Oslo kommune
Bymiljøetaten

EV CHARGING POINTS IN OSLO – 400 PUBLIC CHARGING POINTS IN 4 YEARS 2008-2011

A CITY'S STRATEGY TO SUPPORT THE USE OF ELECTRIC VEHICLES
AND BECOME THE WORLD'S ELECTRIC VEHICLE CAPITAL

TABLET OF CONTENTS

INTRODUCTION – ELECTRIC VEHICLES IN NORWAY

Oslo is the capital where you find the most electric vehicles (EV) per inhabitant in the world, and the only country where a pure electric car was one of the top 10 most sold cars in 2012[1].

Norway and its capital Oslo may not be the obvious choice when it comes to promoting electric mobility. The city and surrounding areas are full of small and big hills and during the winter months the temperatures are cold and the roads filled with snow. All these factors affect battery and range, and thus an EV may not seem like the optimal choice as a family car.

However, since the early 1990's, electric vehicles has been present in Oslo, even produced in factories in Oslo and the surrounding areas. This was namely Pivco (later developed into Think) and Kewet (now named "Buddy"). Kewet production was moved to Norway around 1998 after the company was bought from Denmark[2]. While for the most part only being appealing to a small group of drivers and EV enthusiasts, these companies were able to sell EVs throughout the 2000's. At this point, although not highly popular as a mode of transport, EVs had from early on gained a lot of benefits and advantages:

- There is no VAT (25%) on electric vehicles (since 2001)[3];
- There is no "first-time registration fee" on new electric vehicles (since 2003)[4];
- EVs are allowed to drive in lanes reserved for bus and taxi (since 2004)[5];
- EVs can drive for free on toll roads and travel for free on ferries part on the regional road system (since 2009)[6];

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[1] http://bestsellingcarsblog.com/2013/01/09/norway-full-year-2012-vw-tiguan-and-nissan-leaf-impress/

[2] http://en.wikipedia.org/wiki/Buddy_(electric_car)

[3] http://www.lovdata.no/all/tl-20090619-058-013.html#6-6

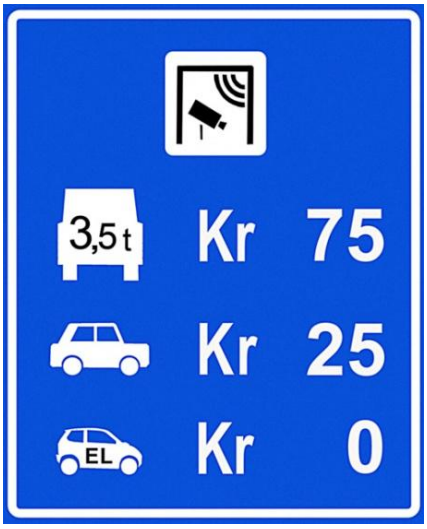
[4] http://www.lovdata.no/cgi-wift/ldles?doc=/sf/sf/sf-20010319-0268.html#4-10

[5] http://www.lovdata.no/cgi-wift/ldles?doc=/sf/sf/sf-19860321-0747.html#5

[6] http://www.regjeringen.no/nb/dep/sd/aktuelt/taler_og_artikler/ministeren/samferdselsminister-liv-signe-navarsete/2008/innlegg-pa-elbil-seminar-lardal.html?id=525697

- EVs in Norway have a strong user association (The Norwegian EV Users Association);
- EVs can park for free in all public parking spaces[7].

Benefit of driving in the bus and taxi lane



No fee on toll roads for electric vehicles (illustration)

The reduced taxes meant that a new Think or Buddy EV cost less than a new VW Golf, which has usually been the most sold car on the Norwegian market.

Space and safety in these EVs were not at its best during the years when they gained their incentives in the early 2000's. Most were very small, the Think and Buddy only had two seats and with limited trunk space. A lot of Norwegians have summer homes near the coast or cottages in the mountains. The reduced trunk space and seats meant that most people still needed a second car for traveling long distances. However, 39% of Norwegian households have two-cars anyway[8]. A lot of times people kept their larger station wagon or SUV, sold their small gas or diesel commuter cars, and replaced it with an EV. For this purpose it was quite useful, and the small size made it easy to park in the city. It is still not uncommon to see two Buddy's sharing one parking space.

