30 The Netherlands

30.1 Major Developments in 2017

By 2030, only zero-emission cars will be sold in the Netherlands. That is the Dutch government's ambition. With this goal in mind, businesses, social institutions, knowledge institutions and the government all work together in the Formula E-Team, the Dutch PPS platform to promote e-mobility, to accelerate the transition to electric vehicles. The aim is to help meet the climate targets and, in addition, to take advantage of the associated economic opportunities.

And their efforts bore fruit in 2017: the number of electric cars in the Netherlands grew once again. For the first time, the growth came entirely from fully electric cars: more than 8,600 new, fully electric passenger vehicles were registered, while the total fleet number of plug-in hybrids fell slightly.

The economic impact of e-mobility was monitored and research showed that in 2016, 3,730 fte were working in the sector. The number of jobs and the production volume has increased 40 % year-to-year. It is clear, therefore, that e-mobility is an innovation that offers economic opportunities for Dutch businesses. Amongst others, Dutch companies are active in the field of charging infrastructure, charging services, consultancy, the manufacture of electric trucks and buses, the manufacture of components and the manufacture of light electric vehicles, including electric scooters.

30.1.1 Policy Developments

In October 2017, the Rutte III new Dutch cabinet presented its coalition agreement. In the mobility chapter, the aim is for all new cars to be zero emission by 2030 at the latest. Tax incentives for zero emission cars will be phased out as this ambition is achieved. The cabinet states that it will ensure that charging infrastructure is in place to meet the needs of the new stock of electric vehicles, but that market parties will continue to bear primary responsibility for supplying and operating charging equipment. And by introducing low emission zones, and reducing parking charges for zero emission vehicles, the municipal authorities have instruments at their disposal to improve air quality in inner cities. Some cities already have environmental zones at place, but not yet for zero emission vehicles only.

The cabinet aims for a 49 % reduction in greenhouse gas emissions by 2030. In order to give economic sectors certainty about the long-term targets, a national climate and energy agreement will be made and should be ready in 2018.

Figure 1: Charging in the Netherlands (Source: Living Lab Smart Charging, photo: Bas Stoffelsen

Figure 2: Representatives from the Benelux countries signing e-roaming partnership agreement (Source: Benelux.int)

Together with her colleagues from Luxembourg and Belgium, the Netherlands' State Secretary for Infrastructure and Water Management, Ms Stientje van Veldhoven, is to put measures in place to make it easier for e-drivers to find charging stations and to make payment at these charging stations more user friendly. The countries have signed a partnership agreement that aims to promote "cross-border access to e-mobility services in the Benelux countries". This is designed to enable drivers of electric vehicles to travel seamlessly through the

Benelux countries. Under the agreement, drivers will be able to charge an electric vehicle in all three countries using a single charging card or app, and prices will be transparent. For this reason, Open Chargepoint Belgium, eViolin and Chargy – the sector organisations for providers of charging services from Belgium, the Netherlands and Luxembourg – are also party to the agreement.

30.1.2 Market Developments

Several regions have completed their tendering processes for (additional) public charging infrastructure. In the South, in the provinces of Brabant and Limburg, 1,250 additional charging points will be installed under a tender where a government grant per charging point is no longer required. The Metropolitan Region of Amsterdam has organized a successful tender for the operation of 360 existing charging points. The tender is unique in that it is the first time that a commercial player will pay for operation of the charging stations. Previously, the government provided co-finance.

Five European fast charging companies, including the Dutch company Fastned, have joined forces to form the Open Fast Charging Alliance. The parties will connect their networks through roaming to provide a high-quality network of fast charging stations throughout Europe. This network will be open to all fully electric vehicles, thereby facilitating long-distance travel.

More and more electric buses are being taken in operation in the Netherlands. Examples include the cities of Utrecht, Dordrecht, Haarlem and Amersfoort. Operator Hermes has reached a milestone for its 43 electric buses around Eindhoven, because it has covered 1 million electric kilometers with the buses – in operation since December 2016.

VDL Bus & Coach has launched an electric minibus called the MidCity Electric. The new electric vehicle is suitable for small-scale passenger transport. The fully electric minibus is 8 m long and has a low floor, which facilitates boarding for passengers and wheelchair users. In addition, the longer wheelbase provides a high level of flexibility in terms of the type and number of seats. The MidCity Electric has a maximum range of 220 km. VDL also produces the fully electric 12 to 18 meter long Citea, flexible in options of several electric drives, battery packs and charging systems, so that the ideal, optimal combination can be put together for any area of operation.

