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The Importance of EVs and How to Sustainably Create Widespread Use

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SUMMARY

The goal of this paper is to describe the importance of main-stream electric vehicle adoption in the United States. To achieve this dream, our society will need to accomplish this serious challenge in a sustainable way to keep daily operations running smoothly as well as creating long-term particular use to Americans across the country.

This paper mentions different methods to encourage the public to adopt electric vehicles like environmental, cost, and lack of maintenance as positive incentives to make the switch. Our society has been reliant on the use of ICE vehicles since the early 20th century. The 20th century was one of the rapidly changing times in human history. Huge advancements such as the ICE vehicle and airplanes made our society global. Climate change is destroying our planet and greenhouse gas emissions from the transportation industry are making the problem worse. Reducing our greenhouse gas emissions in the United States by encouraging clean transportation is one of the easiest ways to lower our carbon footprint. The 21st century introduced revolutionary technology like laptops and smartphones used by billions across the world. Electric vehicles will be the next revolutionary piece of technology within our lifetimes. In order to make the switch, we will need to understand how an electric vehicle works. All electric vehicles use a motor instead of an internal combustion engine to pollute significantly less carbon dioxide. To fill up the vehicle, battery packs much bigger than traditional car batteries, store energy in an traction battery pack for power. Electric vehicles are sustainable by using recycled and organic materials to build new vehicles. Pursuing electric vehicles allows our country to lower greenhouse emissions, follow international protocols to protect our environment and future generations. There are logistical and personal problems preventing or delaying the change to these new technologies. Our infrastructure for electric vehicles is minimal in the majority of the country, people are afraid of running out of power during the day, people who refuse to switch due to political views and or the initial cost of buying an electric vehicle. We will discuss about how National Grid is contributing to a sustainable tomorrow in our fleet department and operational goals.

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KEYWORDS

All-Electric Auxiliary Battery, DC/DC Converter, Fleet Turnover, Internal Combustion (ICE), Electric Vehicles (EV), Lithium-Ion Batteries

INTRODUCTION

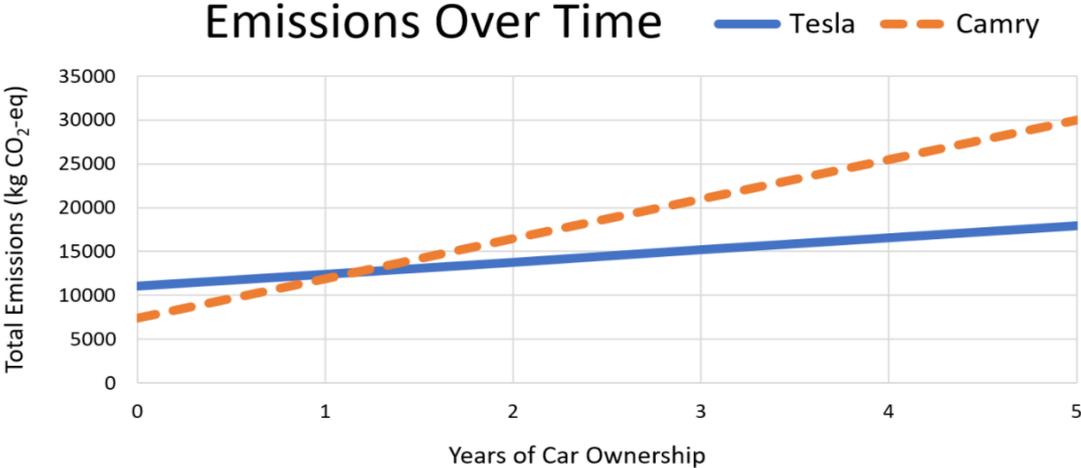
Imagine two futures for our world by 2050. Imagine yourself waking up in 2050, checking outside of your home and seeing that it is a perfect sunny day in April. You decide to go for a walk this morning before your typical workday at the office. Before you leave your house, you check your mobile device to see the temperature is sixty-five-degree Fahrenheit which is warmer than a regular day in April. In the weather report, there is a warning stating that you need to wear a mask outside to protect against the harmful effects of air pollution. Air pollution killed more than 10 million people every year across the globe, greater than the entire population of the Chicago Metro Area. According to this projection, assuming these statistics do not get worse, 290 million people will die from air pollution by 2050. Why do we not talk about these statistics in our society? Simple answer, this is not happening to us. India and China experienced 64% of all related air pollution on the global stage compared to approximately 500 hundred-thousand deaths in the United States. Once those countries fully develop, other countries will suffer the consequences of air pollution. This is the beginning of the problems that humanity will face in 2050 if we do not curb this trend. The Arctic Ice Cap is projected to be fully melted which will raise sea levels to endanger coastal cities like Boston and Miami. The lower amount of sea ice will make it harder to prevent an increase of global temperatures across the world. Natural disasters like hurricanes, and tornados will ravage significant areas in our country, costing trillions of dollars. Heat waves, wildfires and droughts will become more frequent, making some areas uninhabitable for human life. Diseases will become easier to spread due to the increased temperatures. Much of the wildlife, we see today, will be go extinct, creating a potential mass-extinction event.

