T-611-NYTI-21652 New Technology

RESEARCH PAPER

ELECTRIC VEHICLES

Spring Semester | Student : Þuríður Björg Guðnadóttir

Table of Contents

Electric vehicles

Introduction

In every home there is a lot of electric powered tools, some are used inside and other outside. We can toast our bread, dry our hair, vacuum clean and so on. But there is one thing that is not powered with electricity. We start the day of using this product, the workday ends often by using it, we use it after work and some people use it in work, on weekends and so on. This product can be a symbol of personality, a symbol of power status, a sign of success or sign of taste. I think it‘s now obvious that I‘m talking about the car. Why is the typical home car not powered with electricity?

In this essay my main focus is going to be the electric car, how the technology has evolved and what the prospects are. In my opinion, this technique can and should be used more.

Can we in Iceland use our resources to produce energy that is possible to use in electric cars? This is a quistion that I want to find a answear to and also I want to find out what are the disadvantages of electric cars.

I think it is time to consider it necessary to produce varied types of electric cars. The reason is simple, we need to find substitute for oil and gasoline powered cars and we need to lower the pollution from vehicles. I think the best solution is electric and I am positive that is a big part of our future.

History of electricity

Electricity is a general term covering the presence flow of electric charge. It has not always been part of the history but it goes back more than two thousand years. The Greeks rubbed fur on amber and that caused an attraction between them. This is the beginning of electricity.

By the 17th century, many electricity-related discoveries had been made, such as the invention of an early electrostatic generator, the differentiation between positive and negative currents, and the classification of materials as conductors or insulators. (Bocco, Who Discovered Electricity, 2011)

In 1752 Franklin was said to have performed the famous experiment of flying a kite during a thunderstorm. This led to the discovery that lightning and electricity were somehow related. Modern scientists know this to be some kind of a tall tale, since being hit by lightning would have been fatal. It's however likely that Franklin was actually insulated, away from the path of lightning. The kite experiment helped Franklin establish a relationship between lightning and electricity, which led to the invention of the lightning rod. (Bocco, Who Discovered Electricity?, 2011)

Picture 1

Alessandro Volta, Italian physicist, is known for his pioneering work in electricity. By 1800 he had developed the so-called voltaic pile, a forerunner of the electric battery, which produced a steady stream of electricity. It was Volta who discovered that certain chemical reactions could produce electricity. Volta also created the first transmission of electricity by linking positively-charged and negatively-charged connectors and driving an electrical charge, or voltage, through them. In recognition of his work in the field of electricity, the electrical unit known as the volt was named in his honor. (Ament, 2006)

It wasn't until 1831 that electricity became viable for use in technology. English scientist Michael Faraday created the electric dynamo, a crude precursor of modern power generators. This invention opened the door to the new era of electricity. (Abernathy, 2005)

A few decades later, in 1879, Thomas Alva Edison an American inventor and scientist invented the light bulb. The light bulb, in particular, profoundly changed human existence by

illuminating the night and making it hospitable to a wide range of human activity. (Ament, 2006)

The electricity that we use today was the invention of a genius who was forgotten in the tides of time. He is Nikola Tesla, inventor, mechanical engineer, and electrical engineer. He was an important contributor to the birth of commercial electricity, and is best known for his many revolutionary developments in the field of electromagnetism in the late 19th and early 20th centuries. (Unknown, Wikipedia, 2011) Some people say he is the man responsible for our present world. Tesla's patents and theoretical work formed the basis of modern alternating current (AC) electric power systems, including the polyphone system of electrical distribution and the AC motor. The actual power systems we use today were developed by Nikola Tesla. His first power plant is still able to be viewed on the Canadian side of Niagara Falls.

Much later, in 1904, Sir John Ambrose Fleming, English electrical engineer and physicist invented the first thermionic calce or vacuum tube; this opened a new horizon for the advent of electronic components.

Electric devices, vehicles and communicational systems have been available since then; home appliances, airplanes, computers, automobiles, spacecraft, medical equipment and many more have become part of our everyday life. (Kokkinidou, 2010)

There have been many others including Ampere, Faraday, Ohm, and Oersted that managed to develop simple electrical devices after having understood the basic electrical principles. Today we thank them for their incredible work that we enjoy the benefits from every day

History of Electric cars

Between 1832 and 1839, Robert Anderson of Scotland invented the first crude electric carriage. A small-scale electric car was designed by Professor Stratingh of Groningen, Holland, and built by his assistant Christopher Becker in 1835. Practical and more successful electric road vehicles were invented by both American Thomas Davenport and Scotsmen Robert Davidson around 1842. Both inventors were the first to use non-rechargeable electric cells. Frenchmen Gaston Plante invented a better storage battery in 1865 and his fellow countrymen Camille Faure improved the storage battery in 1881. This improved-capacity storage battery paved the way for electric vehicles to flourish. (Bellis, 2011)

By the turn of the century, America had good supply of cars, they were now available in steam, electric, or gasoline versions. Electric vehicles had many advantages over their competitors in the early 1900s. They did not have the vibration, smell, and noise associated with gasoline cars. Electric vehicles did not require gear changes but changing gears on gasoline cars was the most difficult part of driving. Steam-powered cars also had no gear shifting but they suffered from long start-up times on cold mornings. The steam cars also had less range before needing water than an electric's range on a single charge.

