles, this White Paper emphasizes the opportunities within the currently more achievable SAE Level 2 and Level 3 driving automation. It is tailored for automotive professionals, automated driving enthusiasts, industry observers and financial investors looking for grounded, realistic opportunities amidst the noise.

Focused on the transformative impact of advanced driver assistance systems (ADAS) and autonomous driving (AD), this document analyzes the shift in market dynamics, the role of consumer trust and the shifting trends in mobility. This White Paper provides an overview of the current state of ADAS and AD with respect to consumer adoption and trust. Additionally, it covers topics such as ADAS market penetration, its influence on new vehicle purchase decisions, factors impacting consumer trust and the limitations of existing solutions.

Introduction

McKinsey values the autonomous driving mobility ecosystem market at US$ 300 - US$ 400 billion in the next decade and beyond. Future Market Insights estimates that the global ADAS market will be worth US$ 131 billion by 2032. MarketsandMarkets expects the ADAS worldwide market size to reach US$ 65 billion by 2030. While artificial intelligence (AI) has caused great excitement and frenzy in the last year or so, it has been widely employed in the ADAS and AD space through computer vision and machine learning. Despite predictions in the last decade that self-driving cars would become ubiquitous in the 2020s, this vision has not materialized. It is commonly accepted that the opportunity in automated/assisted driving lies not in Level 5 full self-driving vehicles but in Level 2 and Level 3 advanced driver assistance systems.

Understanding Assisted/Automated Driving

The Society of Automotive Engineers (SAE) has categorized driving automation into six levels, spanning from Level 0 (no driving automation) to Level 5 (full driving automation). Each of these levels is explained below:

- **Level 0 (no automation):** At this level, the vehicle's system provides no control over its dynamics; it remains entirely under the driver's manual control. Automation features at this stage may include basic warning alerts but do not involve active vehicle control.
- **Level 1 (driver assistance):** In this category, specific control functions such as steering or acceleration/deceleration are automated, but not both simultaneously. An illustrative example is adaptive cruise control (ACC). The driver retains responsibility for all remaining aspects of the driving task.
- **Level 2 (partial automation):** At this stage, the vehicle takes charge of both steering and acceleration/deceleration based on information about the driving environment. Nevertheless, the human driver must remain actively engaged, supervising the system and ready to assume full control when prompted or in response to system limits or failures.
- **Level 3 (conditional automation):** The vehicle is capable of executing all aspects of the dynamic driving task within specific conditions, such as highway driving. It will prompt human intervention when these conditions are not met. While the driver must be available to take over, continuous monitoring of the environment is not mandatory.
- **Level 4 (high automation):** The vehicle can achieve all driving tasks independently within specific conditions, such as geofenced areas or particular road types. No expectation exists for human driver intervention in these predefined environments, and no continuous driver attention is necessary.
- **Level 5 (full automation):** The highest level of automation, where the vehicle can perform all driving functions under all conditions. The vehicle is designed to be fully autonomous and operates without the need for a human driver.

Every level represents a significant step in integrating and advancing intricate systems, encompassing sensor fusion, machine learning, sophisticated decision-making algorithms and robust fail-safe mechanisms, pivotal for ensuring the safety and efficiency of autonomous and assisted vehicle operations.