[7] http://www.lovdata.no/cgi-wift/ldles?doc=/sf/sf/sf-19931001-0921.html#8a

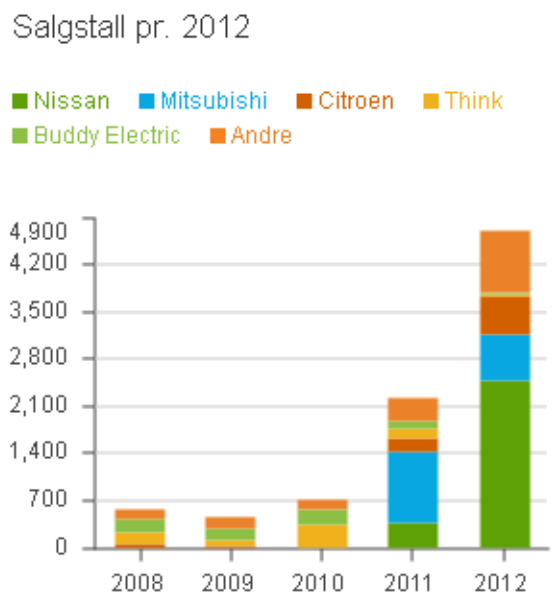
[8] https://www.toi.no/getfile.php/Publikasjoner/T%D8I%20rapporter/2006/856-2006/856-hele%20rapporten%20el.pdf

«Buddy-parking» Credit: Agency for Urban Environment

In addition to all the benefits, one important fact to the high number of EVs even before the big sales increase in 2011 is that EVs have *been available* ever since the early 2000s. They were possible to buy if you really wanted to drive electric. You could visit the Buddy factory at Økern in Oslo and order your own new Buddy, buy a 1st Generation Think, or import a used Citroen or Peugeot from France. During these early years a few charging stations were available in Oslo as the result of a collaboration between Hafslund, the local energy provider, and the EV Association.

A few owners were dependent on their charging cable hanging out of their 3rd floor apartment and down on the city street to be able to charge or to stretch an extension cord across the street. This was about to change in late 2007 when politicians, the EV Association and the environmental organizations in Oslo started working towards even better conditions for EVs in the city.

This effort and the previous incentives received by EV have ensured that since 2011 there has been a high growth of new EVs being registered, something highly due to the Mitsubishi i-MiEV and its siblings Peugeot iON and Citroen C-Zero which came in December 2010, and the Nissan Leaf in late 2011.



Sales numbers from 2008 - 2012[9] "Andre" relates to other brands such as Tesla and Reva (G-Wiz).

TASK OF ESTABLISHING 400 CHARGING POINTS IN FOR YEARS IN OSLO

In January 2008, The Oslo City Council decided to set focus on reducing CO_2 emissions from the transport sector in Oslo. This included beginning a large-scale preparation for EVs in the city. After a push by the EV community and environmental organizations towards politicians in the City Council, the City Council decided to establish 400 charging points for electric vehicles in the period 2008-2011. This decision was part of a 10 point plan to reduce emissions and improve air quality in Oslo. The planning and establishing of the charging points became the responsibility of the Agency for Urban Environment[10].

[9] http://www.gronnbil.no/elbiluniverset/kart.php

[10] Originally the Traffic Agency, an agency in the City of Oslo which in 2010 was merged together with three other municipal agencies to form the Agency for Urban Environment.

The decision in the City Council meant that the politicians agreed to build 400 charging points in 4 years for EVs during 2008-2011. At the same time, they decided to allocate 4 million Norwegian kroner ($ 730 000 / € 540 000) each year to the purpose. This meant that the time schedule had been set and that money was secured for all four years of progress.

The project received a lot of interest both from politicians, and the EV community, including foreign companies and other European and Norwegian cities. The Agency for Urban Environment soon got requests on where to place charging stations, and the electric vehicle owners were eager to begin to use them. For the Agency for Urban Environment however, this task lead to a lot of questions:

- What kind of technical equipment was needed to charge an EV and how to procure it?
- How to find locations for the charging points?
- Where to find the electricity needed to provide the charging stations with power?
- What kind of parking signs to be used on the charging stations?
- How to control that only electric vehicles are parked at the charging points?
- What kind of services was needed to be procured from an electrical entrepreneur?
- Should the electricity be free or how would we charge for the consumption?
- Should there be mandatory charging at the charging stations?
- How could the number of off-street charging points also be increased?

