

ST.GALLEN SYMPOSIUM

Global Essay Competition 2024

Title: Solving the Electrical Energy Storage Scarcity: How Structural changes and Innovation in upcoming EV industries can help us solve this storage crisis and help combat Climate Change.

Essay:

Introduction

Our World today is growing at a rapid pace. Human civilization has tremendously improved in various facets of life over the past two centuries. We have seen discoveries and innovations of the form we have never imagined such as telecommunications [1830s], electric lights [1879], electric engines [1821], automobiles [1885], industries [late 19th Century], computers [1940s], mobile phones [1973], internet [1969], Information technology [1970s], digital economy [1990s], AI [20th Century], etc. But what do you think was the main force behind it? What led to humans improving their standard of living so drastically in a short period of time? What led to a primitive man become one of the most powerful people having all information about the world at the tip of their fingers? It was all due to Electrical Energy (Electricity).

Electricity has been the main driver behind all these innovations we discussed above. Though there may be no direct linkages of these innovations with electricity but only because of it, humans were able to build upon certain things to reach at this stage. But you must be wondering, everyone is already aware about all these facts so why shifting our focus to this at this very moment? Why are we talking about it anyway since it is easily accessible and available to everyone in the contemporary world? It is because sooner or later, we will be having shortage of it. No, I don't mean we will run out of it, but in a world moving towards net zero carbon emissions, we will not be able to replace our current dependency on fossil fuels with enough renewable energy sources. Although, it's not like we have a renewable energy generation bottleneck but its more about our limited capacity to store the energy generated from the renewable energy sources. In this essay, we will be touching upon different issues at hand regarding renewable energy storage and we will discuss how certain fundamental changes in booming industry like EV can help us solve the crisis.

Climate Change

Humanity is facing a larger issue right now where climate change is changing the landscape of the earth. Glaciers are melting 5x faster than two decades ago. "According to NOAA's 2023 Annual Climate Report the combined land and ocean temperature has increased at an average rate of 0.11° Fahrenheit (0.06° Celsius) per decade since 1850, or about 2° F in total. The rate of warming since 1982 is more

than three times as fast: 0.36° F (0.20° C) per decade”¹. This is going to change weather patterns abruptly, leading to dramatic changes on earth such as occurrence of more severe storms & droughts, loss of species, poverty and displacement, and substantial rise in global sea level which will engulf many prominent coastal cities around the world such as Venice, Mumbai, Amsterdam, etc.

As the Earth's climate undergoes unprecedented shifts, the need for urgent and collective action becomes increasingly evident. You must be scared till now that for such a grave issue what are we doing as human beings and whether our powerful governments care about this serious problem or not?

Yes, the governments all around the world realised that we will have to implement some radical changes in our country such that we avoid the negative impact of global warming as discussed above. So, as a promising step in the right direction, governments all around the world called for The UN Climate Change Conference in Glasgow (COP26) to sit together and discuss ways to avoid such crisis to happen.

“The UN Climate Change Conference in Glasgow (COP26) brought together 120 world leaders and over 40,000 registered participants, including 22,274 party delegates, 14,124 observers and 3,886 media representatives. For two weeks in 2021, the world was riveted on all facets of climate change — the science, the solutions, the political will to act, and clear indications of action”². There was a mutual understanding among nations and governments agreed to – recognize the emergency, accelerate action, move away from fossil fuels, deliver on climate finance, stepping up support for adaptation of green energy, completing the Paris rulebook, and focussing on loss & damage.

Now in order to control climate change, “The latest science suggests that limiting warming to 1.5 degrees C depends on CO₂ emissions reaching net zero between 2050 and 2060”³. Many nations have set their own targets of achieving net zero emissions such as India by 2070, US by 2050, etc. So why there is a worry around? If promised on the international stage, nations will fulfil their promises.

But there is a high chance that they will not. These targets are far more optimistic than real. See, a large chunk of carbon emissions is generated because of Electricity & heat production – 31%⁴ (Global Manmade Greenhouse Gas Emissions by Sector, 2013 – Data by Centre for Climate and Energy Solution). Currently only “1/3rd of the world's primary energy is sourced from renewable technologies in which Solar and wind occupies a major part of the pie”⁵. We are still heavily dependent on fossil fuels to

¹ [https://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature#:~:text=According%20to%20NOAA's%202023%20Annual,0.20%C2%B0%20C\)%20per%20decade](https://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature#:~:text=According%20to%20NOAA's%202023%20Annual,0.20%C2%B0%20C)%20per%20decade).

² <https://www.un.org/en/climatechange/cop26>

³ <https://www.wri.org/insights/net-zero-ghg-emissions-questions-answered>

⁴ [https://www.c2es.org/content/international-emissions/#:~:text=by%20Sector%2C%202013-,%25\)%20and%20manufacturing%20\(12%25\)](https://www.c2es.org/content/international-emissions/#:~:text=by%20Sector%2C%202013-,%25)%20and%20manufacturing%20(12%25)).

⁵ <https://ourworldindata.org/renewable-energy#:~:text=Approximately%20one%2Dseventh%20of%20the,share%20in%20the%20energy%20mix>.

generate electricity. It's not like we don't have the capacity or capability to increase our renewable energy generation, we surely can! But due to the intermittent nature of Solar and Wind, we must store that energy somewhere such that we can make use of it when required. That requires us to build batteries – highly efficient, durable, and not just a few but millions of it to cope up with the increasing demand for energy. For that, we will need tons and tons of Lithium (most efficient batteries available nowadays are Lithium Batteries – also used in EVs) mined from beneath the earth. So, let's mine the Lithium on this scale, but is there any problem in doing so?