Picture 2
Here we se the first electric car

Despite all these benefits the electric vehicles had, it somehow disappeared by 1935. The years following until the 1960s were dead years for electric vehicle development and for using as personal transportation. (Bellis, 2011)

The 1960s and 1970s saw a need for alternative fueled vehicles to reduce the problems of exhaust emissions from internal combustion engines and to reduce the dependency on imported foreign crude oil. Many attempts to produce practical electric vehicles occurred during the years from 1960 to the present. (Bellis, 2011)

In the years 1973 to 1983 two companies were leaders in electric car production, Sebring-Vanguard and Elcar Corporation. (Bellis, 2011). During 1998 were available Toyota RAV4 sport utility, the Honda EV Plus sedan, and the Chrysler EPIC minivan. These three vehicles were all equipped with advanced nickel metal hydride battery packs.

Now in 2011 there are growing signs that the electric car, once on the road to extinction, may jolt back to life. Several small, independent automakers are juicing up electric cars as an environmental statement amid renewed concern about global warming and dependence on imported oil.

Myers Motors **Chevy Volt** **Nissan Leaf** **Tesla Roadster** **Tango**

Mynd 3

Who killed the electrical car ?

In the early chapter of history of electric cars, states that the first electric car came on the street during the years 1832-1839. The cars were sought working well for the consumer‘s requirements in those days and every car sold out. Therefore, might think that this development would continue and would be advanced in 200 years.

But on the other hand the development and production of these cars stopped and petrol cars became the only produced cars and electric cars were no longer gettable. What was the reason behind this decision and who took it. Who benefitted from this action, the oil barons ?

The movie "Who Killed the Electric Car?" is a documentary film that came out 2006. It is about the creation, limited commercialization and subsequent destruction of the battery electric vehicle. The film explores the roles of automobile manufactures, the oil industry, the US government, batteries, and consumers in limiting the development and adoption of this technology. (Paine, 2006)

In my opinion it is obvious that someone wanted to get rid of the electric cars and profited from this action. The only supply of cars use oil and the oil barons get all of the profit.

Last 100 years the world's habitant lived with the illusion that the electric technology was not sufficiently advanced to work well enough to drive cars.

The statement has been disproved with cars that able to perform very similar to the petrol car and some even better. (Paine, 2006)

Like I said in the history chapter, electric vehicles had all but disappeared by 1935. And until the 1960s they were all dead for use as personal transportation.

The Electric Car

An electric car is an alternative-design automobile that uses an electric motor to power the car, with the electricity being provided by a battery. While a conventional car does have a lead-acid battery as part of its standard equipment, this battery is for operating the starter and not powering the vehicle. (Walton, 2011)

How does the technology work ?

Electric cars have a motor just like conventional, internal combustion engine cars. The difference is that the power supply is derived from battery-stored electricity rather than the mechanical power derived from burning gasoline. The batteries used in electric cars vary in design, and include the lead-acid type familiar to all conventional car owners, lithium ion, similar to those used in laptops and mobile phones, but once again much larger, molten salt, zinc-air, and various nickel-based designs. (Walton, 2011)

In an electric vehicle the traditional gasoline or diesel engine and fuel tank is replaced with an electric motor, a battery pack and controllers. The vehicle also has a controller that powers the electric motor that uses rechargeable batteries as its energy source. The motor itself can be either AC or DC. The main advantage to electric vehicles is that the motor and battery configuration allows the vehicle to run more fuel-efficiently. (McClellan, 2010)

DC motor installations tend to be easier and less expensive to build. DC motors also have an overdrive feature which means that for a short period of time the motor will accept more energy and deliver more horsepower as a result. This feature is useful in a vehicle because it can help during acceleration. The motor, however, cannot be run in overdrive too often because the motor will overheat and could malfunction. (McClellan, 2010)

AC motor installations are more expensive than DC installations. They usually use a three-phase AC motor that allows regenerative braking. This means that during braking the motor acts in reverse as a generator and delivers power back to the batteries. 15% of the energy used for acceleration can be recovered using regenerative braking. This amount is not enough to fully recharge the battery pack, but it will extend the range of the vehicle. (McClellan, 2010)

In a DC electric car, the controller delivers the power from the batteries to the engine in a controlled way. The controller pulses the power to the engine usually at a frequency of 15,000 times per second. The frequency is outside of normal human hearing which is why the controller and motor is silent. In an AC electric car, the controller needs to create three

pseudo-sine waves. The controller takes the DC voltage from the batteries and pulses it to the motor. In addition, the controller via transistors reverses the polarity of the voltage. (McClellan, 2010)

The biggest technology challenge for electric vehicle engineers comes with the batteries. Lead acid batteries are not ideal for the job because they are heavy and bulky, have a limited capacity, take a long time to charge, have a short life, and are expensive. Therefore, either lithium-ion or nickel metal-hydride (NiMH) batteries are used instead. NiMH batteries double the range of the car and have a long useful life. However, the cost of the batteries is at least ten times higher than lead-acid batteries, and like lead-acid batteries, they are not good for the life of the vehicle. (McClellan, 2010)

An electric vehicle also has a normal 12-volt lead-acid battery. This is the same type of battery that every vehicle has and is used to power all of the vehicle accessories such as the radio, lights, power windows, etc. An electric car needs a DC to DC convertor to convert the voltage from the main battery back to 12 volts and to keep this battery charged.

