TØI report 1681/2019

Paal Brevik Wangsness

Institute of Transport Economics
Norwegian Centre for Transport Research

Norwegian business opportunities on the way to an electrified transport sector

Enterprise opportunities lab – Work Package 6 of Electromobility Lab Norway (ELAN-project)

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Sammendrag:

I denne rapporten systematiserer vi kunnskap, erfaringer og ideer knyttet til forretningsmuligheter på veien til en elektrifisert transportsektor. Norske virksomheter blir kategorisert etter hvordan de passer inn i en modell av "elbil-økosystemet". Gjennom en litteraturgjennomgang og to workshoper har vi identifisert hvilke deler av økosystemet som kan ha de beste potensielle forretningsmulighetene for norske virksomheter. Workshopdeltagere identifiserte og diskuterte 22 utfordringer og 21 forretningsmuligheter på vei til en elektrifisert transportsektor. I rapporten er det en noe lengre diskusjon av de seks viktigste utfordringene og forretningsmulighetene.

Summary:

In this report we systemize the knowledge, experiences and ideas related to the business opportunities on the way to an electrified transport sector. Norwegian firms are categorized in how they fit into a model of the electric vehicle ecosystem. Through literature reviews and workshops we identify which parts of the ecosystem that may have the greatest potential business opportunities for Norwegian enterprises. Workshop participants identified and discussed 22 challenges and 21 business opportunities on the way to an electrified transport sector, and this report discusses the 6 most important ones of each in depth.

Language of report: English

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Preface

This report is part of the work in the research project Electromobility Lab Norway (ELAN). ELAN is led by the Institute of Transport Economics and is financed by the Research Council of Norway.

This report is an output from work package 6 of the ELAN project; WP6 Enterprise opportunities lab. The motivation behind this work package is that the switchover to electromobility will give Norwegian enterprises new opportunities, such as delivering parts to vehicle manufacturers, services to vehicle importers and dealers, and vehicle owners and operators. While some of these opportunities are evident, such as development of charging infrastructure services, the purpose of WP 6 of the ELAN-project is to identify the broad spectrum of opportunities that may arise.

In this report we systemize the knowledge, experiences and ideas related to the business opportunities on the way to an electrified transport sector. Norwegian firms are categorized in how they fit into a model of the electric vehicle ecosystem. Through literature reviews and workshops we identify which parts of the ecosystem that may have the greatest potential business opportunities for Norwegian enterprises.

The report has been written by Paal Brevik Wangsness. Project manager Erik Figenbaum has provided guidance and useful discussions during the project. Quality assurance has been done by Research Director Jardar Andersen. Trude Rømming has been responsible for the final finish of the report.

Oslo, January 2019
Institute of Transport Economics

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Managing Director

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Research Director

Content

Institute of Transport Economics
Norwegian Centre for Transport Research

Summary

Norwegian business opportunities on the way to an electrified transport sector

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In this report we systemize the knowledge, experiences and ideas related to the business opportunities on the way to an electrified transport sector. Norwegian firms are categorized in how they fit into a model of the electric vehicle ecosystem. Through literature reviews and workshops we identify which parts of the ecosystem that may have the greatest potential business opportunities for Norwegian enterprises.

Background

This report is an output from the research project Electromobility Lab Norway; WP6 Enterprise opportunities lab. The motivation behind this work package is that the switchover to electromobility is expected to give Norwegian enterprises new opportunities. This study is carried out to identify the broad spectrum of opportunities that may arise.

Opportunities arising from the prospect of a relatively drastic switch to electrified passenger car transport can be about removing barriers and bringing down (or compensating for) the total cost of ownership (TCO) of BEVs (Battery Electric Vehicles), so that the obvious benefits over internal combustion engine vehicles (ICEVs) can be realized. BEVs have the benefits of higher energy efficiency and far lower direct user costs than ICEVs, and they provide the possibility of maintaining high mobility while still adapting to a low-emission society. This has both great consumer and social value, but there are barriers and other costs that reduce the net social gain from electromobility. Since the potential social gain from electromobility is so large, there surely exists some willingness to pay for solutions that bring down these costs and barriers. This basis can potentially provide large enterprise opportunities. The potentially low TCO of BEVs can also create enterprise opportunities for new types of services, for example strengthening Mobility-as-a-service (MaaS) value chains.

In this report we will attempt to systemize the knowledge, experiences and ideas related to these enterprise opportunities. The main focus will be on, though not limited to, opportunities for Norwegian enterprises. Some of these opportunities are directly related to electromobility, while other opportunities have serving electric vehicles as one of many services in a larger set of offerings. The study is based on literature reviews and workshops.

A stylized view of the electric vehicle ecosystem

The framework we use for systemizing the knowledge, experiences and ideas related to these enterprise opportunities is based on the stylized electric vehicle "ecosystem" model from Leviäkangas, Kinnunen, and Kess (2014). This model has been modified in Figure 4 to fit the focus of this work package.

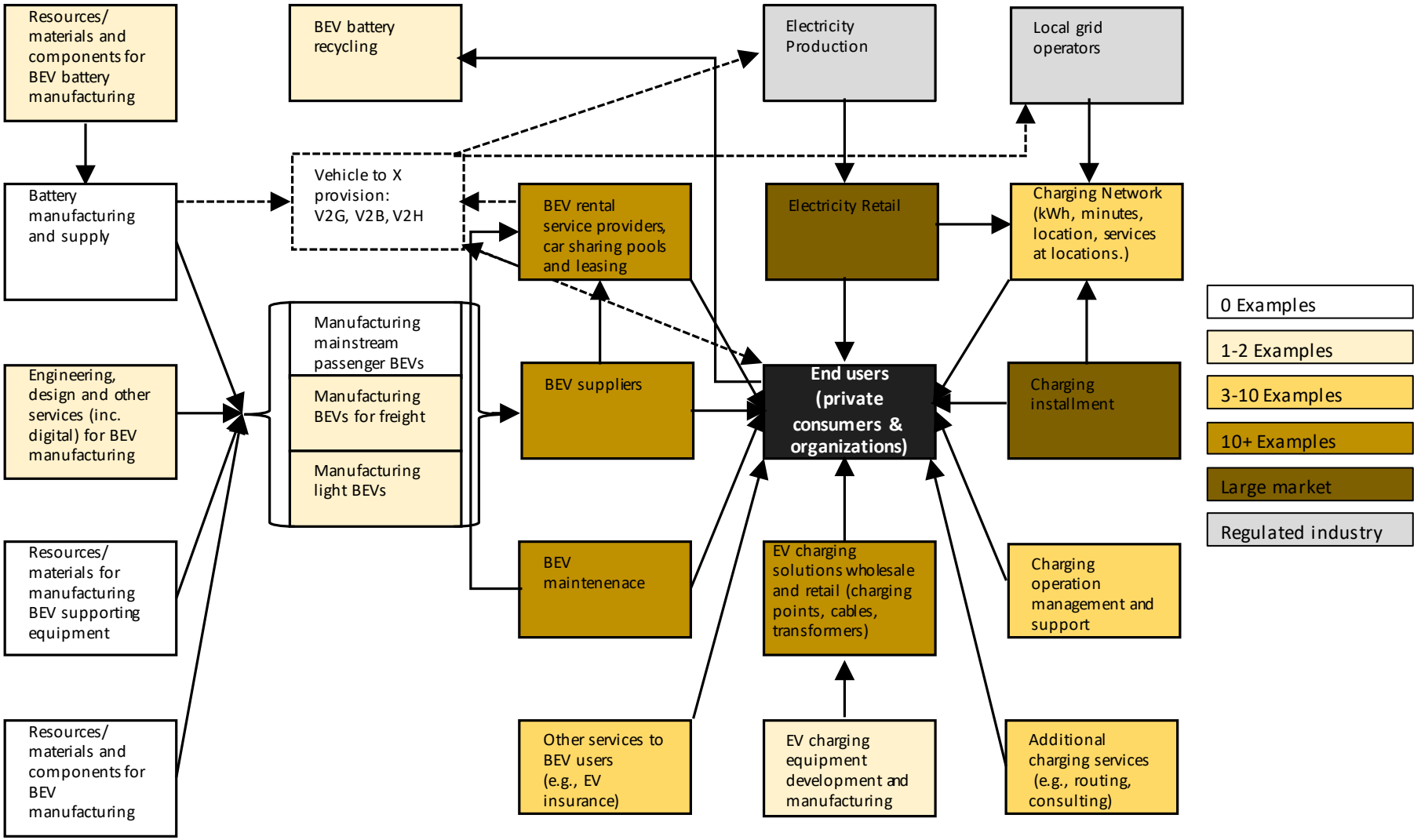


Figure 1: Stylized view of EV ecosystem. Color codes to capture magnitude of Norwegian firms.

With the framework of the stylized electric vehicle ecosystem in place, we search and categorize Norwegian firms and sectors in this framework. We find that most of the firms in this ecosystem are placed close to the end of the value chain, close to the end user. Few are placed upstream with resources, materials and manufacturing.

Moreover, the part of the ecosystem with the highest number of involved firms are traditional sectors like electricity retail, electricians (for BEV equipment installment), car dealerships and car maintenance, and regulated sectors like electricity production and local grid operators. Many of these firms have expanded the scope of their business to include electromobility solutions. With regards to "new" sectors that grow to meet the demands in the EV ecosystem, we see as of now most firms in the category "Charging solutions wholesale and retail".

Remaining challenges on the way to an electrified transport sector

The workshop participants identified 22 challenges on the way to an electrified transport sector and landed on the following 6 challenges as the most important ones:

- Payment systems
- Knowledge among users and potential users
- Home charging for apartment buildings
- Access to charging during peak times
- Long waiting time for new BEVs, especially for freight
- Push for excessive investment in grid capacity

A list of all the challenges discussed in the workshop is given in section 5.7

Opportunities on the way to an electrified transport sector

The workshops and the literature review seem to point at these 6 opportunities as the most promising ones:

- Development of a top-notch standardized system for payment for charging
- MaaS around the BEV - car sharing, ride-sharing, last-mile solutions and other subscription services
- Advisory services, in Norway and abroad
- Second life for BEV batteries
- Converting conventional freight cars to electric
- Development of fleet-charging systems

A list of all the 21 business opportunities discussed in the workshop is given in section 6.7.

Some firms seem to already be working on seizing some of these opportunities, while some of these opportunities seem to remain untouched. Having more firms stepping up and seizing the enterprise opportunities that emerge as the transport sector becomes more electrified, will be key in order to make the EV ecosystem in Norway thrive.

Transportøkonomisk institutt
Stiftelsen Norsk senter for samferdselsforskning

Sammendrag

Norske forretningsmuligheter på vei til en elektrifisert transportsektor

TØI rapport 1681/2019
Forfatter: Paal Brevik Wangsness
Oslo 2019 37 sider

I denne rapporten systematiserer vi kunnskap, erfaringer og ideer knyttet til forretningsmuligheter på veien til en elektrifisert transportsektor. Norske virksomheter blir kategorisert etter hvordan de passer inn i en modell av "elbil-økosystemet". Gjennom en litteraturgjennomgang og to workshoper har vi identifisert hvilke deler av økosystemet som kan ha de beste potensielle forretningsmulighetene for norske virksomheter.

