INTESA SANPAOLO
INNOVATION CENTER

INDUSTRY TRENDS REPORT
AUTOMOTIVE, TRANSPORTATION AND LOGISTICS

FUTURE OF MOBILITY – DECARBONIZATION AND PNRR IMPACTS

FROST & SULLIVAN

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EXECUTIVE SUMMARY

In April 2021 the Italian government launched the **National Recovery and Resilience Plan** (*Piano Nazionale di Ripresa e Resilienza,* PNRR) which forms part of the European Union's Next Generation EU (NGEU) package of €750 billion post-pandemic investment. The Plan is developed around three main axes – digitisation and innovation, ecological transition and social inclusion – and aims to repair some of the economic and social damage caused by the Covid-19 crisis while at the same time supporting the country with negotiating climate change and narrowing territorial, generational and gender gaps.

The **Automotive, Transportation and Logistics** sector is one of the chief beneficiaries of the PNNR and is notably being shaped by the third of six missions which is focused on developing modern and sustainable infrastructure for mobility. It is also impacted, to a lesser extent, by mission two which centres on the enabling a "green revolution" and ecological by supporting the use of hydrogen in transport.

Indeed, the automotive sector – like many others - is being fundamentally reshaped by governments' commitments to achieving net zero. The need for **mobility decarbonisation** is made all the more urgent given that the industry is one of the largest contributors to CO2 emissions in the European Union. Market participants are, however, responding to the challenge in a number of ways including embracing disruptive ***technologies*** and adopting new ***business models***.

From a ***technology*** perspective, the automotive sector continues to electrify with a range of factors driving a shift in the commercial segment in particular. In Italy, a combination of public and private stakeholders is supporting up-take of **electric vehicles** with growth across categories being supported by advances in motor technology. Innovation is focused on driving performance improvements and, at the same time, boosting environmental credentials by moving away from the use of rare earths. In parallel, charging infrastructure continues to evolve with operators developing ultra-fast solutions.

Advances in electric vehicle, motor and charging technologies are being matched by progress in **batteries** with lithium-ion remaining dominant. Researchers are, however, increasingly combining lithium with emerging chemistries to increase energy density and reduce pack costs. Overall, the combined global capacity of EV batteries has grown ten times over five years and industry focus is now switching to integrating these technologies into Cell To Pack architectures. The main advantage of module-less battery

packs is that they have the potential to reduce weight but they require the presence of sophisticated management systems to guarantee safety.

In the longer term, **hydrogen mobility** represents an alternative to fossil fuels, offers competition to batteries and has the potential to reshape the Automotive, Transportation and Logistics sector. Challenges to wider adoption do, however, remain with market participants looking to improve the efficiency and economics of fuels cells in order to boost penetration. Hydrogen promises to bring multiple benefits to commercial vehicle markets in particular where Proton Exchange Membrane solutions are gaining traction.

From a ***business model*** perspective, **local transport** is moving from individual modes of transport towards integrated Mobility as a Service (MaaS) platforms. Interest is driven by inefficient road and rail networks which cause congestion and pollution with providers currently exploring a variety of different MaaS approaches and models. In the short term, the digitization of public transport ticketing is seen as a first step but Frost & Sullivan expects that MaaS will evolve over time to become a more complex operating system which manages mobility based on data and includes autonomous vehicles.

In addition to decarbonisation, the mobility space is also being impacted by value chain compression and **supply chain disruption**. Market participants have responded by developing and deploying solutions which have matured from point applications to become fully integrated platforms while supply chain management is currently being transformed by the incorporation of AI.

In recent times, the automotive sector has been particularly impacted by a shortage of **semiconductors**. Improved business continuity planning, the localization of production and vertical integration are three strategies that OEMs are deploying to address supply issues. In parallel, demand is growing robustly with chips finding an increasing number of applications in electric, connected and autonomous vehicles.

This **Industry Trends Report** examines many of the principal disruptive ***technologies*** and new ***business models*** within the Automotive, Transportation and Logistic sector which are being shaped by the National Recovery and Resilience Plan. It provides an overview of some of the key opportunities and challenges that are presenting themselves in the context of an industry which is wrestling with the on-going need to decarbonise and addressing more recent supply side issues.