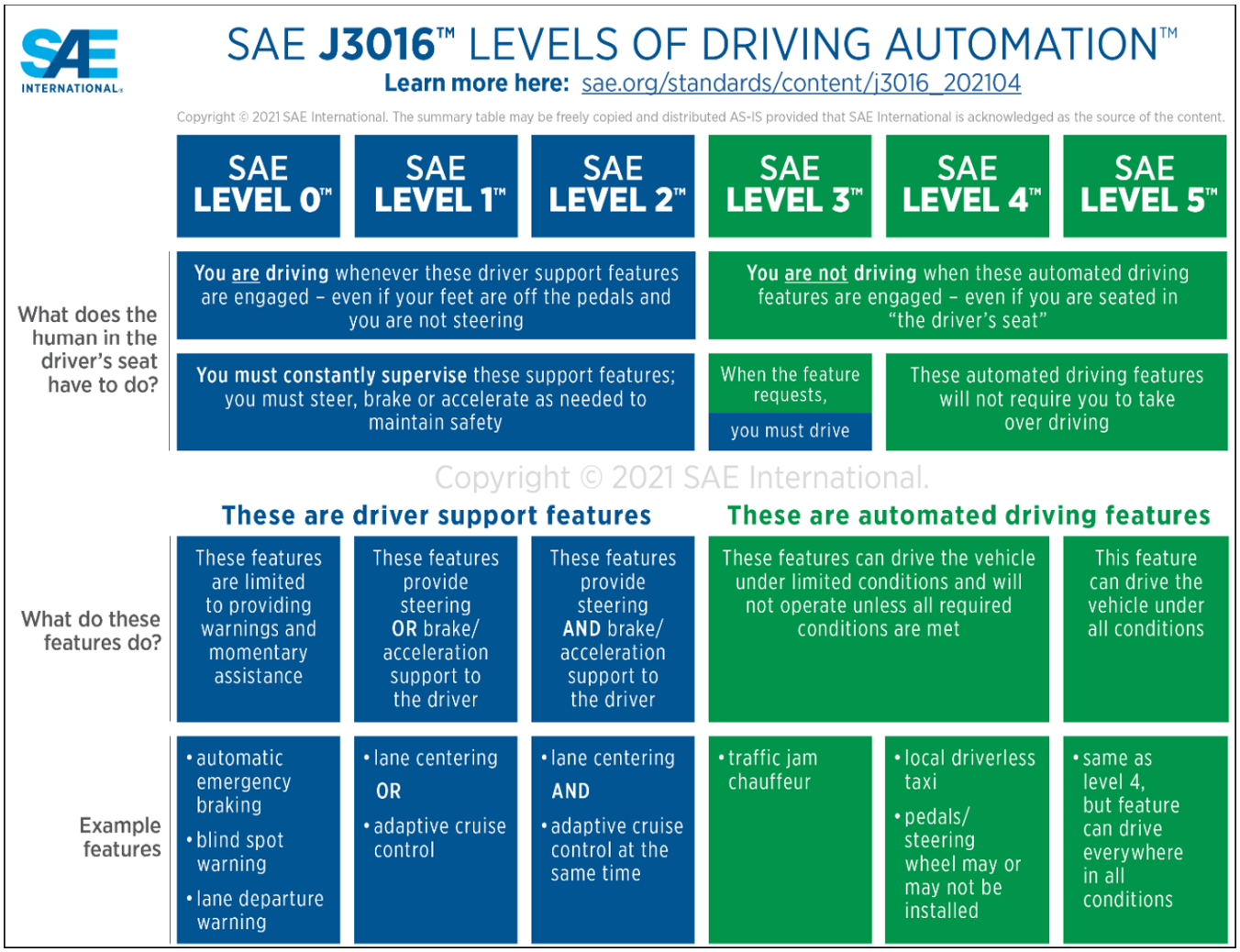

Figure 1 – The different levels of driving automation as defined by SAE International

AD or ADAS: The Long and Short of It

In November 2023, GM's Cruise initiated a recall of all its autonomous vehicles following an incident in which one vehicle pulled a pedestrian to the side of a street, prompting a subsequent ban by California regulators. In January 2024, Aptiv announced the cessation of capital allocation to the Motional robotaxi project, a joint venture with Hyundai. Notably, in December 2020, Uber divested its self-driving arm to Aurora. Facing technical and commercial challenges, both Embark Truck and Argo AI have encountered obstacles leading to their closures.

While negative news coverage of robotaxis is not unprecedented, the scrutiny faced by autonomous vehicle developers and their parent organizations is unparalleled. This scrutiny emanates from the public, legislators and authorities, financial investors and company shareholders. The development of autonomous vehicles is a monumental undertaking, demanding substantial investments in financial and human resources, technical expertise and infrastructure. In this economically challenging environment, compounded by negative and mixed public sentiment surrounding autonomous vehicles, manufacturers are swiftly redirecting their efforts toward realizing short and medium-term opportunities, which are readily found and better realized in advanced driver assistance systems.