Bakgrunn

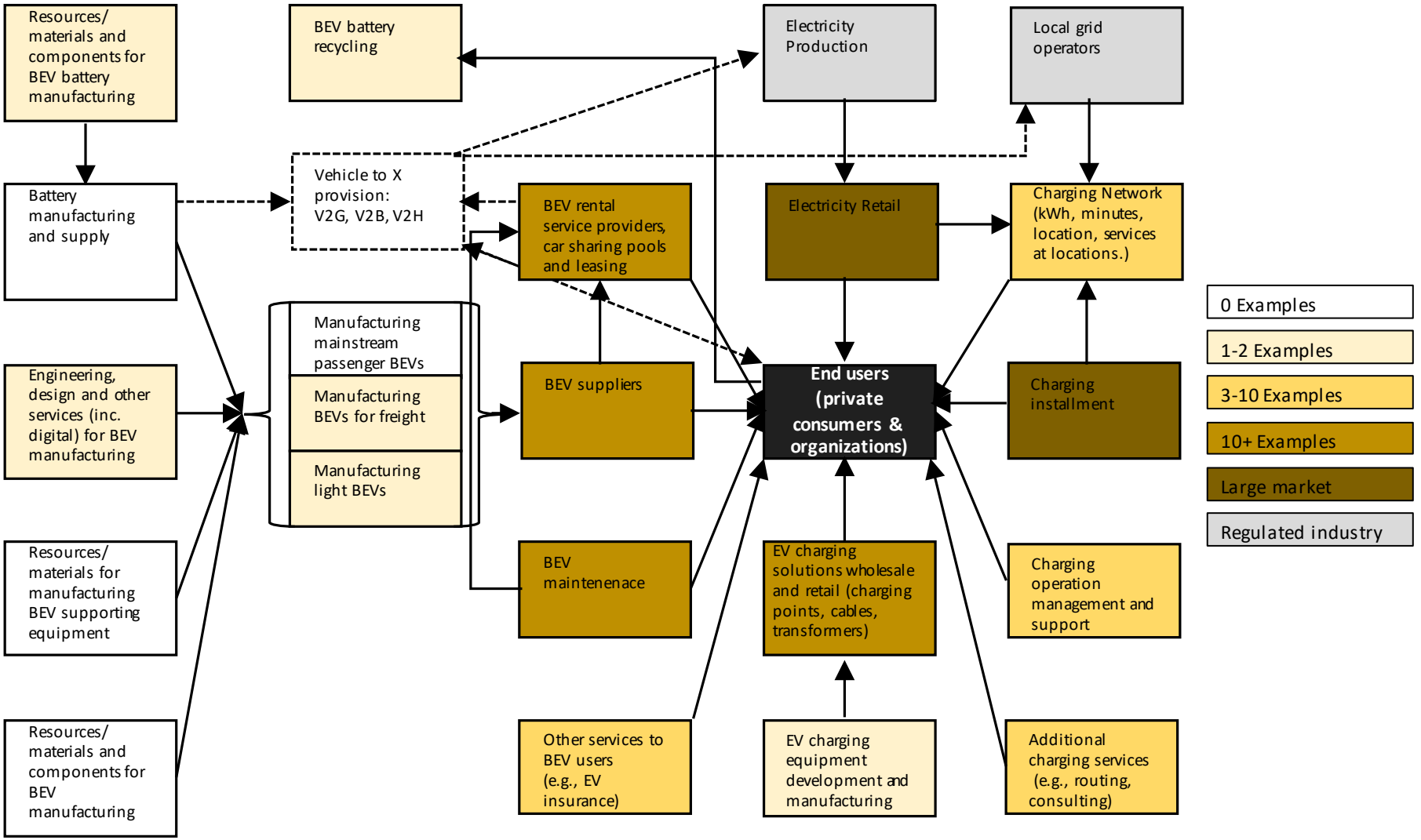
Denne rapporten er et produkt av arbeidspakke 6 i forskningsprosjektet Electromobility Lab Norway; WP6 Enterprise opportunities lab. Motivasjonen bak arbeidspakken er at overgangen til en elektrifisert transportsektor kan forventes å gi norske virksomheter nye forretningsmuligheter. Hensikten med studien er å identifisere det brede spekteret av forretningsmuligheter som kan oppstå.

Mulighetene som oppstår i kjølvannet av en relativt drastisk overgang til elektrifisert persontransport kan handle om å fjerne barrierer eller redusere (eller kompensere for) totalkostnadene ved eierskap (TCO) for elbiler, slik at de åpenbare fordelene de har overfor konvensjonelle biler kan bli realisert. Elbiler har fordeler av høyere energieffektivitet og lavere brukskostnader enn konvensjonelle biler, og de muliggjør fortsatt høy mobilitet samtidig som man tilpasser seg til et lavutslippssamfunn. Dette har verdi for både forbrukere og samfunn, men det er barrierer og andre kostnader som reduserer netto samfunnsnytte av en elektrifisert transportsektor. Siden den potensielle nytten er såpass stor, kan man forvente at det finnes noe betalingsvilje for løsninger som reduserer disse kostnadene og barrierene. Dette åpner for potensielt store forretningsmuligheter. Den potensielt lave totalkostnaden ved eierskap av elbiler kan også skape forretningsmuligheter for helt nye typer tjenester, for eksempel en styrking og utvidelse av tilbudet til nye mobilitetstjenester.

I denne rapporten vil vi forsøke å systematisere kunnskap, erfaringer og ideer knyttet til disse forretningsmulighetene. Hovedfokus vil være på, men ikke begrenset til, muligheter for norske virksomheter. Noen av disse mulighetene er direkte relatert til elektromobilitet, mens andre handler om å levere tjenester til elbilbrukere direkte eller indirekte som en del av en større tjenesteportefølje. Studien er basert på litteraturgjennomgang og workshoper.

En stilisert modell av elbil-økosystemet

Rammeverket vi bruker til å systematisere kunnskap, erfaringer og ideer knyttet til forretningsmuligheter knyttet til elektromobilitet er basert på en stilisert modell av «elbil-økosystemet» hentet fra Leviäkangas et al. (2014). Denne modellen har blitt modifisert i Figur 2 for å passe inn i fokuset til denne arbeidspakken.



Figur 2: En stilisert modell av elbil-økosystemet. Fargekodene illustrerer antallet norske virksomheter i hver kategori.

Med utgangspunkt i elbil-økosystemet som rammeverk, har vi søkt opp og kategorisert norske virksomheter og sektorer inn i rammeverket. Vi finner at de fleste av virksomhetene i dette økosystemet befinner seg ganske langt nedstrøms i verdikjeden, nær sluttbrukeren. Få virksomheter befinner seg oppstrøms i verdikjeden med bearbeiding av materialer og produksjon av biler og komponenter.

Området av økosystemet med flest virksomheter er tradisjonelle sektorer som salg av elektrisitet, elektrikere (for installering av ladeinfrastruktur), bilforhandlere og bilmekanikere og regulerte sektorer som elproduksjon og lokale nettoperatører. Mange av disse firmaene har utvidet omfanget av sin virksomhet til å omfatte produktet og tjenester knyttet til elektromobilitet. Med hensyn til «nye» sektorer som vokser for å møte etterspørselen i elbil-økosystemet, ser vi så langt de fleste bedrifter i kategorien «Ladeløsninger - engros og detaljhandel».

Gjenværende utfordringer på vei til en elektrifisert transportsektor

Workshopdeltagerne identifiserte 22 utfordringer på veien til en elektrifisert transportsektor, og vurderte de følgende 6 som de viktigste:

- Betalingssystemer
- Kunnskap blant elbil-brukere og potensielle brukere
- Hjemmelading i borettslag og sameier
- Tilgang til hurtiglading på tider med høy etterspørsel
- Lang ventetid på å få nye elbiler på markedet, spesielt for godstransport
- Et trykk mot overdrevne investeringer i kapasitet i det lokale distribusjonsnettet

En liste av alle utfordringene diskutert i workshopen er gitt i delkapittel 5.7.

Forretningsmuligheter på vei til en elektrifisert transportsektor

Workshopene og litteraturstudien peker mot følgende 6 forretningsmuligheter som mest lovende for norske virksomheter:

- Utviklingen av et topp-moderne standardisert betalingssystem for lading
- Mobilitetstjenester (MaaS) med elbil i porteføljen – bildeling, samkjøring, "last-mile" løsninger og andre abonnementstjenester
- Rådgivningstjenester for elbilløsninger, i både Norge og utland
- Videre bruk av elbilbatterier etter at de er tatt ut av bilen
- Konvertering av konvensjonelle godsbiler til elektriske
- Utvikling av bilflåteladingssystemer

En liste av alle 21 forretningsmuligheter diskutert i workshopen er gitt i delkapittel 6.7.

Noen virksomheter har allerede begynt å gripe etter noen av disse mulighetene, mens andre av disse mulighetene synes fortsatt urørt. Å få flere bedrifter til å heve innsatsen og gripe etter de forretningsmulighetene som kommer i kjølevannet av elektrifiseringen av transportsektoren, vil være sentralt for at elbil-økosystemet i Norge skal blomstre.

1 Introduction

Over the last few years Norway has seen a rapid growth in the number of electric vehicles in the passenger car fleet. Since 2013, the number of BEVs (Battery Electric Vehicles) have grown from just below 20 000 cars in 2013 to over 190 000 cars in 2018[1] (Norwegian Electric Vehicle Association, 2019). The BEV market share of new passenger car sales reached 31% in 2018. They now (in January 2019) make up 7.2 % of the Norwegian passenger car fleet. On top of this, PHEVs (Plug-In Hybrid Electric Vehicles) make up 3.5% of the car fleet. Norway is the country with by far the highest market share of BEVs in the world (International Energy Agency, 2018), making Norway serve as a potentially full-scale national electromobility laboratory. As other countries' shares of BEVs are also growing, they can look to the successes and failures from the Norwegian experience.

This is exactly the motivation for the research project ELAN (Electromobility Lab Norway). The main purpose of the ELAN project is to develop enhanced and accurate knowledge on the diffusion of electric vehicles and on the innovations and strategies required to reach Norway's ambitious national goals for the low emission society. Using state of the art research methods, the project will monitor and take advantage of the extraordinary battery electric vehicle market development taking place in Norway. The main focus of ELAN will therefore be on battery electric passenger cars, as this is where the largest changes are happening to the Norwegian transport sector at this point in time. The electrification of other parts of the transport sector (e.g. maritime transport or e-bikes) is considered out of scope.

This report is an output from work package 6 of the ELAN project; WP6 Enterprise opportunities lab. The motivation behind this work package is that the switchover to electromobility will give Norwegian enterprises new opportunities, such as delivering parts to vehicle manufacturers, services to vehicle importers and dealers, and vehicle owners and operators. While some of these opportunities are evident, such as development of charging infrastructure services, the purpose of WP 6 of the ELAN-project is to identify the broad spectrum of opportunities that may arise.

Opportunities arising from the prospect of a relatively drastic switch to electrified passenger car transport can be about removing barriers and bringing down (or compensating for) the total cost of ownership (TCO) of BEVs, so that the obvious benefits over internal combustion engine vehicles (ICEVs) can be realized. BEVs have the benefits of higher energy efficiency and far lower direct user costs than ICEVs, and they provide the possibility of maintaining high mobility while still adapting to a low-emission society. This has both great consumer and social value, but there are barriers and other costs that reduce the net social gain from electromobility. Such costs and barriers may be the inability to charge close to home in dense cities, the inability to establish charging stations in potentially high-demand areas because of high grid costs or long waiting time at charging stations. But because the potential social gain from electromobility is so large, there surely exists some willingness to pay for solutions that bring down these costs and barriers. This provides potentially large enterprise opportunities. The potentially low TCO

[1] Number of registered vehicles on December 31st in the relevant year.

of BEVs can also create enterprise opportunities for new types of services, for example strengthening Mobility-as-a-service (MaaS) value chains.

In this report we systemize the knowledge of these enterprise opportunities. The main focus will be on, though not limited to, opportunities for Norwegian enterprises. Some of these opportunities are directly related to electromobility, while other opportunities have serving electric vehicles as one of many services in a larger set of offerings. The study is based on literature reviews and workshops.

The report is structured as follows: Chapter 2 gives a description of methods used in this report. Chapter 3 gives a stylized view of the "EV ecosystem", while chapter 4 describes the ecosystem, piece-by-piece. Chapter 5 looks at the remaining challenges on the way to an electrified transport sector, while chapter 6 looks at the enterprise opportunities. Chapter 7 briefly looks at which sectors that can expect to lose out as the transport sector becomes more electrified, while chapter 8 concludes.

2 Methods

In this study we have gathered information about Norwegian firms that can be placed in the "EV ecosystem" (see chapter 3), through a literature review and workshops with relevant Norwegian stakeholders within the EV ecosystem. We consider this to be an efficient way to systemize the knowledge, experiences and ideas related to enterprise opportunities as the transport sector gets more and more electrified.

Literature review:

The information for the systemizing of Norwegian firms' place in the EV ecosystem has been gathered through web-searching. Relevant firms with their products and services have been documented in an Excel-spreadsheet throughout the search. Many suggestions for firms have been given by the Norwegian Electric Vehicle Association (Norsk Elbilforening), MobilityLab and participants at Workshop on charging and charging infrastructure (arranged by MobilityLab in February 2018), and participants at Workshop on Business opportunities on the way to an electrified transport sector (arranged by the Institute of Transport Economics and MobilityLab in October 2018).