Finally, an electric vehicle needs a charging system to recharge the batteries. The two main functions of the charging system are to charge the batteries as quickly as possible and to avoid damaging the battery pack during the charging process. (McClellan, 2010)

The technology and components used in an electric vehicle is constantly evolving, and engineers are finding new solutions every day to the technological issues. It looks like electric vehicles are here to stay, and the battery and other electric vehicle technology will only continue to improve. (McClellan, 2010)

The Problems with Batteries

The problems with electric cars all stem from the limits of existing battery design. Simply put, it requires a huge, expensive battery to even approach matching the power performance of an internal combustion engine. (Walton, 2011) Also, few battery designs can last for as long as the expectations are and the recharging time is substantially longer than refilling a fuel tank.

How does it work in Iceland?

Energy production has become the foundation of the Icelandic economy, fisheries is important but may not be the basis and pillar of our economy simply because Pelagic as capelin, which most of the fishing is starting to fluctuate significantly in quantity is not known how long and much we can count on the sea.

Iceland is blessed with abundant hydro-electric opportunities, and currently generates 6.5 TWh (Terawatt hours, which is equal to a million megawatt hours) per year, with the potential of 25-30 TWh per year. Geothermal currently generates 1.3 TWh per year, with a potential of 15 TWh per year over the next 100 years. Almost 100 percent of electricity in Iceland comes from these two sources. Geothermal energy is also used for space heating. (Romm, 2008)
Icelanders can generate electricity and hydrogen, and we should focus on that respect to the utilization of resources. Yet 30 percent of total energy consumption still comes from oil, which is primarily used in transportation (cars and boats). Iceland seeks to get rid of its remaining fossil-fuel dependence, and for a while it was intensely focused on becoming one of the first hydrogen economies. (K., 2008)
Iceland is in an interesting economic space right now, following that country's devastating 2008 bankruptcy. (Blanco, 2010)

Even the country's 840-mile-long ring road could theoretically be covered with just 14 fast-charging stations. The Icelandic government is expected to ease the way for the E.V.'s by removing import taxes on them, as was recommended by a Finance Ministry working group. (Hartsfield, 2008)

The challenge focuses on converting the whole Icelandic car fleet from fossil fuel to electrical cars, using Iceland's abundant, clean and self-sustaining energy sources. The goal is to make electrical cars a concrete choice for Icelandic commuters by the end of 2012 (Blanco, 2010).

Performance in cold

Iceland has long been touted as a hydrogen economy pioneer. So it is quite shocking that electric vehicles, both plug-in hybrids and pure battery electric cars are so new in our country. Is it because of the cold weather? For some reason, many people seem to think that EVs won't work in the cold but that is wrong. Electic vehicles can perform quite well in the cold, the electric motor prefers to be cool, and cooling air is blown through the electric motor in some EVs. The motor controllers also require some cooling capability. Lead-acid batteries do lose a lot of capacity when they are cold, but this is easily remedied by keeping the batteries warm using insulation and battery warmers.

Several techniques are used for keeping the windshield and passengers warm, including fossil-fueled heaters and electric heaters.

Effect

The nature

We, the people on this earth, have some common growing problems. Pollution is one and a shortage of gasoline and crude oil is another. Oil is limited and the price of oil continues to increase worldwide.

I will take Iceland as an example, it does not produce oil so it has to be imported and that is very expensive for the nation. There are added all sorts of surcharges, including taxes, duties assessment, shipping and more taxes.

Iceland is very dependent on the use of fuel and most habitants buy gasoline to get from place to place. We only have to monitor the morning traffic for a few minutes to see it. Most Icelanders want to have the freedom to move were they want when they want using the way to travel as suited to each, personal cars, busses or taxes. All these options consumes gasoline, and many other factors regarding the fuel engine, including the engine oil for lubrication of the engine and gearbox oil for lubrication of the gearbox . All these products are imported and so let's not forget that all these cars pollute our environment.

Picture 4

With the depletion of the earth's ozone layer and the shortage of our oil supply becoming an issue, we have had to look at alternative fueled vehicles that will not harm the environment, but will still provide us with a reliable source of transportation. What is really the solution to this problem? There is solution to solve how to travel from place to place without polluting and significantly reduce imports of oil and gas. That solution is electric! The future of transportation lies in electric cars! It is good for mother earth and in this case we would we are able to protect the environment and reduce maintenance costs that follow cars.

