

Axilion Smart Mobility - Update Report

29.08.2021

Stock exchange
TASESymbol
AILNSector
TechnologySub-sector
SoftwareStock price target
15.8 NISClosing price
4.9 NISMarket cap
143.6 NISNo. of shares
29.0 millionAverage daily
trading volume
5,307 stocksStock performance
(Since Jan. 2021)
-88.3%

Changes in senior management, along with efforts to increase the transparency of the company's activities by publishing development and pilots schedules; price target remains unchanged

Axilion is an artificial intelligence (AI) software company that **develops AI-based systems** to better manage **traffic mobility** in cities, thereby **reducing their carbon footprint** and **improving urban traffic safety**.

Major events since the publication of our previous [report](#):

- TransEM - the company submitted a request to extend the validity of the permit on behalf of the Ministry of Transportation in Israel.
- X Way Pulse - The module was successfully implemented in the city of Bolzano (Italy). The company is in commercial negotiations with the city and its strategic partners (Microsoft and Vetrya). Last June, the company announced the cancellation of a pilot in Reims (France) and its intention to promote piloting in an alternative city. Following this announcement, the company is planning another pilot to integrate its module in Dunkirk (France) in collaboration with Transdev.
- X Way Twin - The Company is expected to complete an MVP by the end of 2021 for the sake of verifying the business model and pricing model.
- The Company continues to seek additional partners in the US, in the areas of B2G, B2B, and with other entities.

Strategy and business model - The company conducts pilots for its X Way Pulse product with Microsoft Azure as a strategic partner. Axilion is in the stage of technological feasibility and building the business model, and before the sales stage. Therefore, **there is also a certain risk involved in commercializing the company's services**. We identify difficulty in closing deals as the company's customers are mainly institutions (municipalities, etc.), characterized by relatively long sale cycles. Due to the Covid-19 outbreak, the mentioned customers, especially in the US market, are focusing their resources on issues related to health and fighting the coronavirus, rather than issues that were more on the agenda in the past like urban transport.

Recall that Axilion is addressing the AI-based traffic management market. We anticipate 2021 being the year in which AI systems will be deployed globally, utilizing the new infrastructure built into data centers. This will attract more investments in the coming years.



Key events in the first quarter and the passing months of 2021:

Milestone	Timeline	Status
Permit to continue operating the TransEM system	Q3-2022	The software is in commercial use, pending the extension of the permit validity by the Ministry of Transportation in Israel
Development of additional features for TransEM	Q4-2021	Features development – Done. The features will be included in a future version which will be submitted for approval as well
Completion of the development of the X Way Pulse system	Q4-2021	The system is in the testing stage
Development of an MVP for the X Way Twin system	Q1-2022	Advanced development processes (focusing on calibration and validation)
Completion of the development of the X Way Neural system	2023	Product characterization and requirements specification stage
Pilot in Jerusalem - Simulation of traffic light plans	Q1-2022	Conducting field tests to validate and calibrate the simulation model
Bolzano - Commercial agreement and pilot for the X Way Twin system	Q1-2022	The X Way Pulse module has been implemented in parts of the city in collaboration with Microsoft and Vetrya. Commercial negotiations with the local municipality and strategic partners to continue the paid service, along with another pilot for the X Way Twin system
Pilot in Dunkirk to implement the X Way Pulse module in collaboration with Transdev	Q2-2022	Formulating the statement of work content document in collaboration with Transdev

In conclusion, the company continues to develop its products, managing pilots around the world (Italy, France & Israel) to examine the feasibility of its products and their integration in transportation systems in various cities and is working to strengthen its business development capabilities. In our view, the decline in Axilion's market value in recent months reflects a reduction in the expectations gap between the company and the market, which expected the company to reach technological and business achievements at an earlier stage.

The company's financial statements show that its making efforts to increase transparency about the pace of technological development, pilots, and business activity by publishing schedules. Our assessment of the company's activity is based on these schedules. We estimate that the company has sufficient cash balance to support its operations in the next two years.

Investment Thesis

Executive Summary

A significant share of global fossil fuel-based energy generation goes to the transportation sector. The combustion of fossil fuels, such as gasoline and diesel, releases carbon dioxide and other greenhouse gases (GHG), causing adverse environmental impacts, such as global warming and air pollution, that can result in respiratory illness in humans. Climate change due to global warming also has other, far more serious, consequences, such as disrupted monsoons (threatening the global food supply chain) and increased occurrences of natural disasters, such as drought. In 2020, in the United States alone, GHG emissions from the transportation sector accounted for 28% of total U.S. GHG emissions¹, making it the largest contributor to U.S. GHG emissions.