The following factors have contributed to the acceleration in the development of ADAS systems:

- Recognition that fully autonomous vehicles cannot be deployed in the short term
- Immediate revenue opportunities
- A growing population of tech-savvy drivers
- Incremental change that allows drivers to gradually adapt to ADAS vs. a complete mindset overhaul required to experience AD
- Governmental regulations mandating enhanced road safety through ADAS

With the automotive industry's shift to software-defined vehicles and the increasing importance of technology, ADAS is a key pillar of this transformation. Car buyers are receptive to new pricing models, such as monthly or yearly subscriptions for ADAS features like adaptive cruise control, highway assist and traffic jam assist. General Motors has told investors it aims to generate up to $25 billion in software and services subscription revenue annually by 2030 –up from an estimated $2 billion in 2021. Stellantis, formerly known as Fiat Chrysler, is shooting for $23 billion by 2030. These plans enable the buyer to experience first-hand the benefits and features without committing to purchasing the application upfront.

The Next Step: Improving ADAS Systems and Consumer Confidence

As per the INRIX 2022 report, the average driver in London, Chicago and Paris lost 156,155 and 138 hours of the year in traffic jams respectively. ADAS developers realize that developing a solution to combat such mobility experiences is not just a matter of convenience but also safety, mental health and comfort. ADAS features such as blind spot warning, automatic emergency braking and lane keep assist have been developed to enhance safety while traffic jam assist, highway assist and automatic lane change improve the driving experience. Further on, automated or assisted parking features enhance the comfort and safety of the driver and surroundings at the start and end of each journey.

However, as highlighted in J.D. Power's 2022 Mobility Confidence Index Study, the comprehension of ADAS among consumers is not yet widespread. Inconsistencies in operation and performance could exacerbate consumer understanding, acceptance and overall adoption challenges. The study revealed that 65% of respondents inaccurately define fully automated, self-driving vehicles. Bridging the technical definition of various levels of automated driving with consumer understanding has proven to be a long-standing issue. J.D. Power's 2023 Mobility Confidence Index Study also pointed out that "consumers inaccurately cite examples of personal vehicles available to purchase or lease today, as 22% indicate that 'Tesla' or 'Autopilot' are fully automated."

Additionally, consumer trust in the system is shaped by legal liabilities. The question of responsibility arises if the vehicle, while ADAS such as the highway pilot is engaged, causes an accident. Furthermore, the extensive and exhaustive list of conditions under which the ADAS system can operate safely contributes to consumer hesitancy. This compilation of conditions is known as the operational design domain (ODD), representing the set of conditions that must be fulfilled for the system to operate accurately. While informing customers of these technical necessities positively contributes to their understanding of the system, it could also negatively impact driver satisfaction with the system's ability and capability.

As an example, in this DRIVE PILOT video (Level 3 system), Mercedes makes several noteworthy statements, including:

"Please note that DRIVE PILOT will only operate up to 40 mph in traffic jams on a pre-mapped freeway network approved by Mercedes-Benz."

"DRIVE PILOT will not exit the current lane and, therefore, you may need to disengage the system to follow your planned route."

DRIVE PILOT is used here as an example to highlight the limitations of today's ADAS systems. Numerous online videos showcase instances of full self-driving software in Tesla vehicles behaving erratically. This phenomenon is not exclusive to Tesla; other vehicle manufacturers face similar issues regardless of location. In 2022, an XPeng P7 vehicle crashed into a car parked on the side of the highway, near the guardrails, while its lane-centering control (LCC) ADAS was active. These limitations in ADAS performance stem from subpar system functionality. Factors such as instances of ADAS malfunctioning, the heavy use of technical and legal jargon around ADAS, consumer misunderstanding, the non-standardization of terminology across automotive original equipment manufacturers (OEMs) and the absence of ADAS performance standards all contribute to consumer confusion.

According to Consumer Reports' Consumer Perceptions of ADAS: Driver Monitoring Systems, a significant portion of the 35,250 respondents did not express a high level of satisfaction with their ADAS systems.