WHAT KIND OF TECHNICAL EQUIPMENT IS NEEDED TO CHARGE AN EV AND HOW TO PROCURE IT?

In 2008 there were few options when it came to charging stations or charging points, and the Agency for Urban Environment lacked knowledge. Throughout the years the charging points have been established, this has often been a difficult subject, as there have been few European standards to follow. When looking into what other cities have done, few have went for the same options or technology.

For the Agency for Urban Environment it was a challenge to write the specification for the procurement and to decide what was “nice to have” and what was “need to have”. The result was a small procurement in 2008, where the equipment that ended up being purchased was the same as being used as engine block heaters in Scandinavia. They were cheap and easy to use, but their design did not fit as a product to be placed in very high numbers on public streets.

Through cooperation and suggestions from the EV association, the charging points were to be installed with the Schuko household socket used in Norway protected with 16A circuit breaker.


The two versions of 1st Generation charging points bought in 2008. Left: Garo. Right: Defa. (Credit: Agency for Urban Environment)

When procuring and establishing the 400 charging points, both during the first small procurement in 2008 and the larger one in 2009 the Agency for Urban Environment decided to use the same charging system as the one which has been used by the EV community in Oslo since the late 1990's:

- To access the charging points, EV drivers use a key. The same key is used for most charging points in all of Norway;
- The key is included in the "Welcome as a new EV driver"-kit that comes with every new EV sold in Norway and is provided through a partnership by the EV Users Association and the various EV manufacturers. The key is also available for free from the Agency for Urban Environment;
- Parking and charging is free. There is no registration or membership required.

"Welcome as a new EV driver"-kit

2nd Generation charging stations

By law, parking for electric cars is free in public parking spaces. As the procured charging stations are simple to use and were relatively cheap at the time of purchase, the Agency for Urban Environment decided it was not necessary to implement a costly and complicated system for paying for electricity when charging.

In 2010, the total bill for electricity for the 270 charging stations that had been established up until then, was around NOK 330 000 ($ 60 000 / € 45 000). This was an average of $.50 / €.40 per charging point per day. At that point the expenses of installing payment equipment exceeded the possible revenue and it was decided to let charging continue to be free and rather reconsider it at a later stage.

HOW TO FIND LOCATIONS FOR CHARGING POINTS

Because Oslo had a large EV community and a strong users association, the Agency for Urban Environment asked the EV Association for tips and suggestions for charging points. This has continued, and on a yearly basis, the Agency for Urban Environment has asked for suggestions from the community, and also Oslo residents in general via the local newspaper. Many charging points have been placed on the basis of this.