Figure 3: VDL's electric minibus for small-scale passenger transport (Source: VDL)

E-Trucks Europe has manufactured a fully electric garbage truck for the municipality of Breda. The electric garbage truck produces no emissions and is equipped to run on hydrogen in the future. The vehicle is currently capable of fast charging, i.e. its battery can be re-charged from empty within 2 hours.

Figure 4: E-Trucks's electric garbage truck (Source: E-Trucks Europe)

In Rotterdam, the first fully electric water taxi has been brought into service. The water taxi has a converted Tesla battery under its bonnet. It has enough power to run for a day at an average speed of 12 km an hour.

Figure 5: Rotterdam water taxi (Source: Watertaxi Rotterdam)

In 2017, a number of Dutch companies launched new models on the light electric vehicle market. Urban mobility firm Stint and the municipality of Zaanstad, for example, have developed a vehicle that the municipality will use for landscaping and street cleaning. Previously, municipality employees had to walk 6 km a day with a wheelie bin to empty the bins; now they use an electric vehicle developed by Stint, which can transport a load of up to 400 kg over a range of 90 km.

Figure 6: Stint especially developed for Zaanstad municipality (Source: https://stintum.com/projecten/zaanstad/)

Electric car sharing is gaining ground in the Netherlands, with several new initiatives in 2017. Hyundai, eg., has launched a project in Amsterdam and Ameland with more than 100 fully electric vehicles. And car2go welcomed its 50,000th member in Amsterdam. Their Smarts are now used almost 2,000 times a day. 4 % of all shared passenger cars in the Netherlands are electric. Also bike sharing is taking up in Dutch cities.

In 2017, a number of Dutch companies caught the eye of major multinationals. Some companies were taken over completely (eg. NewMotion by Shell and EVBox by Engie), while others sold a percentage of their shares (eg. 25 % stake in Jedlix by Renault).

30.1.3 Innovation and Research

The city of Arnhem has introduced a charging point for electric vehicles that derives its energy from batteries that are housed in the pylon of a trolley bus wire. This is the first time in Europe that power from braking trolleybuses has been harnessed to power electric vehicles. The city plans to introduce more of these charging points over the next few years.

ElaadNL, Liander, GreenFlux, NewMotion and EVnetNL have demonstrated in a pilot that charging electric vehicles more slowly during the evening peak does not adversely affect drivers of electric vehicles. During the project, the electric vehicles of 71 participants were charged at half the normal speed during the evening peak for 1 year in order to reduce the burden on the grid. This was offset by charging the fully electric vehicles 25 % more quickly outside peak hours.

Lightyear has unveiled the pre-design for its commercial solar car, the Lightyear One. The vehicle is fully electric, is powered exclusively by solar energy and will be launched in 2019. With a full battery, the vehicle can travel up to 800 km. The integrated solar panels on the roof of the new car generate enough energy to charge the battery during the day and plugging in to charge is rarely necessary. For very long journeys, the car can be charged using a normal socket, so a separate charging infrastructure is not required. In the meantime, more than 10 of the vehicles have already been sold at the pre-sale stage, even before the first prototype is ready.

Figure 7: Lightyear One (Source: Lightyear)

The province of Noord-Brabant, the Ministry of Infrastructure and Water Management, Rijkswaterstaat (the Dutch agency responsible for water and road management), and the municipalities of Eindhoven, Helmond and Tilburg, have set up the MobilitymoveZ.NL Urban Mobility Testing Area. The initiative comprises of a stretch of national, provincial and local roads that runs from Helmond to Tilburg via Eindhoven. MobilitymoveZ.NL provides national and international players with a controlled, manageable section of a public highway to develop and test new technologies and services in the field of smart mobility and innovative mobility services in practical situations.

Just as in previous years, the Dutch student teams had an excellent year in 2017, with the unveiling and development of new vehicles and technology and participation in international competitions:

- TU/ecomotive, a team of students from Eindhoven University of technology, has presented the design of Lina the car in the world to be made of a biocomposite. The electric city car, which can accommodate 4 people, weighs just 225 kg.
- Team FAST, a team of students from Eindhoven University of Technology, has unveiled an electric bus that runs on Hydrozine, a sustainably produced formic acid. The self-built system is housed in a small trailer that is connected to an electric bus, which converts the formic acid into electricity by splitting it into hydrogen and CO_2. The hydrogen is then used to generate electricity, which is used to power the bus.
- The Nuon Solar Team and the Solar Team Eindhoven have won the World Solar Challenge. Delft University of Technology's Nuna9 took first prize in the Challenger Class of the World Solar Challenge in Australia. Solar Team Eindhoven's Stella Vie won the Cruiser Class for 'practical' solar cars. Stella Vie can accommodate 5 people but can still cover some 1,000 km a day on solar power.