Positive

Compared to gasoline powered vehicles, electric vehicles are considered to be 97 percent cleaner, producing absolutely no tailpipe emissions that can place particulate matter into the air. (Unknown, Oracle, 2011) Particulate matter can increase asthma conditions, as well as irritate respiratory systems. Because EVs produce no emissions, there are no requirements for

EV owners to ever take in their vehicle to DEQ for an emissions inspection. Another factor that makes these vehicles so clean is that since they don't use half of the parts that a gasoline powered vehicle does they are not at risk of shedding any worn out radiator hoses and fuel filters to be dumped in our over crowded landfills, and leaking contaminated oil into our water supply, killing plant and animal life. (Unknown, Oracle, 2011)

Gasoline vehicles currently create almost one half of the total atmospheric pollution of three major air toxins: carbon monoxide, nitrogen oxides, and hydrocarbons. They cause damage to the global atmosphere. This is the most powerful reason for the development of electric cars; they produce no direct emissions since they don't burn fuel. (Unknown, Oracle, 2011)

Electric cars are completely silent because there is no internal combustion engine. In fact they are so quiet that manufacturers are thinking that EVs may one day require some kind of noise device on them to alert pedestrians that they are within the area.

In a gasoline powered vehicle, the then engine must be kept running even when the vehicle is idle. When an EV is idle, the electric motor is not running and the vehicle is not using any energy. On hot days, a few hundred gas-powered cars sitting on the freeway produce an unimaginable amount of pollution. In case of gas powered vehicles, while being idle on the freeway because of the traffic produce an incredible amount of contamination. However, electric vehicles running in a cold day, hot day, at day or at night, and can remain redundant or accelerate but will not produce any pollution.

Many people claim that EVs merely relocate the source of pollution to the power plants. Even though EVs produce no tailpipe emissions, they still need electricity to be recharged, which means they need power plants to produce the electricity. These people fail to realize, however, that many modern power plants (especially in states like California) are "clean", meaning they produce no pollution. Examples of "clean" power plants include nuclear reactors, windmills, hydroelectric plants and solar panels. Also, it is much easier to deal with isolated pollution sources such as power plants than it is to deal with millions of automobiles, each a source of pollution.

As more and more power plants become "clean" and as more people realize what EVs can do for the environment, EV use will increase, and our environment will become much nicer and we can reduce noise pollution from cars.

Negative

If the increase in electric cars will also increase production of electricity from thermal and nuclear power plants, impact on the environment will be negative, warn the environmentalists!

The non-governmental organizations warn that an increased number of electric cars on the roads could increase emissions of carbon! Plain mathematics proves this danger to be real. Except in the event that cars are propelled by green energy. Therefore it is vital that national target for renewable energy sources are set, as only these would ensure that emissions from electric cars to really be zero. (Unknown, Oracle, 2011)

A study ordered by the NGO Friends of the Earth Europe, Greenpeace and Transport & Environment, concludes that electric cars contribute significantly to the DE carbonation of road passenger transport. Increasing the number of electric cars on the roads, taking into account the current legislation, could lead to an increase in electricity production from thermal and nuclear power rather than increasing energy production from renewable sources, the report shows. (Zemanta, 2010)

To exploit the environmental potential of electric cars, the EU should eliminate the so-called super credits for electric cars, non-governmental organizations warn. Super credits also reduce the contribution of electric vehicles to achieve emission targets in transport, which is part of EUs directive on renewable energies. (Zemanta, 2010)

Results

The study shows that the electric car's Li-ion battery drive is in fact only a moderate environmental burden. At most only 15 per cent of the total burden can be ascribed to the battery (including its manufacture, maintenance and disposal). Half of this figure, that is about 7.5 per cent of the total environmental burden, occurs during the refining and manufacture of the battery's raw materials, copper and aluminum. The production of the lithium, in the other hand, is responsible for only 2.3 per cent of the total.

"Lithium-ion rechargeable batteries are not as bad as previously assumed," according to Dominic Notter, coauthor of the study which has just been published in the scientific journal Environmental Science & Technology. (Notter, 2010)

The outlook is not as rosy when one looks at the operation of an electric vehicle over an expected lifetime of 150,000 kilometers (93,205 miles). The greatest ecological impact is caused by the regular recharging of the battery, that is, the "fuel" of the e-car. Topping-up with electricity sourced from a mixture of atomic, coal-fired and hydroelectric power stations, as is usual in Europe, results in three times as much pollution as from the Li-ion battery alone. If the electricity is generated exclusively by coal-fired power stations, the Eco balance worsens by another 13 per cent. If, on the other hand, the power is purely hydroelectric, then this figure improves by no less than 40 per cent. (Notter, 2010)

The EMPA team concluded that a petrol engine car must consume between three and four liters per 100km (or about 70mpg) in order to be as environmentally friendly as the electric car studied, powered with Li-ion batteries and charged with a typical European electricity mix. (Quick, 2010)

Interview

Gisli Gislason has been a lawyer, a real estate mogul, a film producer and now he is working on a big project, bring electric cars to Iceland and put up electric power stations around the country. A few years ago, he moved back to his home of Iceland after a stint in Denmark and realized no one there was really working to bring in electric cars. So, he set out to be the change he wished to see and co-founded Northern Lights Energy (NLE) and then a spin-off called Even.