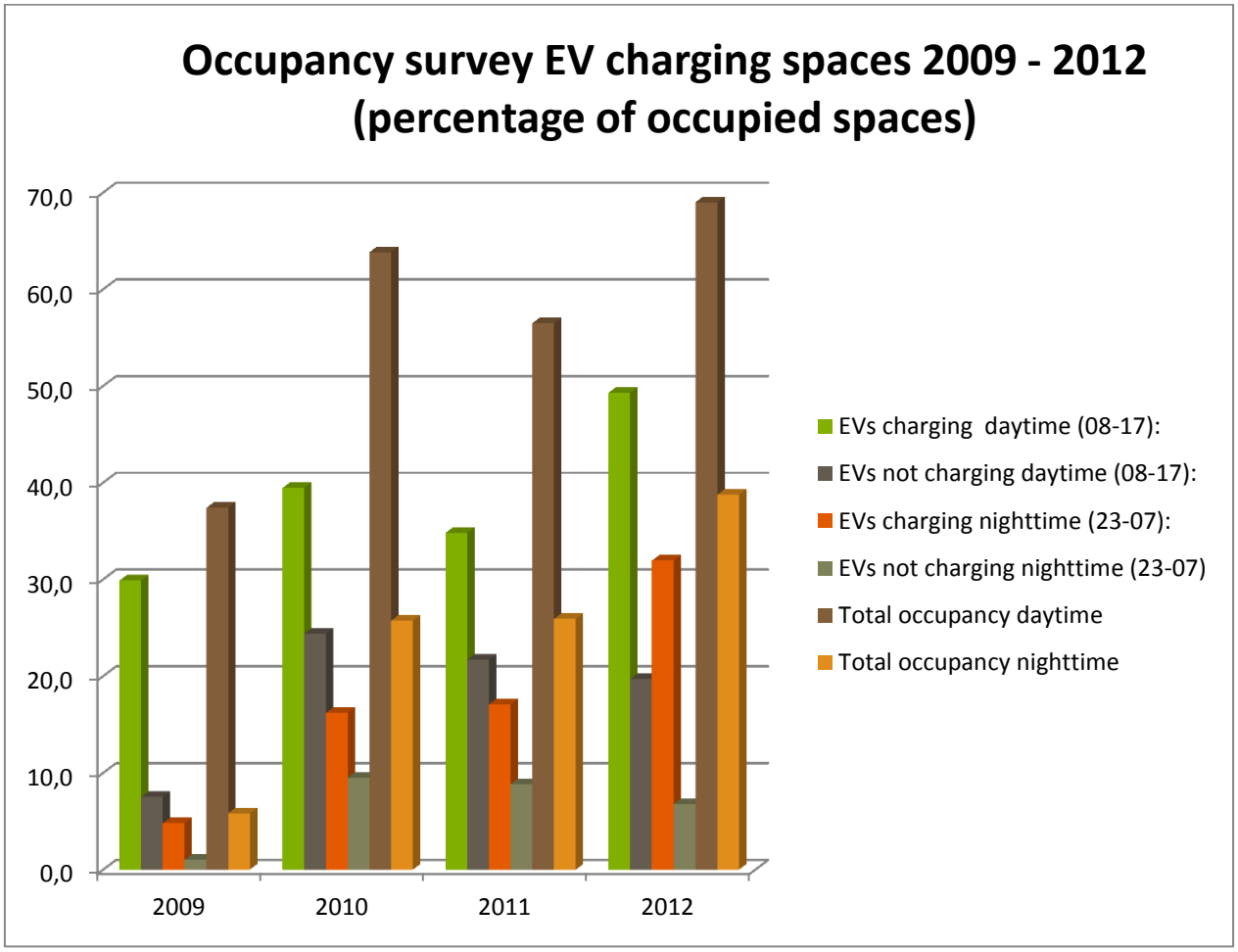
Early on a lot of EV drivers suggested public spaces, near sports arenas, concert halls, theatres and downtown shopping areas. There were also requests to place charging points in more residential areas where residents were dependent on on-street parking for their EVs. In additions to this, the Agency for Urban environment strolled and drove through the city, looking for streets where EVs were parked, and where they had no opportunities for charging.

Charging cable stretched across the street. Langgata, Oslo June 2009 (Credit: Google Maps StreetView)

When surveying streets like this, the Agency for Urban Environment also looked for places to find power needed for the charging stations to as to minimize the need for more field trips. This reduces the cost and time spent on finding good locations. Google Maps Street View also provides the possibility to get an impression of an area and to locate potential sources of electricity, although field trips are necessary to confirm actual electricity cabinets and placements.

Since the charging stations are placed in residential areas as well as more commercial areas, it is also important to consider the surroundings when placing a charging point. One lesson learnt from this is to not place a charging point right outside a Ground floor or 1st floor apartment window, as the LED-light on charging poles will be visible and may seem intrusive for those inside the apartments.

Annually the Agency for Urban Environment has also done occupancy surveys during fall to see how many and how much the charging points are being used. Normally new charging stations are planned during wintertime, and the physical work with establishing them are done between April and November. The snow is mostly gone from the streets during this time and does not complicate working in the ground. Having the occupancy survey after most of the years charging points are established and before all plans and locations for new charging points are finalized fits in well with the planning process.



WHERE TO FIND THE ELECTRICITY NEEDED TO PROVIDE THE CHARGING STATIONS WITH POWER

When the Agency for Urban Environment first looked to provide the charging points with electricity there were uncertainties of how much power was needed to support the charging stations and where to get the electricity from. It later became certain through talks with the electrical entrepreneur who won the tender to establish the charging points, that the two best sources of electricity was “FS-cabinets” that are placed all around the streets of Oslo, and the larger transformer cabinets. Street light fixtures etc. did not provide enough electricity as needed, and were not an option.