Workshops:

All firm-specific issues described in this report are either public information or they have given consent to publish information from workshops.

Two workshops provided inputs to this study:

The first of these workshops, with the subject "Charging and charging infrastructure" was arranged by MobilityLab on February 15th 2018 in the Oslo Science Park. The main questions to be discussed at this workshop were:

1. How does your firm expect the charging infrastructure to be like in 5-10 years' time (the future vision of the firm on this topic)?
2. What challenges and opportunities does this imply?
3. Given questions 1 and 2, how can you best position yourself?

The stated goal and desired outputs of the workshop was for participants to share perspectives on future challenges and opportunities related to future charging and charging infrastructure, get a discussion, gain insight and uncover areas for cooperation. Participants at this workshop were representatives from:

- Møller Mobility Group
- Posten
- Oslo Kommune (v/ Bymiljøetaten)
- Circle K
- IF Forsikring
- Hafslund
- OBOS
- ABB

- MobilityLab
- Telenor
- Institute of Transport Economics

The agenda for the workshop can be found in Appendix A (in Norwegian).

The second workshop in this study, with the subject "Business opportunities on the way to an electrified transport sector" was arranged by the Institute of Transport Economics and MobilityLab on October 18th 2018 in the Oslo Science Park. The main questions to be discussed at this workshop were:

1. What are the most important challenges on the way to an electrified transport sector?
2. Underutilized business opportunities on the way to an electrified transport sector – How can Norwegian enterprises make money from solving, circumventing or compensating for the challenges?

In total 20 people participated in the workshop (including 2 moderators). The participants were divided into two groups. Each of the two questions were given an own session in the workshop. Each session was divided into three parts. The first part was 10 minutes of individual thinking in silence, where participants would write down their suggestions on post-it notes. This was to ensure participation from everyone and avoid group-think. In the second part of the session all post-it notes were put up on a board and discussed in each group. In the third part of the workshop the two groups got together to discuss their findings and conclusions.

The stated goal and desired outputs of the workshop was for participants to share perspectives on challenges and opportunities on the way to an electrified transport sector, get a discussion, gain insight and document ideas for this report. Participants at this workshop were representatives from:

- Møller Mobility Group
- Posten
- Telenor
- IF Forsikring
- Hafslund
- Flexibility AS
- ABB
- DEFA AS
- E-Motive
- Bilimportørenes Landsforening (Norwegian Association of car Importers)
- MobilityLab
- Institute of Transport Economics

The agenda for the workshop can be found in Appendix B (in Norwegian).

3 A stylized view of the electric vehicle ecosystem

In order to identify the broad spectrum of enterprise opportunities, it can be useful to take a look at the electric vehicle "ecosystem". As a starting point we use the stylized ecosystem model developed by Leviäkangas et al. (2014) from the paper *The Electric Vehicles Ecosystem Model: Construct, Analysis and Identification of Key Challenges*. The model is shown in Figure 3. This has been modified in Figure 4 to fit the focus of this work package.

Our focus is on Norwegian enterprises in this ecosystem. We are therefore not interested in players such as regulators, universities and research institutes, and environmental organizations. In this report we will go through each of the main parts of the ecosystem and document the role of Norwegian enterprises in it, the products and services they provide, and which products and services that are missed and possible roles for Norwegian enterprises for providing these missing products and services.

In Figure 4 our presentation of a stylized view of the EV ecosystem is presented. This gives an overview of all the main value chains related to the making and use of EVs, from upstream to end user. In the figure we have given each category in the EV ecosystem a color code according to how many examples of Norwegian firms we have found up to the end of 2018.

As can be seen from the color codes in the figure we find that most of the firms in this ecosystem are placed close to the end of the value chain, i.e. close to the end user. Few are placed upstream with resources, materials and manufacturing.

Moreover, the parts of the ecosystem with the highest number of involved firms are traditional sectors like electricity retail, electricians (for EV equipment installment), car dealerships and car maintenance, and regulated sectors like electricity production and local grid operators. With regards to "new" sectors that grow to meet the demands in the EV ecosystem, we see as of now most firms in the category "Charging solutions wholesale and retail". All of this will be further elaborated in section 4.

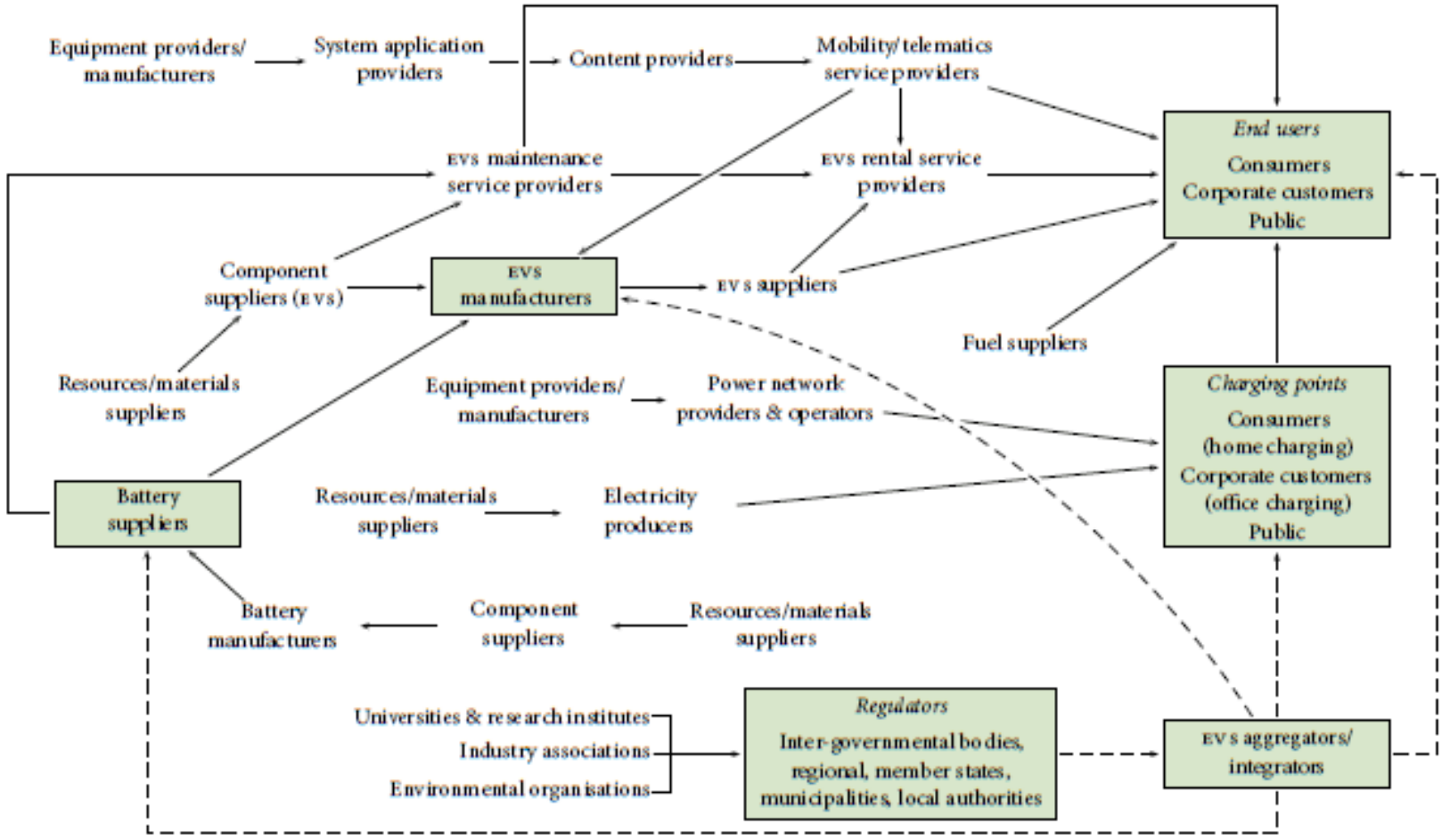


Figure 3: Electric Vehicles Ecosystem (eve) Model (solid – current offerings/actors, dashed – future offerings/actors). From Leviäkangas et al. (2014)

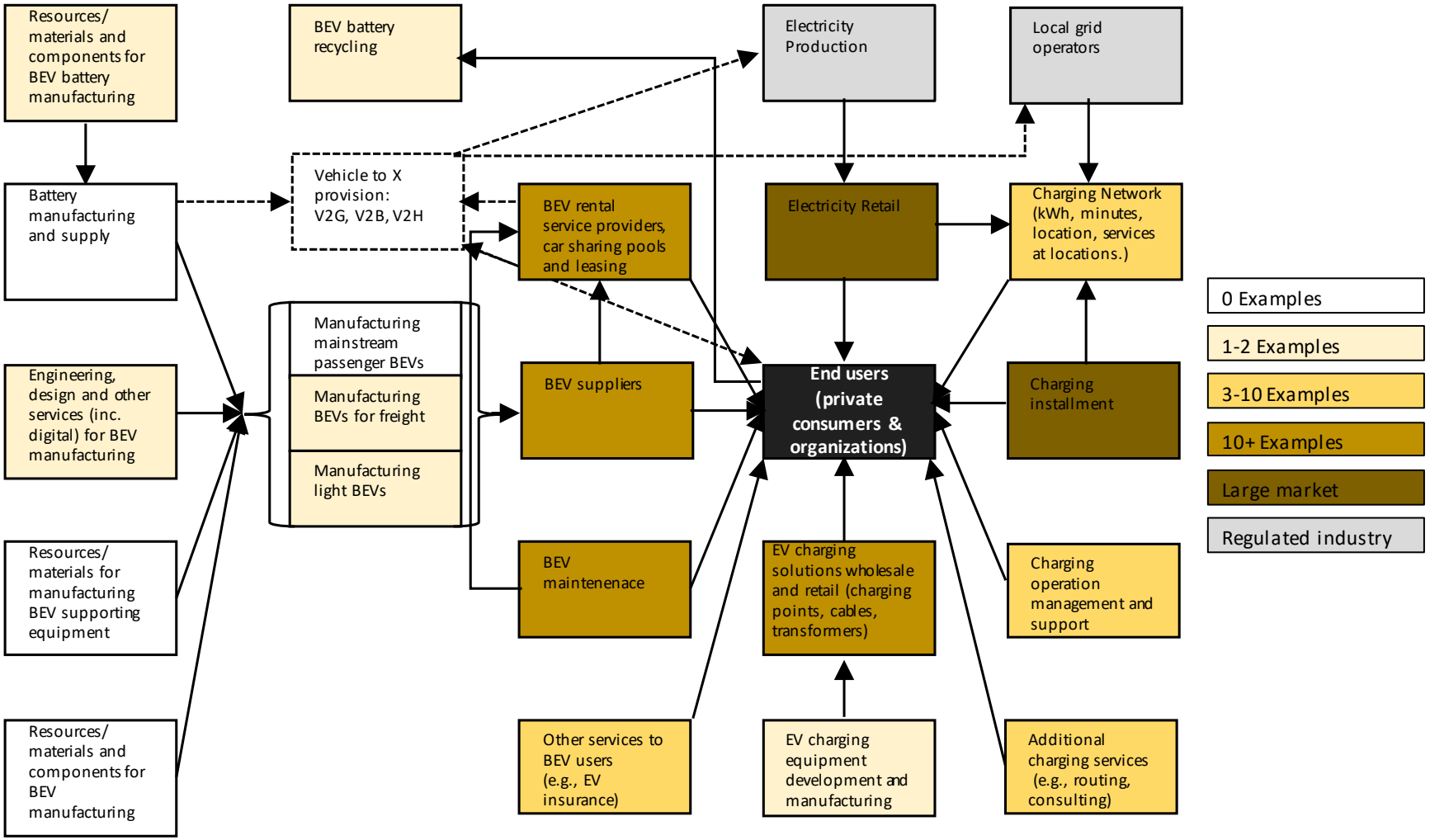


Figure 4: Stylized view of EV ecosystem. Color codes to capture magnitude of Norwegian firms.The EV ecosystem, piece-by-piece

4 The EV ecosystem, piece-by-piece

Each subsection corresponds to a category in the stylized EV ecosystem overview (Figure 4.) In each subsection we give a brief presentation of the examples of Norwegian firms (or lack thereof) we have found up to the end of 2018. We start at the top of the value chain and work our way down.

