New opportunities

Electric mobility: Innovative practices and business models

Business model innovation is one kind of disruptive innovations that will bring new effect on the market and bring challenges to the incumbent firm. It will enlarge the existing economic pie by attracting new customers or by encouraging existing customers to consume more.

Electric vehicle technology is a product and experience, new and unfamiliar to most consumers. This technology is more expensive to build than conventional automobile technology but less expensive to maintain and operate. New ways of mobility occupy different utility and performance envelope relative to conventional automobiles. This includes range and refueling characteristics which displace the demand for gasoline and diesel for powering a transportation services and place it on electricity. This change the sources and levels of air emissions and environmental pollutions in transportation sector. Electric vehicle technology is a technology distinct from conventional automobiles with a potentially wider range of utility to a broader array of stake holders.

The electric vehicles (EVs) have long been under emerging stage. It has a history of more than 100 years, with significant efforts in the early 20th century, followed by sequences of stops and starts and now new enthusiasm in the last decade. The new enthusiasm comes with high oil prices, climate protection policies, battery technology and recharging infrastructure development, and the rise of organized car sharing and intermodality.

EVs are believed to play an important part in the near future according to policy makers, car companies and other stakeholders. Ambitious regional and national goals have stimulated the progress of EV penetration by subsidizes for the vehicle and corresponding infrastructure deployment.
Meanwhile, most car manufacturers have added EVs in their portfolios and prepared to make mass production with different level of strategies and expectations. However, commercialization has been ineffective thus far, and dominant design is still dormant.

Sales of EV are far from satisfaction and lag behind from national goals. Accordingly, EV industry is still in the introduction stage in product life cycle, and struggling to take

advantage of economies of scale in small niche markets. EV enterprises, including incumbent and entrepreneurial companies, have long taken numerous endeavors to promote EV in the niche markets by providing innovative business models, to promote EVs and overcome technological shortcomings like range anxiety.

Tesla Motor, viewed as a black horse to the auto industry, is an entrepreneurial firm dedicated to Electric vehicle scenario. Founded in 2003, Tesla Motor obtains a success as a Company dedicated to EV, and changed people's idea of EV as well as re-initiated the enthusiasm for pure Evs. Comparing to incumbent firm, entrepreneurial firms are generally less constrained in the evaluation of alternative models and more flexible in pursuing radical business models.

While most companies still take 'business as usual' approach for developing their EV production and offers, Tesla Motors stands out by providing disruptive innovation solutions.

An accepted business model approach in research and practice involve a fundamental reconsideration of the value proposition (product/services), the customer interface (channel, relationship and customer segment), infrastructure management (capability, partnership and value configuration) and the financial aspects (revenue model, profit and cost).

As EVs are in the emerging stage and paradigmatic design is still dormant, the elements on value creation and value capture design will have more influence in deciding the success of an disruptive technology.

The transition into an electric mobility trajectory will lead to fundamental changes in the value chain of the automobile which basically involving components from supplier, core components and assembling from companies, the energy utilities.

First of all, some modules such as internal combustion engine will become less important in the long-term. While modules such as battery, charging infrastructure will enter the value chain and act as critical roles as a result of high cost and changing peoples' driving behavior.
Secondly, new services enabled by EVs such as energy services or those enlarged by Evs such as car-sharing services and connective services will have numerous influences in the

auto value chain.

At the moment, customer facing services such as energy services and mobility services still wait for EV penetration and changes in electricity grid regulation and people's behavior. As a result, the current EV value chain is emphasizing on battery (battery cell manufacturing and battery packing), vehicle (EV design, assembling and sales), and infrastructure enabling grid connection (infrastructure manufacturing and infrastructure network deployment) as it is showed below.