MOBILITY
DECARBONISATION

Over the mid-term, the automotive sector – like many others – is being fundamentally reshaped by governments' commitments to achieving net zero

In June 2019, the **United Kingdom** became the first Group of Seven (G7) country to enact a law requiring it to achieve carbon-neutral status by 2050. Its carbon emissions have fallen by 29% in the past decade. In July 2021, **Ireland** similarly made a legally binding commitment to achieving the same milestone in the same timeframe. The country aims to reduce emissions by 7% each year which totals up to a 63% reduction by 2030.

Scandinavia is even further ahead of the game.

In June 2017, **Sweden** became the first country globally to pass legislation aimed at achieving carbon neutrality. By 2045, it plans to cut absolute emissions by 85% compared to its 1990 levels and achieve the remaining 15% reduction by investing in green projects. In June 2019, **Denmark** also committed to carbon-neutral status by 2050 and, by 2030, the country aspires to reduce its emissions by 70% versus 1990.

Outside of Europe, the direction of travel is similar.

In May 2021, **Japan** began work towards reaching its own net-zero target. By 2030, the country aims to produce about 44% of its energy from renewables and nuclear power sources while reducing its dependency on fossil fuels. In November 2019, **New Zealand** similarly enacted a law which requires it to emit no CO2 emissions by 2050. The country plans to source 80% of its power from renewables, phasing out fossil fuel.

The industry is amongst the largest contributors to carbon dioxide (CO2) emissions

In the United Kingdom alone, manufacturing cars and components consumes about 5.2 billion liters of water and generates about 1 million tons of CO2 every year.

Overall, according to the European Parliament, transport is responsible for nearly 30% of the European Union's total CO2 emissions of which 72% stems from road transportation and 61% from passenger cars. Heavy duty trucks contribute 26% and light duty trucks 12%. Within this, the environmental costs of automotive manufacturing is difficult to quantify but experts cited in the National Geographic suggest that between 80% and 90% of emissions occur during a vehicle's use due to both fuel consumption and air pollution.

The need for greater sustainability in the automotive space extends beyond this with End of Life Vehicles (ELVs) generating 7 to 8 million tons of waste annually in the European Union while incorporating environmentally-friendly production and operational practices have the potential to reduce a car's life cycle carbon dioxide emissions by 75% for each passenger kilometer and non-circular resource consumption by up to 80% by 2030. This corresponds to financial savings of $5.2 billion across the industry.

Source: Frost & Sullivan

Market participants are responding to this challenge in a number of ways, notably by embracing disruptive technologies and new business models

Disruptive technologies

The advent of enablers such as Artificial Intelligence (AI), predictive analytics, Machine Learning (ML) and cloud computing coupled with automotive-specific technologies like telematics can help increase the life span of components and cars.

This, in turn, can reduce the impact of ELVs on the environment.

Frost & Sullivan notes that, as Electric Vehicles (EVs) become more mainstream, battery health management will be essential to optimize their life spans. Over the next few years, predictive maintenance will play an important role in monitoring battery performance to ensure longevity and optimal contribution.