4.1 Resources/materials and components for BEV manufacturing

We have so far been unable to uncover whether any players in the Norwegian chemical or mineral industry supply resources or materials to manufacturers of BEVs.

The Norwegian automotive parts industry is mainly involved in delivering plastic and metal parts and electromechanical assemblies to vehicle manufacturers. They have diverted into the BEV business with for instance Kongsberg Automotive supplying chargers to Volvo through the subsidiary ePower. ePower was however in November 2017 sold to the German automotive supplier Preh (Kongsberg Automotive 2017).

4.2 Resources/materials and components for BEV battery manufacturing

The Norwegian industry company Elkem has developed the silisium product Silgrain® e-Sim that has useful properties for rechargeable lithium-ion batteries applicable in BEVs. The development has been carried out in cooperation with the Japanese company AIST Kansai.

4.3 Resources/materials for manufacturing of supporting equipment for BEVs

We have so far been unable to uncover whether any players in the Norwegian chemical or mineral industry supply resources or materials to manufacturers of BEV supporting equipment.

4.4 Battery manufacturing and supply

We have so far been unable to uncover whether any players in the Norwegian manufacturing industry that manufacture and/or supply BEV batteries to BEV producers.

4.5 Engineering, design and other services (including digital) for the manufacturing of BEVs

The Trondheim-based company Alva Motorsolutions sell design, engineering and consultancy services related to electric motors. They can offer expertise on initial specifications and requirements, motor design, simulation and analysis, prototyping, pilot testing and production. They have no references on their website, and we have not enquired them on whether they have provided services related to electric vehicles.

The technology company E-Motive Technology AS started up in the autumn of 2018 and works with e-mobility technology development and testing. They provide services such as developing battery systems and charging solutions, improving existing components and subsystems, managing subsystems and supplier contact during development phase, managing and performing test and validation programs, developing custom battery solutions and testing of new battery and charging solutions in cooperation with a local battery research institute. They are located in Asker, and there are currently 2 people working there.

4.6 EV manufacturing

4.6.1 Mainstream passenger BEVs

Norway does not have a well-established car industry. There used to be two Norwegian manufacturers, which produced the Think and Buddy vehicles. These are now out of business.

4.6.2 BEVs for freight

Paxster is Norwegian company that produces a small four-wheel electric delivery vehicle called Paxster. The company had 28 employees in 2017 and is located in Sarpsborg. It has delivered Paxsters both to the Norwegian Postal service and to the New Zealand postal service.

They describe their product with the following: *With a 200 kg loading capacity you will make fewer deposit roundtrips compared to any other small delivery vehicle. For easy access, Paxster can carry 3 x 15 kg up front, and the rear cargo box with a volume up to 820 liters can be tailor-made to fit your postal trays.*

4.6.3 Light BEVs

Podbike is a Norwegian company that has designed an electric assisted velomobile called Podbike. It can be described as an e-bike (which it is registered as) with four wheels that provides weather protection, two seats and a small trunk. The product is at a pre-order stage. The company has also designed a garage concept for the Podbike, consisting of a storage carousel with room for four bikes that can charge the vehicles using integral solar panels. This is a stated as future development. The company had 7 employees in 2017 and is located in Sandnes.

CityQ is a Norwegian company that has designed an electric assisted velomobile called CityQ. The company claims it is registered as an ebike, but with the benefits of a small city car, and serves the main purpose of assisting in cities where cars are hard to use and access. It is in the pre-order phase. The company is located in Oslo and has no employees as of 2017 according to official firm information sources.

4.7 BEV suppliers

All new cars sold in Norway are imported, and car dealerships are distributed widely across the country (the word "bilforhandlere" i.e. Norwegian for "car dealers", got 4565 hits on gulesider.no[2]). The 19 BEV models currently for sale in the new cars market in Norway are, according to Elbilforeningen, mainly supplied by BMW Norge AS (BMW i3), Ford Motor Norge AS (Ford Focus Electric), Hyundai Motor Norway (Hyundai IONIQ Electric, Hyundai Kona), Kia Bil Norge AS (Kia Soul Electric), Mercedes-Benz Norge (Mercedes-Benz B250e), Mitsubishi Motors Norge (Mitsubishi i-MiEV), Nissan (Nissan e-NV200 Evalia, Nissan LEAF), Opel (Opel Ampera-e), Bertel O. Steen (Peugeot iOn, Citroën C-Zero, Smart ForFour Electric Drive), RBI Norge(Renault Zoe R90 Z.E. 40), Tesla (Tesla Model S 75, Tesla Model S 90D and P100D, Tesla Model X 90D and P100D), Møller Gruppen (Volkswagen e-Golf, Volkswagen e-up!).

With the exception of Tesla, these car dealerships sell conventional cars in addition to BEVs. The introduction of BEVs has led to a higher product variety. Although some of the BEV sales have come at the expense of ICEV sales, the net sale of new cars has grown over the last 6 years (SSB Statistikkbanken).

4.8 BEV rental service providers, car sharing pools and leasing

The car rental service sector is a well-established market in Norway (the sector "Bilutleie", i.e. "car rental", had 805 hits on Proff.no[3]).

With a brief search among the large rental car providers, we find that some but not all have BEVs in their fleet. For example, Hertz, AVIS, Sixt and Bislet have BEVs available. However, we could not find any at Budget or Europcar. Our search also found Whitecar, who specializes in Tesla rental. We also find a special offer from Birger N. Haug directed towards BEV-owners for trips where their BEV may not suffice.

The car sharing pools Bilkollektivet, Nabobil, Hyre, Hertz Carpool and GoMore all have BEVs available. The car pool MoveAbout specializes in renting out BEVs to its members, and has an own service for firms wanting to have car pools for their employees. Since the start of January 2019 the train operator NSB has been offering 250 electric city cars in Oslo through the concept Din Bybil, administered by daughter company Nettbuss, as a franchise holder for the Danish company GreenMobility.

Like the more traditional rental car market for BEVs, the car pools are mainly placed in the larger cities, mostly in Oslo. Most of the brand car dealerships with BEVs mentioned in section 4.7 also provide leasing services (e.g., Nissan and Volkswagen). In addition, there are some other leasing companies that offer a wide selection of BEVs, such as Autolease, LeasePlan Norge, Bildeal and AutoMedia. Bildeal also has a branch in Oslo, Elbil leasing, that specializes in exclusively leasing BEVs and PHEVs.

[2] Web service for Gule Sider ® [Yellow Pages]. Used for searches here to get a sense of the magnitude of firms in this sector.

[3] A business finder database and search engine. Used for searches here to get a sense of the magnitude of firms in this sector.

4.9 BEV maintenance

The auto repair shop sector is a well-established market in Norway (the sector "bilverksteder", i.e. "vehicle repair shop", had 9930 hits on Proff.no). As the growth in the EV stock seems to coincide with the growth in the overall car stock, this sector is experiencing an expanding customer base. On the other hand, the maintenance requirements of BEVs could over time prove to be significantly less than that of ICEVs due to fewer moving parts. This could mean that even though the customer base is expanding, the frequency of need for service and repairs is reduced.

For an auto repair shop to take on service of BEVs, they need to invest in the necessary competence and special equipment, e.g., for working with the electrical wiring and inspecting the battery (Würthbloggen, 2017). This comes at a cost. This suggests that even though the total customer base might be growing, the growth stemming from BEVs, will be less profitable per vehicle seen from the auto repair sector point of view.

The car dealerships that sell the BEVs often provide auto repair shop services. The non-brand auto repair shops come in addition. Some BEV dealers require the owner to take the car to brand repair shops for the regular service in order to maintain the warranty. And where it is not required to have service at the brand auto repair shop, it is often stated that it is the owner's responsibility to make sure that the car is inspected according to factory recommendations (Elbilforeningen, 2014). In addition, not all non-brand auto repair shops have invested in the necessary competence and special equipment for servicing BEVs. According to Würthbloggen (2017) this has led to relatively high prices on repair shop service for BEVs, about as high as for conventional cars, in spite of BEVs having fewer critical parts to inspect. However, more non-brand auto repair shops have taken the steps to provide service to BEVs, thus providing more competition for this segment of the market. There are some examples of non-brand auto repair shops that explicitly target BEV owners, such as Elbilmek and Envirobil. Competition for BEV owners will be fiercer as the new car warranty expires for a larger and larger pool of BEVs.

4.10 BEV charging equipment development and manufacturing

There are some cases where the actual manufacturing of hardware such as charging stations or cables is done by Norwegian companies in Norway.

Zaptec is a Norwegian company that designs, develops and manufactures charging stations and charging cables. Their products consist of the ZapCharger Portable, a portable charging cable with an electronic transformer built in, and the ZapCharger Pro, an AC wall or column-mounted charging station that adjusts an optimal load of power, protecting the car and the electrical grid at the same time. Zaptec is located in Stavanger.

The Norwegian company *Salto* designs and develops products for BEV charging – both hardware and software. They also import equipment from abroad (see next section). Salto is a part of DEFA, and is located in Bærum.

4.11 BEV charging solutions wholesale and retail

There are numerous sellers of charging solutions in Norway, with hardware manufactured abroad.

The previously mentioned Bærum-based company *Salto* (a part of DEFA) specializes in selling charging related products and associated services. They sell more than 30 products related to charging – charging stations (between 3.7 and 22 kW capacity), cables, transformers and accessories. Salto is a part of DEFA, and is located in Bærum.

Proxll is a Norwegian company that specializes within development, implementation, operations and management of green technology for the construction, industry and infrastructure sectors. They sell 11 different charging stations for public and/or home use (between 3.7 and 22 kW capacity). Proxll is located in Oslo.

The Norwegian company Kontroll Elektro sells a variety of charging stations (up to 22 kW capacity), cables, transformers and accessories. They are located in Bærum.

Elbilgrossisten is a Norwegian company specializing in selling products for BEV charging. They market more than 25 different wallbox charging stations (between 3.7 kW and 22 kW), and a large variety of cables, transformers and other accessories. They are located in Oslo.

Ladefabrikken AS is a similar company, based in Oslo. They market 9 types of charging stations from 4 different brands, in addition to charging cables, transformers and accessories. They also market the *Solarport*, a carport with built in-solar panels and BEV charger from Salto. The Solarport is developed and delivered by the Fredrikstad-based construction company BD Husservice AS. Ladefabrikken also markets the Tidybox, a box for practical storage and usage of charging cables, designed and sold by Vestfossen-based Tidybox.

The Norwegian company *NorCharge* is a distributor for charging stations from VESTEL and ENSTO for electric cars, and charging stations from HELIOX for buses. They are currently marketing 10 different charging stations for cars (between 3.7 and 22 kW capacity) and 6 different charging stations for buses. They also provide some accessories to charging stations and associated services. They are located in Drammen.

The Norwegian branch of the company Evbox sells a variety of charging stations (between 3.7 and 22 kW capacity), cables and accessories. They are located in Oslo.

The Norwegian branch of the energy technology and management company Schneider Electric sells a variety of charging stations (between 3.7 and 22 kW capacity), cables and accessories. They are located several places in Norway, but have their national headquarters in Oslo.

The Norwegian branch of the Finnish technology company Ensto sells a variety of charging stations (up to 22 kW capacity) for home and/or public use, a fast-charging station (up to 100 kW) and accessories. They are located in Oslo.

The Norwegian branch of the Swedish electro-installation products company Garo sells a variety of charging stations (between 1.4 and 22 kW capacity) for home and/or public use, 3 fast-charging stations (up to 50 kW), cables and accessories. They are located in Drammen.

The Norwegian branch of the British company EO Charging sells a variety of charging stations (between 3.7 and 22 kW capacity), transformers and accessories. They are located several places in Norway, but have their national headquarters in Tønsberg.

The Norwegian branch of the German company Pheonix Contact sells a variety of cables for BEV charging (more than 300 types for AC charging and more than 50 types of DC cables) and accessories. They are located in Oslo.

The Norwegian branch of the Swiss-Swedish multinational technology and industry company ABB sells charging stations for both electric cars, trucks and buses. For cars they sell 4 types of AC wallboxes (between 11 and 22 kW), 6 types of multistandard DC

charging stations, a DC wallbox fast charger and a high power charger (150 kW). The Norwegian sales team for ABB is located in Bærum.