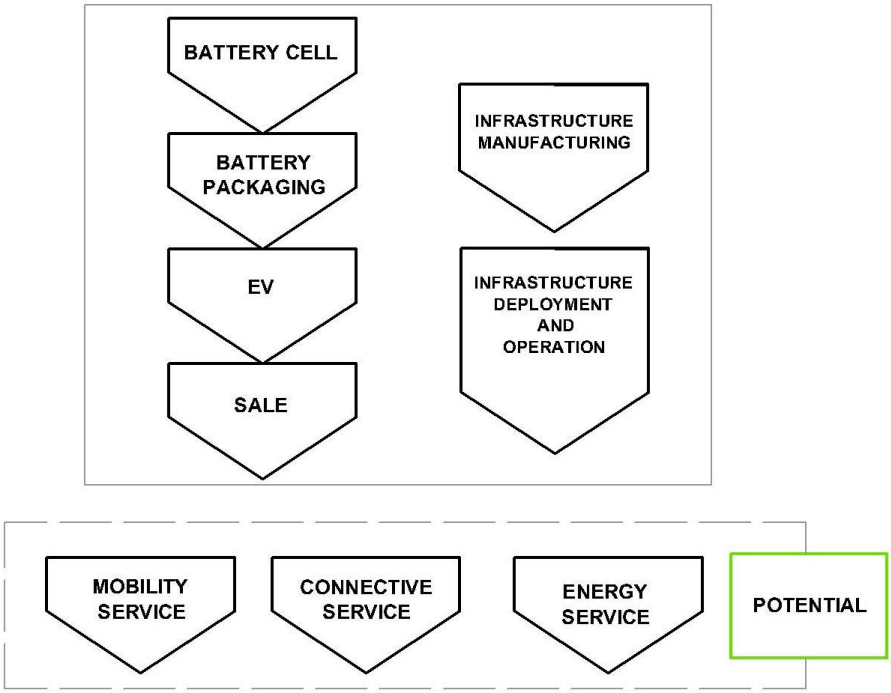

Figure 1: Example of EV value chain

Source: Tesla Motors: A Silicon Valley Version of the Automotive Business Model

Furthermore, the EV industry involves new modules and components as a result of battery-based electric mobility concepts such as recharging infrastructure and related services.

It is necessary to identify the different dimensions of the product and service from an EV firm in order to analyse its business model design. Three dimensions have been classified in a holistic study of EV, which are the vehicle together with battery; the infrastructure system; the system services which integrate electric vehicles into the energy system. At the moment, energy system service such as vehicle to grid services still wait for EV penetration and changes in electricity grid regulation and people's behavior.

Electric vehicles

Tesla motor has thus far released three vehicle models into market: a two doors sport car Tesla Roadster and a sedan Tesla Model S., SUV Tesla Model X. Two other prototypes are waiting for commercialization: a family car Tesla Model 3 and another yet unknown model, most likely SUV version of Tesla Model 3. Tesla gained high reputation for its high performance of the vehicle, which is corresponding to its high-end customer segment.

Besides the fancy appearance and strong vehicle performance, Tesla innovatively increased the connectivity between users and the environment (eg. recharging station navigation, charging control and autopilot) enabled by IT based hardware and software applications. It innovatively offers data network in the car with telecommunication partners, and connects the car with maintenance centre, infotainment centre and so on.

Tesla Motors entered the market by targeting on the high-end niche market, by offering luxury specific purpose vehicle Roadster. Model S target on luxury multi-purpose car market as a result the selling number is magnificently larger than the Roadster. Furthermore, according to the planning map of Tesla Motor, it will continue to offer an SUV version luxury multi-purpose car, followed by a more economically multi-purpose car. It is corresponding to the strategy goal to create an affordable mass market EV. The customer segments of battery and recharging system need to match the customer segment of vehicle.

As a new comer to auto industry, Tesla Motor did not use the conventional dealership network for vehicle distribution. In contrast, it created a new multi-channel model for purchasing vehicles, which involved online stores and apple-like retail outlets. The online stores offer potential customer the chance to purchase the car directly online. Furthermore, the retail outlets are usually located in high traffic space, enhanced with technology with high integration of IT in order to present Tesla vehicle and its company culture better. Tesla applies a vertical integration on selling, which means the price of vehicle is non-negotiable. This caused some disputes in the conventional dealership network.

Even BMW, the company that is offering electric vehicles to the market in the most conventional way, recognized our fast changing society as a key ingredient for developing

new products and services. After identifying the key external trends and challenges, e.g. urbanization, smaller households and climate change, in 2007 BMW started to create new and comprehensive concept for sustainable mobility: project i. They are selling urban mobility rather than a car. The concept for the BMW i3 appeals to two customer segments: urbanites and young couples who work and/or live in the city. The BMW i3 is 100% emission-free and characterized by the use of high-quality and sustainable materials. In addition an i3 car can be recycled for 95%. Regardless of the new BMW brand, sustainability in every step of production and urban mobility offer, the company is still selling electric vehicles within established model. From production line, through dealers to customers.