The Dutch Automobile Association, ANWB, published the E-mobility Monitor, which outlines developments in e-mobility in the Netherlands, consumer response to electric vehicles and any obstacles that have been encountered. The first edition of the Monitor indicates, amongst others, that 38 % of consumers are interested in e-mobility.

In 2017, the Netherlands Knowledge Platform for Charging Infrastructure (NKL) published their yearly benchmark of the costs associated with public charging infrastructure. This report indicates that the costs of public charging infrastructure continued to fall in 2017 to 35 % of the costs in the reference year (2013). Another

of the report's findings is that, from 2017 onwards, the focus moves from cost reduction to professionalization of the market.

Figure 8: Nuon Solar Team win at the World Solar Challenge (Source: Delft University of Technology)

Figure 9: NKL maturity model (Source: http://en.nklnederland.nl)

This report "Charging infrastructure on private property built environment", which was produced by Ecorys and EVConsult, highlights obstacles to the installation of charging points for electric vehicles on private property built environment, such as shared car parks in apartment complexes and offices. According to the writers of the report, there are a number of different policy measures that could be implemented by the government to speed up an increase in the number of charging points.

PwC's research on the institutional barriers and potential solutions for the smart charging of electric vehicles reviews current obstacles to optimum use of electric vehicles in the Netherlands and suggests potential solutions. The report's recommendations include the following: optimization of the incentive to store energy in an electric vehicle for own use, avoidance of a double tax on energy use and reduction of the transmission charge.

30.1.4 Financial and Fiscal Incentives

One of the main drivers behind the increase of electric vehicles in the Netherlands is fiscal stimulation. As from 2016, there is more focus on zero emission vehicles. Until 2020, fiscal incentives for plug-in hybrid cars will gradually be reduced to the same level as for conventional cars. Table 1 provides an overview of the incentives that were in place in 2017.

Table 1: Fiscal incentives in the Netherlands 2017

Policy Measure	Details
Registration tax	Zero emission cars are exempt from paying registration tax. For conventional cars the system is progressive, with a starting tariff and 5 levels of CO_2 emissions and amounts of registration tax. Plug-in hybrid cars get a discount compared to conventional ones; they do not have a starting tariff and have 3 levels of CO_2 emissions and amounts of registration tax.
Road tax	Zero emission cars are exempt from paying road tax. Plug-in hybrid cars < 51 gr CO_2/km pay half tariff (up to 2020). This is compared to 400 to 1.200 EUR otherwise (depending on fuel, weight and address).
Surcharge on income tax for the private use of company cars	In the Netherlands, income tax has to be paid on the private use of a company car. This is implemented by imposing a surcharge of 4 or 22 % of the catalogue value on the taxable income. For zero emission cars this percentage is 4 %. For all other cars, including plug-in hybrid cars, it is 22 %.
Tax deductible investments	The Netherlands has a system of facilitating investments in clean technology, by making these investments partially deductible from corporate and income taxes. Zero emission and plug-in hybrid cars < 31 g CO_2/km (and not with a diesel engine) are on the list of deductible investments, as are the accompanying charging points.
Various local incentive schemes	Various Dutch municipalities, such as Amsterdam, The Hague and Rotterdam, offered different grants and schemes for electric vehicles.

As part of the Green Deal on Publicly Accessible Charging Infrastructure, the national government has committed a total of 7.2 million EUR to contribute to the installing of public charging points by municipalities. In the period mid-2015 to mid-2018 a gradually decreasing contribution per pole can be granted, provided that a municipality contributes the same amount and a market party also

contributes. Up to the end of 2017, 216 municipalities have installed 7,800 charging poles through this arrangement.

30.2 HEVs, PHEVs and EVs on the Road

The number of plugged-in electric vehicles grows steadily in the Netherlands. At the end of 2017, almost 120,000 electric passenger cars were registered. Of these, almost 18 % were Battery Electric Vehicles (BEVs), the majority consisting of Plug-in Hybrid Electric Vehicles (PHEVs). When compared to the end of 2016, the number of BEVs increased by 61 % and the total number of PHEVs decreased for the first time by 1 %.

There were 158,245 HEVs on the road at the end of December 2017.

