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Overview of Commercial and Off-Highway Vehicle Segment

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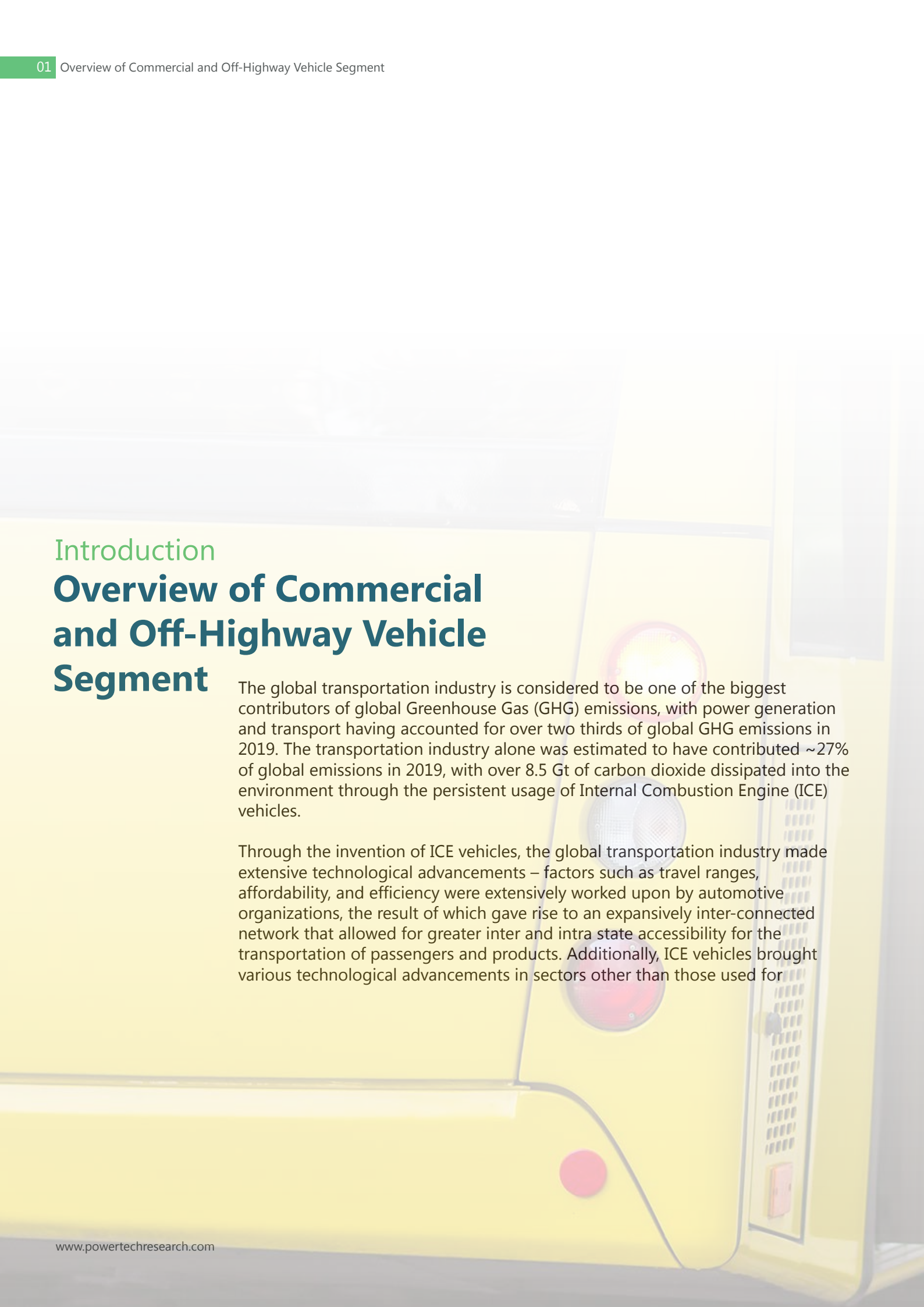


Introduction

Overview of Commercial and Off-Highway Vehicle Segment

The global transportation industry is considered to be one of the biggest contributors of global Greenhouse Gas (GHG) emissions, with power generation and transport having accounted for over two thirds of global GHG emissions in 2019. The transportation industry alone was estimated to have contributed ~27% of global emissions in 2019, with over 8.5 Gt of carbon dioxide dissipated into the environment through the persistent usage of Internal Combustion Engine (ICE) vehicles.