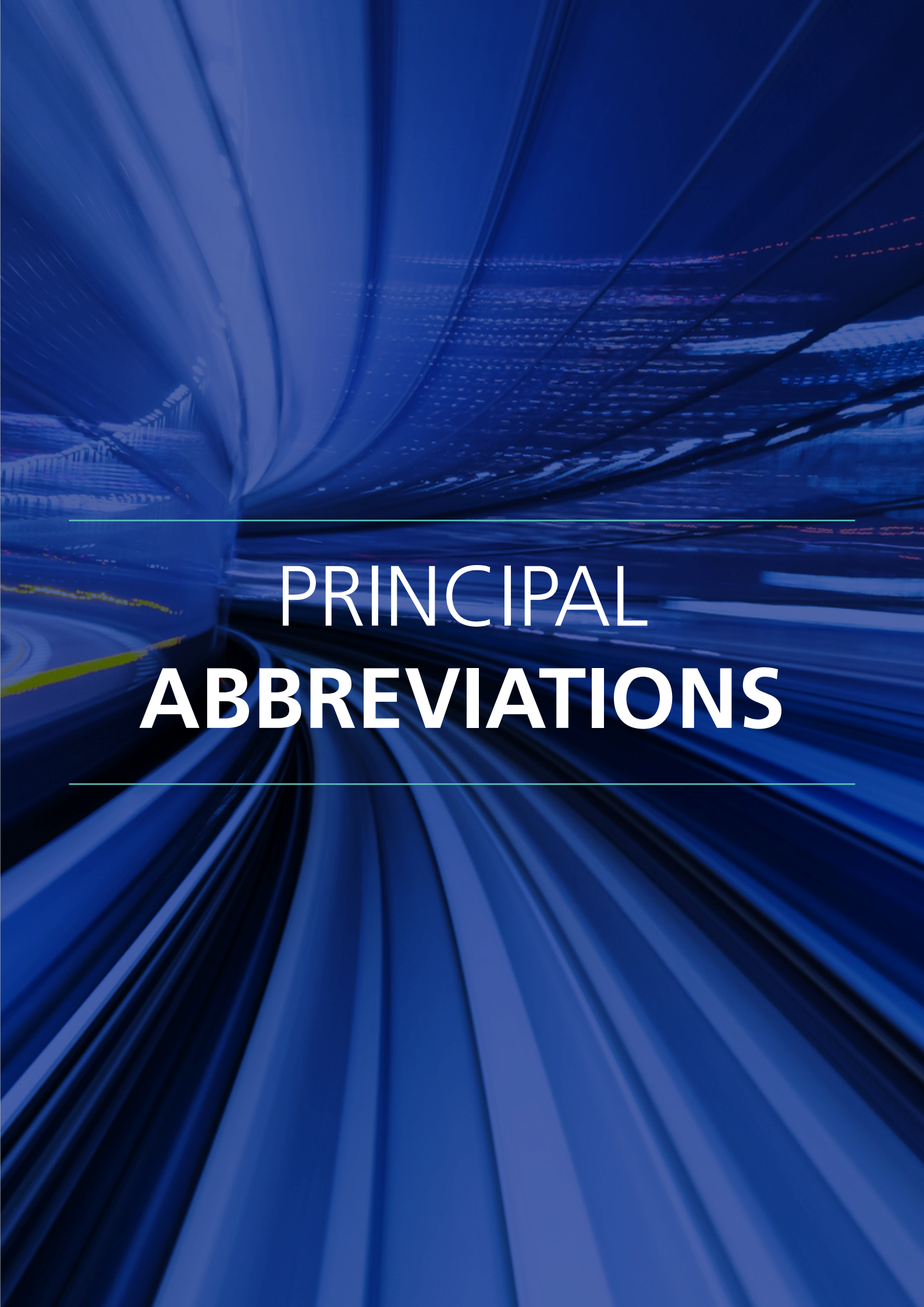
New business models

The advent of EVs and their associated value chain components will create new, innovative business models. Disposing of End-of-Life (EOL) batteries can be a challenge but second-life applications will prolong their life cycle.

OEMs are exploring new avenues for monetizing EOL batteries.

Frost & Sullivan notes that stationary energy storage system providers have already begun using spent cells from the Nissan Leaf. In 2018, Toyota (Japan) teamed up with BatteryLoop (Sweden) to develop solar-powered energy storage systems using EOL batteries from its range of commercial and passenger EVs.

These selected examples illustrate how the automotive industry is innovating from a **disruptive technology** and **business model** point of view with the aim of decarbonizing the mobility space to the benefit of direct and indirect stakeholders. This report examines in detail some of the main domains in which activity is taking place.