Gisli figured having vehicles on hand was key to getting people excited about plug-in cars. Thus, he ordered and then took delivery of the first Tesla Roadster in Europe. Last November, NLE and Reva signed a deal to bring Reva's NXR to Iceland. In the coming months, NLE will get delivery vans from Smith Electric and has put in an order for 1,000 Tesla Model S vehicles, which are scheduled to reach the market in 2012. Read on past the jump to find out how NLE's work will put people into these cars and move one of the last sectors in Iceland that uses fossil fuels into the renewable space. (Gíslason, 2010)

This is very exciting and hopefully there will be put up electric power stations around the country so people can use this new possibility in transportation.

Tesla Roadster

My personal favorite electric car is Tesla Roadster. The reason why is because it is opposite to the image people have of electric cars. They both have a classy sports car that is also fast and a efficient family car.

It takes about four seconds to go a hundred miles per hour, which makes it one of the fastest cars in the world. The company says its sophisticated lithium-ion battery will allow a range of 250 miles on a single charge and a top speed of 130 mph. That means that Tesla drives a three hundred and fifty kilo meters on a single charge and a desires half an hour to fully charge up. For example it costs about one cent to drive three-kilo meter and costs just over a hundred Icelandic kroners to drive to Akureyri from Reykjavik. The car is similar to the loud as laptop and is loaded with all kinds of accessories.

The best thing about charging the battery is that there is never a need to worry about waiting for the battery pack to be fully discharged before recharging it, since the car can be charged for as long as you like whenever you have access to power. There are three ways to charge the vehicle. First, it has a built-in battery charging system that can basically plug into any electrical outlet. Also, the car will be shipped with a Home Charging Station that will need to be installed in your garage by a qualified electrician. This seems like it will be the quickest way to charge the battery, since the company suggests it will only take about 3.5 hours to complete. (Adams, 2007)

The car costs 98,000 dollars with no accessories or 105,475 dollars with all the accessories. Some people will not find this to be great price and why should people prefer to buy a Tesla Roadster instead of a new Ford Mustang or Corvetta? What do people gain by buying a Tesla Roadster?

It cannot be denied that the gain is hidden in the car, because people are willing to pay the same money for a similar gasoline car. We could say that the gain is in fuel and maintenance cost. When people buy a Ford Mustang they are ready to pay a lot of money on gas and maintenance per month that they would not have to pay if they would buy.

Normal four cylinders petrol machine consists of over a hundred things that are in motion and heat up and cool down alternately, depending on whether if the car is running or not. The same capability has the engine in the car Tesla only one thing on moving a roto denominator.

As a result, the car is lighter and has fewer parts that can break or require maintenance. Take another example. The machine is pretty normal to petrol car and partitions that need lubricating, air-filter, oil-filters, coolant, spark plugs, oxygen skin functions, timing belt, fan belt, water pump and -pipes, clutch, exhaust pipe mufflers. All these things need maintenance. None of these things is in the Tesla Roadster electric car.

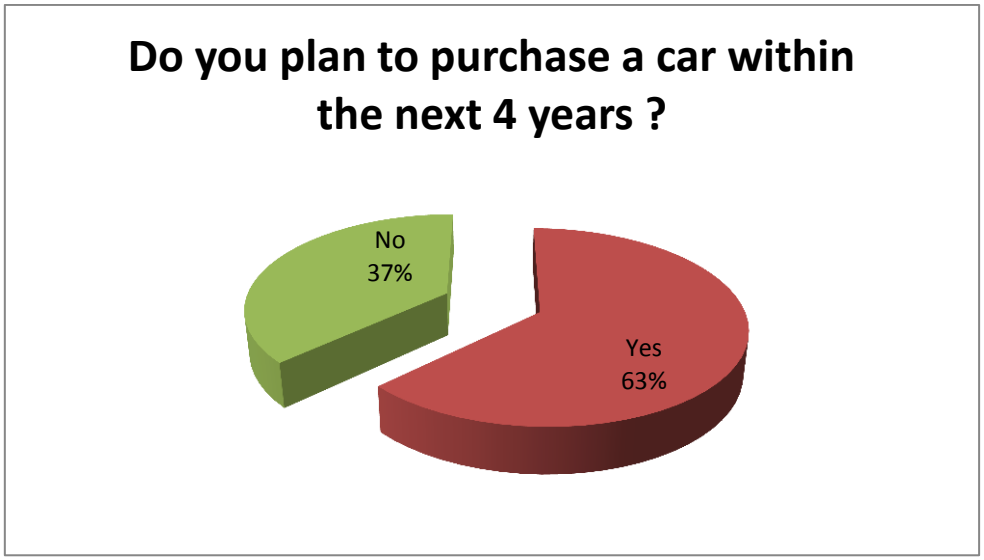
In the end we can see that the Tesla Roadster rate advantage over most of the other cars.