The Norwegian branch of the electric component company Wago sells a flexible charging concept to small and large garage facilities, with own-produced components for the charging infrastructure. They are located in Oslo.

The charging station operator Grønn Kontakt also sells charging stations for home, work and/or public use (between 3.7 and 22 kW capacity). They also provide add-on services like billing and payment for work and public use. They are located in Kristiansand.

The energy company Fortum also sells charging stations for home use on the Norwegian market. They market 3 different packages for home charging stations (between 3.7 and 7.4 kW capacity). The Norwegian branch of Fortum Markets is located in Oslo.

Smart:Liv, a company established by the electricity company Ringeriks Kraft AS and the technology company eSmart Systems, sells a home charging station package (up to 11 kW capacity), along with add-on services. They are located in Hønefoss.

Smartly, a company established by the electricity company Lyse, sells a home charging package (unspecified wattage), along with add-on services. They are located in Stavanger.

4.12 BEV charging solutions services

4.12.1 Installment

Installment of charging equipment is typically done by electricians. There are numerous providers of electrician's services (the sector "elektroentreprenører", i.e. "electricians" had 7555 hits on Proff.no). An example of this is Infratek, who has played a large role in installing public charging infrastructure, both fast, semi-fast and slow chargers.

Many of the companies offering charging solutions hardware also offer installment to their customers, sometimes by themselves, sometimes with a third party installation partner. From the companies mentioned above, these include NorCharge, Smartly, Smart:Liv, Schneider Electric, Fortum, Grønn Kontakt and ABB.

4.12.2 Operations, management and support

Some companies offer management and operations services to owners of charging stations. Examples of such services include monitoring and remote management through back-end, trouble shooting and error correcting, identification and access management for registered users, payment solutions, support and maintenance. Several of the companies mentioned above offer services of this kind. These include NorCharge, Salto, Smartly, Smart:Liv, Schneider Electric, Fortum, Grønn Kontakt and ABB.

The Oslo-based technology company Meshcrafts also offer software services that allows for managing, monitoring, supporting and updating charging infrastructure. It connects the operator, user, vehicle and grid and enables load management and selling of self-generated power. Smart:Liv also provides software that enables load management, marketed as a way for the user of the charging station to minimize the electricity cost of charging. Smartly also offers software for optimal energy management of the charging stations.

The Førde-based technology company Tibber offers, among other services, an app for smart charging. It allows the user to minimize its electricity cost for a set charging level at a set time. This service is integrated with the charging processes for BMW, Tesla, Volvo and VW.

The Oslo-based technology company eRate has specialized in data collection and billing in the telecom sector. In presentations they talk about using this experience to provide data collection and billing solutions for charging BEVs.

EasyPark is an Oslo-based company that specializes on parking location and payment solutions that has expanded internationally. According to their website, they are currently working with charging providers and charging station manufacturers in order to integrate the localizing, accessing and paying for BEV charging in their parking app.

4.12.3 Additional services

Including charging into trip routing: Meshcrafts offers an app that can route the BEV-driver through multiple charging stations from point A to point B. It can dynamically change the route according to real-time information about congestion and availability of charging infrastructure.

The Stavanger-based technology company Easee has developed a prototype of a charging robot that is in the process of certification. The aim is to simplify and optimize the charging experience for the BEV owner.

The Rakkestad-based company Enmira AS provides consulting services for projects related to charging infrastructure on subjects like systems architecture, strategy, risk assessment, technical support and project support. The company also provides courses on EV and charging infrastructure for electricians, consulting engineers, municipalities and car dealerships.

The Norwegian Electric Vehicle Association also provides advisory services related to charging infrastructure. These services are directed towards housing cooperatives or condominium apartment buildings. The purpose of their assessment and advice is to help their customers choose the charging solutions best suited for them and get the best possible offer on installment. The association has also initiated and developed the NOBIL database that provides open access data on charging locations all across Norway. The detailed data is available through an API, and this data is used to provide other services. Previously mentioned firms that use this data include Fortum, Grønn Kontakt and Meshcrafts.

4.12.4 Charging network

There are about 1000 fast chargers available in Norway, along with about 7500 slow and semi-fast chargers publically available (and/or at workplaces). Many of these charging stations are a part of the network of some large charging stations operators. The largest charging network is that of Fortum, with over 1200 charging stations across the country. They cooperate with many large enterprises, for example the fast-food chain McDonalds, the food store chain Kiwi and the retail giant IKEA and have set up chargers at numerous of their locations across the country.

Grønn Kontakt also offers a network of charging stations in many parts of the country. They cooperate with many large enterprises, for example the fast-food chain Burger King, and the shopping malls and hotels of the Olav Thon Group and have set up chargers at numerous of their locations across the country.

The fuel station franchise Circle K operate 58 fast chargers in their network of Circle K stations. Circle K also cooperates with IONITY, which is a joint venture between BMW Group, Daimler AG, Ford Motor Company and Volkswagen Group, that is working on establishing a high power charging network (HPC), with capacity up to 350 kW per charging point, across Europe. Circle K will establish HPC at stations in 7 Nordic and

Baltic countries. 20 HPC stations with about 6 charging points per station will be established in Norway.

The fuel station franchise YX has a similar cooperation with the energy company E.ON and the e-mobility service provider Clever. They are also aiming to establish a HPC network in Europe. In the Norwegian part of this network, YX will establish 20 HPC stations along the main transport corridors between the largest cities with a capacity of 150 kW per point, but with a module for future upgrading to 350 kW.

Energy companies like BKK and Lyse also provide a number of charging locations in their local regions. The former, which have taken over the charging network of Ishavsveien/Arctic Roads, have 21 charging locations in the Western part of Norway, while the latter offer six charging locations in the Stavanger area.

4.13 Other services to BEV users

There are other services to car users that that can be more tailored towards BEV users and thus be a part of the EV ecosystem. Examples of this include car insurance. The large banking and insurance provider Storebrand has together with the Norwegian Electric Vehicle Association developed a specialized car insurance for BEV owners. Insurance providers from Gjensidige, Tryg and If advertise car insurance to BEV and PHEV owners, but the insurance menu is the same for all cars.

4.14 Local grid operators

Local grid operators belong to a regulated industry. The companies' annual revenue is capped according to their costs, and a benchmarking with the other companies. This benchmarking competition means that if a local grid company can increase their customer base within its area and/or reduce costs more than their peers, the profitability will increase. Many new charging stations will be new additions to the customer base. And as the roll out of smart meters (Advanced Metering System – AMS) is coming close to completion, the possibility of better power load management, to reduce maintenance and expansion costs, improves. With a pricing structure that incentivizes load shifting away from grid capacity peaks, particularly with many BEVs that can do their charging off-peak, the opportunity for better grid utilization and lower costs increases. However, if the pricing structure does not provide enough incentive to load shift, and many BEV users systematically charge during peak hours, costs may increase for local grid operators. Figenbaum and Kolbenstvedt (2016) found that the peak demand period for charging is in the afternoon when people come home from work, coinciding with the overall peaks in the grid. This may again result in lower profits and/or higher grid rents for consumers.

4.15 Electricity retail

Electricity retail is a well-established sector in Norway with more than 120 electricity providers, according to strøm.no. With higher prevalence of BEVs, electricity consumption will be higher, thus increasing their sales. It is also possible for new customer segmentation, making it possible to offer new subscription packages that may be attractive to BEV-owners and profitable to retailers, particularly accompanied with AMS, as this may allow for cost efficient load shifting.

4.16 Electricity production

As with the retailers, more BEVs means more sale of electricity. If electricity retailers and local grid operators manage to incentivize efficient load shifting, production costs may also decrease.

4.17 Services to electricity production and grid operation

The Oslo-based technology company Greenbird provides system integration services for utilities and DSOs with their Metercloud integration Platform as a Service (iPaaS), with applications for smart metering, smart billing and smart grids. This can for example be used by a grid operator to simulate future scenarios with BEVs in order to plan future investments and operations.

4.18 Vehicle to X provision: V2G, V2B and V2H

With increasing energy storage capacity in BEV batteries and possibilities for discharging them not only to power the vehicle, opens up for vehicle to X electricity provision: Vehicle to grid (V2G), vehicle to building (V2B), vehicle to home (V2H) (see e.g., Perez, 2018).

V2G, where the vehicle owner can discharge the vehicle battery in order to sell electricity back to the grid, opens up for short-run balancing in the electricity market, peak shaving and better utilization of spinning reserves. This could have potentially high market value in the electricity market (both capacity and energy).

V2B helps building managers reduce electricity costs over time, mainly through peak shaving.

V2H helps home owners reduce electricity costs over time, mainly through charging the BEV during low price hours and discharging the BEV to contribute to meeting demand of the home during high price hours.

We have so far been unable to uncover whether any players in the Norwegian manufacturing industry that manufacture and/or supply V2X solutions.

4.19 BEV battery recycling

The Fredrikstad-based battery recycling company Batteriretur AS has a daughter company Batteriretur Høyenergi AS that specializes in collection and sorting of batteries from electric vehicles and the marine sector before they are shipped to approved recycling facilities in Europe. The mother organization was first established by initiative by the Ministry of Environment, and has the responsibility of handling the Extended Producer Responsibility for batteries in Norway. Batteriretur Høyenergi are financed by an environmental fee per imported car. The batteries are taken out of the vehicles by the traditional car breakers and shipped to the Batteriretur facility for further disassembly.

5 Remaining challenges on the way to an electrified transport sector

As a part of this study, the Institute of Transport Economics co-hosted a workshop together with MobilityLab on the subject "Business opportunities on the way to an electrified transport sector" on October 18th 2018 in the Oslo Science Park. This is further described in chapter 2 of this report.

In this chapter we will go through the first of the main questions discussed in the workshop, namely "What are the most important challenges on the way to an electrified transport sector?" We will first describe what the workshop participants identified as the top six challenges on the way to an electrified transport sector. The findings from the workshop discussions are sometimes supplemented with findings from the literature. The last part of this chapter summarizes all of the challenges that came up and were discussed during the workshop.

5.1 Payment systems

The BEV user faces a variety of different ways to pay for charging at different charging providers. Several workshop participants gave descriptions of the variety of payment solutions and lack of standardization as "unpredictable" and "bureaucratic". One meant that Nordic countries, with a large share of the people often paying electronically or by mobile apps, should in particular be expected to have more seamless payment solutions. But he noted that it was not as bad as in Germany, where he had to download 5 different mobile apps in order to charge his BEV on a trip through the country.

This is a challenge also addressed in a paper the Norwegian Electric Vehicle Association presented at a conference in Germany (Lorentzen, Haugneland, Bu, & Hauge, 2017):

> *There is still a challenge related to payment for charging. However, this has improved in recent years due to improvement in the operator's own systems, the introduction of a universal charging tag (RFID card) from the EV Association and the rapid development of app based solutions. In our view, it is not instrumental to have a single, national payment system or roaming solution. If there is a customer friendly drop in system for payment, the user experience is safeguarded. Charging as a service should not be something exotic that requires special payment solutions.*

There was a broad agreement in the workshop of the need for more user friendly and efficient payment system with low transaction costs (less than 0.1 NOK per transaction was mentioned by one workshop participant as the target).

5.2 Knowledge among users and potential users

Some workshop participants claim that many BEV users are not getting the best user experience for the money they spend, and many potential users are shying away from adopting BEVs and charging solutions, in many cases because of lack of knowledge.

One participant claimed that many potential users need to take a good look at what car transport they actually need. Most households do not need much range for most of the trips they have throughout the year. For them it would make good economic sense to have a small BEV for the day-to-day trips and rent (or car-share) an ICEV for the occasional long trips. A change in mindset (at least getting rid of the exaggerated range anxiety) could save many households thousands of kroner per year without reducing their mobility needs.

Some workshop participants claim that many users and potential users have a hard time finding objective information about solutions for charging. The information is spread across many different private and government agencies, and it is therefore hard to find places with answers to all the new problems arising. Those who provide answers often have a vested interest in selling and/or installing their equipment, which may not always lead to the provision of objective information. This means that individuals, apartment and office building managers, and small and large organizations may not be getting good advice on what solutions to invest in to support the transition into electrified transport. Many can find themselves locked-in with a solution sub-optimal for them. Further, it could be that electricity companies or installers can lock their customers into proprietary solutions from a certain provider. This is a potential hurdle for healthy competition in the market.