Taking electricity directly from larger corporate buildings was minimized as this could complicate and make the process more time-consuming because permission would be necessary from the building owners.

FS-cabinet (credit: Agency for Urban Environment)

Transformer cabinet (credit: Agency for Urban Environment)

WHAT KIND OF PARKING SIGNS TO BE USED ON THE CHARGING STATIONS?

Since the charging points were to be placed on public streets and function both as parking spaces and charging spaces, the Agency for Urban Environment wanted to reserve the spaces solely for electric vehicles. For this the Agency needed to be sure that the correct parking signs were being used.

After consulting with the Norwegian Public Roads Administration their suggestion was to use the ordinary white P on blue background, along with a subtext that stated “Electric vehicle”. This could also be combined with a time-limit if necessary to have circulation of EVs in the parking spaces.

During 2008 the Agency for Urban Environment decided on a time limit of maximum 3 hours during 09.00 – 18.00 on weekdays and 09.00 – 15.00 on Saturdays at the most centrally located places. Other areas would have a maximum of 8 hours. This came as a suggestion from the EV Association, as on average an EV will fill up from 20-80% in 3 hours and 0-100% in 8 hours. Later the 8 hour maximum was found as a bit impractical, as this would not work for those EV drivers who lived in residential areas and came home and charged after work. This meant that they would need to move their vehicle again in the middle of the night. It was therefore decided to mainly use a 16 hour time limit as this meant an EV driver could park from 17.00-09.00 without needing to move it. In less popular areas a 24 hour time limit is used, and on some places there is no time limit at all. Places without time limits are locations such as near the Oslo forest, which makes it possible for EV drivers to go on longer hikes and go overnight camping during the weekends.

When plug-in hybrids came on the market, there was a need to change the text on the parking signs to "Chargeable vehicle" (ladbar motorvogn) in order for the plug-in hybrids to legally be able to use the charging spaces. Although plug-in hybrids can run on fossil fuel and is not as dependent on charging their battery, for the sake of environment, the more they run on electric power, the more local emissions are reduced.

Various parking signs. Electric vehicle maximum 16 hours and maximum 3 hours. Chargeable vehicle with no time limit. (Credit: Agency for Urban Environment, Municipal of Ås)

HOW TO CONTROL THAT ONLY ELECTRIC VEHICLES USE THE CHARGING POINTS?

Since the charging stations are public regulated parking spaces, control of the use of the spaces are done by parking officers who work for the City of Oslo. The parking officers are also employed by the Agency for Urban Environment. This makes it easy to get feedback on the use or misuse of charging points.

If a fossil-fueled car or other non-chargeable vehicle parks in at a charging station they will receive a parking fee of NOK 500 ($90 / €67). If an EV owner comes to a charging station with a critical need of charging and finds it occupied by a fossil-fueled car, they can contact the Agency for Urban Environment and have the wrongly parked car towed away. It will cost the driver of the fossil car a minimum of NOK 2800 ($500 / €375) to retrieve their car from the municipal tow pound.

When the Agency for Urban Environment started using the 2nd generation charging poles in late 2009, the number of vehicles parked wrongly decreased. This was due to the new charging points being more visible through an LED light which increased the awareness of the charging points among all drivers. This ensured that drivers of fossil-fueled cars looked more carefully at the parking sign and became more easily aware if they were wrongly parked.

WHAT KIND OF SERVICES IS NEEDED TO BE PROCURED FROM AN ELECTRICAL ENTREPRENEUR?

Although EVs up to this day have not been able to travel far, driving electric between Scandinavian countries is not uncommon, and many Norwegians like to drive and spend their holidays in Sweden and Denmark, or other European countries. A simple and user friendly system has therefore been important. The lack of a standard when it comes to how to open a charging station to make the charging point available this may make driving electric in Oslo a challenge if you are a tourist. Even more so if each country or city has multiple charging station providers, each with their own key, RFID chip, cell phone number to call etc. The use of the key in Oslo's charging station has been a success until now, but will need to be revised in the future as it is not optimal for international use.