Driven by stringent environmental norms and increasing environmental awareness, industry participants across the globe have begun adopting technology solutions that enable them to adhere to zero-emission protocols. Electrification of the transportation sector is considered to be an important stepping stone towards a sustainable transportation sector; however, the electrification process entails its own cost and infrastructure-related challenges. Another approach towards reducing the carbon footprint of transportation networks is establishing congestion-free road networks and increasing public transportation utilization, as the carbon footprint per person traveling via public transportation is much lower than that per person traveling via private vehicle.

The traditional method of building more flyovers, highways, roads, and underpasses is costly and time-consuming. An alternative solution, which is derived from the idea of **Industry 4.0**, or the fourth industrial revolution, is the increased **automation of traditional industrial practices** using smart and modern technology solutions. This entails developing highly adaptive and AI-powered smart traffic management systems capable of autonomously managing the traffic flow and prioritizing fixed-schedule vehicles (primarily public transportation vehicles). There is an urgent need for a traffic-management system capable of accurately predicting traffic patterns to determine the optimum traffic light sequence. AI and deep reinforcement learning technology are ideal candidates to enable such smart traffic management systems.

¹ Source: United States Environmental Protection Agency



Deep Reinforcement Learning
Technology for Autonomous
Mobility Optimization
Saving time and resources,
transforming the transportation
network without costly infrastructure
changes



Utilizing an AI Mobile Edge Camera, Axilion's technology solution (X Way Suite) is able to capture the road-traffic network and convert the collected data into actionable insights via X Way Suite's AI cloud services. The idea is to leverage the data collected from **AI-based cameras** via the proprietary **trained neural network** to determine the optimum traffic signal schedule across the network.

X Way Suite's advanced algorithms continuously analyze the incoming data from dashboard cameras and, in parallel, simulate the entire city's transportation network via a **digital twin**, where solutions such as **deep reinforcement learning AI** technology are used to run multiple tests and determine the most efficient traffic signal schedule for multiple intersections. Data collected from the cameras are streamed through Microsoft Azure's IoT hub, where Azure Edge's encryption technology is utilized for data protection and enhanced cyber security.



In addition to the above, the developed system leverages the fixed route of the public transportation system and onboard cameras to dynamically track the traffic pattern on a real-time basis and to change traffic light signals, prioritizing the movement of public transportation to reduce travel time.

The digitization of public transportation schedules and coordination with traffic signals creates a far more efficient public transportation network, where users can track the entire schedule from mobile apps or screens at bus stops, and plan their travel accordingly. In the long run, faster and more efficient public transportation networks aid in changing commuter preferences toward public transportation over private vehicles, thereby directly reducing the carbon footprint of the transportation network.

We view Axilion as a great opportunity for those seeking to invest in sustainable and smart mobility and specifically in a primary element of traffic flow management.

Company Overview

Axilion (TLV: AILN) hereafter "the Company" and/or "Axilion" is a publicly-traded AI software company headquartered in Israel and has offices in Israel, US, UAE, and Europe. The company focuses on developing **AI-based software systems** to better manage **traffic mobility** in cities, thereby **reducing the carbon footprint** and **improved safety**. In recent years, the company has been successful in implementing as well as in piloting its software solutions across multiple geographies: Israel, France, Switzerland, the United Arab Emirates, the city of Jerusalem, and the United States. In Israel, US, and Europe alone Axilion's solutions have been deployed at more than 1,000 traffic intersections.

Strategy and Business Model

The company's vision has primarily been towards leveraging AI capabilities to reduce the carbon emissions of the transportation sector. Traffic congestion is a challenge that contributes to millions of dollars in lost time and waste fuel across the globe. Further, the issue of traffic congestion is more frequent in urban centres than in rural settings primarily due to a larger number of private vehicles, commercial vehicles, and sometimes also due to heavyweight vehicles. Axilion has developed its X Way Suite specifically to address the challenges faced by urban centres with minimum required investment. The X Way cloud services are based on more than 10 years of the company's experience in developing and implementing traffic light program planning software - TransEm (the company's previous generation of products), which is used by more than 100 traffic engineers in Israel and around the world.