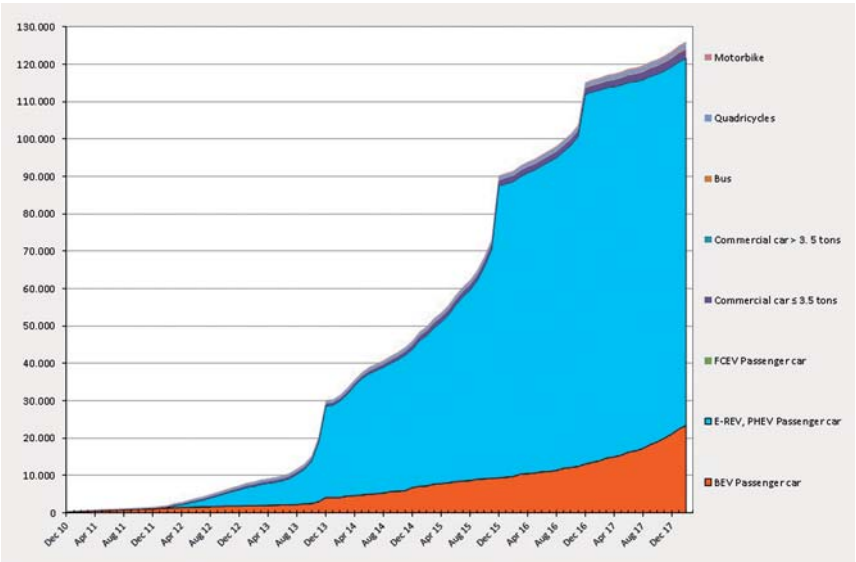

Figure 10: Development of plugged-in electric vehicles 2010-2017 in the Netherlands (Source: Dutch Road Authority, edited by RVO.nl)

Over the year 2017, 2.6 % of new registrations were BEVs or PHEVs. In 2016 this percentage was 6.7. About 1 % of the total passenger car fleet was electric.

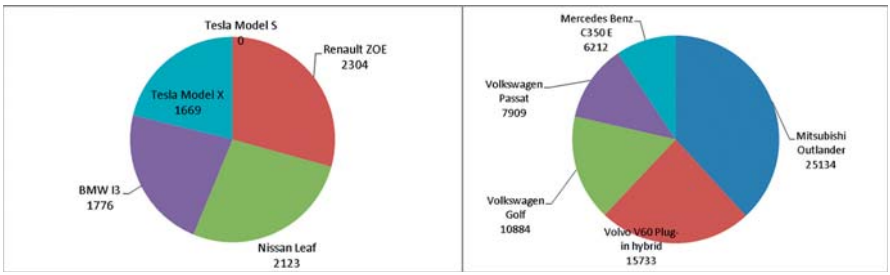

Figure 11: Top 5 registrations in fleet BEV (left) and PHEV (right), 31 December 2017 (Source: Dutch Road Authority, edited by RVO.nl)

Table 2: Distribution and sales of EVs, PHEVs and HEVs in 2017 (Data source: Dutch Road Authority, edited by RVO.nl; fleet totals: CBS except buses: CROW; 2017 registration totals: BOVAG/RAI)

Fleet Totals on 31 December 2017					
Vehicle Type	**EVs**	**PHEVs**	**HEVs**	**FCVs**	**Total[6]**
2- and 3-Wheelers[1]	1,542,474	n.a.	n.a.	n.a.	n.a.
Passenger Vehicles[2]	21,115	98,217	158,245	43	8,373,244
Buses and Minibuses[3]	296*	n.a.	n.a.	6	5,000
Light commercial vehicles[4]	2,210	n.a.	n.a.	n.a.	883,350
Medium and Heavy Weight Trucks[5]	81	n.a.	n.a.	n.a.	139,656
Totals without bicycles	**66,176**	**98,217**	**158,245**	**49**	**9,401,250**

Total Sales during 2017					
Vehicle Type	**EVs**	**PHEVs**	**HEVs**	**FCVs**	**Total[6]**
2- and 3-Wheelers[1]	299,887	n.a.	n.a.	n.a.	393,733
Passenger Vehicles[2]	8,116	1,093	23,459	13	418,461
Buses and Minibuses[3]	128*	n.a.	n.a.	5	n.a.
Light commercial vehicles[4]	582	n.a.	n.a.	n.a.	73,478
Medium and Heavy Weight Trucks[5]	15	n.a.	n.a.	n.a.	15,529
Totals without bicycles	**14,728**	**1,093**	**23,459**	**18**	**901,201**