Some participants told about their experiences with how many of those who want to install charging systems in apartment buildings seem to lack understanding about grid capacity issues and the cost of expanding transformer stations. They said this has led to unrealistic expectations and some disappointed user experiences. Easily accessible advisory services helping customers navigate through such issues seems to be lacking.

5.3 Home charging for apartment buildings

Several workshop participants had experience with the difficulties of getting their housing cooperative or condominium apartment buildings to invest in a charging system for BEVs for the garage. At least 50% of the co-owners need to consent to the investment. It will still take some time before it will be common with apartment buildings where more than 50% of the households have a BEV, and it is a potentially large investment. In addition, there is large price uncertainty.

Among the challenges are how to split the cost among residents of the apartment building, when only a few of the residents own a BEV. It seems to be hard to find a good cost-sharing model under such circumstances. Even if the installment of charging solution raises the attractiveness and property value of the building, it can still be tough sell for the non-BEV users.

It is worth noting that a relatively recent (January 1st 2018) change in the law regulating these types of co-owned apartment buildings means that the appointed boards can no longer ignore requests for charging capability by individual co-owners. They have to investigate and propose solutions (advokatsidene.no, 2018).

Even if the residents and the board members decide to move forward and investigate the possibilities for setting up a charging system, the project can meet problems. These can arise from e.g. their lack of professionality to make large investments and low competence on energy and capacity issues, and during a poor planning process end up with a system that is unnecessarily complex.

5.4 Access to charging during peak times

There seems to be risk of charge queues at fast and semi-fast chargers in the largest cities, along the main highways on peak holiday travel times, as well as at street chargers in the evening in some cities. One workshop participant told about holidays with 3-4 hours wait at charging stations. The problem could be solved with more charging points per charging station. However, this is costly and would result in excess capacity most of the year, and these charging points would not be profitable. They would be unlikely to be profitable in isolation, but they could still add value to owners as parts of an operator's larger network.

5.5 Long waiting time for BEVs, particularly for freight

The waiting lists for many of the upcoming BEV-models are long, meaning that there is a lot of unsatisfied demand for BEVs in Norway. Some potential users can be expected to buy a conventional car now instead of waiting. Although it is hard for any Norwegian firm to deal with this issue directly, it is nonetheless a major challenge on the way to an electrified transport sector.

This challenge is even bigger for freight transport, as the availability of electric vans and trucks is either inadequate or non-existent. One workshop participant said this was her organizations biggest challenge in their transition to electromobility. This is corroborated by a recent report from Jordbakke, Amundsen, Sundvor, Figenbaum, and Hovi (2018), which documents the lack of availability and cost barriers for electric options in this market segment.

5.6 Push for excessive investment in grid capacity

With little variation in electricity prices throughout the day, and currently no grid tariff differentiated between peak and off-peak for the grid capacity, there is little incentive for BEV owners to charge their car during off-peak hours. For many, it is most convenient to plug in the BEV after coming home from work, which is when capacity usage for households is at its highest even without taking BEVs into account. This seems to currently be the dominating pattern, as can be seen in Figure 5.

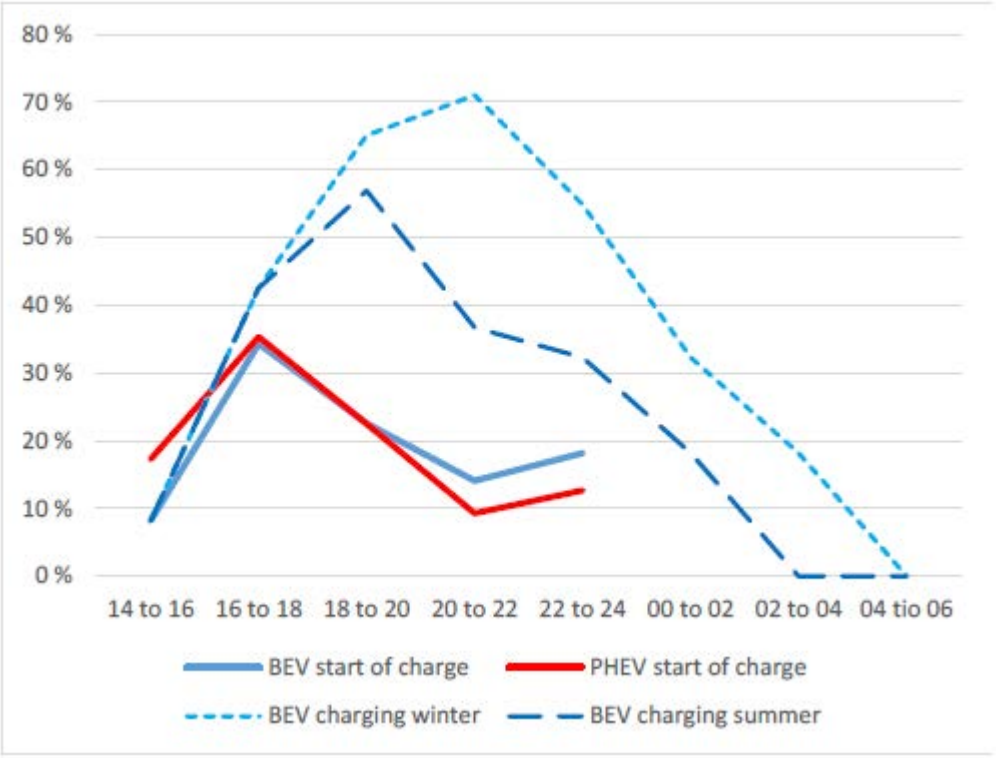


Figure 5: Time interval when normal charging normally starts up at home, estimated percentage of BEVs charging (stippled lines) summer and winter. N_{BEV}=1957 N_{PHEV}=1462. Source: Figenbaum and Kolbenstvedt (2016).

It is worth noting that problem of grid capacity is mostly related to the local distribution grid. National and regional grids do not seem to have any capacity issues that may stem from the charging of electric cars (Skotland, Eggum, & Spilde, 2016).

5.7 List of challenges discussed at the October workshop

The 16 workshop participants were divided into 2 groups. Each participant produced suggestions for top challenges during a silent individual session. After that, all individual suggestions were discussed within the group, and new additional challenges were identified. The following gives a total list of challenges discussed by the 2 groups:

1. Lack of standardized, efficient and convenient payment systems (discussed in both groups)
2. Lack of knowledge and understanding among BEV users and potential users (discussed in both groups)
    a. Examples include how to approach investing in for e.g. an office building or an apartment building, how to stay within the regulatory framework of the grid, and how to get good competition between charging solution providers, and rational decisions about what kind of cars and charging solutions end users actually need (e.g., exaggerated range anxiety").
    b. This lack of knowledge is found among both private users and professional users

   c. Information is spread across many different private and government agencies – hard to find places with answers to all the new problems arising
   d. A lot of information comes from vested interests and may lack objectivity
3. Difficulties in establishing good home charging solutions for apartment buildings (discussed in both groups)
   a. Lack of professionality to make good investments
   b. Low competence on both energy and capacity issues
   c. The investment maybe made unnecessarily complex
   d. Large price uncertainty
   e. Hard to get a good cost-sharing model between residents, when the share of BEV-owners still is low
4. Access to charging during peak times (discussed in both groups)
   a. In cities
   b. Along highways on certain times during holidays
5. Long waiting time for new BEVs, particularly for freight (discussed in both groups)
   a. The current demand is unmet, with long waiting lists
   b. This is particularly a problem for freight vehicles, especially for larger ones
6. Push for excessive investment in grid capacity (discussed in both groups)
   a. Inability to apply of peak capacity pricing in the grid tariff (yet), so BEV chargers are contributing to a push for excessive investments in grid capacity. This will drive up grid costs for all electricity users
   b. Some grid companies (still) practice that only the last BEV-owner in the neighborhood that pushes up capacity needs so much that new investments are warranted, has to pay for the entire or parts of additional investment ("anleggsbidrag"). Neighbors who have gotten an BEV before do not have to pay for this investment.
7. The inconvenience of having to plug to charge (unmet desire for inductive charging)
8. Excess capacity and inefficient use of BEV through lack of ride-sharing and car-sharing
9. Many smart-chargers are not very "smart"
   a. Claim that most of them can't even cost minimize
10. Different proprietary systems for charging lead to lock-in
   a. For example, a charging system, with monitoring, payment and support may be locked to a single service provider, e.g., an electricity retailer or electrical contractor.
   b. End users may be locked in to inferior solutions, even if better and cheaper solutions have been made available.

    c. This drives up the cost of electrifying the transport sector and hinders efficient competition

11. Difficult for private charging companies to operate when they are undermined by the municipalities providing electricity for free from their street chargers.
12. People experience uncertainty for how long the incentives for purchasing and owning EVs will last (discussed in both groups)
    a. For personal transport we may be close to the tipping point, where there will be a sufficient market even without incentives
    b. For freight transport we seem to be pretty far from the tipping point
13. There is lack of coordination between all the various agencies for expanding charging capacity (discussed in both groups)
    a. The system will not be a result of a well-thought-out-plan
    b. It will not be "smart" (discussed in both groups)
14. There is an unmet need for real-time information about available charging stations, particularly for the car display
15. Barriers to adopting BEVs for freight transport (discussed in both groups)
    a. EVs for freight are heavier than their ICE counterparts, for the same cargo volume. This creates a barrier to using BEVs for freight, as some cars would need a special driver's license in order to drive them, because of the weight.
    b. Unavailable or occupied charging stations are bad for business– perhaps a need for designated times and places for freight transport
16. All the different charging standards (AC, CCS, Chademo, Tesla etc.) creates a sub-optimal user experience
17. Unpredictable charging time at charging stations
18. Fast charging at capacities above 50 kW could become challenging
19. Some experience of low capacity for and low competence on BEVs in the auto repair sector
20. An unmet desire for combining solar power and charging BEVs
21. Not enough learning in the BEV ecosystem, many mistakes may be repeated, both in Norway and abroad
22. ENOVA's cap on subsidies creates less incentive for larger investments

6 Opportunities on the way to an electrified transport sector

It is important to remember that the social value of BEVs relative to ICEVs is the lower tailpipe emissions, increased energy efficiency and the lower total cost of ownership (TCO) in most cases. This difference in TCO is social value that materializes itself into higher disposable income for households, which is spent on whatever households want (products, services, housing etc.) and thus generates business. This point is also made in Todd, Chen, and Clogston (2013).

Following up from chapter 5, we will in this chapter go through the second of the main questions discussed in the workshop held on October 18th 2018, namely "Underutilized business opportunities on the way to an electrified transport sector – How can Norwegian enterprises make money from solving, circumventing or compensating for the challenges?". Details of the workshop procedure and participants are given in chapter 2. We will in this chapter first describe what the workshop participants identified as the top six business opportunities on the way to an electrified transport sector. The findings from the workshop discussions are sometimes supplemented with findings from the literature. The last part of the chapter summarizes all of the challenges that came up and were discussed during the workshop.

6.1 Development of a top-notch standardized system for payment for charging

Creating a well-functioning standardized system for payment for charging would be a great enhancement of the user experience. A particular enhancement, many workshop participants stressed, is to be certain that wherever there is charging capacity, it will be possible to purchase charging without having to download a new app or get a new user card etc. They expressed a high desire for more seamless payment across charging providers, and easy subscription services. A greater user experience will attract more usage and thus more revenue.

There are past examples of Norwegian developers creating widely used payment solutions in the transport sector with a high level of satisfaction, perhaps most notably EasyPark. Since starting up in 1999 they have grown internationally, with a presence in 14 countries and 700 European cities. A similar development for payment for charging was considered a golden enterprise opportunity.

Once a payment standard has been created, it will also be easier to combine charging with other services, generating even more enterprise opportunities. Such services could include booking of charging times, booking of parking space. The bundling of other services along with car charging could also include services not related to transport, such as insurance, broadband subscription, streaming services etc.

It is a challenge to create a standard between competitors. There could be a need for different firms to get together and cooperate to create a standard.

6.2 MaaS around the BEV - car sharing, ride-sharing, last-mile solutions and other subscription services

Many Mobility as a Service (MaaS) solutions would benefit from using BEVs over ICEVs because of the low use costs, leading to low total cost of ownership (TCO), particular in use cases that involve high utilization with mostly short trips and mostly slow charging. And many MaaS solutions would also help in the use cases where BEVs may have a disadvantage, such as parking and charging opportunities in dense areas of cities.