Through the invention of ICE vehicles, the global transportation industry made extensive technological advancements – factors such as travel ranges, affordability, and efficiency were extensively worked upon by automotive organizations, the result of which gave rise to an expansively inter-connected network that allowed for greater inter and intra state accessibility for the transportation of passengers and products. Additionally, ICE vehicles brought various technological advancements in sectors other than those used for

transportation. Conventional technologies were used to introduce vehicles within industries such as construction and agriculture, greatly reducing the amount of manpower and effort required to carry out operations, thereby decreasing operational costs and increasing productivity within sectors.

However, the explicit tradeoff that exists with the rise of ICE technology has detrimentally impacted the earth's environment and climate. ICE vehicles make use of fossil fuels to generate power and operate, thereby emitting by-products such as carbon dioxide, particulate matter (soot), oxides of sulfur, nitrogen dioxide, nitric oxide, and carbon monoxide. These emissions interact with the earth's environment, giving rise to various forms of harmful aftereffects including but not limited to ozone depletion, global warming, acid rain, and air pollution. Carbon dioxide is one of the most commonly found forms of GHG and is responsible for global warming. This global warming in turn gives rise to increasing surface temperatures, leading to devastations such as the melting of polar ice caps, rise in sea levels and flooding. Carbon monoxide is extremely poisonous in nature, while soot and other carbon particles formed through the burning of carbon-based fossil fuels are known to cause respiratory diseases. Coal and diesel combustion results in the formation of sulfur dioxide, while petrol combustion forms various oxides of sulfur, both of which are extremely corrosive and can dissolve in rainwater to cause acid rain, a phenomenon that is extremely harmful to plants, animals, and land fertility. Nitrogen oxides are harmful to plant and animal health, and result in the production of ozone, which on ground levels is harmful to human health and the environment.

The Introduction of Electric Vehicles: BEVs and PHEVs

The persistent usage of ICE vehicles within the transportation segment may have led to numerous technological advancements; however, as this technology continues to grow, the unsustainability of it has now become apparent. The extensive use of fossil fuels does not only pose a threat to the environment and climate, but also leads the global community closer to supply exhaustion. The finite nature of resources such as petrol, coal, and diesel will eventually cause the global community to deplete these resources, bringing about unparalleled levels of inflation, economic disparity, and industrial collapse.
As the gravity of the situation at hand became clear to global industries, they began researching and investing in technologies that not only offered a solution to the problems at hand, but also held the potential of sustainability in the long run. In response to the global ICE pandemic, electricity was introduced in the automotive market. Technologies replacing conventional engines with cleaner, and safer alternatives were introduced into the market, allowing the international community to enter the age of Electric Vehicles (EVs). The EV market today comprises of numerous types of technologies that are in the process of successfully being integrated into the global transportation network. The different types of technologies present within the EV sector as of today are as follows:

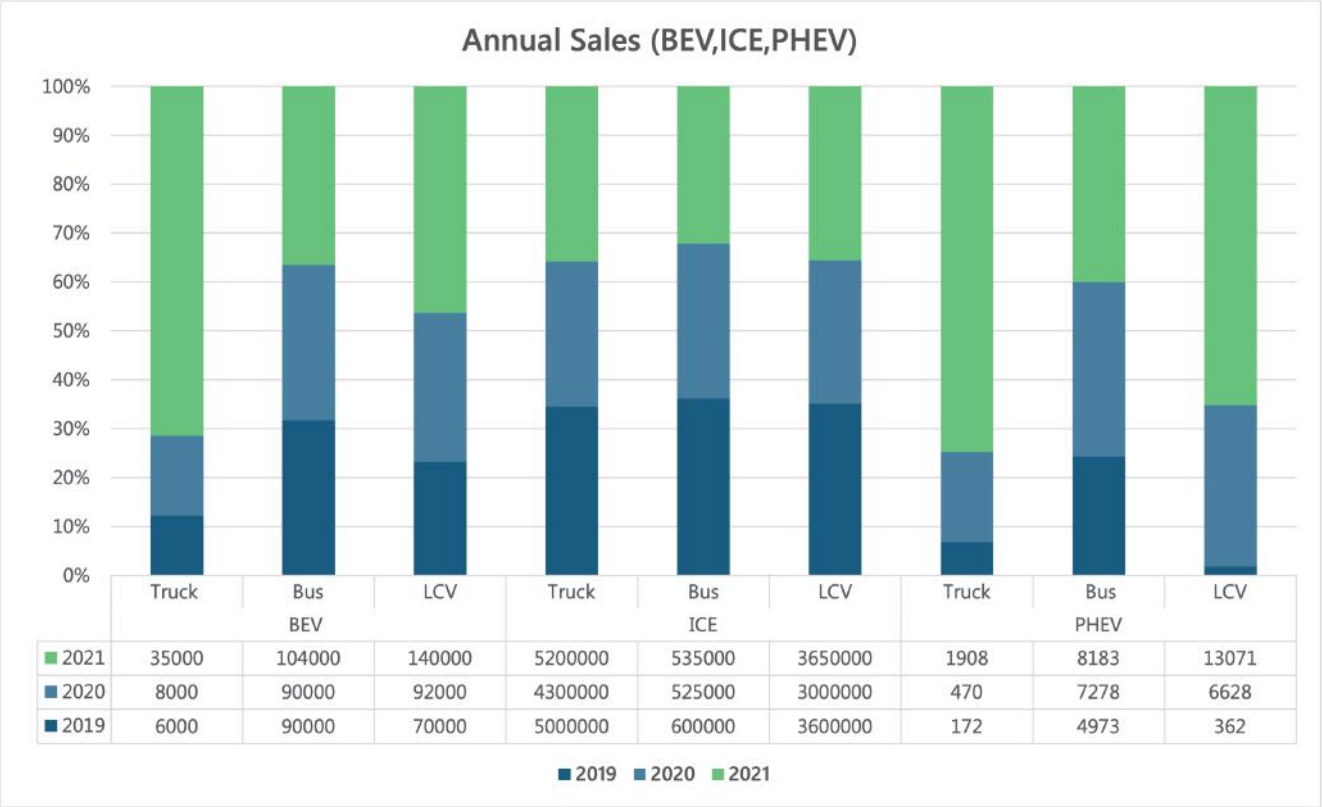
Battery Electric Vehicle (BEV) is a type of electrical vehicle that uses chemical energy stored in rechargeable battery packs, with no secondary sources of propulsion such as internal combustion engines, and hydrogen fuel cells.

Plug-in Hybrid Electric Vehicle (PHEV) is a hybrid electric vehicle making use of a conventional internal combustion engine system and an electric propulsion system. PHEVs contain batteries that can be recharged by plugging a charging cable into an external power source, similar to a BEV, and by its on-board internal combustion engine-powered generator.

These technologies, on their own, have various advantages and disadvantages over each other in terms of efficiency, carbon footprints, and environmental impacts. Due to these reasons, the adoption of these technologies has varied over the years. PHEVs and HEVs were the pioneers of the EV industry, as they allowed vehicles to operate on both electricity and conventional combustion. The vehicles allowed individuals to reduce their ROI duration through the amount saved from fuel costs, and, additionally, helped users reduce carbon emissions. However, with the introduction of BEVs, the industry achieved a significant milestone through which it could not only reduce, but completely eliminate fossil fuel dependency.