* including trolley buses

n.a. = not available
[1] UNECE categories L1-L5
[2] UNECE categories M1
[3] UNECE categories M2-M3
[4] UNECE categories N1
[5] UNECE categories N2-N3
[6] Including non-electric vehicles

Table 3: Available vehicles and prices (Data source: https://ev-database.nl/, March 2018)

Market-Price Comparison of Selected EVs and PHEVs in the Netherlands	
Available Passenger Vehicles	**Untaxed, Unsubsidized Sales Price (in EUR; prices include 21% VAT)**
Audi Q7 E-Tron	92,325
Audi A3 Sportpack E-Tron	42,975
BMW i3	40,412
BMW i3s	44,081
BMW330e	50,678
BMW 530e iPerformance	63,601
BMW X5 xDrive40e	94,552
BMW 740e	100,848
BMW i3s Range Extender	49,120
BMW i3 Range Extender	45,433
Citroën C-Zero	22,360
Citroën E-Berlingo Multispace	31,670
Hyundai IONIQ Electric	34,295
Jaguar I-Pace	80,330
Kia Optima Plug-In Hybrid	41,475
Kia Soul EV	36,335
Kia Niro PHEV	34,595
Kia Optima Sportswagon PHEV	42,975
Mercedes E 350e Plug-In	66,997
Mercedes GLE 500e Plug-In	93,879
Mercedes C 350e Estate	52,740
Mercedes C 350e Limousine	50,969
Mini Countryman Cooper S E ALL4	40,700
Mitsubishi i-MIEV	27,615
Mitsubishi Outlander PHEV	35,990
Nissan Leaf	33,990

Nissan e-NV200 Evalia Connect Edition	38,950
Opel Ampera-e	46,699
Peugeot Partner Tepee Electric	30,470
Peugeot iOn	22,360
Porsche Panamera S E-Hybrid	117,600
Renault ZOË R90	32,890
Renault ZOË Q90	33,590
Renault ZOË R90 Entry	30,390
Renault Kangoo Maxi	37,503
Smart ForFour Electric Drive	24,050
Smart ForTwo Electric Drive	23,669
Smart ForTwo Cabrio Electric Drive	27,043
Tesla Model S 100D	109,635
Tesla Model X 100D	112,985
Tesla Model S P100D	149,685
Tesla Model S 75D	86,585
Tesla Model X P100D	158,935
Tesla Model X 75D	93,335
Toyota Prius Plug-in	37,995
Volkswagen e-Golf	39,540
Volkswagen Passat GTE	45,570
Volkswagen e-up!	27,760
Volkswagen Golf GTE	41,050
Volkswagen Passat GTE Variant	47,170
Volvo V60 D6 AWD	57,975
Volvo XC-90 T8 Twin-Engine	81,875
Volvo V60 D5 AWD	54,975

30.3 Charging Infrastructure or EVSE

The Netherlands has a well-developed charging network.

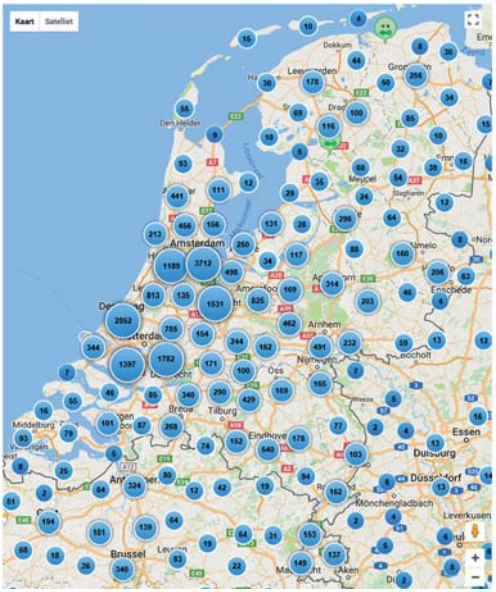

Figure 12: Map of (semi)public charging infrastructure for electric cars (Source: Oplaadpalen.nl)

Table 4: Information on charging infrastructure in 2017 (Source: oplaadpalen.nl, edited by RVO.nl)

Charging Infrastructure on 31 December 2017	
Chargers	**Quantity**
AC Level 1 Chargers	1,730
AC Level 2 Chargers	31,138
Fast Chargers	755 (178 locations)
Superchargers	118 (12 locations)
Inductive Charging	1 project passenger cars (Rotterdam) 1 bus line (Utrecht)
Totals	**33,743**

At the end of 2017, there were 32,875 regular charging points in the country, an increase of 26 % compared with the year before. 15,288 of these were public charging points and 17,587 were semi-public, the majority of those being destination chargers. The number of fast charging points increased by 23 %

compared to 2016, to a total of 755 – in total 178 locations along highways but also in cities.
Next to these public charging points, an estimated minimum of at least 80,000 private charging points was in operation.