The company deals via Microsoft's existing agreement with government bodies where the Axilion X Way suite is provided as an add-on solution. For every camera installed, Axilion generates about USD 150-600 per month of Azure credit depending upon data requirements. Further, Axilion charges the city for managing the traffic patterns, whereas it takes a share of 50% of the cost incurred to the city for utilizing Microsoft Azure.

Additionally, the developed system is hardware agnostic and in the coming years is likely to be integrated with multiple types of sensors, which might be already present in a city's transportation infrastructure (stand-alone pedestrian traffic signals, speed gun detectors, and others) to ensure that at the least all the vehicles with a predefined route faces as fewer red lights as possible. For instance, the X Way Suite has ensured that the Light Rail in Jerusalem always passes through the green light, all the while taking pedestrian safety under

consideration. The end result was that the Jerusalem average commute time drastically dropped to 42 minutes from the previous 80 minutes, headway reduced to 6 minutes and the ridership increased by as much as 387.4%.

Products and Technology

As sensors and cameras continue to enhance their data collection capabilities, AI has taken a central role in understanding patterns and enabling data driven decisions to maximize operational efficiency and accuracy. With innumerable successful trials, pilots and growing number of commercial implementations, AI based smart traffic management systems are being seen as an inseparable element of the urban environment. In fact, futuristic algorithms such as RL (reinforcement learning) are also finding adoption in smart traffic management systems, imparting higher autonomy and adaptability to these systems.

Axi's Deep Learning AI-based traffic management system has been extensively researched and refined by testing in multiple geographies.

In addition, the company has been actively collaborating with research institutes such as Technion, Tel Aviv University, and the Innovation Authority for continuous development in the X Way Suite.

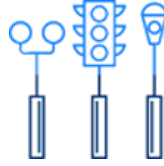


Unlike autonomous vehicles which analyse the data from multiple cost intensive and in-vehicle hardware units such as LIDAR, RADAR, and other processing units, the X Way suite optimizes the traffic flow pattern without physical infrastructure changes and without any expensive hardware installation. Only a dashboard camera (equipped with GPS and a wireless connection) installation is required which allows for real time video analysis. In general, about 40 – 50 operational cameras are required for mid-sized city intersections (about 24 traffic signal arterials).

Axilion technology decreases average commute times, improves pedestrian safety, reduces air pollution, decreases stoppage times at red lights, drives public transit use, improving quality of life.

Axilion's X Way Suite's key attributes

Deep Reinforcement Learning AI Technology



Maximize Existing Traffic Infrastructure



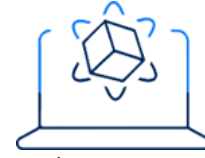
Real-Time, Adaptive Control



Smart & Scalable



Hardware Agnostic



Efficient Simulation via Digital Twin

The company has three SaaS service offerings:

1) X Way Pulse

Identification and analysis of the traffic light network and its efficiency by collecting and analysing video footage captured by cameras installed on moving vehicles as well as cameras installed on intersections. X Way Pulse analyses the information via deep learning networks designed to understand the video for an in-depth understanding of the driving behaviour from the driver's perspective.



In order to effectively manage the large amount of incoming data and to analyse it with foremost efficiency, Axilion has smartly optimized the incoming data flow by reducing both the frame rates as well as image resolution of incoming video feeds making the data collection and analysis process more efficient.

X Way Pulse generates actionable insights for not only traffic intersection points but also for entire routes and transportation networks, enabling granular visibility into network activity and easy identification of root causes behind traffic issues.

2) X Way Twin (Technology under development)

By utilizing all the data gathered by X Way Pulse, X Way Twin creates a digital twin or a digital replica of the entire city's transportation network in the cloud. The digital twin model is then used to run multiple simulations or test multiple "what-if" scenarios for deciding the optimum traffic light schedule with the best possible outcome. The digital twin utilizes the origin-destination matrix or the OD matrix which allows the digital twin to identify where vehicles are going and where they are coming from, to identify heavy load junctions so that most critical traffic intersections can be tweaked for optimization.



Further, the X Way Twin also provides granular insights about the city on a real-time basis by leveraging the data collected by X Way Pulse. Data points such as traffic signal progression (queue length, queue time, average vehicular speed through intersections), pedestrian density, two-wheeler density, and abstract data points such as pedestrian face mask usage is also available.