As EV technology advanced, so did the needs of the transportation industry. One of the biggest issues within the commercial vehicle segment is the ever-present problem of range anxiety. Commercial vehicles such as long-haul trucks, buses, and last-mile delivery vehicles need to travel long distances in order to deliver goods and passengers. The commercial vehicle industry, hence, cannot afford long breaks in between travel. BEVs, although providing a completely emission-free form of travel, were restricted by battery sizes and capacities, due to which users were required to stop in order to recharge their vehicles, which, in turn, translated to a clear loss for companies using commercial vehicles. The ICE and electric commercial vehicle industry have seen fluctuating trajectories of growth in the past years. In 2019, the global ICE Truck market achieved annual sales amounting to over 5 million units, in comparison to which BEVs and PHEVs amounted to ~6,000 units and ~200 units respectively. The global bus and coach industry had a total of 600,000 units ICEs, 90,000 BEVs, ~5,000 PHEVs. LCVs, 362 PHEVs, 70,000 BEVs, 36 million ICEs. Annual sales, however, saw a declining increase in the subsequent year due to the Covid-19 pandemic-nation-wide lockdowns, and a decrease in imports and exports led to commercial vehicle operations coming to a halt in order to curb the spread of the coronavirus. The global truck market registered a 14% decrease in ICE sales, while the BEV and PHEV truck market saw a 33.33% and 173.3% increase in sales compared to 2019. The global bus and coach market registered a 12.5% decrease in ICE sales, while the

PHEV market saw a 46.4% increase in sales compared to 2019. The BEV segment within the bus market remained stagnant due to restrictions on public transport due to Covid-19. The LCV market saw a decrease of 16.7% in ICE sales, 31.5% increase in BEVs, and a drastic 1700% increase in PHEVs. BEV annual sales remained significantly higher than PHEVs even in 2020, but less than ICE sales. Global ICE sales, however, saw decreases in all commercial vehicle segments, owing to increased electrification of the transportation industry.



	Truck	Bus	LCV	Truck	Bus	LCV	Truck	Bus	LCV
	BEV			ICE			PHEV		
2021	35000	104000	140000	5200000	535000	3650000	1908	8183	13071
2020	8000	90000	92000	4300000	525000	3000000	470	7278	6628
2019	6000	90000	70000	5000000	600000	3600000	172	4973	362

Fig 1: Annual Sales-BEV, ICE,PHEV (2019-2021)
Source: Power Technology Research

When comparing growth rates for each type of vehicle segment in accordance with fuel type, a clear contrast in between projection trends was seen – while it can clearly be seen that the market is steadily heading towards electrification, the year-on-year increase in BEVs and PHEVs greatly vary through certain segments. Comparing 2020 and projected 2030 annual sales, an accelerated market trend towards electrification can be observed: battery electric trucks and buses can be seen to have the greatest annual growth in their respective vehicle fuel types (45% and 17%), while plug-in hybrid electric LCVs can be observed to lead market trends with an annual growth of 25% compared to other fuel types.