About half the number of (semi)public charging points are already smart charging ready, reports the Living Lab Smart Charging. Moreover, all charging is interoperable, and has been so since the beginning of 2011. The Open Charge Point Interface (OCPI) protocol, an independent roaming protocol for providers of charging infrastructure and services, was designed in the Netherlands for this purpose. It provides information about location, real-time availability, prices, and real-time billing, as well as mobile access of chargers.

The Dutch government, knowledge institutes and companies together call for the use of open standards and open protocols in charging infrastructure, so as to stimulate innovation and global access – thus stimulating EV uptake.

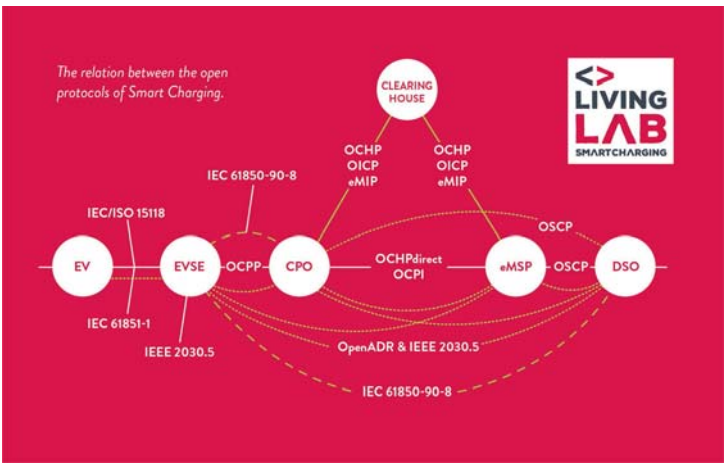

Figure 13: The relation between the open protocols of smart charging (Source: Living Lab Smart Charging)

30.4 EV Demonstration Projects

There are a great number of projects going on. This is only a small selection.

In partnership with Nuon, Liander and ElaadNL, the municipality of Amsterdam has introduced flexible charging of electric vehicles. In this pilot, electric vehicles are charged up using more power when there is less demand for electricity from other energy users and the demand for power is therefore low. And they are charged up using less power when less energy is available. 200 charging points in Amsterdam Centre, West, New West and South are taking part in this pilot.

In conjunction with car manufacturer Mitsubishi and network operator TenneT, NewMotion has launched a pilot that involves bidirectional charging of a number of electric vehicles in an effort to balance peak demand on the grid more effectively. A first charging station has now been brought into service.

After a successful pilot in Lombok, the sustainable energy system Smart Solar Charging is to be expanded to 5 districts in the Utrecht region and will include 70 electric We Drive Solar cars. During the day, a smart charging station stores local solar power in electric car-share cars, while at other times the excess energy is used locally thanks to vehicle2grid (V2G) technology.

The project 'Amsterdam Arena' is one of the pilots in the 'SEEV4-City' Interreg project. It researches and tests energy storage and V2G applications through 280 used Nissan Leaf batteries.

30.5 Outlook

In the summer of 2018 the new Energy and Climate Agreement will be ready, taken into account the large task on CO2 emissions reductions that the Netherlands will need to accomplish to meet the goals of the Paris Climate Agreement. This will serve as the new policy focus for all relevant sectors, including transport and mobility.

Technology is moving fast, as smart mobility, connected and autonomous driving gain terrain. The Netherlands wants to be prepared for changing mobility demand by facilitating developments and removing hurdles. It also acts as a testing ground for connective, cooperative and automated driving.

As far as electric mobility is concerned, the market is anxiously looking forward to many new models with a larger battery capacity that will arrive in 2018/2019. There are also some challenges towards the future of e-mobility for the Netherlands. As most electric cars are still business (leased) cars, consumers need to adopt electric vehicles for actual market scale-up. The installation of easily accessible public charging infrastructure remains a point of attention for the government. Besides that, the number of workplace chargers will need to increase. And last but not least, the importance of open standards worldwide is undeniable for the creation of a global e-mobility market.