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Some Aspects of E-Mobility

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Introduction

The development of electric vehicles has a very long history. Even a little longer than the development of cars with internal combustion engines. The first working electric vehicle appeared as early as in 1881, while Carl Benz built his Patent-Motorwagen only in 1885. In 1899, Camille Jenatzy became the first person in the world to break the 100 KMPH (more than 66 MPH) mark in his electric car, setting a world speed record that lasted until 1902. Since then, the development of electric vehicles has come a long way, and there has not been a decade when something new would not come along in the field. So, there is a lot of experience with them. However, we have reached a stage where electric cars are being forced on the population of the world with various reasons and incentives, and people are being manipulated with misleading information or half-truths. This article has been written as a result of many discussions with Marketing Management students at University, when I tried to explain to them, using this specific example, how to find, connect and verify the necessary information to get the true picture. Everything specified below is known to experts or can be calculated relatively easily. But the facts are not presented in summary form, or the provided information is separated, or it is omitted.

Any currency of the world is a relative product and has a variable value in a place and time. So "money and price" cannot be used to objectively evaluate any process, let alone a product. For this, it is always necessary to find an independent comparable parameter. The following table therefore shows the energy efficiency of the processes leading from the extraction of raw materials to their transformation into the movement of a car. In the case of electric mobility, it is a common and big mistake to compare the price of electricity consumed with the price of fuel for an internal combustion engine. An even bigger mistake is the comparison of financial costs per distance traveled.

In any technological process, or when analyzing the actual costs (not price) of a product, there is necessary to start at the beginning of the process. Therefore, the table starts with the process of crude oil refining, through its conversion into electricity or fuel for engines, to the use of that energy for a movement (Table 1). The above calculation table clearly shows that an electric vehicle is 6 times more energy intensive than a car with a petrol or diesel engine. And that is assuming that petroleum products or natural gas are used to generate electricity. If a coal is used to generate electricity, this value shifts to 10 times worse.

This low energy efficiency of electric vehicles has a number of consequences. Not only will be much more electricity needed to be generated, but also distributed. Few power grids in the world are capable of transmitting the amount of energy needed. This means not only strengthening existing lines, but also building or rebuilding substations. And that is not a cheap and easy thing to do. People will then pay the increased costs of such conversion in the electricity prices. But the situation is even worse when it comes to how to generate the amount of electricity needed. Not many more hydroelectric plants can be built. Thermal power plants have significant disadvantages. See below. Wind farms are not energy efficient. Nowadays, they are categorized into classes: it is known how many kg (lb) of what construction material is used for their manufacturing, what the electricity consumption for the manufacture of 1 kg (1 lb) of the given construction material is in kWh, etc. And because of their many years of operation, it is also known how many MWh they will generate over their lifetime.

As a result, wind farms produce as much electricity over their lifetime as is roughly needed for their manufacturing. And when the energy consumption for their disposal is included in this balance, the result is negative. Solar photovoltaic panels are semiconductors and will be discussed next. Their manufacturing

also consumes more electricity than what they generate over their lifetime. In addition, because of the impedance load they induce, it is necessary to rebuild substations. Burning biomass is ecological nonsense. The efficiency of the process is 5-6 times lower than that of fossil fuels, at the cost of producing toxic and carcinogenic fumes which enter the air and at the cost of oxygen depletion in the atmosphere (see below). While nuclear power plants are able to produce a given amount of electricity efficiently and cheaply, they also pose issues. The only true information on them is provided in the bulletins of the International Atomic Energy Agency in Vienna.

Table 1: Energetic Effeciency.

Electric Cars		
Process	**Separate Process Efficiency [%]**	**Total Efficiency [%]**
Crude oil refinement	15	15
Heat generation – fuel burning #	30	5
Heat electric power generation	34	2
Electric power grid and distribution	92	1
Charging and accumulation	95	1
Combustion Engine Cars		
Process	**Separate Process Efficiency [%]**	**Total Efficiency [%]**
Gasoline production	24	24
Combustion engine	25	6

Notice #: If there are fossil fuels used for heat generation process the efficiency of this separate process is 16% only. Peter Stuchlik: Corporate Marketing Management, VSFS Praha, class 2021.

Thermal power plants burning both fossil fuels and oil derivatives or natural gas have more disadvantages compared to car engines. Car engines have particles filters as well as catalytic converters. Power plants have particles separators and flue gas desulphurization. They are not equipped with catalytic converters. Therefore, they emit much more hazardous substances into the air. And considering that 6 times more energy will be needed to power the electric cars, the number of hazardous substances in the air will become very significant. Yet, paradoxically, the biggest currently known source of air pollution are the engines of the air crafts, not cars.