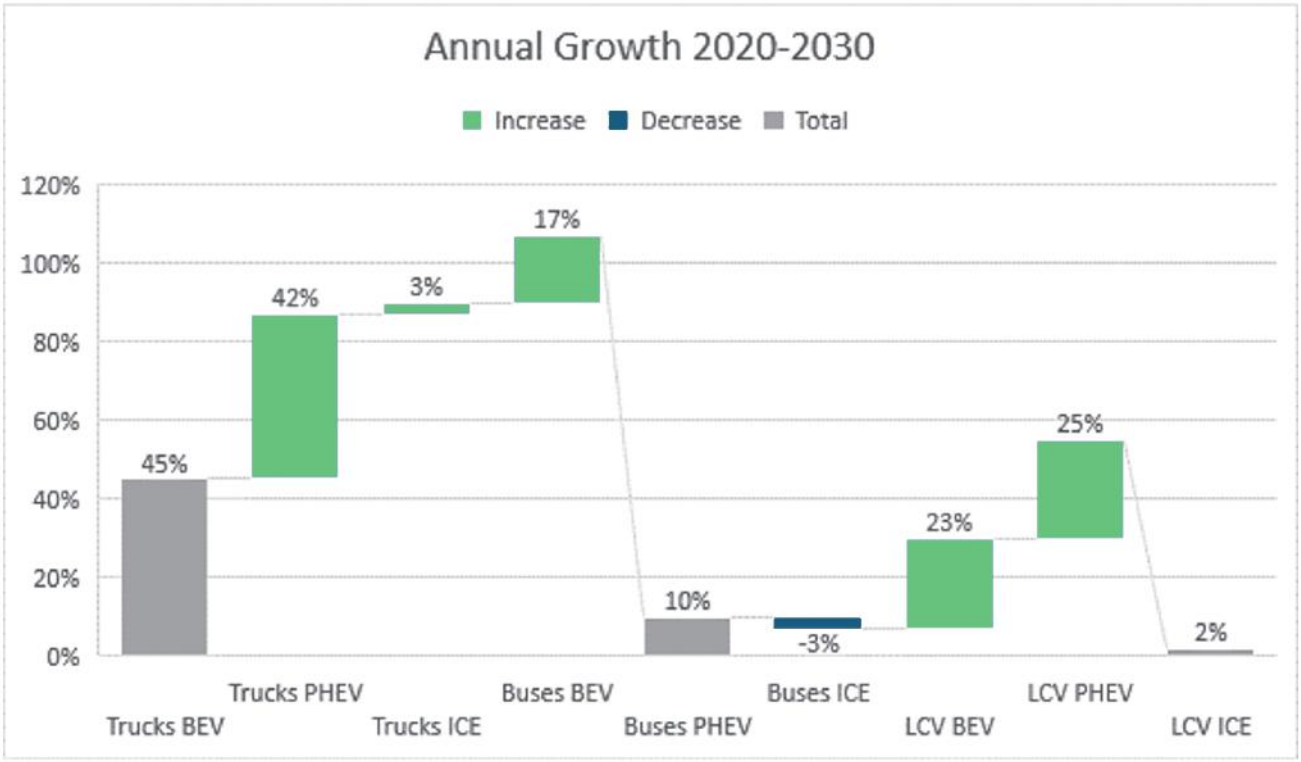
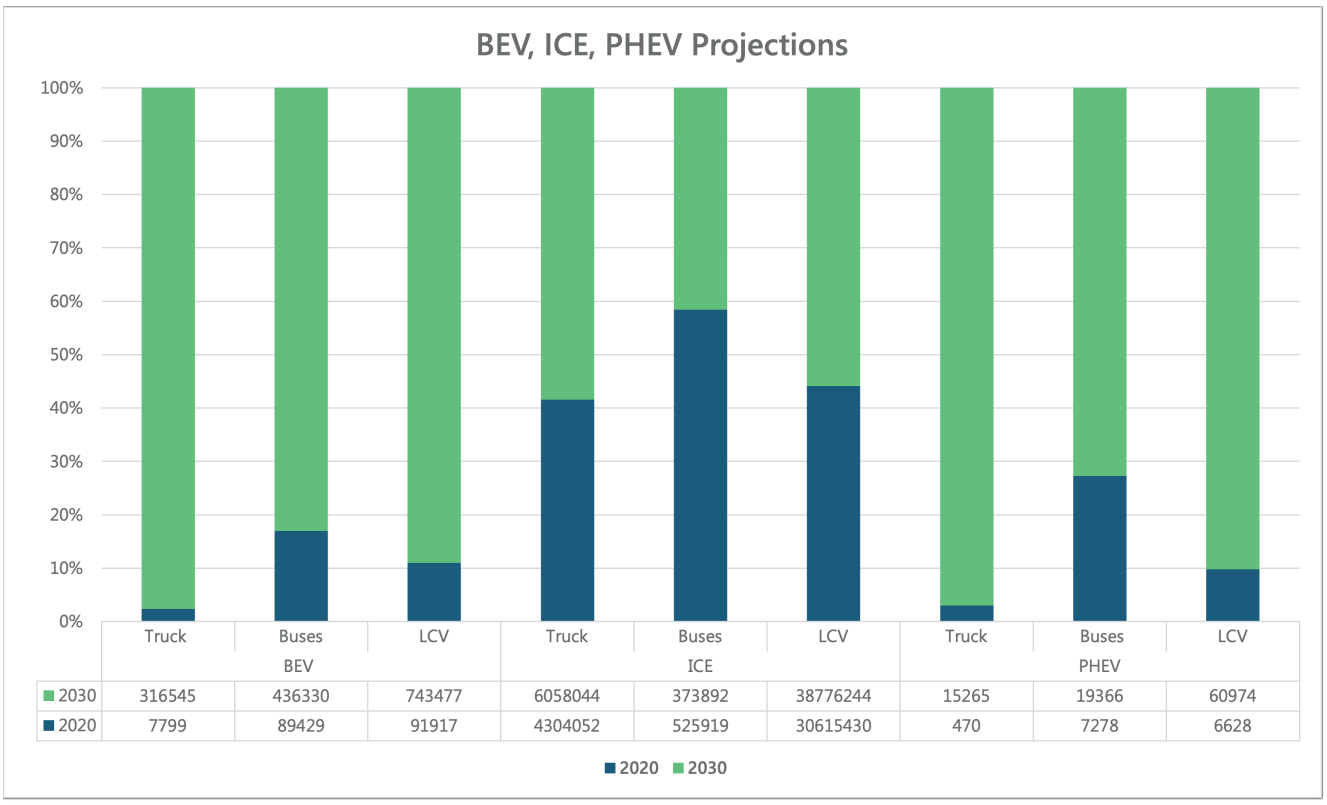