Negative impacts of Lithium Extraction

Though emissions deriving from mining Lithium is lower than those deriving from fossil fuels production, the extraction methods for lithium can be very energy intensive – leading to air and water pollution, land degradation, and potential for groundwater contamination. Lithium mining is responsible for around 1.3+ million tonnes of carbon annually, with every tonne of mined lithium equating to 15 tonnes of CO₂ into the air.⁶ We will need these lithium batteries for mobile applications (EVs) since it is a lighter, high density battery option as compared to the alternatives and we will also be needing it for other essential components such as solar panels and wind turbines which are basis for renewable energy. Even if we find alternate green extraction methods for Lithium extraction, we still would not be having enough Lithium to cater to the demands of the growing EV industry as well as the storage capacity required to turn to completely renewable options. So, what to do? How to tackle this problem?

Need to thrive with less – Smartly!

To navigate ourselves out of this situation, we will have to think of some innovative solutions which can reduce our need to bring in storage solutions specifically for the energy generation. What if we use the booming EV industry to our advantage? Will that solve a part of the problem?

“Electric vehicles are the key technology to decarbonise road transport, a sector that accounts for over 15% of global energy-related emissions”⁷. With improved range, wider model availability and increased performance, people are shifting from conventional ICE vehicles to EVs. “Passenger electric cars are surging in popularity – we estimate that 18% of new cars sold in 2023 will be electric”⁸.

Here we can leverage this growth and technology of this industry to solve our issue. You must be wondering how? Simply, by making EVs act as mobile storage units for our energy.

EVs run on batteries, and these are not any small batteries, they can store an average energy of 35-40 KWh – enough to cater to the needs of a normal household for about 5-6 hours minimum (calculation

⁶ <https://earth.org/lithium-and-cobalt-mining/#:~:text=Though%20emissions%20deriving%20from%20mining,and%20potential%20for%20groundwater%20contamination.>

⁷ <https://www.iea.org/energy-system/transport/electric-vehicles>

⁸ <https://www.iea.org/energy-system/transport/electric-vehicles>

done considering household using certain appliances such as AC, Refrigerator, Lights, Fans, Washing machine, etc continuously for the given period). So, the idea is if we use our EVs to store energy in the day when there is abundance of renewable energy available for generation then instead of installing huge batteries at remote locations costing huge sums of money and huge Lithium reserves, we can just make use of the existing resource available at our doorstep to good use.

So, how will this model work? If we observe, majority of the time in a day, a vehicle is usually parked at some parking spaces either at offices, public parking, co-operative society parking, etc. Now in this model, whenever an EV is idle or in standby mode, a bi-directional charger will be connected to it (consent will be taken from EV owners). These vehicles will be getting charged with the help of energy from solar panels portably installed above this infrastructure. Now this energy stored will be used at certain times to power the grid – Surge demand, night energy requirements (when solar energy is not generated), etc. You must be thinking about there would still not be enough power to cater to global demand. Initially – yes but this would be a major transition from energy derived from fossil fuels to renewables. Also, since millions and millions of cars would come under the model, those tiny-tiny contributions will look like a major chunk catering to a major part of the energy needs. This way even without deploying extra storage resources, we partly solve the storage scarcity problem.

Also, this solution could be extended to the battery swapping systems deployed by various companies.

Although this solution will require support from the community since energy is getting stored in people's personal vehicles, and support from Industry where they will have to ensure that suitable safety devices are employed making this model a safer solution for everyone. What do you think what other issues can we face?

Roadblocks/Challenges

We have seen that EVs can be viable solution or part of the solution moving forward – solving the energy storage scarcity problem. However, many countries are yet to see EVs entering their market. Even if people get access to EVs in their countries, it will take time for them to adopt EV into their life and the ecosystem. Also, it has been observed that sales in developing and emerging economies have remained low due to relative high price of an electric vehicle as compared to an ICE vehicle and due to lack of charging infrastructure availability. Again, this is just a part of the solution to the storage scarcity, we will still have to figure out how can we develop on the existing system to make it a full-blown system. There's another battle to fight in terms of regulatory issues arising from this eco-system. Also, safety could be an area of concern for this system. Moreover, to facilitate Vehicle-to-Grid energy flow, charging infrastructure would need to be modified for bi-directional capability which will require additional costs. Lastly, but most important roadblock would be establishing community alliance since repetitive charging-discharging can degrade battery and reduce the lifetime of the vehicle.

Recommendations – Tackling Challenges

International organizations such as United Nations must lead from the front ensuring rapid adoption and penetration of EVs into countries around the world. Companies must play their part by ensuring that EV prices drop in the future through economies of scale and innovative economical solutions. Governments needs to further push such organizations to take initiatives by incentivizing them and must ensure infrastructure is laid out for smooth adoption of EVs. Companies must make sure that they are continuously involved in R&D to look for new innovative efficient solutions which could further enhance the system. Governments must step up to implement policies supporting this model and pushing for innovative solutions in this field.

Conclusion

To address the energy storage scarcity issue and support humanity's long-term sustenance by tackling climate change, it is crucial to make good use of the opportunity of tapping into the nascent EV industry to incorporate structural changes and push for innovation – this way instead of thriving for more resources, we can thrive with less and solve this grave issue blocking our way to achieving independence from fossil fuels. Although, the solution will not eradicate the problem completely, it will be an optimistic step towards striving for more such solutions which can work for the betterment of the contemporary world. Thereby allowing humanity to continue its streak of new inventions, and discoveries backed by the power of clean energy.

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Word Count (essay text only): (2084 /2100)