Imagine Earth in 2050 with gardens full of fresh food for your family and solar panels generating clean energy on the rooftops. Electric vehicles in 2050 can travel incredible distances using your renewable energy becoming main-stream, clean public transportation that can take you all over the Northeast within 30 minutes. You walk out of your house, take a deep breath, enjoying the brisk air of the spring morning, unplug your charging port from your EV, and drive your EV to work. We may be wondering how we achieve this fulfilling future. To succeed in creating this future, one of the first steps to achieve is introducing the mass adoption of electric vehicles to reduce our carbon footprint.

GREENHOUSE GAS EMISSIONS

The United States has approximately 250 million vehicles on the road are ICE cars. Every car in the United States creates 4.6 metric tons of carbon dioxide per year. According to these numbers, the United States emits 2.5 trillion pounds of carbon dioxide in a year. To put this number into perspective, one-third of all greenhouse gas emissions in the United States are contributed by the transportation industry. Greenhouse gases consist of carbon dioxide, methane, nitrous oxide, and fluorinated gases, with 80% of emissions being carbon dioxide. The transportation industry emits more emissions than the fossil fuel and natural gas industry.

The bright side to this dilemma is we can fix these statistics with the reduction of ICE vehicles and the introduction of electric vehicles. Electric vehicles have zero tailgate emissions but have a higher starting emissions count compared to traditional ICE vehicles due to the beginning stages of production.



ELECTRIC VEHICLES DEFINED

EV's are vehicles that fully rely on power generated by the electrical grid, solar, nuclear, or another source of energy. Electric Vehicles have an all-electric motor to power up the vehicle instead of a traditional internal combustion engine. The electric transmission takes power from the motor to begin using the wheels to drive the vehicle. Occasionally, electric vehicles will have a form of motor generators to use driving and regenerative features. Electric vehicles have two batteries with the all-electric auxiliary battery powering up accessories with electricity, and the traction battery pack used to store electricity received from charging your vehicle. An important tool in a electric vehicle is the power electronics controller which keeps the flow of electricity from the traction battery pack to contain the speed of the motor. To make sure, the vehicle does not overheat, electric vehicles use a cooling thermal system to manage operational temperatures in the motor, transmission and other accessories of the car. Recharging an EV is straight forward and can be completed at a fast charger, at work or at your home for your convenience. The charging port provides the vehicle with electricity by using an external power supply to send energy towards the traction battery pack. The onboard charger converts the AC electricity provided by the external power supply into high voltage DC electricity to charge the traction battery pack. The electricity becomes high voltage DC electricity, the DC/DC converter will convert the energy into lower voltage DC to run vehicle accessories and recharge the auxiliary battery to keep the vehicle running.

ELECTRIC VEHICLE COSTS

Electric Vehicle ownership never been more lucrative than now in our society. Owning a EV is shown to be cheaper in long-term ownership compared to a traditional ICE vehicle. The federal government is offering tax credits of up to seventy-five hundred dollars to help compensate for a higher purchasing price of an EV. Some states will offer rebates of up to \$2500 depending on your state for purchasing or leasing an EV. Electric companies can give rebates towards your purchase as well. EV have minimal maintenance costs and last years without the need for serious repairs. The Lithium-ion batteries last for a guaranteed 8-10 years with battery warranties granted on all EV’s being purchased or leased. Miles per dollar are lower for EV’s than ICE vehicles. The miles per dollar can be shrunk by charging at your work or home. Counting for the ownership of owning an EV against an ICE vehicle, the savings can be thousands of dollars over the lifespan of the vehicle. The cost savings for EV’s can be help them be more competitive to ICE vehicles.