I think it is not a question whether electric cars do stream into our country but when. We are gradually combining petrol and electric cars, and ultimately I believe the power to take over, simply because it pollutes a lot less.

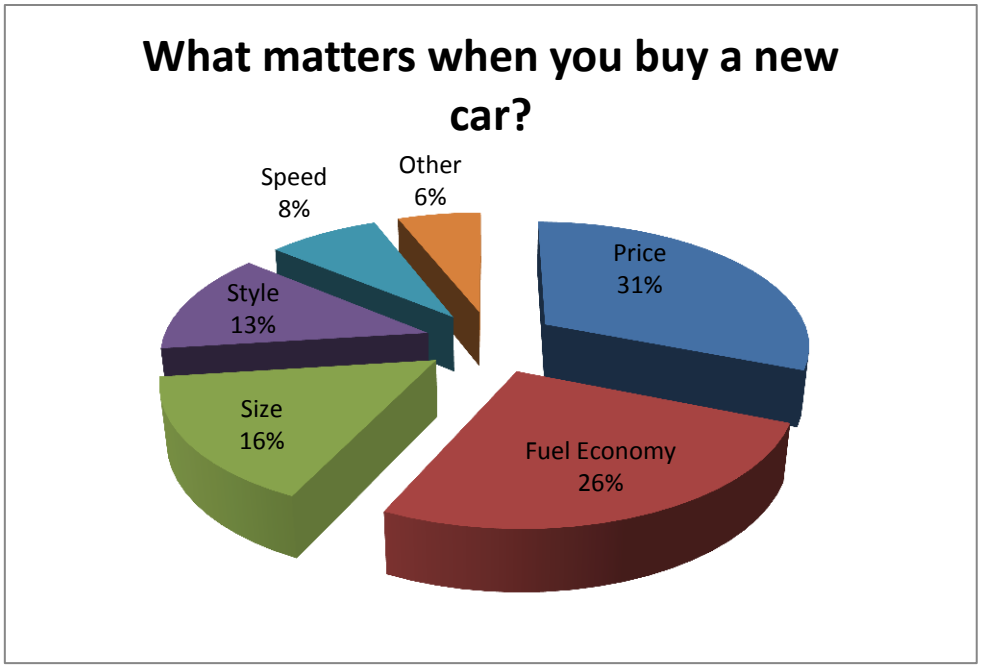
I think those cars open a new dimension in the field and they also bring us hope that if the gas will run out or market worth, smoking through the roof, we can still easily drive the cars in the class we're already used if not better. My opinion is that Tesla Motors is one step ahead of what electric cars can offer and hopefully they encourage more car manufacturers to think it’s fair. This is a free exhibition that we have been waiting for.

Electric cars survey

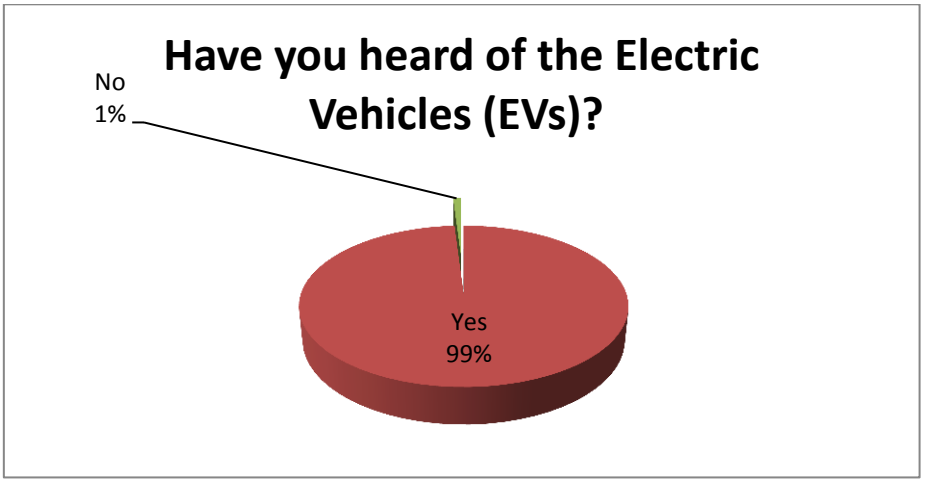
On the days 17th of March until 23th I did a survey in University of Reykjavík, all participants are students. The total number of participants was 100. Here I am going to view the results from survey in pictures.