3) X Way Neural (Technology under development)

X Way Neural utilizes an AI-driven algorithm for automating the traffic light schedule as per several parameters: traffic volume, vehicle types, road capacity, pedestrian presence, driving patterns, and weather conditions amongst other factors.



X Way Neural is essentially an addition to the X Way Pulse Monitoring system and X Way twin digital modelling system. X Way Neural uses deep reinforcement learning techniques to identify the most optimum traffic light pattern across multiple city intersections to identify the one with the highest average traffic intersection vehicular speed, further the traffic pattern is beforehand tested on the digital twin and the performance is evaluated for proposing a new mobility plan.

X Way Pulse Monitoring system uses proprietary AI video technology to capture safety hotspots and probable traffic issues and performs a root cause analysis. The data is then sent across Microsoft Azure Cloud on a real-time basis, where the incoming data feed is redacted (faces and number plates are blurred) per General Data Protection Regulation (GDPR) compliance. X Way Neural constantly alters the digital Twin Model parameter and proposes the most optimum changes required for the best possible outcome.

Further, the system is also equipped with deep reinforcement learning AI, which means the system is continuously improving and is always learning. For instance, for a blocked intersection the suite captures and understands the issue, recommends an optimized plan, and then analyses the result, until finally a similar situation arises and the suite leverages the previous analysis to generate more valuable suggestions.



Impact of Axilion's X Way Suite in Haifa (A metropolitan city in Israel)

Haifa was one of the first cities to adopt Axilion's X Way Suite, and the city upgraded its Metronit bus rapid transport (BRT) network by adopting Axilion's X Way Suite for 200 traffic lights along the bus route, for continuous and automated optimization of the traffic flow. In a short period, the BRT network witnessed roughly a two-fold increase in ridership (115,000 travellers from a previous 60,000 travellers per day), faster commute (average traveling speed of buses increased from 20 kilometres per hour or kmph to 26 kmph, whereas the average travel time decreased from 73 minutes to 58 minutes), less congestion, and enhanced pedestrian safety.

In addition to the above, there was a drop of 11% in the private vehicle utilization, an estimated annual savings of USD 7 million in operations and maintenance, along with an estimated 140,000 tons of annual CO2 emissions avoided.

Impact of Axilion's X Way Suite in Jerusalem

The tram network in the city of Jerusalem updated its 273 intersection points by Axilion X Way suite for enhanced traffic management.

- Estimated savings due to reduction in fleet size: USD 600 million annually
- Estimated reduction in energy requirements of trams: 28%
- CO2 Savings: 100,000 tons annually (Primarily due to decrease in operational tram fleet size, increase in public transportation utilization, and decrease in private vehicle utilization)

	Before	After	Benefits
Travel time	80 min	42 min	47%
Number of trams required	32	21	34%
Tram frequency (headway)	15 min	5 min	66%
Number of Passengers	40,000	200,000	400%

AI in Traffic Management Market Overview



Artificial Intelligence has a strong potential to overcome the deficiencies in the automotive sector and provide significant benefits in terms of improved productivity and added revenue. AI acts as a crucial technology enabler in transforming every aspect of the automotive value chain starting from research and development to enhancing the car driving experience. In the automotive sector, a

major chunk of the innovations is focused at streamlining the in-vehicle driving experience, whereas just a few are focused at the overall scenario of smart traffic management.