Slightly different approach at offering of electric vehicles to the market took Renault-Nissan alliance. Both companies already have many stores, services and dealers across the globe and they didn't have to start from the scratch. Electric vehicles are higher initial investment than conventional vehicles of the same size. Battery pack in each electric vehicle carries approximately 1/3 of the automobile price. Besides, batteries are constantly evolving and are the center of development and research lately.

Companies would like to improve energy management, capacity and extend vehicle overall range. Because of those reasons, Renault-Nissan alliance decided to decrease the overall purchase price of an electric vehicle to make them more accessible and are offering battery lease for a monthly fee which is much less than petrol price for the same mileage. This lease is also a guarantee for the battery and EV owners get their battery packs replaced when the company introduces a new battery technology. Tesla applied an ownership-as-usual model for revenue. Customers purchase the EV in order to possess the full ownership of the car including expensive batteries.
Battery is a critical module in electric vehicle since it carries high cost and value. The choice of battery will largely define the range anxiety that customers face. Tesla applied an ambitious plan on the battery strategy, with expecting movements on battery factory and enters also the stationary battery market. It draws a lot of attention for its high range, and innovative battery pack technology.

Performance

All three models Tesla Roadster, Model S and Model X show a large capability for the range due to the high energy stored in battery. Tesla Model S equipped with very large 70 or 85 kWh battery. This pack is able to run for 335 km under standard condition, while most other companies choose a 16-24 kWh battery pack allowing a small range from 100 km to 160 km. Tesla motor has a good knowledge on battery pack and management system. It innovatively equipped Tesla Roaster with thousands of laptop Lithium-ion cells and assembles them into a performance and cost optimized battery pack. During the delivery of Tesla Model S, it developed a closer relationship with its battery cell supplier Panasonic, on both battery technology and scale of production.

Connectivity

As it is enabled by the connective service inside vehicle, Tesla user can have some control on battery system. For example, user can control the temperature of battery system before entering the car when the environment temperature is too low. The battery is generally sold to customers along with the vehicle, with possibility for extra purchase when the old one is at the end of life and need to be replaced.

Infrastructure

Another ambitious plan of Tesla Motors is the expansion of supercharger network. It is famous for its high performance in charging ability, well established network and free to Tesla user strategy. In alignment to the large capacity of battery adapted by Tesla, the supercharger station offers fast charging in order to satisfy the charging need for customers. It can deliver direct current up to 120kW and capable of charging to 80% of an 85kWh Tesla Model S within 40min. Beside the premium function of supercharger station, Tesla is enduring an ambitious expansion plan to establish superchargers network along well-travelled highways and in congested city centers. As a substitute to charging station, a pilot battery swap program is also launched in California to meet the charging need for customer and to reduce range anxiety. As it is enabled by the connective service inside vehicle, Tesla user can find the nearest supercharging station and control the charging when connected.

The public network is solely deployed by Tesla Motor Company. This is mainly due to the different charging technology and standard adapted by the companies, and the different cable designed and adapted. But in order to foster the adoption of these in-house technologies, Tesla allows the use of the patent for free if other companies want to use its new high performance charging system. Tesla goes open source.

Tesla Motor shows a very original value configuration when compared to other companies. During the delivery time of the Tesla Roadster, most components as well as battery cell manufacturing and vehicle design are outsourcing to the suppliers mainly due to the initial stage of the company and immaturity of the EV market; however, the packing and assembling of the battery cells and the energy management are conducted by Tesla. When the commercial delivery of Tesla Model S began, Tesla motor began to show a high level of vertical integration along its value chain. According to the value proposition of Tesla motor, it shows an integrated value configuration from battery packing, EV design, retail distribution to an intensively emphasized supercharger network.

In contrast to the conventional auto industry, the value chain constitutes of the pyramid relationship between supplier and company relationship - which supplier provides the fringe modules to companies such as gearbox and auxiliary battery and company produces the core component such as motor design and assemble the vehicle. On the other hand, energy utility will fill the car with fuel during the car lifetime.