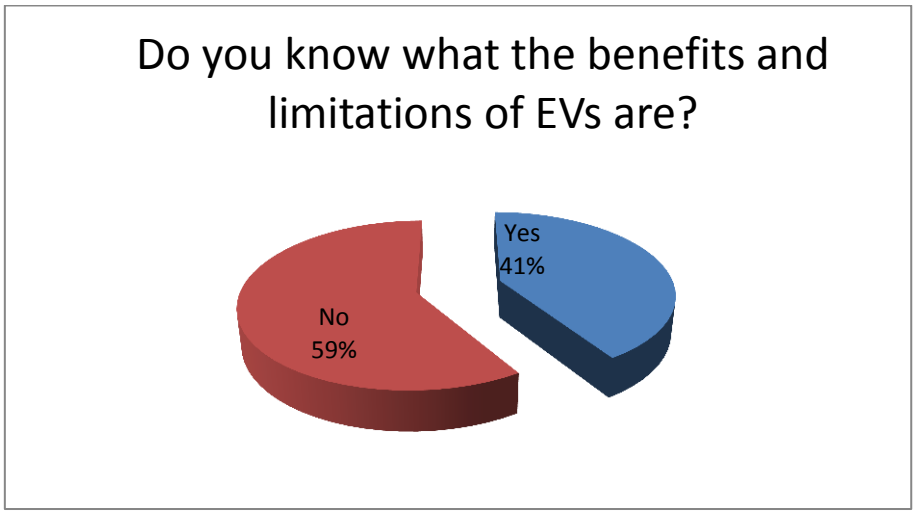
Survey Pie 1



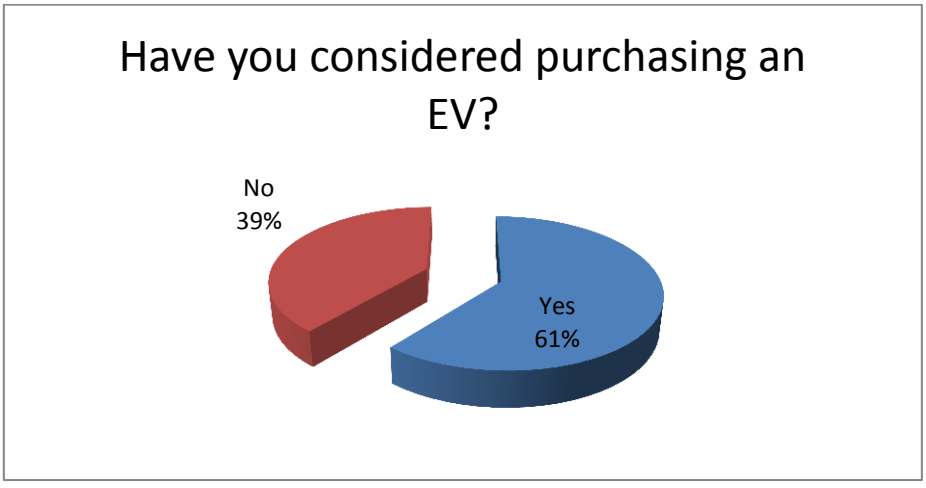
Survey Pie 2



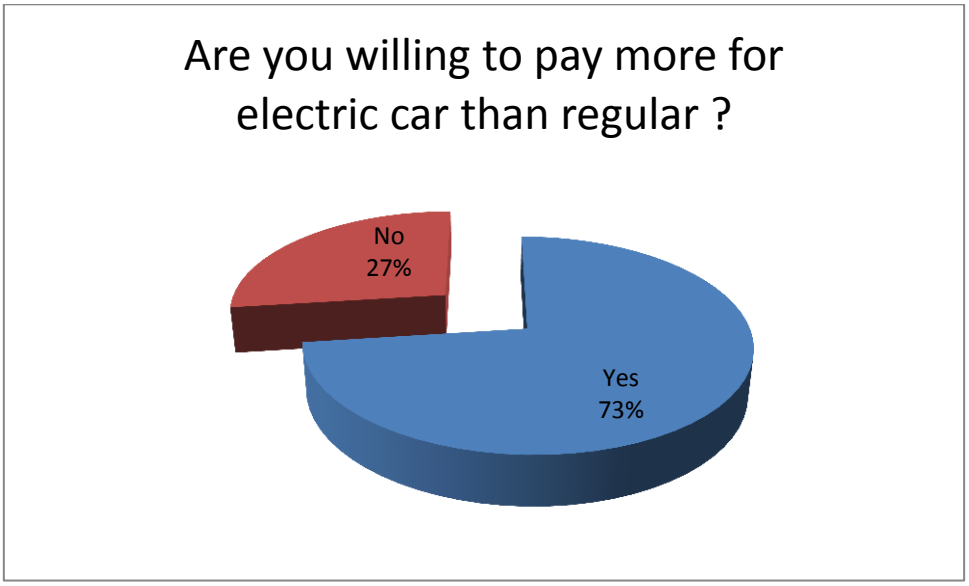
Survey Pie 3



Survey Pie 4



Survey Pie 5



Survey Pie 6

Of all participants 63 % are planning to buy a car within the next four years. It surprised me that 26% think thank fuel economy is what matters most when buying a new car. That shows us that people care and really want to lower the money spending on gasoline and people also want to reduce pollution.