Another serious problem of e-mobility involves batteries. What a wonder that some of their features are even discussed. Lithium (Li) is a very reactive element. The electrolytes currently used are derivatives of ethane and propane, so they are highly flammable and capable of forming an explosive mixture with air. To this day there is no suitable extinguishing agent for them, except for CO_2. However, such big fire extinguishers with enough content to extinguish an electric vehicle are quite large and even fire-fighters do not bring them along. So the safest way to deal with a burning electric vehicle is to let it burn freely. And run away from it far upwind. With the number of accidents in automobile traffic on a daily basis, the sight of a bonfire on the side of the road will soon become commonplace. Even though non-flammable batteries are being developed, they are a thing of a very distant future. Because factories for conventional Li-ion batteries are being built all over the world, and it will be necessary to wait for these factories to make a proper profit.

But what is not discussed, and yet is an environmental disaster and a "time bomb", is something else tied to these batteries. Absolutely all semiconductors, and also Li-ion batteries, need dopants. Without them, they would not have semiconductor properties. These include some rare-earth elements. Their occurrence in the rocks where they are present and their estimated amount in the Earth's crust are shown in the (Table 2).

These figures have two important implications. If we run out of those elements, that's the end of all electronics. There will be no chips, no computers, no TVs, no phones, no LEDs, nothing like that. And since these dopants are also needed in lithium batteries, we will run out of them very soon because of their expected consumption in electric vehicles.

But their concentration in rocks, which are found in only a few places in the world, is also a serious problem. For a better understanding, at a concentration of 1 ppm, 1,000 kg (1.2 long T) of the rock would need to be mined and processed to extract 1 g (0.035 oz) of the element. But that's not the end of the process. The elements are isolated in aqueous media using acids and hydroxides. At the very end of the isolation process, chromatographic or ion-exchange methods are used. Thus, roughly 1 million liters (264,000 gal) of water are required to process 1 kg (2.2 lb) of the parent material. This is usually neutralized after the process, but metal salts it contains are not removed. And this is the biggest environmental burden mankind has yet managed to create.

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Table 2: Rare Elements (Dopants).

Doping element	Ore concentration [ppm]	World reserves [ml t]
Tellurium	5	0,019
Gallium	16	1
Indium	50	0,004
Lanthanum	39	?
Europium	2	0,004
Gadolinium	6	

Peter Stuchlik: Corporate Marketing Management, VSFS Praha, class 2021.

But the problems with car batteries do not end there. Magnetic Pulse Weapons (MPW) have been developed for 2 decades. Some armies or even police forces already have them, even in portable versions. They look like bulkier rifles. If this weapon hits a conventional car with an internal combustion engine, it is difficult to repair, but it can be done. There is no chance to fix it on electric vehicles. Moreover, the Li-ion batteries used will explode like a bomb when hit by such a weapon. The most common argument for the introduction of electric vehicles is the environment and air emissions. The above energy balance shows that emissions will increase many times due to thermal power plants and the 6 times higher energy intensity of electric vehicles. And to boot, they will contain hazardous substances that current cars do not produce. The so-called green sources of electricity are in fact not green at all, nor are they energy efficient.

Although there is a relationship between the CO_2 content of the atmosphere and its temperature, which is always being used as argument, none of the theories used are conclusive. The global climate change we are experiencing is due to something else entirely. A completely different phenomenon, fully independent of human activities. Moreover, the increase in CO_2 in the atmosphere is not that significant. But the repeated references to the so-called "carbon footprint" mask something much more important. And that is a significant decrease in the oxygen (O_2) content of the atmosphere. This decline is due to several factors. Some are caused by mankind, while others are independent. Moreover, if e-mobility does not pass us by, oxygen consumption can be expected to increase. The misinformation being spread on the effect of CO_2 in the atmosphere on the Earth's temperature is of the same kind as the "Ozone Hole" debate. In fact, it has been proved that space rocket launches are the largest contributor to its formation. Then comes air transport. But somehow nobody talks or writes about it.

Conclusion

As regards the issues of e-mobility, people prove every day that Mr Goebbels was actually right. "A lie repeated a hundred times becomes the truth." So many people believe that e-mobility will do something good for the environment. The opposite is a true. It is just a high game at the international level.

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