Car sharing

For many households, the TCO of a car can be disproportionately high relative to how much they actually use the car. Car sharing solutions can provide economically attractive services to such households. These services can be enhanced by using BEVs for several reasons:

- The low use costs and potentially frequent use of the shared BEV can drive the TCO down to very competitive levels.
- It can be an attractive option in dense urban areas, where it could make economic sense for the car sharing provider to buy relatively expensive parking spaces with charging options.
- More intense use of each car reduces the problem of buying an BEV now relative to a better BEV a few years later, as the life time driven distance for the car is reached after fewer years.

The use of car sharing services is growing in Norway, but a workshop participant expressed that in order to maintain that growth, the technical solutions need to be improved to make car sharing services more seamless and efficient. Developing such solutions would also be a good enterprise opportunity.

If car sharing service providers develop such quality solutions, that would be a service with high export potential.

Ride-hailing and ride-sharing

For the same reasons that EV's potentially low TCO makes them attractive for car sharing services, they are also attractive for ride-hailing and ride-sharing services. A report by Knupfer et al. (2017) finds that this could be a particularly attractive enterprise opportunity for fleet managers operating ride-hailing services (e.g., Uber and Lyft). This could also provide an opportunity for automakers that could increase their volumes of EVs by offering fleet operators more competitive sales/leasing options that detail the lower operating costs as compared to ICEVs. They also find that more than 30% of consumers said they preferred an EV model over an ICEV model when using e-hailing services. In addition, our research indicates that around 35% of those consumers said they would pay a premium for a ride in an EV.

Knupfer et al (2017) provide a list of mobility models, shown in Figure 6. With the exception of e-hailing (ride-hailing via websites and mobile apps) and carpooling 2.0 (basically app-based carpooling), the Norwegian market seems to be growing at a healthy rate with Bilkollektivet, Nabobil, GoMore and Hyre. Besides, these model can strengthen the economics of all cars, not just EVs.

Exhibit 17 Automakers can sell EVs in a range of alternative mobility models to improve economics

Emerging mobility models that can improve EV economics

	Mobility model	Description of model	Typical trip duration
Traditional alternatives to vehicle ownership	Traditional rental cars	Renting cars to individual drivers for a predetermined number of days	Days
	Taxis	Hired to transport passengers point-to-point; based on distance and time traveled	Minutes
	Carpooling	Traditional method of aggregating carpools by driver and riders; based upon a fixed departure schedule	Minutes/hours
Emerging vehicle ownership alternatives	E-hailing	On-demand hiring of a private car using a virtual app or electronic device; one group of riders matches with one driver	Minutes
	Shared e-hailing	On-demand hiring of a shared-occupancy car using a virtual app or electronic device; multiple riders can match with one driver	Minutes
	Car sharing – fleet operator	On-demand short-term car rentals with the vehicle owned and managed by a fleet operator	Hours
	P2P car rental	Consumers go onto platform and share individual vehicles. A peer-to-peer way to rent vehicles per hour or per day	Hours or days
	Carpooling v2.0	Technology and app-enabled carpooling between a non-professional driver and riders to share empty seats; multiple riders can match with one driver	Minutes/hours

SOURCE: McKinsey Sustainable Mobility Initiative

Figure 6: List of mobility models with room for EVs. Source: Knupfer et al. (2017)

Car dealers also selling long trip mobility guarantees to BEV buyers

A BEV may be perfectly right-sized for the everyday use, but may be too small and with too short range for long trips, particularly to mountain cabins etc. A workshop participant stressed that for many it would be better to use MaaS instead of owning a car that is dimensioned for the few occasional trips. BEV dealers may then sell a "long trip mobility guarantee" that gives its customer quick access to larger ICEVs for the occasional long trip.

Such services are also discussed in Kley, Lerch, & Dallinger (2011). The service could e.g., be combined with bringing the BEV into service. The automaker will then also get to learn something about their customers' trip distribution, which can help optimizing vehicles. With the ambitious target of all new cars sold from 2025 and onwards shall be ZEV, this may be a way for the market to function. You buy a BEV for your everyday trips, but you also buy a guarantee for an inspected used ICEV for your long trips. Nissan dealers have previously tested out this model in Norway (Figenbaum, Kolbenstvedt, & Elvebakk, 2014).

Last-mile solutions

For dense urban areas it could be a challenge to find available parking space close to home for many households, not to mention available charging space. There may be areas just right outside of walking distance for some households with ample parking and charging facilities. In order to match BEV owning households in dense urban areas with parking and charging space, there could be a potential for last-mile solutions like electric scooters affiliated with the parking and charging facility. Subscription services could be a good way to solve the issue of access to parking, charging and last-mile solutions. Such subscriptions could also be integrated into both public transport services and car sharing services, making out complete MaaS subscriptions.

6.3 Advisory services, in Norway and abroad

As addressed among the challenges, a lot of relevant knowledge seems to be lacking among users and potential users of BEVs. There is a potentially untapped market for advisory services for helping organizations make a smooth and efficient transition into electric mobility.

There are many ways to get low value for money when buying BEVs, and buying and installing charging equipment. Independent consulting services on electric mobility for apartment buildings, office buildings, small and large organizations could be a good enterprise opportunity.

Both governments and businesses abroad could benefit from advisory services based on Norwegian experiences in their transition to an electrified transport sector. A case in point is Fortum advising the Greek government based on the experiences from electrifying transport in Norway. This is a way to apply results from evidence-based research on topics such as "What technologies and/or other solutions cover urban electric transport needs" and "The cheap and expensive ways to get the first 10% of the car fleet electric".

Norwegian firms should be in a good position to provide consulting and engineering services for foreign automotive businesses. With first-hand experience of the needs that arise in areas where a large share of the transport gets electrified, they could offer advisory services under what one workshop participant called "Improvements based on early-mover experiences".

6.4 "Second life" for BEV batteries

As suggested in Kley et al. (2011), batteries will still have a large share (70%-80%) of its capacity left even after they have played out their role for the BEVs. This remaining capacity can be used in a stationary fashion, either decentralized (e.g., in individual homes) or with larger players in the electricity market. Battery parks can for example provide electricity to avoid price spikes due to peak generation or bottleneck issues in the grid. Another mentioned use of second life BEV batteries would be to provide power capacity for homes in a way to alleviate the local distribution grid and local transformer station. This could help avoid expensive investments.

A workshop participant thought that Høyenergi AS (mentioned in section 4.19) should have the expertise to safely separate damaged batteries from those who have potential for a second life and take the latter out of the recycling stream.

6.5 Converting conventional freight cars to electric

The workshop participants expected that large manufacturers of freight cars at some point will be able to meet the market needs with zero emission vehicles. However, that could be many years away. A recent report from Jordbakke et al. (2018) shows that the uptake of zero emission vans and trucks is sluggish due to cost barriers and inadequate (or non-existent) availability of these types of vehicles in today's commercial market.

In the short run, there could be a business opportunity in converting conventional freight cars to electric. It could be possible to buy "vehicle gliders", i.e. vehicles without a power train, in particular an engine, and install battery packs and electric motors into them, and sell it as a freight vehicle (or lease or have subscription for vehicle kilometers). It is not expected to be a long term match for large scale production, but in order to meet short-

term ambitious goals for electrification in the national transport plan, and certain cities' ban on diesel cars, there may be a scope for Norwegian firms getting into retrofitting.

6.6 Development of fleet-charging systems

As mentioned above, the low TCO of BEVs makes them a potentially attractive investment for fleet managers. That means that traditional fleet management systems need to be supplemented with fleet-charging systems. In order to get the most of the fleet, the fleet manager needs to optimize where and when the BEVs are used, and when and how much to charge the BEVs. Development of such systems could be a good enterprise opportunity.

6.7 List of opportunities discussed at workshops

The 16 participants were divided into 2 groups. Each participant produced suggestions for top opportunities during a silent individual session. After that, all individual suggestions were discussed within the group, and new additional opportunities were identified. The following gives a total list of enterprise opportunities discussed by the 2 groups:

1. Development of a top-notch standardized system for payment for charging (discussed in both groups)
   See description above.
2. MaaS around the BEV - car sharing, ride-sharing, last-mile solutions and other subscription services (discussed in both groups)
   See description above
3. Advisory services, in Norway and abroad (discussed in both groups)
4. "Second life" for BEV batteries (discussed in both groups)
5. Converting conventional freight cars to electric
6. Development of fleet-charge systems
7. Petrol station conversion to electro stations
   a. Standardized expert project management and equipment
   b. Need to solve the problem of how to use the space more efficiently, as each car occupies space longer while charging than with traditional fueling
8. Exploit street light poles for charging BEVs (discussed in both groups)
   a. At least during daylight hours
   b. Perhaps reserved for freight transport
9. Components and devices – development, manufacturing and sales
   a. Should be directed towards the automotive Original Equipment Manufacturer (OEM) market
   b. Possibilities for companies like Kongsberg Automotive
10. Develop better software for smart-charging
    a. Need to utilize the infrastructure capacity in apartment buildings, office buildings and the local grid in better ways.
    b. The system needs to monitor the power capacity usage to provide optimal amount of power to each car
11. Develop a better identification system between charging stations and BEV.
    a. Could be GPS-based
    b. Could use similar technology as AutoPass or any future road pricing on-board-unit

    c. Could also work as an efficient method of payment for charging
    d. Could use the vehicle itself to identify the account, enabling a pure plug-n-charge system
12. Charging bundled with other services. (discussed in both groups)
    Examples include
    a. Free Wi-Fi at fast-chargers
    b. Streaming
    c. Insurance
13. One-stop-shop for charging
    a. Irrespective of charging standards
    b. Useful for those who lease BEVs
14. Develop solutions for combining BEVs and solar power
    a. On-site solar with micro grids and battery parks
    b. Off-site solar delivery and financing models (people could buy shares in solar parks and/or buy electricity from them – a way to guarantee green electricity and participate in the growth of solar power for those with less opportunity to have own solar panels installed at home)
15. Create a great user experience with "charging hubs" with coffee shops and convenience stores
16. Develop solutions for inductive charging (discussed in both groups)
17. Develop solutions for better real-time information about charging availability
    a. Better apps
    b. Digital road signs with live info
18. Develop solutions for V2G
19. Crowdfunding of charging stations
20. Valet service for picking up BEV, charging them and returning them
21. "Learn-to-use-an-EV" courses
    a. If consumer readiness is still a problem (Knupfer et al., 2017), how can they be educated in a meaningful way?
    b. Can the Norwegian electric vehicle association or car dealerships or municipalities provide citizens with a crash course in using an BEV so that they may choose one themselves from their car pool, or at least consider their new car with a de-mystified view of BEVs?

The following points were not exactly business opportunities, but what some participants wanted to push on policy makers:

- Push for forced open access for charging standards, data flows and grid access – will allow many to participate and facilitate more innovation
- Push for mandatory charging options for all new buildings
- A workshop participant told about his experiences with public procurement of charging services and/or equipment. They told about having to spend a lot of time helping the government body understand the service and equipment so that they could write a tender. This "teaching service" is unpaid and does not yield any payoff unless they win the tender. The work helping the government body understand the product/service could be considered consultancy work, and paid thereafter. It would be like splitting the public procurement process into two phases: 1) Consulting. 2) Providing.

7 Who is losing out?

In the paper *Who gains and who loses in the shift to electric vehicles: impact assessment through multi-criteria multi-stakeholder analysis* (Talantsev, 2017), the author looks at the simulated losses and gains (both monetary and non-monetary) for different stakeholder groups when government subsidies lead to a large shift to BEVs. The summary of how different stakeholders are impacted can be seen in Figure 7.