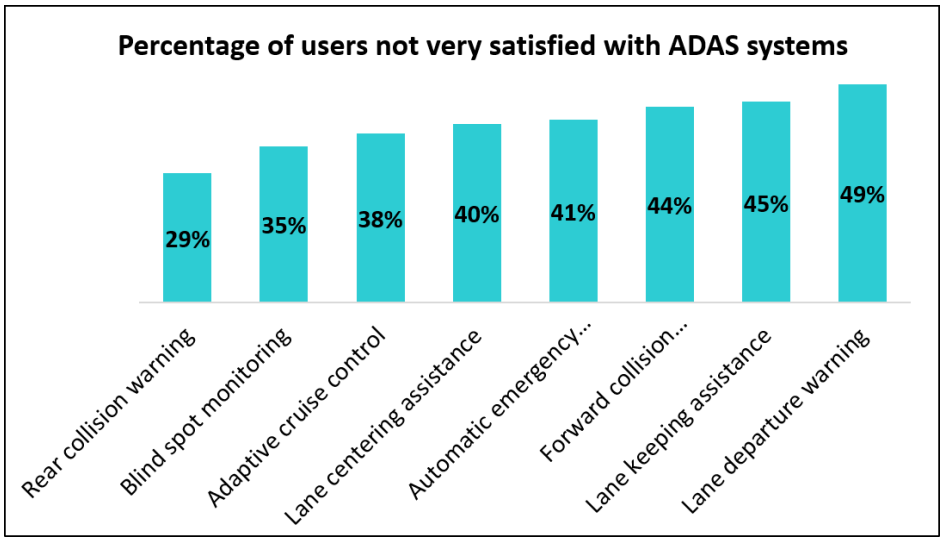

Figure 2 – Consumer dissatisfaction poll for ADAS, broken down by feature (source: Consumer Reports' Consumer Perception of ADAS: Driver Monitoring System Study)

Purchasing Patterns of Consumers in ADAS

The success of any product, technology or innovation always hinges on customer adoption and appetite, and ADAS is no exception. The value proposition of ADAS to the driver in terms of safety and comfort is robust. In July 2023, McKinsey released the Hands Off: Consumer Perceptions of Advanced Driver Assistance Systems study, featuring insights from their mobility consumer pulse survey conducted among 20,978 mobility users across various countries[1]. The report delves into the perceptions and preferences of mobility users regarding future mobility, encompassing ADAS and AD.

The report concludes that merely 5 percent of electric vehicle (EV) buyers express a lack of interest in any ADAS features in their cars. In the premium EV segment, this number drops to 1 percent. There exists a robust correlation in consumer perception between electric vehicles and technology. ADAS systems benefit from this positive correlation, resulting in a heightened propensity for consumers to purchase ADAS systems.

[1] Australia, Brazil, China, Egypt, France, Germany, Italy, Japan, Norway, Saudi Arabia, South Africa, South Korea, the United Arab Emirates, the United Kingdom and the United States.

The report notes, “Today’s usage patterns reveal some consumers rarely use advanced driver assistance system (ADAS) features despite having them in their cars. On average, 25 to 30 percent of consumers who have basic ADAS features such as active cruise control (ACC) or parking assistance in their cars today never or seldom use them. Their prime reasons for not using ADAS range from the joy of driving to not knowing when to use them to a fear of technology failure. Overall, consumers indicate reasonable satisfaction with their ADAS experience in their current cars. … For future purchases, we see a stronger consumer pull for increasing degrees of driving assistance and technology-enabled autonomy in their next cars, especially as more people seek electrified mobility options.”