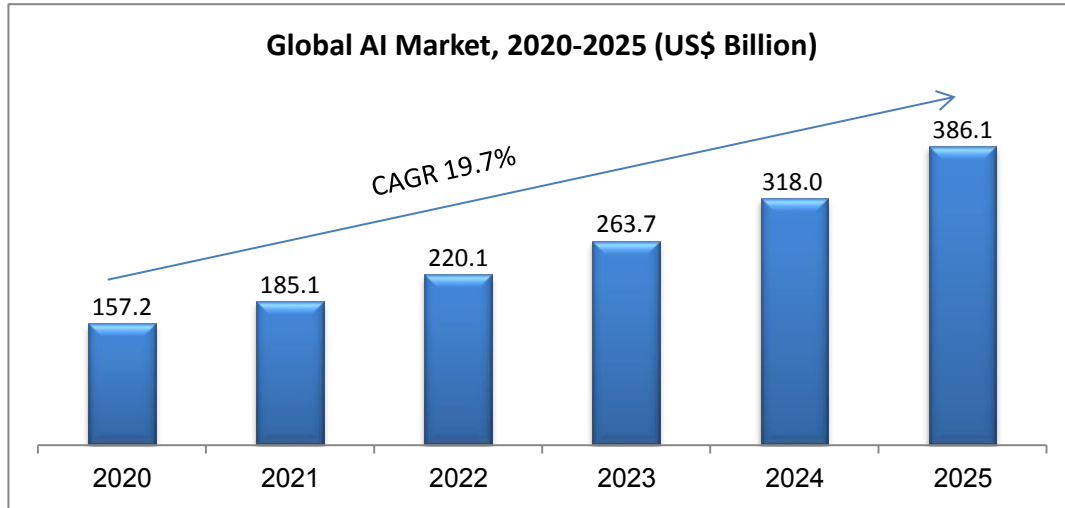
Traffic congestion is a problem faced by both the developing as well as developed economies, where AI powered systems for managing traffic lights is expected to be the most ideal solution due to its massive data handling and analysis capabilities. AI is considered to be a promising technology solution for transport authorities to achieve rapid improvements in relieving traffic congestion, improved travel time, and improved utilization of their assets for enhanced revenue generation, productivity, and lower carbon footprint. **Among the prominent players specifically catering towards technology solutions streamlining traffic flow across the city are: Nexar (Israel), Mobileye (Israel), Moovit (Israel), C3 AI (United States), Google WAZE (Israel), NoTraffic (United States). Rapid Flow Technologies LLC (United States), FLIR Systems Inc. (United States), Alibaba Cloud City Brain (China), Telefonaktiebolaget LM Ericsson (Sweden), and AlndraLabs (India) amongst others.**

Global Artificial Intelligence Market:

The global artificial intelligence (AI) market is expected to grow from US\$157.2 billion in 2020 to US\$386.1 billion by 2025, at a CAGR of 19.7%. The rapid growth in the volume of data being generated along with the increasing deployment of cloud-based computing platforms is fueling AI adoption across various industry verticals including automotive, transportation, retail, telecom, healthcare, etc.

Axilion is well placed to address the emerging need of smart traffic management systems. The company's X Way Suite combines data analytics (data gathered via AI based cameras), digital twin, and a deep learning AI technology platform, to achieve a highly autonomous and adaptive traffic management system.

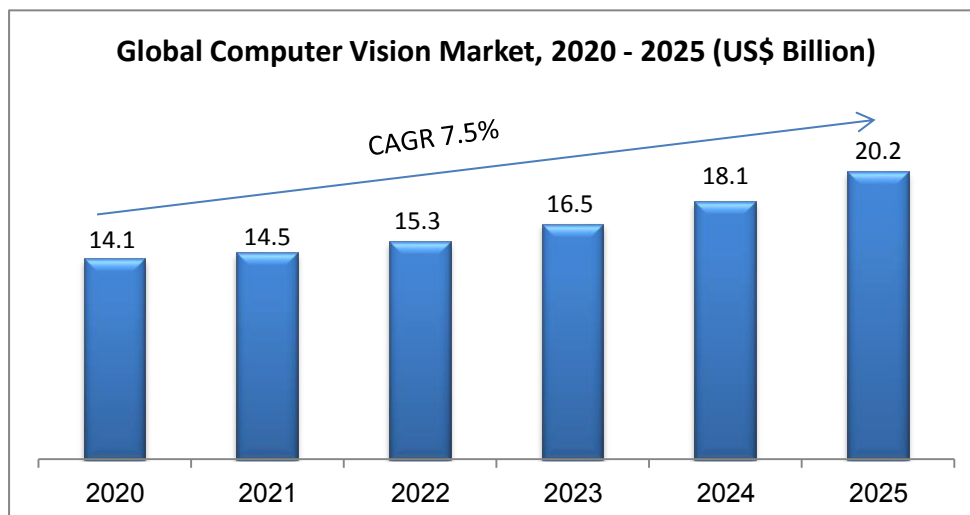
The AI market includes revenue from three technology sub-segments – Software, Hardware, Services. Software is the largest AI technology segment delivering close to 80% of all AI revenue.