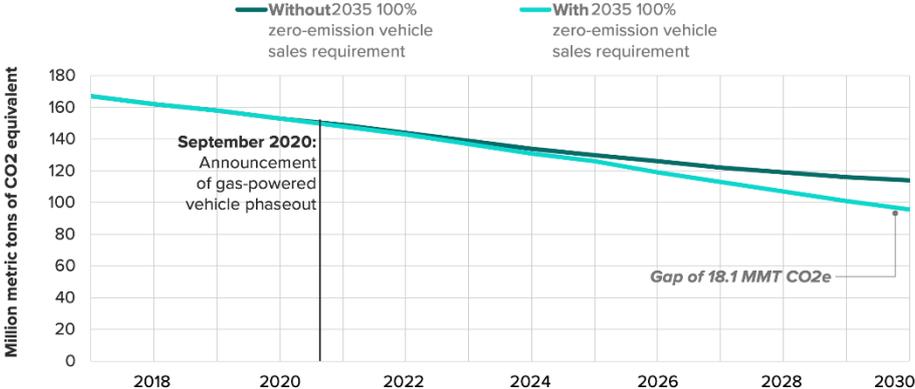
Fuel Operating Cost Comparison ICE vs. BEV	Internal Combustion (ICE) TYPE: Compact car RANGE: 360 miles. MPG: 30 miles per gallon TANK SIZE: 12 Gallon Tank GASOLINE: \$4.50/gallon Cost for a Tank of Gas for 360 Miles: \$54.00	Battery Electric Vehicle (BEV) TYPE: Nissan LEAF BATTERY CAPACITY = 24 KW RANGE: 70 miles .34 kWh per mile COSTS: \$0.36 / kWh Electricity Fuel Cost for 360 miles: \$44.06	Usage TERM: 6 Yrs. USAGE: 12,000 mi. / year TOTAL Mileage: 72,000
Fuel	Gasoline (ICE)	Electric (BEV)	Fuel Cost Savings
Cost (per mile)	\$0.15	\$0.1224	\$0.0276
Six Year Total Fuel Cost	\$10,800	\$8,813	\$ 1,987
Maintenance Costs	Gasoline (ICE)	Electric (BEV)	Maintenance Savings
Routine Service and Maintenance	\$6,000	\$2,000	\$4,000
TOTAL Costs	\$16,800	\$10,813	\$5,987 SAVINGS

SUSTAINABILITY IN ELECTRIC VEHICLES

Over the last few years, the switch from ICE vehicles to EVs has begun due to our concern for climate change prevention over the following generations. The sustainability provided by EVs is a big incentive to make the switch. Manufacturers use recycled and organic materials instead of new metals and plastics which will minimize the environmental impact from creating the vehicle. EV’s are known to have zero tailgate emissions when driving, however, still emit carbon dioxide. The production process is more demanding on the environment than ICE vehicles as manufacturing batteries can be very polluting. Materials like lithium, cobalt and graphite used for electric vehicle batteries are found underneath the surface of the Earth.

Mining processes behind the extraction of these rare earth materials are contributors of the increased pollution. The good news is many manufacturers of EV's like Tesla are switching to 100% renewable methods of extracting batteries and setting guidelines for only using clean energy during production. Another question, needing to be answered is the source powering our vehicle. We may not be directly polluting our environment and our intention is making sustainable change using the vehicle. The pollution could come from a distant power plant that creates electricity from the use of fossil fuels, oil, and or natural gas. Even with these flaws in the production process, EV's only emit half of carbon dioxide emissions, ICE vehicles produce. Environmental movement towards clean transportation is rising across the world. California and Massachusetts are banning the sales of gas vehicles by 2035. In China, a country heavily reliant on the use of coal for energy, greenhouse emissions dropped 20% by using electric vehicles. For us to be fully sustainable when it comes to powering up electric vehicles, we need forms of clean energy available for consumption. Sources like solar, nuclear, geothermic, wind, hydro-electric are excellent sources of clean, renewable energy to help our sustainability be absolute.