PRINCIPAL ABBREVIATIONS

AC	*Alternating Current*
ADAS	*Advanced Driving Assistance System*
AFC	*Alkaline Fuel Cell*
AI	*Artificial Intelligence*
AIM	*Asynchronous Induction Motor*
APAC	*Asia Pacific*
API	*Application Programming Interface*
B	*Billion*
B2B	*Business to Business*
B2C	*Business to Consumer*
B2G	*Business to Government*
BEV	*Battery Electric Vehicle*
BMS	*Battery Management System*
CAGR	*Compound Annual Growth Rate*
CCUS	*Carbon Capture, Utilization and Storage*
CH4	*Methane*
CO2	*Carbon Dioxide*
CPO	*Charging Point Operator*
CTP	*Cell To Pack*
DC	*Direct Current*
DRT	*Demand Responsive Transit*
DSRC	*Direct Short-range Communication*
ELV	*End of Life Vehicle*
EOL	*End-of-Life*
EV	*Electric Vehicle*
FCEV	*Fuel Cell Electric Vehicle*
G5	*Group of Five*
G7	*Group of Seven*
GB	*Gigabyte*
GHG	*Greenhouse Gas*
H2	*Hydrogen*
HD	*Heavy Duty*
HPC	*High Power Charging*
IaaS	*Infrastructure as a Service*
ICE	*Internal Combustion Engine*
IoT	*Internet of Things*
KPI	*Key Performance Indicator*
LCO	*Lithium Cobalt Oxide*

LCV	*Light Commercial Vehicle*
LEZ	*Low-Emission Zone*
LFP	*Lithium Iron Phosphate*
LMNO	*Lithium Manganese Nickel Oxide*
LMO	*Lithium Manganese Oxide*
LTO	*Lithium Titanate Oxide*
M	*Million*
MaaS	*Mobility as a Service*
MCFC	*Molten Carbonate Fuel Cell*
MD	*Medium Duty*
ML	*Machine Learning*
MSP	*Mobility Service Provider*
NCA	*Lithium Nickel Cobalt Aluminium Oxide*
NCMA	*Nickel, Cobalt, Manganese, Aluminium*
NGEU	*Next Generation EU*
NMC	*Lithium Nickel Manganese Cobalt Oxide*
OBC	*On Board Charger*
OEM	*Original Equipment Manufacturer*
OHV	*Off-Highway Vehicle*
PAFC	*Phosphoric Acid Fuel Cell*
PCM	*Protection Circuit Module*
PEM	*Proton Exchange Membrane*
PEMFC	*Proton Exchange Membrane Fuel Cell*
PMSM	*Permanent Magnetic Synchronous Motor*
PNRR	*Piano Nazionale di Ripresa e Resilienza*
SaaS	*Software as a Service*
SCM	*Supply Chain Management*
SOFC	*Solid Oxide Fuel Cell*
SSL	*Solid-State Lithium*
UK	*United Kingdom*
ULEZ	*Ultra-Low-Emission Zone*
V2I	*Vehicle to Infrastructure*
V2P	*Vehicle to People*
V2V	*Vehicle to Vehicle*
WBMS	*Wireless Battery Management System*
ZEZ	*Zero-Emission Zone*

Source: Frost & Sullivan

ABOUT INTESA SANPAOLO INNOVATION CENTER:

Intesa Sanpaolo Innovation Center is the company of Intesa Sanpaolo Group dedicated to innovation: it explores and learns new business and research models and acts as a stimulus and engine for the new economy in Italy. The company invests in applied research projects and high potential start-ups, to foster the competitiveness of the Group and its customers and accelerate the development of the circular economy in Italy.

Based in the Turin skyscraper designed by Renzo Piano, with its national and international network of hubs and laboratories, the Innovation Center is an enabler of relations with other stakeholders of the innovation ecosystem - such as tech companies, start-ups, incubators, research centres and universities - and a promoter of new forms of entrepreneurship in accessing venture capital. Intesa Sanpaolo Innovation Center focuses mainly on circular economy, development of the most promising start-ups, venture capital investments of the management company Neva SGR and applied research

For further detail on Intesa Sanpaolo Innovation Center products and services, please contact businessdevelopment@intesasanpaoloinnovationcenter.com

ABOUT FROST & SULLIVAN:

For over five decades, Frost & Sullivan has become world-renowned for its role in helping investors, corporate leaders and governments navigate economic changes and identify disruptive technologies, Mega Trends, new business models and companies to action, resulting in a continuous flow of growth opportunities to drive future success.

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Published: May 2022