99 % of participants have heard about EV but only 41 % know what the benefits and limitations of EVs are. But despite that 61% of the participants have consider buying a Electric Vehicle and 73 % are willing to pay more for EV than a regular car.

This survey showed me that the demand is existing but the supply is missing.

Conclusion

After careful consideration I think electricity is the perfect substitute for oil and gasoline consuming vehicles and it is great that we can lower the pollution at the same time. It is time to consider it necessary to produce varied types of electric cars.

Electric car need to become commercially available so people can choose between electric or other options. According to the survey I did, there is a demand for EV but the supply is very poor.

We, the people living in Iceland are blessed with resource that can be used to produce electric power. Now is defiantly the time because electric cars are back in fashion, they are greener and cheaper to run than petrol- or diesel cars.

As I went through in the chapter "How does the technology works?" this type of cars performance is similar to petrol cars. The speed is similar and the battery lifetime is good and always getting better.

My conclusion is that electric vehicles have much to offer and I am positive it is going to be a big part of our future.

Bibliography

Abernathy, P. W. (September 2005). *Inspecting the world*. Sótt 2. March 2011 frá http://www.nachi.org/forum/f19/discovered-electricity-article-9613/.

Adams, M. (23. March 2007). *esla Motors pioneers all-electric performance sports car*. Sótt 24. March 2011 frá Natural News: http://www.naturalnews.com/021734_Tesla_Motors_electric_vehicles.html

Ament, P. (25. October 2006). *Ideafinder*. Sótt 2. March 2011 frá http://www.ideafinder.com/history/inventions/battery.htm.

Bellis, M. (2011). *About.com Inventors*. Sótt 2. March 2011 frá http://inventors.about.com/library/weekly/aacarselectrica.htm.

Blanco, S. (19. September 2010). *AutoblogGreen*. Sótt 22. March 2011 frá Driving Sustainability: Here's the plan to make Iceland a nation full of plug-in vehicles: http://green.autoblog.com/2010/09/19/driving-sustainability-the-plan-to-make-iceland-nation-full-of/

Bocco, D. (March. 15 2011). *Who Discovered Electricity*. Sótt 2. March 2011 frá Wise Geek: http://www.wisegeek.com/who-discovered-electricity.htm

Bocco, D. (March. 15 2011). *Who Discovered Electricity?* Sótt 2. March 2011 frá Wise Geek: http://www.wisegeek.com/who-discovered-electricity.htm

Bocco, D., & Bocco, D. (15. March 2011). *Wise Geek*. Sótt 15. March 2011 frá http://www.wisegeek.com/who-discovered-electricity.htm.

Gíslason, G. (2010). Driving Sustainability: Here’s the plan to make Iceland a nation full of plug-in vehicles. *Green Dump*.

Hartsfield, J. (2008). Iceland: Fossil Fuel Independence by 2050. *New York Times*, 15-17.

K., E. (26. September 2008). *Climate Progress*. Sótt 20. March 2011 frá Iceland gives hydrogen the cold shoulder: http://climateprogress.org/2008/09/26/iceland-gives-hydrogen-the-cold-shoulder/

Kokkinidou, A. (9. Desember 2010). ELECTRICAL TECHNOLOGY DEFINED. *Brigth Hub*.

McClellan, R. (2010). What makes an Electric Vehicle go. *Lamar Stonecypher*.

Notter, D. (30. August 2010). *Globe Net*. Sótt 2011. March 5 frá © Copyright 2009 GLOBE Communications: http://www.globe-net.com/articles/2010/september/1/rechargeable-batteries-for-electric-cars-greener-than-expected-.aspx?sub=15

Paine, C. (Leikstjóri). (2006). *Who killed the electric car* [Kvikmynd].

Quick, D. (31. August 2010). *Gizmag*. Sótt 5. March 2011 frá All content copyright © gizmag 2003 - 2011: http://www.gizmag.com/empa-study-environmental-impact-electric-car/16181/

Romm, J. (28. September 2008). *Electric vehicles crowd out hydrogen brethren at sustainable driving conference*. Sótt March. 20 2011 frá Grist : http://www.grist.org/article/iceland-gives-hydrogen-the-cold-shoulder/

Unknown. (2011). *Oracle*. Sótt 2. March 2011 frá http://library.thinkquest.org/20463/environment.html.

Unknown. (2011). *Wikipedia*. Sótt 2. March 2011 frá http://en.wikipedia.org/wiki/Nikola_Tesla.

Walton, J. (2011). *eHow*. Sótt 2. March 2011 frá http://www.ehow.com/how-does_4587851_electric-car-work.html.

Wikipedia, t. f. (9. March 2011). *Who Killed the Electric Car?* Sótt 20. March 2011 frá Wikipedia, the free encyclopedia: http://en.wikipedia.org/wiki/Who_Killed_the_Electric_Car%3F

Zemanta. (9. March 2010). *Electric Cars // Go Electric*. Sótt 5. March 2011 frá http://electric-car-on.net/2010/03/09/the-negative-impact-of-electric-cars-on-the-environment/.