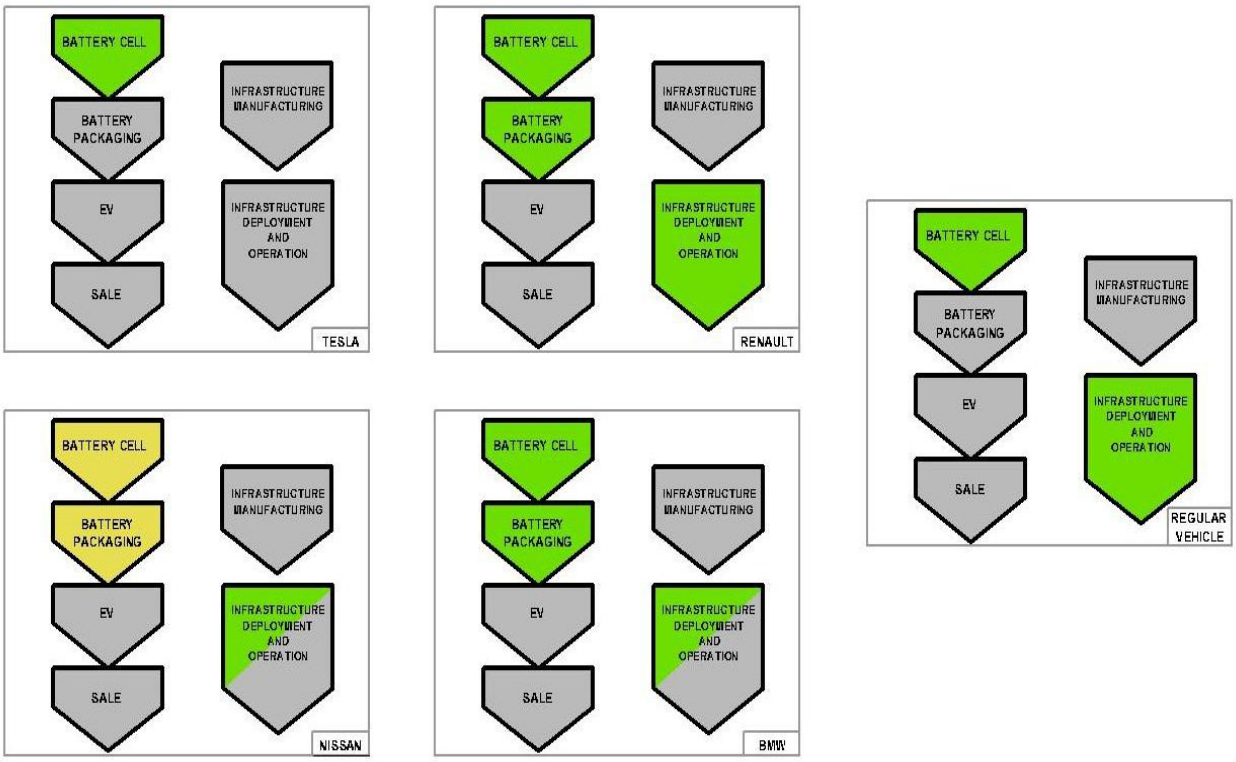

Figure 2: OEM's and value chain accents

Source: Tesla Motors: A Silicon Valley Version of the Automotive Business Model

In EV industry, most companies who are greatly engaging in the EV market choose to follow their old routine of value configuration, which refers to integration-as-usual. In this type of value chain, companies treat battery as a module for outsource as before, it could be because of the limitation on technology knowledge or transaction cost concern. BMW and Renault are examples as showed above. A more involved choice could be the company and battery supplier form an joint venture company, as it is the case for Nissan.

On the other hand, as for the recharging network deployment, most companies wait for the action from recharging operation company or other stakeholder such as national or local government. Renault, BMW and Nissan followed this strategy. Furthermore, BMW and Nissan started to invest in the recharging infrastructure network with partners from 2015.

The shift towards electric mobility introduces a novel end-to-end value chain. For every challenge and new consideration that arises from this technology there is an opportunity for the creation of new or enhancement of existing business models along this new value chain.

Figure 3: Impact of powertrain transformation on value chain

Source: McKinsey – Boost! Powertrain KIP

Incumbents of the traditional automotive value chain as well as new entrants are testing new approaches and models to meet the needs of the new value chain and take advantage of the emerging markets for new applications and services.