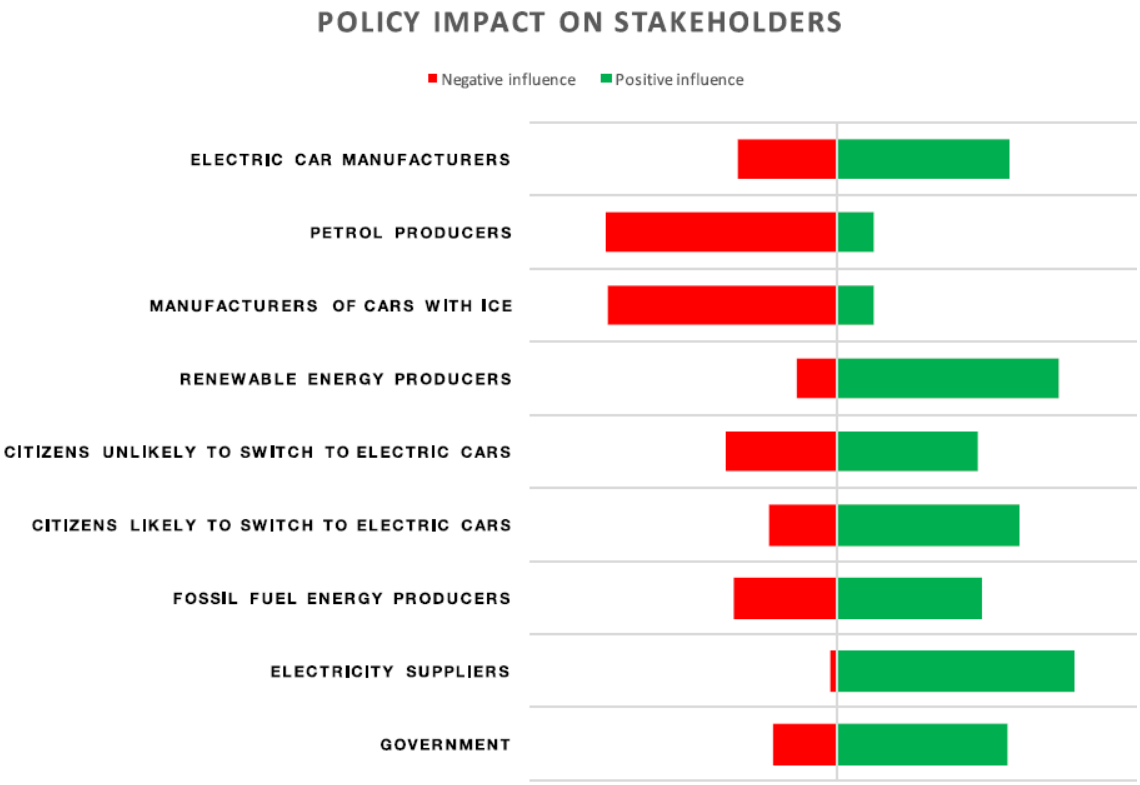


Figure 7: Policy impact on stakeholder groups. Source: Talantsev (2017).

When we look at the gains and losses of stakeholders in this report, we have a somewhat different focus than Talantsev (2017). We focus on the shift to BEVs in Norway, and the impact that shift will have on Norwegian *firms*. The question can be formulated as: What Norwegian sectors are losing out from the transition to an electrified transport sector *ceteris paribus*[4] ? In this thought experiment, the only thing that changes is that ICEVs are replaced by BEVs. This includes that the firms that loses, *ceteris paribus*, are not doing anything to adapt to the new business environment with BEVs. Losing out means here that the large shift to BEVs will involve less demand for their current products and services.

[4]Everything else held constant

Three sectors in Norway stand out to lose from a *ceteris paribus* shift to BEVs:

- Vehicle maintenance
- Petrol stations
- Public transportation operators

Vehicle maintenance

As discussed in section 4.9, car maintenance is a necessary part of the EV ecosystem, but because of the far lower numbers of moving parts in a BEV compared to an ICEV, the demand for mechanic's services is expected to decrease, *ceteris paribus*. This is also discussed in both Todd et al. (2013) and Knupfer et al. (2017).

The isolated effect of a large shift to BEVs is expected to be less overall demand in this sector, but the net effect after adaptation could be far less severe. The workshop participants discussed some ways for this sector to adapt. The main suggestion here is discussed in section 6.5 *Converting conventional freight cars to electric*. As the demand for electric freight cars is rising faster than production, and the overall demand for mechanic's services may be decreasing, a way to maintain activity in this sector could be to get into installing electric powertrain into either used freight vehicles or into new "vehicle gliders" to ramp up the availability of electric freight vehicles in the short run.

Petrol stations

As vehicles will demand less petrol and diesel, there will *ceteris paribus* be fewer reasons for drivers to stop at petrol stations, leading to fewer customers. And even if petrol stations installed charging stations, they would face competition from home charging and other charging points on streets and at offices and stores.

We are observing petrol stations adapting by installing charging points, often fast-chargers, and becoming more like energy stations. Yet, for the reasons mentioned above, more adaptation will probably be needed in order to maintain the same activity. In addition to converting from petrol station to energy station, the workshop participants discussed other business opportunities that also may apply for energy stations. These include bundling other services along with charging, and perhaps getting into the MaaS value chain where they provide charging and parking space, and last-mile solutions. It was also mentioned how energy stations have an opportunity to exploit the fact that fast charging takes longer time than filling fuel and the vehicles will stay longer at each station fitted with chargers. This situation will allow the station to sell more additional services such as food, coffee or other goods. Relatively long charging stays accompanied with food, drink and perhaps free Wi-Fi could provide both business opportunities and customer value.

Public transport operators

Because of the low use costs of BEVs (and subsequently the low TCO), this is not only competitive with ICEVs, it is also competitive with public transport. A rise in the share of BEVs can, *ceteris paribus*, be expected to lead to a reduction in demand for public transport. This is one of the findings in Wangsness, Proost, and Rødseth (2018).

Some of the enterprise opportunities discussed in the workshop can apply to public transport operators. Public transport operators (irrespective of policy makers) can adapt to this shift by getting into the MaaS-value chain. Making it possible to seamlessly combine public transport and e.g., car-sharing of BEVs and other last-mile services could be attractive for customers from both a mobility and economic point of view. An example of this is NSBs 250 GreenMobility BEVs in Oslo mentioned in section 4.8.

As the passenger vehicle fleet becomes more electrified, one can expect cities to put pressure on public transport companies to switch to electric buses in order to further reduce pollution. While over time the TCO of an electric bus may be competitive with a conventional bus, the transition may be costly.

8 Concluding remarks

In this report we have presented a stylized view of the electric vehicle ecosystem, and placed Norwegian firms and sectors in this framework. We find that most of the firms in this ecosystem are placed close to the end of the value chain, close to the end user. Few are placed upstream with resources, materials and manufacturing.

Moreover, the part of the ecosystem with the highest number of involved firms are traditional sectors like electricity retail, electricians (for BEV equipment installment), car dealerships and car maintenance and regulated sectors like electricity production and local grid operators. Many of these firms have expanded the scope of their business to include electromobility solutions. With regards to "new" sectors that grow to meet the demands in the EV ecosystem, we see as of now most firms in the category "Charging solutions wholesale and retail".

The workshops and the literature review seem to point at the most promising opportunities in this area for Norwegian businesses lie in the following categories:

- "Charging operations, management and support" (Development of a top-notch standardized system for payment for charging),
- "EV rental service providers and car-sharing pools" (MaaS around the BEV - car sharing, ride-sharing, last-mile solutions and other subscription services)
- "Engineering, design and other services for BEV manufacturing/ Additional charging services" (Advisory services, in Norway and abroad)
- "Battery recycling/Electricity generation/Local grid operators" (Second life for BEV batteries)
- "Manufacturing BEVs for freight transportation" (Converting conventional freight cars to electric)
- "Additional charging services" (Development of fleet-charging systems)

Some firms seem to already be working on seizing some of these opportunities, while some of these opportunities seem to remain untouched. Having more firms stepping up and seizing the enterprise opportunities that emerge as the transport sector becomes more electrified will be key in order to make the EV ecosystem in Norway thrive.

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Appendix 1: Workshop on charging and charging infrastructure, February 2018

Workshop: Lading- og ladeinfratruktur

Dato: **15. februar 2018**

Tidspunkt: **Kl. 12:00 – 16:00**

Sted: **StartupLab ("Hagen 3")**

Formål: **Partnere deler egne perspektiver, strategier og utfordringer rundt elektrifisering - få til diskusjon!**

Output: **Øke innsikt, utfordre egne perspektiver, avdekke muligheter for samarbeid**

Tanken er å spinne videre på momentum som oppstår rundt Nordic EV Summit 2018 i begynnelsen av februar, og bruke de to første ukene i februar til å sparre med hver og en av partnerene. Dette for å stille bedre forberedt til workshopen, avdekke overlapp / synergier på tematikk og kanskje få i gang noen diskusjoner også i forkant.

De overordnete problemstillingene vi ønsker å jobbe med:

1. Hvordan ser infrastruktur rundt lading ut 5-10 år frem i tid (selskapets fremtidssyn)?

2. Hvilke utfordringer og muligheter impliserer dette?

3. Hvordan kan man posisjonere seg gitt pkt. 1 og 2?

I utgangspunktet tenker vi holde dette til en corporate-to-corporate workshop. Hvis det øker verdien på workshopen så har vi et utvalg av relevante startups som kan trekkes på, men tanken er å begrense deltakerne til våre corporate partners.

Tentativ agenda:

12:00 – 14:00 Hver partner presenterer egen organisasjons fremtidssyn og utfordringer/muligheter innen temaet + Q&A fra tilhørende forsamling

14:00 – 14:45 Deler inn i 2-3 grupper som sammen skal svare ut problemstilling 2 – dvs. enes om "Topp 3 utfordringer" og "Topp 3 muligheter"

14:45 – 16:00 Kort presentasjon der panterne svarer ut hvordan egen organisasjon kan agere på overnevnte utfordringer/muligheter – alene og i potensielle partnerskap

Partnere som har meldt interesse til nå (kan bli utvidet):

- Møller Mobility Group
- Posten
- Oslo Kommune (v/ Bymiljøetaten)
- Circle K
- IF Forsikring

Øvrige partnere som har meldt interesse (ikke definert som medlemmer i MobilityLab):

- Hafslund
- OBOS
- ABB

Med vennlig hilsen

Henrik, Per Einar og resten av teamet

Appendix 2: Workshop: Forretnings-muligheter på vei til en elektrifisert transportsektor

Dato: 18.10.2018

Tidspunkt: Kl. 12:00 – 16:00

Sted: Forskningsparken, møterom VIA

Formål: Deltakere deler perspektiver på utfordringer og forretningsmuligheter på vei til en elektrifisert transportsektor

Output: Økt innsikt, muligheter for samarbeid, dokumentering av ideer

Transportøkonomisk institutt, under prosjektet ELAN, samarbeider med MobilityLab om denne workshopen om utfordringer og muligheter på vei til en elektrifisert transportsektor. Her ønsker vi å gjennomgå følgende problemstillinger:

1. Hva er de viktigste utfordringene på vei til en elektrifisert transportsektor?
2. Underutnyttede forretningsmuligheter på vei til en elektrifisert transportsektor. Hvordan kan norske bedrifter tjene penger på å løse, omgå eller kompensere for utfordringene?

Tentativ agenda:

12:00-12:10	Oppmøte. Lett servering av kaffe, frukt og nøtter
12:10- 12:25	Velkommen, presentasjon av deltagere og kort gjennomgang av workshopens formål
12:25-12:55	En stilisert framstilling av elbil - «økosystemet» og hvordan norske bedrifter passer inn i det i 2018. Deling inn i grupper 5 min pause
13:00 – 14:00	Oppgave 1: Hva er de viktigste utfordringene på vei til en elektrifisert transportsektor? Først individuell tenkning, så gruppediskusjon, så plenumsdiskusjon
14:00 – 14:15	Pause. Lett servering av kaffe, frukt og bakst.
14:15 – 15:30	Oppgave 2: Underutnyttede forretningsmuligheter på vei til en elektrifisert transportsektor. Hvordan kan norske bedrifter tjene penger på å løse, omgå eller kompensere for utfordringene? Først individuell tenkning, så gruppediskusjon, så plenumsdiskusjon
15:30 – 16:00	Oppsummering, avslutning og veien videre

For å få et bredt spekter av perspektiver, ønsker vi deltakelse fra både etablerte virksomheter, startups og fra interesseorganisasjoner. Deltakelse er gratis og det blir lett servering.

Elektronisk påmelding til workshopen her!

Velkommen!

Institute of Transport Economics (TØI)
Norwegian Centre for Transport Research

Established in 1964, the Institute of Transport Economics is an interdisciplinary, applied research centre with approximately 70 professionals. Its mission is to develop and disseminate transportation knowledge that has scientific quality and practical application.

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