California’s Transportation Emissions Projected to Dip by Roughly 18 Million Metric Tons by 2030 Under Newsom Plan



MORNING CONSULT

Data modeled using Energy Innovation’s Energy Policy Simulator. Model assumes ZEV sales increase linearly beginning in 2021 to hit state-mandated targets of 100% ZEVs for passenger light-duty vehicles by 2035 and for medium- and heavy-duty vehicles by 2045.

RANGE ANXIETY AND INFRASTRUCTURE OF ELECTRIC VEHICLES

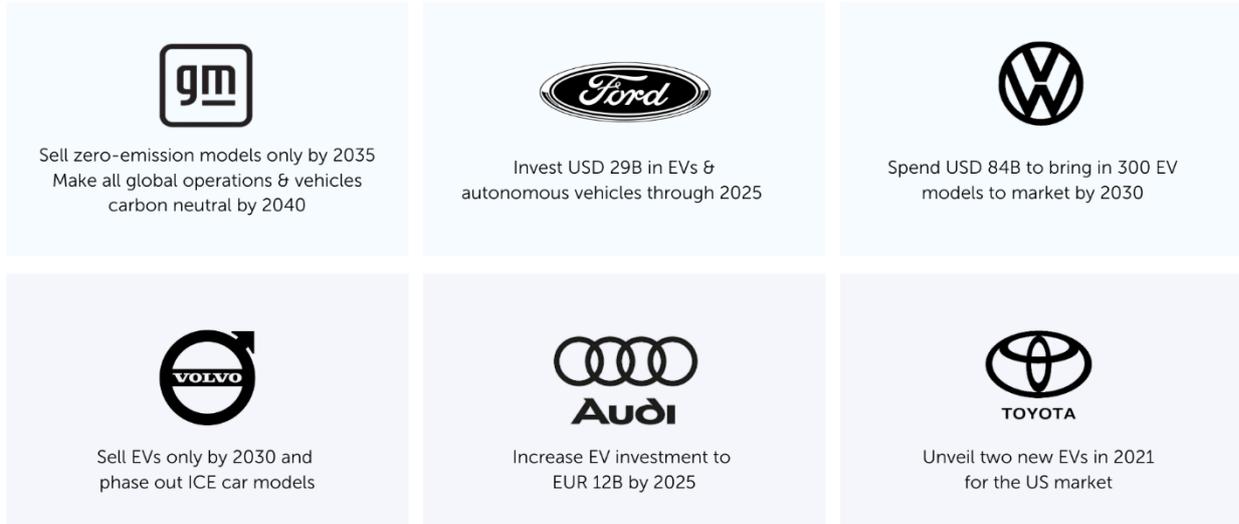
Electric Vehicles are an excellent choice for your next light-duty vehicle. These vehicles can save you thousands of dollars over their lifespan, create tax credits and rebates as well as being a clean method of transportation to change our future in a sustainable way. However, people have concerns about this new method of transportation. Common answers of concerns for people interested in an EV are the lack of infrastructure for fast chargers and range anxiety. The infrastructure is miniscule compared to gas stations for ICE vehicles. This is a major concern for rural populations as the only methods of charging are at home, where charging is much slower compared to a local fast charger. EV's charge fully between forty-

five minutes to an hour with fast chargers, gas stations fill an ICE vehicle within minutes. People who have a tight schedule might not have time to be able to recharge their vehicle unless their work or home will have access to a charging network. The lack of enough charging stations creates a fear of running out of power when driving their vehicle. Average EV's have fewer driving miles than an average ICE vehicle. In the colder months, EV's will use more power to keep your car warm, reducing your total miles. Long road trips can be challenging due to the time required to fill up your EV in the trip. You must plan your trip by only driving on a path leading to a fast charger. Once, you get to a fast charger, it will take longer than filling up your car with gas.