Fig 2: Annual Growth (2020-2030).
Source: Power Technology Research



	Truck	Buses	LCV	Truck	Buses	LCV	Truck	Buses	LCV
		BEV			ICE			PHEV	
2030	316545	436330	743477	6058044	373892	38776244	15265	19366	60974
2020	7799	89429	91917	4304052	525919	30615430	470	7278	6628

Fig 3: BEV, ICE, PHEV Projections (2020-2030).
Source: Power Technology Research

The transportation industry is currently integrating both PHEVs and BEVs into its fleet, owing to the various advantages and disadvantages both technologies have over each other. The issue with commercial vehicles is that their functionalities require them to travel long distances. Long commutes are often necessary and time sensitive due to the nature of production and functionality of commercial vehicles. Additionally, the world, in attempts to transition towards carbon-neutrality, is actively implementing various climate goals and policies, with the emphasis on minimizing and eliminating carbon emissions through fleets. When it comes to tackling climate change, BEVs are superior to PHEVs. However, factors such as the initial investment cost of BEVs being three times higher than that for an ICE, combined with the cost of the issue of range anxiety has greatly curbed the uptake of BEVs. To deal with the latter problem, governments and private sectors around the world are working together to invest in EV charging infrastructure. This includes examples such as Germany's fully charging capable highway network and Europe's TEN-T network. While these developments are likely to alleviate the issue of range anxiety, they still won't be enough for BEVs to be able to replace Class 8 Trucks.

PEVs, on the other hand, can rely on both batteries and secondary sources of power but are not zero emissions vehicles and, therefore, less conducive to achieving climate related goals. Because of the recent increases in fuel prices all over the world, the breakeven point on ROI for PHEVs is now higher, making the argument for BEVs stronger. This also emphasizes another reason why electric vehicles should be preferred. Despite the higher initial investment cost of electric vehicles, they significantly reduce transportation costs related to the refueling aspect. This aspect remains important where BEVs and PHEVs are concerned, leading to developing nations and medium-tier economies moving away from these technologies because of the associated long-term costs.

Policies and Initiatives to Support the EV Transition

Regions around the world have begun to implement policies and initiatives to support the transition to EVs, especially in the commercial vehicle segment, in order to combat climate change. These include:

- The Biden Administration has announced initiatives to electrify more than 635,000 vehicles - including trucks- within the U.S. federal fleet.

- The U.S. government has promised to convert half of all new sales to electric by 2030.

- A memorandum announcing initiatives aiming for 100% zero emission EV sales by 2050 was signed by fifteen U.S. states.

- The state of California currently leads the U.S. when it comes to the integration of electric trucks, with an executive order in 2018 setting the goal of having 200 hydrogen fueling stations and 250,000 EV chargers to support 1.5 Million zero emission vehicles (ZEVs) by 2025, and 5 Million ZEVs by 2030.