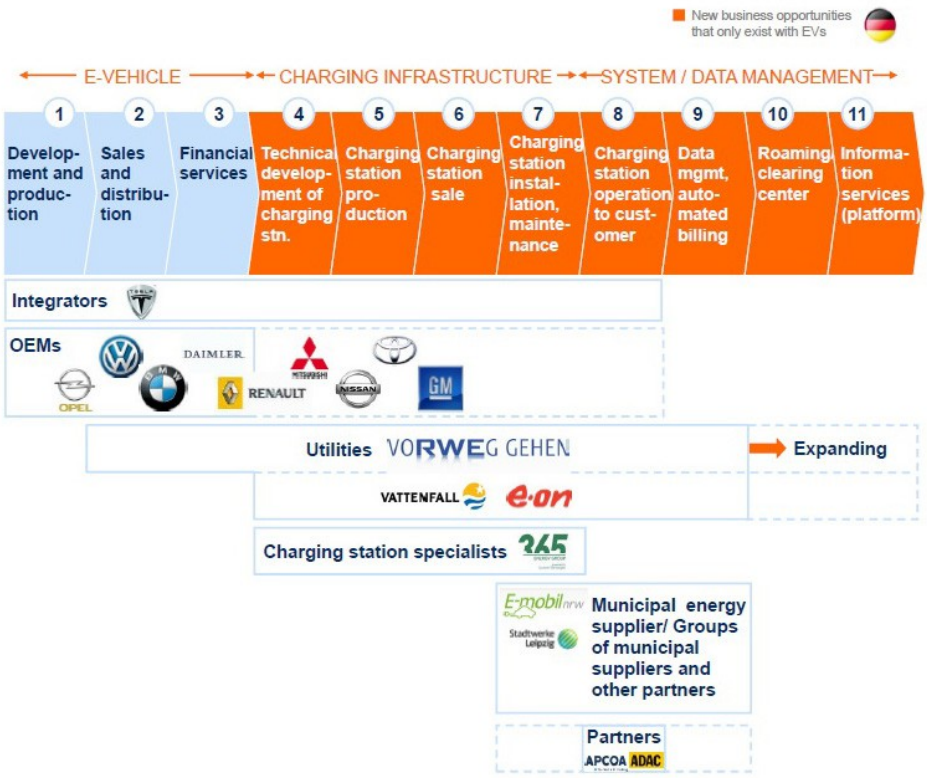

Figure 4: Incumbents and new entrants are trying to capture new opportunities along the EV value chain that did not exist with internal combustion engines

Source: McKinsey

This evolving electric mobility ecosystem is spawning a number of innovative business models. Emerging markets for products and services on the one hand are a result of EV adoption, and on the other hand enable and facilitate further EV scale-up.

Gigafactory

Tesla made an important step towards the mission to expand the role of EVs in the global marketplace. In cooperating with Japanese industrial giant Panasonic Tesla is developing a new, US-based battery production facility. The facility will be able to produce batteries for as many as 500,000 EVs per year by the year 2020. The scale of the production is projected to be so large, in fact, that by 2020 the Gigafactory alone would produce as much battery capacity as the entire world produced in 2013.

The Gigafactory will produce cells for Tesla Motors and Tesla Powerwall (Energy Storage for a Sustainable Home) battery pack. To be sure, the impact of the Gigafactory will positively affect electric auto sales. The Gigafactory's scale and capacity may be felt

across the technology and energy sectors as well. By eschewing the creation of their own proprietary battery technology. Tesla was able to cut significant costs from the most expensive part of any high-performance electric vehicle: the battery. The planned Gigafactory is a key strategic step in carrying out Tesla's long-term mission to deliver lower-cost EVs to consumers around the world.

While battery production and capacity has grown worldwide over the last decade, Tesla notes that nearly all of that growth has been in Asia. In contrast to that trend, the joint collaboration between Panasonic and Tesla will take place at a facility in the American West, close to Fermont where Tesla assembles their automobiles. Without having to ship batteries from Asia, this close proximity will lead to additional cost savings through considerably lower Model S and Model X production times.

The specifications for the Gigafactory are published. In keeping with Elon Musk's environmentally sustainable reputation, the facility, will not only recycle older battery packs but will also be powered by new local renewable energy sources, namely wind turbines and photovoltaic.

Car sharing

Electric vehicles are an important part of sustainable passenger transportation of the future. But unfortunately many people still associate electric vehicles with high prices, uncertainties about life-span of batteries and a concern that the electric vehicle will not be able to fulfill the needs of a regular car user. This makes it hard for the electric vehicle, despite its low running cost and potential environmental advantage, to compete with traditional cars when it is time for the family to buy a new car. But is private car ownership really the solution for future personal transportation needs?