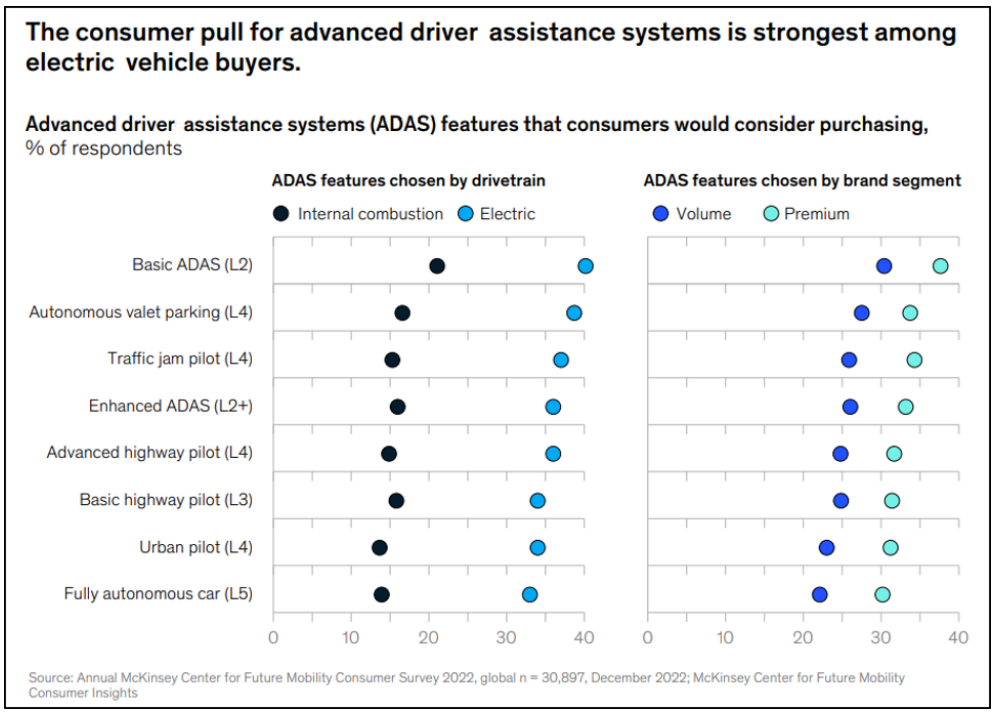

Figure 3 – Consumer pull for ADAS systems (source: Annual McKinsey Center for Future Mobility Consumer Survey 2022; McKinsey Center for Future Mobility Consumer Insights)

In a survey conducted by AlixPartners, customers across the U.S., China and Germany expressed trust in ADAS features, even if they had a negative or no prior experience with them. Importantly, these customers demonstrated a willingness to invest thousands of dollars to obtain advanced driver assistance systems. Other consumer reports support this trend, with 50% of respondents indicating a willingness to pay up to $9,999 for advanced highway autopilot (Level 4) systems.

The inclination of consumers to purchase ADAS systems not only influences their initial decision but also affects their repurchase considerations. A significant majority of car buyers express a willingness to repurchase the ADAS features they currently have and might even consider seeking a discount based on their experience. Importantly for vehicle manufacturers, 42% of EV buyers and 38% of premium-brand car buyers state that they would be highly likely to switch brands for superior ADAS features.

The LeddarTech Perspective

The journey towards autonomous driving necessitates the integration of advanced driver assistance systems. Neither consumer understanding nor trust in Level 5 autonomous vehicles has reached a level where their deployment on roads could be deemed safe. Equally crucial, technology has not yet attained the requisite performance level. The data presented in the previous sections highlights a few noteworthy points:

1. Consumer demand exists for ADAS features, with consumers demonstrating a willingness to pay a premium.
2. Consumers express a potential inclination to switch brands if vehicle technology fails to meet their expectations.
3. Enhancing consumer satisfaction and confidence with ADAS applications will bolster demand and boost sales of vehicles featuring ADAS.
4. Technical deficiencies in today's ADAS systems must be addressed immediately.

While some consumers have shown hesitancy and fear towards robotaxis and autonomous vehicles, they express cautious excitement about ADAS. This caution arises from the fact that, despite increased exposure and improved consumer understanding compared to previous years, concerns still linger around system reliability, knowledge and driver monitoring. Despite this, car buyers recognize the value of advanced driver assistance systems and make it part of their car-buying decision-making process, and subsequently vehicle manufacturers are strategically focusing on ADAS applications to unlock short to medium-term revenue channels, which consequently results in a simultaneous reduction in resource allocation to the development of Level 4-5 vehicles.