- Originating in California, the Advance Clean Trucks (ACT) act is being refurbished in order to be implemented throughout the U.S.. This sets the goal for all new medium- and heavy-duty vehicles sales to be zero emission by 2045.

- Brazil is in the process of executing cost exemptions and subsidies to support the EV transition. EVs manufactured in Brazil are exempt from the IPI tax under Senate Bill 174/2014. Moreover, the bill exempts such manufacturers from paying import taxes on parts that have no domestic value.

- Columbia has set the goal to integrate 600,000 EVs in all modes by 2030.

- The EMEA region has also been taking steps to integrate electric trucks in its transportation network.

•The EU's Fit for 55 is another important step towards EV integration: EU countries must ensure there is sufficient charging capacity for EVs on the road. The Alternative Fuels Infrastructure Regulation requires EU member states to install charging and fueling points every 60 km for EV charging and every 150 km for hydrogen refueling.

•The revision to the Clean Vehicles Directive by the EU has introduced minimum requirements for the procurement of electric trucks.

•Finland has targeted increasing its electric heavy-duty truck stock to 4,600 units by 2030.

•France has targeted increasing its fuel cell electric heavy commercial stock to 200 by 2023 with 100 charge points and to around 2,000 by 2028, with around 1,000 charge points.

•The Italian government plans to transform vehicle procurement by public bodies to consist of a 30% Alternate Fuel market size by 2022, increasing this share to 50% by 2025, and to 85% by 2030.

•The Netherlands is currently targeting a stock of 3000 heavy-duty FCEVs by 2025.

•Norway recently announced that the nation's truck sales would consist of 50% ZEVs by 2030.

•Spain has targeted having 5,000-7,000 Light and Heavy FCEVs on the road by 2030.

•Germany's government has pledged around USD 7.9 Billion devoted to increasing commercial fleets' uptake of electrified powertrains. This includes retrofitting to replace diesel power units. Germany's first Electric Highway, which includes charging stations for hybrid trucks, has greatly encouraged the sale of electric trucks. As of January 2021, Germany is testing the A5 motorway near Frankfurt, and plans on extending it by 7 kilometers, to further allow greater integration of Electric Trucks within the German market.

•The UK has announced plans to completely phase out the sales of fossil fuel vehicles by 2040. Various policies in favor of Electric trucks have been put into effect, including the elimination of over 70% of medium-duty and heavy-duty diesel trucks under the China III emission standards or below by 2020. EVs were exempt from purchase taxes from 2014 to 2017 and the government has renewed the exemption through 2020.

•India, too, has imposed several policies to support the integration of EVs in the country. This includes 2015's Faster Adoption and Manufacturing of Hybrid and Electric Vehicles in India (FAME) which granted several subsidies to promote the adoption of EVs. India is also focusing on procuring electric buses to target GHG emissions from its transportation industry, with the Ministry of Heavy Industries sanctioning 2,877 EV Charging Stations in 68 cities across 25 States, under FAME II.