Computer Vision:

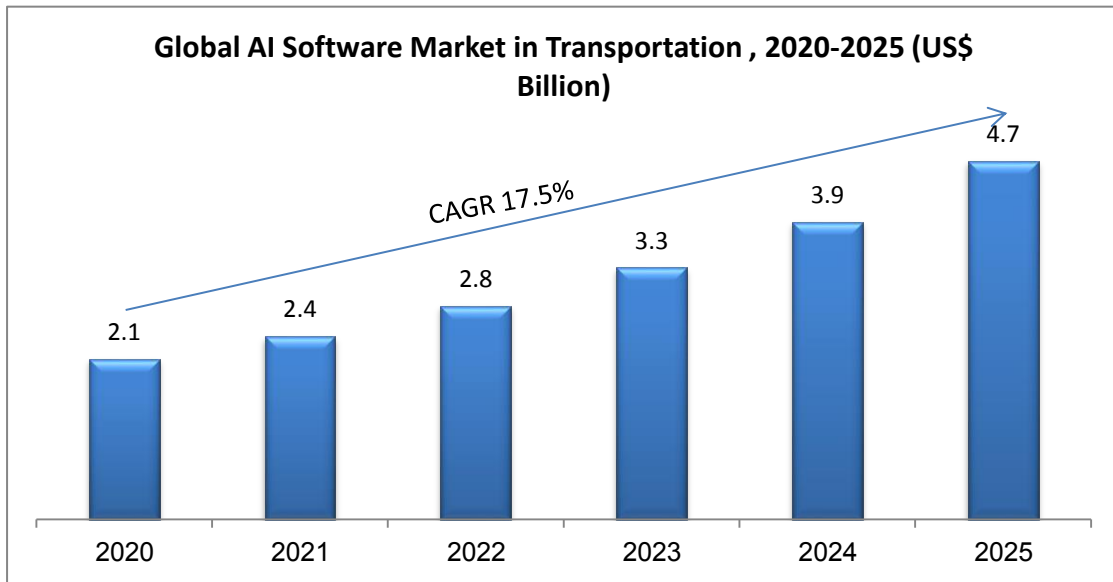
The global computer vision market is expected to grow from US\$14.1 billion in 2020 to US\$20.2 billion by 2025, at a CAGR of 7.5%. The increasing application of computer vision technology in the automotive and transportation industry is one of the key growth drivers. The emergence of self-driving cars equipped with advanced cameras and LiDAR sensors leverages computer vision to have a safe ride.

Axilion's proprietary dashboard cameras are equipped with GPS and wireless, which enables a real-time data transfer. Through Microsoft azure, Axilion uses its video analysis tool for data collection and analysis for an adaptive and autonomous traffic management system.

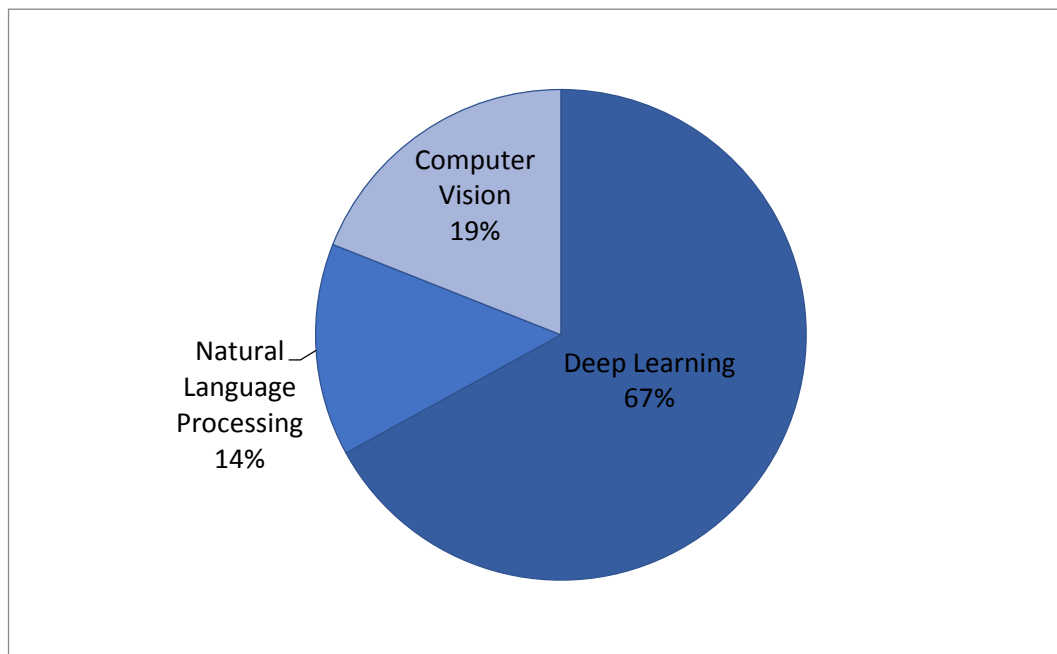


Global AI Software Market in Transportation:

The global AI software market in transportation industry is expected to grow from US\$2.1 billion in 2020 to US\$4.7 billion by 2025, at a CAGR of 17.5%.



Global AI in Transportation Market by Technology – 2020



Deep learning holds the highest share of around 67% in the global AI transportation market 2020. Deep learning algorithms analyze the hidden patterns effectively in huge volume of data and assist the transportation industry to overcome the traffic issues.

Further, deep learning is a fully automated technique which offers more accuracy when compared with the traditional methods. Computer vision accounts for 19% share of the global AI transportation market and it is primarily used to enable the traffic management system to accurately capture images and analyze them under a wide variety of conditions such as bad weather and lighting, tracking vehicles at high speed and extremely congested traffic jams.

Carbon Capture Needs Has Created a Carbon Market and Technology has Created Market Opportunity

There is a great demand on global markets **to reduce carbon emission/carbon capture** solutions. All pathways that limit global warming to 1.5°C project the use of carbon dioxide removal on the order of 100-1000 Gigatons over the 21st century. It is projected that CO₂ removal with the right policy support will become the world's biggest market. The climate math propounded by various agencies suggests a need for 10-20 Gt CO₂ per year. At an average cost of US\$50-100/ton for capture and removal, that creates an industry at least thrice as large as the current size of the Oil and Gas industry.

Tackling the carbon challenge is complex. The world emits an average of 52 Gt CO₂e/yr. However, the cost of capturing that carbon is enormous

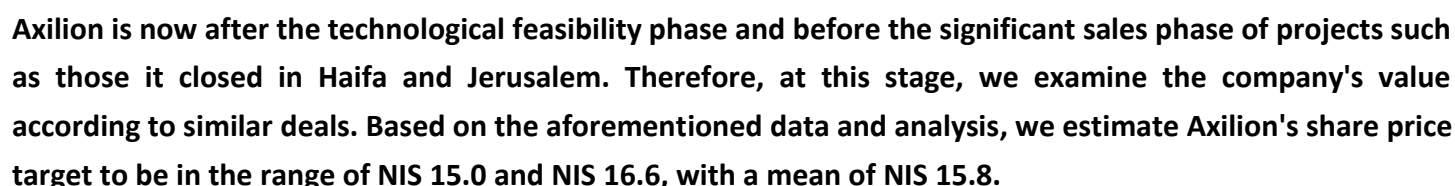
1. Currently, there are no known solutions to capture carbon at any cost above 38 Gt CO₂e/yr
2. The cost of abatement rises quickly at larger volumes to over \$1000 Gt CO₂e/yr. Whereas, ideally, the cost of carbon abatement should be below \$100 per ton to make economic viability
3. The world is already on its way to 80 Gt CO₂e/yr
4. None of the carbon technologies currently addresses legacy CO₂ removal, which is 95% of the problem.

To achieve the hypothetical net-zero, viz. to remove almost the entirety of 50+ Gt CO₂ of annual emissions, the world has to spend at least \$85 trillion annually (i.e., ~6% of the world GDP). If the world achieves a sub \$50/t cost of carbon capture, the world will still ~2.5% of its GDP but makes the entire process more viable.

As discussed earlier, Axilion's solutions help to reduce carbon emissions significantly. In our view, the company could receive a premium for its services due to its carbon-reducing effect.

We based our valuation on a top-down, market benchmark analysis. Observing Axilion market positioning we identified 89 similar companies in terms of activity (AI & ML) and growth stage and excluded outliers from our sample. The average post-money valuation for these similar deals is \$453.7M (See appendix 1 of our initiation of coverage report for the full data set). Below we present a sample of the 10 top AI deals:

We also view AI and Mobility tech firms since 2020 and found that the median post money valuation is \$526.2M, as we present below some of the companies²:



² Source: Pitchbook (showing 38 of 468 companies).

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