Privately owned cars are mostly parked, up to 90 % of the time, and if all costs of ownership are summed up the cost per driven kilometer is very high. In urban regions car ownership also becomes more and more troublesome as the availability of parking space for privately owned cars is steadily decreasing. Maybe it is time to rethink and try to find alternatives to the traditional business models way to provide personal mobility with cars?

Mobility as a service (MaaS) is changing the traditional model of car ownership with an

objective of meeting consumer mobility needs in the most efficient way. Getting from Point A to Point B can be done in a multitude of ways and may mean using a privately owned vehicle for only part of the journey or not owning a car at all - especially in dense urban areas.

Just one example is DriveNow which is the car sharing service in cooperation with BMW i, MINI and Sixt that enables users to rent cars independent of time and place with its core promise: "Pick up anywhere, drop off anywhere."

Daimler and its Car2Go car-sharing service is another example of car sharing, an important and potentially disruptive business model that is already seeing rapid growth in Europe. Despite currently low usage rates, a market survey by McKinsey found that a third of Germany's urban population is a prospective user of car-sharing services. Nearly 40% of young Germans (18- to 39-year olds) living in cities with more than 100,000 inhabitants indicated that ten years from now they "will use car sharing more." This data support supports industry analyst forecasts that the number of car-sharing customers in Europe might increase to 15 million by 2020, up from 1 million today.

To the degree that mobility as a service, and specifically car-sharing as an important new model, can integrate the usage of electric vehicles, it offers new opportunities for EV adoption by removing some of the barriers. First, on the user side, these models eliminate the hurdle of high initial purchase price, because users do not have to buy the cars they are driving. Mobility as a service can also alleviate the "range anxiety" that makes some consumers reluctant to purchase an EV by allowing them to opt for BEV usage only for driving distances that they're comfortable with. Car-sharing fleet operators could possibly benefit from lower fuel and maintenance costs, because they should be able to realize higher utilization rates (especially in dense, urban areas) as compared to private car use.

Mobility tends to be more complicated than just getting from Point A to Point B. When you consider all of the intermediary steps involved in getting from your home to your final destination (e.g., the bus to the train station, the taxi from the train station, or the endless search for an empty parking space) the overall journey ends up using a few more letters of the alphabet. Full mobility describes the set of solutions either focused on the complete journey – from start to finish – or on the parts of the journey not addressed by the first wave of mobility-as-a-service solutions.

Smart grid

Diverse and innovative business models are being adopted globally to enable the commercialisation of electric vehicles. The introduction of information and communication technology in electricity networks is the primary enabler of these new business models at the interface of energy and private transport sectors.

Here are four innovative applications of electric vehicles that can only be achieved in the context of an “intelligent” energy network:

- the value of controlled EV charging;
- the integration of electric vehicles in “smart home” energy systems;
- renewable electricity storage in vehicle batteries;
- electric vehicles as providers for secondary energy markets.

Digital technologies enable communications between vehicles, charging infrastructure, grid operator, and home energy management systems. With controlled vehicle charging, customers can reduce their fuel bills and utilities can optimize the utilization of power system capacity. Integrated into intelligent” power networks, EV batteries can be used to store intermittent renewable production from new technologies such as wind and solar power.

State incentives

With many new regulations regarding air and environmental pollution and European Union plan to reduce fossil fuels and raise the renewable energy sources in every aspect of economy, infrastructure, transportation and production, the only possible way to achieve those goals is the help from states. Incentives for electric vehicles are now applied in many European countries. The incentives mainly consist of tax reductions and bonus payments and premiums for the buyers.

The European car industry supports the further introduction of fiscal incentives for fuel efficiency. Tax measures are an important tool in shaping consumer demand toward fuel-efficient cars and help create a market for breakthrough technologies, notably during the introduction phase.

Innovations generally first enter the market in low volumes and at a significant cost premium and this needs to be offset by a positive policy framework. Electric mobility will make an important contribution towards ensuring sustainable mobility. However, advanced conventional technologies, engines and fuels will play a predominant role for years to come. Governments must continue to include these CO2 efficient technologies and solutions in their overall sustainable mobility policy approach.