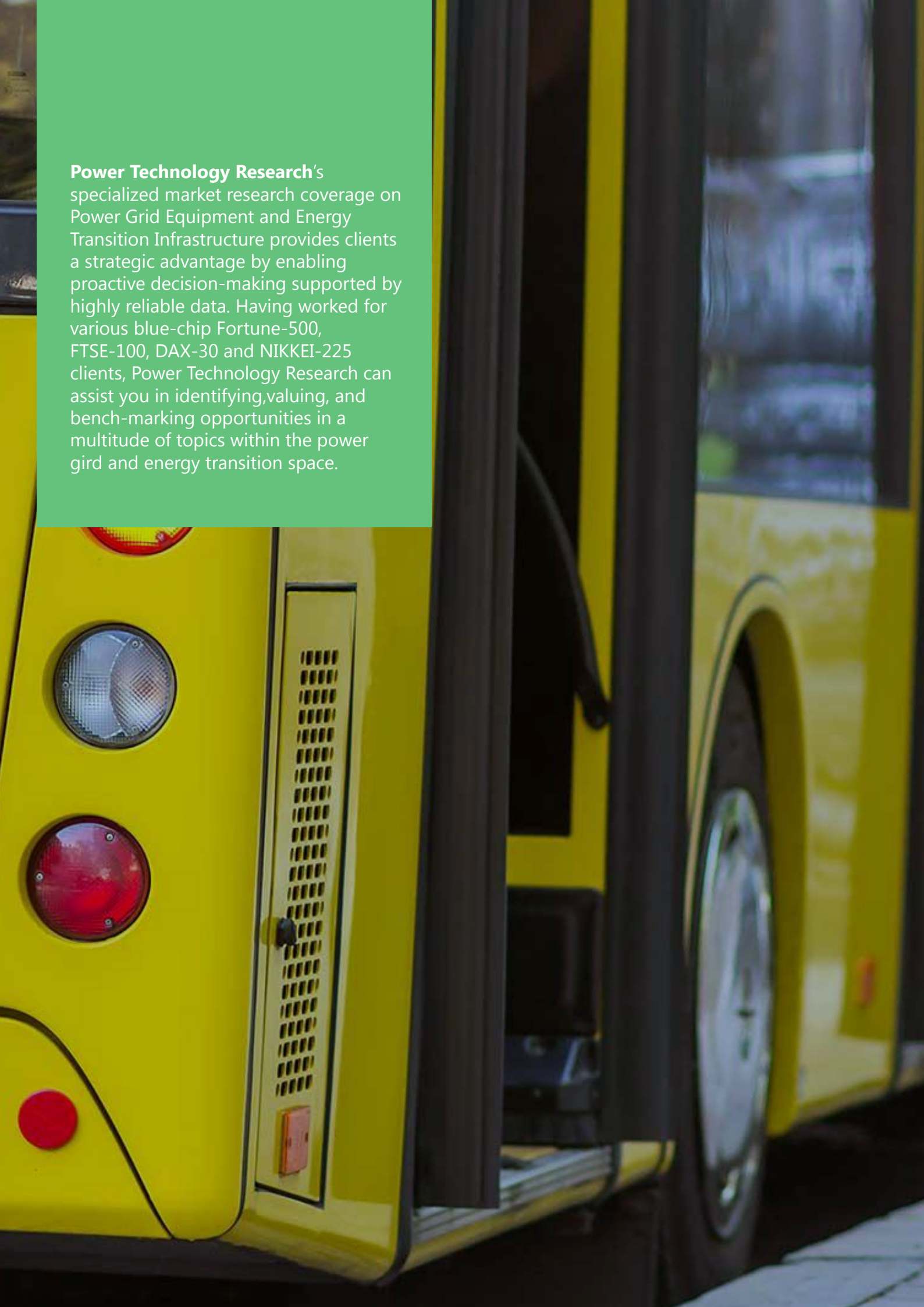
•South Korea has targeted the integration of 30,000 FCEV trucks by 2040. Around 94,000 units of subsidies were made available by the government to purchase electric and hydrogen vehicles. The government also announced that it would build more than 70 units of 350kW-class ultra-fast chargers; these can charge vehicles three times faster than chargers already installed.

•Sri Lanka has announced all state-owned vehicles to be electrified by 2025, a strategy very similar to the policies currently being implemented in the U.S.

•Pakistan's market for electric trucks is currently in its nascent stages. Even still, it is encouraging to see that the government has announced targets of increasing the share of electric trucks to 30% by 2030 and 90% by 2040 in the truck market.

Looking Ahead

The world is steadily transitioning towards a greener future. Due to the efforts being made by both federal governments and private entities, the rate of adoption of electric vehicles in the commercial vehicle segment greatly accelerating. With this acceleration in mind, the future of the transportation industry is set to combat climate degradation actively and efficiently by mediating their carbon emissions.



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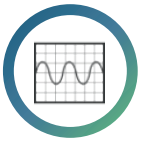

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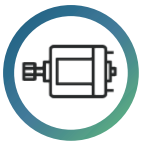

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