SHOULD THERE BE MANDATORY CHARGING AT THE CHARGING STATIONS?

This is a question that the Agency for Urban Environment as well as the EV community has debated several times. It became an even more important question as the number of EVs increased more rapidly than the number of charging points. A lot of the EVs also used the charging stations as a parking space rather than a charging space, which was a problem for those EVs that depended on charging to get to their next destination.

The Agency for Urban Environment consulted the Norwegian Public Roads Administration to inquire whether mandatory charging at EV charging points could be imposed. Due to practical reasons, including too much text on the parking signs which would lead to confusion for the public, it was also deemed difficult to define whether it was only necessary to be *plugged in*, or if the vehicle actually needed to be *charging* the battery. The latter would probably be the most logical, but it would be difficult for users to be aware of the actual time their vehicle was fully

charged. Many of the EVs in Oslo are older vehicles with shorter range and no possibility to get status information via their smartphone, and it would seem unfair for EV drivers to receive a ticket if their charging went faster than anticipated.

The result is that EV charging spaces can also be used solely for parking, which is why the location of the charging points is important. Through experience and reports from the EV community this means that it is not necessary to place the EV charging spaces in the most popular parking spaces, but rather place them at the far end of a street or parking lot, if there is available electricity there. The possibility to charge, and where to find the nearest electricity supply, is more important than establishing charging points closest to the point of destination or the entrance of a building.

HOW TO INCREASE OFF-STREET CHARGING POINTS

In addition to establish 400 charging points on public streets, the Agency for Urban Environment was asked to join the Energy Efficiency Agency in creating a subsidy for private companies, apartment complexes, stores and shopping centers who wish to establish charging points for EVs. The subsidy is meant to promote establishing charging stations in private parking spaces where the Agency for Urban Environment and the municipality does not have jurisdiction to establish charging points on their own.

The Agency for Urban Environment administers applications for this subsidy while funding is provided from a fund controlled by the Energy Efficiency Agency. They also support various other efforts in reducing local emissions in Oslo. Subsidies for charging points range up to 10 000 NOK ($ 1800/€ 1350) per charging point established.

JOINT COLLABORATION WITH OTHER CITIES AND PARTNERS

Throughout the process in 2008-2012, the Agency for Urban Environment has highly benefited from various projects, partnerships and NGOs.

In 2010 the City of Oslo and the Agency for Urban Environment became part of the URBACT project EVUE – Electric Vehicles in Urban Europe. The EVUE-project has consisted of London as lead parter, along with Stockholm, Frankfurt, Beja, Lisbon, Madrid, Katowice and Suceava.

In the EVUE project partner cities have had very various approaches to electric mobility, and some have come further than others both in city plans and strategies, funding for electric mobility projects, raising awareness on EVs among their inhabitants, increasing the number of EVs on the road and the number of charging points. For the Agency for Urban Environment

there has been a great benefit in being able to share experience, knowledge and get a better insight into what plans other European cities have, and what they are working towards in the near future.

The EV Association, Green Car, Zero Emissions Resource Organization have been important and formed the “Local Support Group” as part of the City of Oslo EVUE-project.