An example of a successful support of a transition to electric mobility in Europe is Norway. They have highest percentage of electric car owners per capita in Europe. They set the goal, to reach 50.000 zero emission vehicles by 2018. All electric vehicles are exempt from all non-recurring vehicle fees, including purchase taxes which are extremely high for ordinary cars, and 25% VAT on purchase, together making electric car purchase price competitive with conventional cars. Electric vehicles are also exempt from the annual road tax, all public parking fees and toll payments, as well as being able to use bus lanes. These incentives are in effect until 2018 or until 50.000 zero emission vehicles target is achieved.

Another successful example of European country that is also part of the European Union is Netherlands. The Dutch government set a target of 15.000 – 20.000 electric vehicles on the road in 2015, 200.000 vehicles in 2020 and 1.000.000 vehicles in 2025. First goal was achieved in 2013, two years earlier than expected. Initially, government set incentives such as the total exemption of the registration fee and road taxes. This incentive ended in 2014. In addition, the national government offers 3.000 € subsidy on the purchase of an electric taxi or delivery van, this subsidy is increased to 5.000€ in some cities. Electric car owners also enjoy free parking spots inside the cities.

Rapid adoption of electric vehicles in Netherlands is also due to the small size of the country, which reduces range anxiety, a long tradition of environmental awareness and high gasoline prices.

One more example of a country that greatly supports transition to electric mobility is Slovenia. Again, it benefits from being a small country, which eliminates a lot of range anxiety. Besides, country was fully covered with DC charging stations at the end of 2015. Slovenia is also offering 5.000 € incentives for an electric vehicle purchase and is lately debating about increasing the incentive to 7.500 €. City centers offer free charging options

and free parking spots for electric vehicles further making this mobility appealing to a general customer.

Formula E

The second season of the FIA Formula E Championship was launched in Beijing. Off-track, DHL, the world's leading logistics provider and Official Logistics Partner of Formula E, concluded the inaugural season looking at real progress in the development of environmentally friendly solutions and is continuing the race towards sustainable mobility during the second season.

As part of a business programme that DHL is leading on behalf of Formula E and its partners, called Formula E eStory, the logistics service provider introduced in Beijing a compendium, *"The eStory: Undertaking the Mobility Challenge",* covering mobility innovations, green technology solutions and community initiatives that were facilitated by Formula E, which are expected to have a positive effect on the consumer market and society in the coming years. The eStory business program aims to unlock the potential for boosting innovation and sustainable mobility. With the strong support of Formula E and partners the eStory will facilitate mass market adoption of sustainable mobility solutions, by accelerating technological developments, bringing these to the attention of major market players, and by increasing acceptance through educating people about e-mobility.

The success of electric mobility is influenced by multiple external trends, but also requires other pillars to be activated, including technological progress, having the right infrastructure and business models in place, and communication. Formula E is a powerful unifying platform for players of the various industries to explore and innovate, and thus jointly shape the future of sustainable mobility. The innovations generated and tested during the first season are only the first steps towards this common goal, with much more to be inspired by Formula E.

Formula E acts as a catalyst for technological innovation in the automotive industry. It brings together major global corporations that recognize the benefits of developing cross-industry collaborations and of jointly building innovative and sustainable solutions. Formula E's partners, demonstrate the ability to foster innovation and showcase how the outcomes have far outreached the scope of a racing championship.

One of the innovations in the area of producing clean electricity comes from the British company Aquafuel Research that provides mobile generators which run on glycerine instead of diesel. This fuel is clean on carbon emissions and produces very low particulate and NOx emissions. It is expected that in the next three to five years production of glycerine from salt water algae is commercially viable, thus creating a fully sustainable production. Further progress was made also in the field of charging systems for electric vehicles by Qualcomm Incorporated - Qualcomm's Halo Wireless Electric Vehicle Charging (WEVC). The course cars for the inaugural season were fitted with wireless charging technology that uses resonant magnetic induction to transfer energy wirelessly from a ground based pad to a pad integrated into the vehicle.

In its first season Formula E has proven to be an exciting platform. Not just for spectators, but first and foremost for the automotive industry to exchange ideas and innovate.

Conclusion

This text looked through the business model innovations that involve electric mobility. Several lessons can be drawn and new approaches learned regarding vehicles, infrastructure system, popularization of new mobility and education of more and more urbanised world.

Reduction of range anxiety, top down, flexible product integration, integration of informational technologies, changed mentality about car ownership and mobility can be seen as a major trends regarding inovative business models.

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