INFRASTRUCTURE IMPROVEMENT STRATEGY

Public support for an EV-based society is rapidly expanding with the imminent threat of global disaster. People are concerned about our future if we do not change our traditional ways of life. Change is hardly ever rapid, and this change could take some time to ensure that our electrical operations are ready to take a bigger burden to the grid. There will need to be a gradual transition to clean, renewable energy over the next ten years. If we completely abandon one of our primary sources of energy, our society will come to a standstill and mainstream adoption will never occur. Gas and other polluting energy dependence must decrease with deadlines. Clean, renewable sources of energy must become more prevalent to supply our grid with clean energy. Our electrical grid is over one hundred years old and not capable to handle our advancing society. The House is planning to pass a three and half trillion-dollar plan to improve our infrastructure across our country. This will include investments to our electrical grid, clean energy sources, fast chargers, and electric vehicle manufacturing. The plan includes \$174 billion to improve the capabilities of the electrical vehicle market, and \$100 billion to address the country's electric grid. Millions of homes will be modernized to handle the effects of climate change and be able to receive clean energy more efficiently. Major companies across the United States like Amazon and Lyft have committed to changing their fleet to EVs. Corporations need to be pioneers of change to receive the best personnel to keep operations thriving. Charging infrastructure should be included in standard building plans, smart charging will need to be emphasized to efficiently move electricity around for places needing energy. Upgrading buildings' electrical infrastructure and planning out the electrical system of distribution will attract people for their specific industry as well. The automobile industry has been creating plans to eliminate the sales of gas-powered vehicles, Volvo has committed to stop selling gas-vehicles by 2030, and GM has committed to only selling EVs by 2035.

AUTOMAKERS' EV PLANS & COMMITMENTS



Last updated: June 2021

PEOPLE FACTOR

As we progress towards a future of clean energy and sustainable vehicles. We must look at ourselves and understand that the biggest barrier to achieving this essential future is us. Our mindset of nostalgia and fear of change is a serious issue. Most of us lived with traditional ICE vehicles for all our lives, we created great memories in these vehicles. Many of us experienced the thrill of driving your car, having your own independence of doing what you want to do in a traditional vehicle. People can live in a small rural area with one gas station to fill up their vehicle, making a EV not particular for their situation. Political views can be a source of disagreement, some people may not believe climate change exists or that we have not contributed to the problem. The cost of change prevents business from pursuing cleaner alternatives as modern business tries to reduce cost and maximize profits. Regular people will have a difficult time being able to afford an EV as start-up costs are higher than ICE vehicles. Every situation for every person is unique with different criteria to buying an EV.

NET ZERO

At National Grid, we have ambitious goals to accelerate the transformation of our vehicles to help create a better future. The company-wide goal is to be carbon-neutral in our organization by 2050. We will achieve this goal cutting greenhouse gas emissions 80% by 2030, and 90% by 2040. Moving to fully electric light-duty fleet by 2030 is an essential goal for us to reduce our pollutants. Making our medium-duty fleet 30% plug-in and our heavy-duty fleet 10% plug-in is a priority to our fleet department and throughout the organization. National Grid will support infrastructure development to support future electric vehicle drivers across the service territory. The infrastructure will be flexible in supporting clean energy for other

methods of clean energy like hydrogen. In our operations, we are planning to reduce SF6 emissions 50% by 2030 and eliminate these emissions entirely by 2050. National Grid's aim is creating a fully decarbonized and modern electric grid to supply clean energy in the Northeast United States and the United Kingdom. This electric grid will work by connecting renewable sources of energy in a quick and efficient manner. In addition to our plan to reduce operations-related emissions, National Grid has created measures to reduce energy consumption in our offices 20% and improve natural environments that we own by 2030.

CONCLUSION

Electric vehicles are an essential tool to combat climate change and protect our way of life. The threat is real and will not improve without immediate action and legislation. To protect daily operations and thousands of jobs, we need to act with gradual plans. The mass adoption of EV's in our society is an excellent and simple way to lower our emissions. Lucrative savings offered by the federal government and the states can be an intriguing incentive for new car buyers. EV's produce a substantially less amount of carbon dioxide emissions over the lifetime of the vehicle compared to ICE vehicles. EV's are using eco-friendly materials to build their cars which protect our natural environment by preventing future productions of new resources harming our planet. It is our choice on what future we can achieve. We can do nothing, risk millions of lives, and endure natural disasters costing trillions of dollars. The alternative is everyone putting aside their differences to create meaningful. Anyone can contribute to this greater tomorrow by contacting representatives to support improvements in our infrastructure, encouraging people to make a switch towards clean energy, and or making the switch yourself. It will be a long road until EV's become widespread in the United States. I hope by working together, anything is possible, and we create change lasting for generations.

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