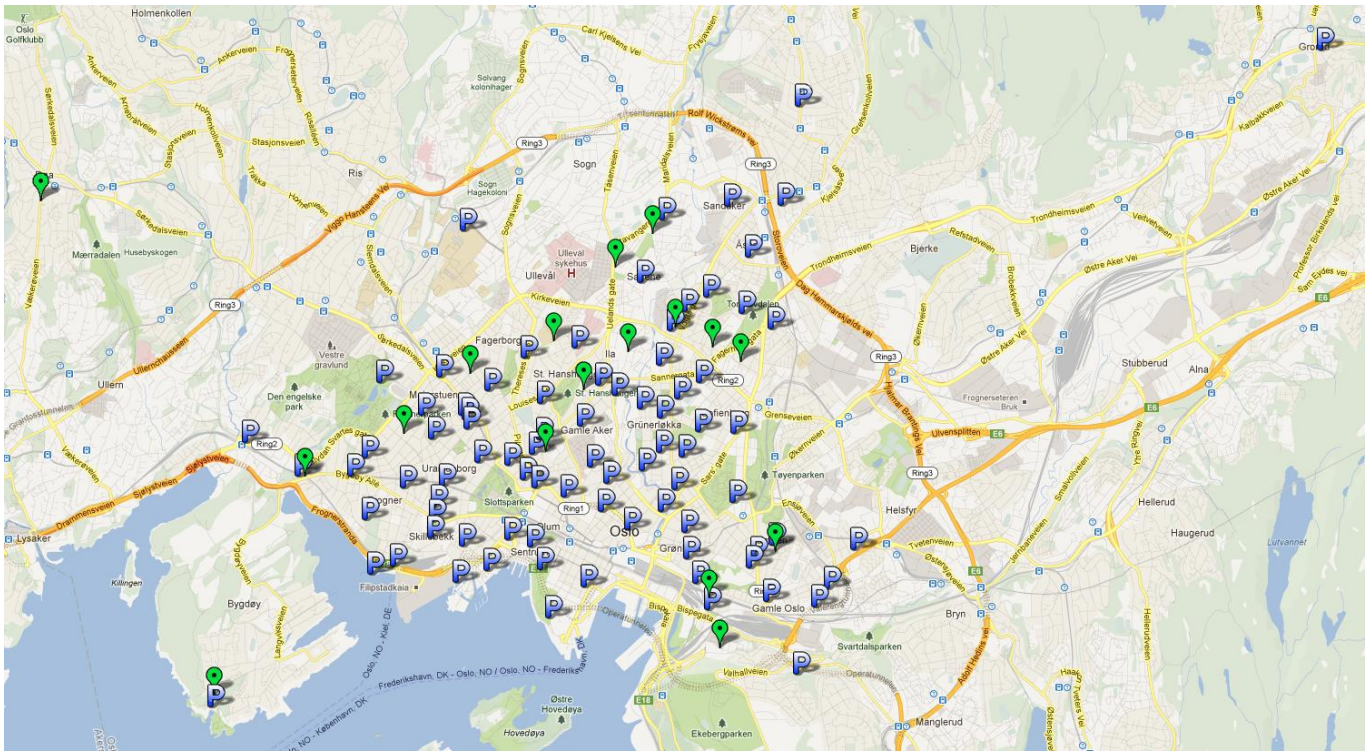
SUMMARY

The time-window of four years was also long enough for the process of establishing charging points to evolve, and for a routine to become established between the City of Oslo and the entrepreneur procured to do the physical establishment of the charging points. It also ensured a good network and communication to be established by the EV Association and the Agency for Urban Environment. This way the Agency was able to get input and feedback on how to plan the charging stations, get suggestions on locations were EV drivers would like to have charging points, and insight to which technical solutions were needed to charge an electric vehicle. By providing on-street charging points, the City of Oslo was able to provide charging for people living in apartments, who previously had charged their vehicle via a charging cable from their window or other various methods.

As of today, the Agency for Urban Environment has established over 400 charging points for electric vehicles in Oslo. Most of these are being used every day, both day and night. The high number of EV’s being sold in Oslo and the surrounding area, may also be partly due to the charging points being established shortly before the mass produced vehicles started being sold. This made potential customers able to see that there actually were places to charge your car, even if they lived in a city street with no private residential parking. Apart from the more popular term “range-anxiety” at least there was less “parking-anxiety” and “charging-anxiety” as parking spaces with charging points started showing up all around the city center.

Due to the success of the city of Oslo's public charging points, and the high number of EV's being sold in Norway, the Vice Mayor for Transport and Environment decided to let the project continue. In 2012 the Agency for Urban Environment was asked to establish 100 new charging points. For 2013 the Agency has been asked to build another 200 charging points in Oslo.

The map for current and future charging points is available on the Agency's website: http://www.bymiljoetaten.oslo.kommune.no/parkering/parkeringsplasser/elbilparkering/



Charging points established by the City of Oslo per 31.12.2012. Blue are established, green are planned for 2013.

As of September 2012, there are a total of 8581[11] EVs in Norway, whereas 1993 registered within the City of Oslo and 2512 in the neighbor county. Divided on the 600.000 inhabitants of Oslo on the 4.8 million in Norway, Oslo and Norway probably has the highest number of EVs per capita in the world. In 2012 EVs had a total market share of 2,48% of new cars sold. The second highest market share was 1,57% in the Netherlands. When it comes to the number of EVs sold, only France had a higher number with 5663 EVs sold compared to Norway's 3950 new EVs in 2012.