LeddarTech recognized that, in the highly competitive automotive market, OEMs require solutions that enable them to design and manufacture ADAS applications faster and at a lower cost to meet consumer demands. To meet this need, LeddarTech introduced LeddarVision™, an AI-based low-level sensor fusion and perception high-performance software that is cost-effective, flexible and scalable to support all SAE autonomy levels by applying AI and computer vision algorithms to fuse raw data from sensors employed in L2 to L5 applications. Its raw data fusion technology detects very small obstacles on the road with better detection rates and fewer false alarms than legacy "object fusion" solutions. Since 2023, LeddarTech has released four products to meet the immediate Level 2-2+ ADAS requirements, enabling OEMs to reduce development time and costs while achieving a faster time-to-market.

LeddarTech's product portfolio consists of comprehensive fusion and perception stacks that employ LeddarVision AI-based low-level sensor fusion software technology:

- **LeddarVision Front-View – Entry (LVF-E):** Supporting entry-level ADAS L2/L2+ highway assist and 5-star NCAP 2025/GSR 2022.
- **LeddarVision Front-View – High (LVF-H):** Supporting premium front-view ADAS L2/L2+ highway assist and 5-star NCAP 2025/GSR 2022 safety applications.
- **LeddarVision Surround-View (LVS-2⁺):** Supporting premium surround-view ADAS L2/L2+ highway assist and 5-star NCAP 2025/GSR 2022 safety applications.
- **LeddarVision Parking (LVP-H):** Supporting premium ADAS L2/L2+ automated parking and parking assist applications.

LeddarTech's approach to ADAS and AD succinctly encapsulates by its mission statement: "To deliver high-performance AI automotive software that enables the market to deploy ADAS features reducing the number of road accidents and making transportation more enjoyable and efficient."

This White Paper does not constitute a reference design. The recommendations contained herein are provided "as is" and do not constitute a guarantee of completeness or correctness.

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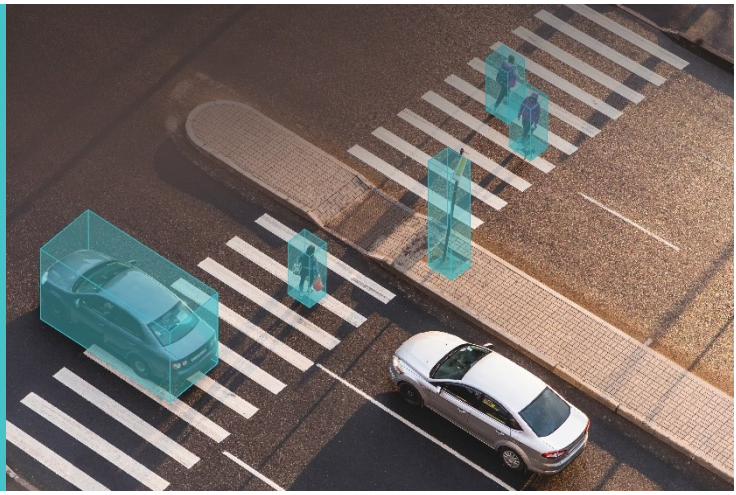
About LeddarTech

A global software company founded in 2007 and headquartered in Quebec City with additional R&D centers in Montreal, Toronto and Tel Aviv, Israel, LeddarTech develops and provides comprehensive AI-based low-level sensor fusion and perception software solutions that enable the deployment of ADAS, autonomous driving (AD) and parking applications. LeddarTech's automotive-grade software applies advanced AI and computer vision algorithms to generate accurate 3D models of the environment to achieve better decision making and safer navigation. This high-performance, scalable, cost-effective technology is available to OEMs and Tier 1-2 suppliers to efficiently implement automotive and off-road vehicle ADAS solutions. LeddarTech is responsible for several remote-sensing innovations, with over 150 patent applications (80 granted) that enhance ADAS, AD and parking capabilities. Better sensory awareness of the environment around the vehicle is critical in making global mobility safer, more efficient, sustainable and affordable: this is what drives LeddarTech to seek to become the most widely adopted sensor fusion and perception software solution.

For more information: sales@leddartech.com



LeddarTech®

CANADA – USA – AUSTRIA – FRANCE – GERMANY – ITALY – ISRAEL – HONG KONG – CHINA

Head Office
4535, boulevard Wilfrid-Hamel, Suite 240
Québec (Québec) G1P 2J7, Canada
leddartech.com

Phone: + 1-418-653-9000
Toll-free: 1-855-865-9900