Western Europe Electric Passenger Car Sales

Market	Dec 2012 Electric	Dec 2012 TIV	% Market Share	12-Mths 2012 Electric	12-Mths 2012 TIV	% Market Share
France	231	160,314	0.14	5,663	1,898,760	0.30
Norway*	232	9,369	2.48	3,950	137,967	2.86
Netherlands	288	18,306	1.57	3,846	502,544	0.77
Germany*	276	204,331	0.14	3,755	3,082,504	0.12
United Kingdom	194	123,557	0.16	2,237	2,044,609	0.11
Sweden	105	26,687	0.39	947	279,478	0.34
Belgium	119	22,324	0.53	826	486,737	0.17
Switzerland	55	29,108	0.19	785	328,139	0.24
Denmark	45	10,707	0.42	537	170,763	0.31
Italy	57	86,735	0.07	513	1,402,089	0.04
Austria	32	18,421	0.17	427	336,010	0.13
Spain	12	51,197	0.02	399	699,589	0.06
Eire	0	316	0.00	137	79,498	0.17
Finland	8	6,410	0.12	116	111,251	0.10
Portugal	6	6,342	0.09	65	95,290	0.07
Greece	0	3,669	0.00	0	58,482	0.00
Western Europe	1,660	777,793	0.21	24,203	11,713,710	0.21

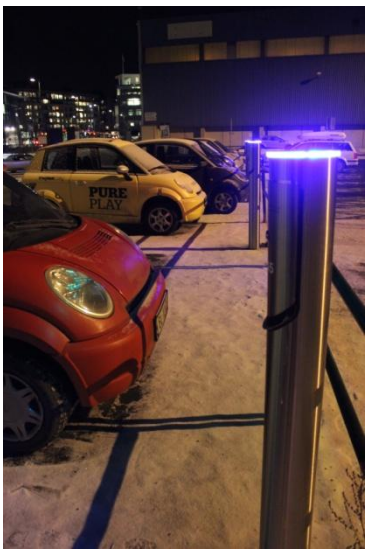
** = Germany includes Opel Ampera from April on, Norway sales adjusted from November to not identify imported used EV sales, United Kingom EV sales adjusted for 12-Months as official figures adjusted*

Source: AID/Industry Sources

[11] http://gronnbil.no/elbiluniverset/kart.php

To sum it up, these are the most important factors that have led to the high numbers of EVs in Norway; some can also be transferred to other countries and cities:

- AVAILABLE ELECTRIC CARS SINCE EARLY 2000;
- ELECTRIC CAR PRODUCERS IN NORWAY HAS LED TO EVEN BETTER CONDITIONS AND INCENTIVES FOR EVS;
- INCENTIVES ARE MARKETED TOWARDS CONSUMERS;
- ENTHUSIASTIC EV COMMUNITY FOR EARLY-ADOPTERS;
- EVS ARE BOUGHT AND DRIVEN BY PRIVATE PERSONS, WHO ARE MOTIVATED CUSTOMERS;
- VISIBLE CARS AND EV DRIVERS HELP GAIN ATTENTION TOWARDS EVS AS BEING FUNCTIONAL CARS;
- CHARGING POINTS ARE ESTABLISHED BEFORE MASS-PRODUCED EVS WERE FOR SALE;
- GOOD NETWORK OF NORMAL CHARGING POINTS NATION-WIDE THROUGH NATIONAL GOVERNMENT SCHEME IN 2009-2010;
- FAST CHARGERS ARE BEING ESTABLISHED NATION-WIDE THROUGH NATIONAL GOVERNMENT FAST-CHARGING SCHEME 2010-2012;
- HIGH TAXES ON FOSSIL-FUEL CARS MAKE EVS HAVE A COMPETITIVE PRICE WITHOUT THE GOVERNMENT HAVING TO SPEND MONEY ON SUBSIDIES, RATHER HAVING REDUCED INCOME BY THE LOSS OF TAX REVENUE.



Occupied charging stations at Aker Brygge and Filipstad (evening) downtown. (Credit: Agency for Urban Environment)

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