Interreg
North Sea Region
SEEV4-City
European Regional Development Fund

EUROPEAN UNION

SEEV4-City Smart, clean Energy and Electric Vehicles 4 the City

Operational Pilots

SEEV4-City at a glance

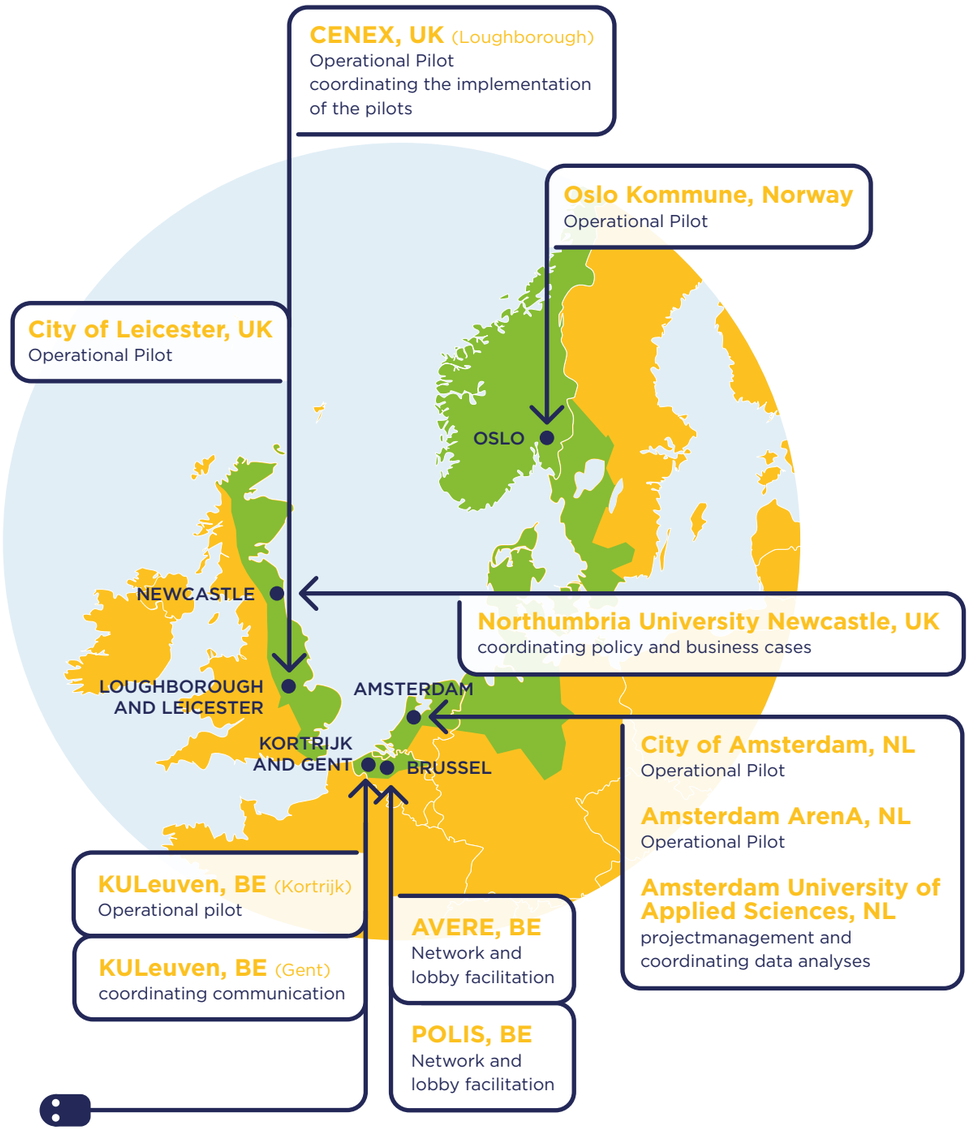
Funding
EU - Interreg North Sea Region
Priority 4: Promoting green transport and mobility

Duration
Sep 2016 → Oct 2019

Budget
5 Million

Consortium
10 partners

Project Coordinator
Amsterdam University of Applied Sciences



Europe is committed to reduce the carbon footprint in both energy and transportation. It is at the forefront of adopting Electric Vehicles (EV) and Renewable Energy Sources (RES). However, an increase in the number of EVs and renewable energy production creates challenges: The renewable energy supply does not match the electricity demand of the EVs. Due to this mismatch, electric vehicles are not always charged with renewable energy. Moreover, this leads to undesirable effects on the electricity grid.

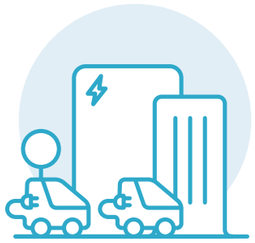
Nevertheless, enabling clean & green transportation by increasing the number of electric vehicles, powered by renewable energy sources, remains a top priority.
The challenge is to structure the system. Within SEEV4-City robust solutions to enable clean, green and smart city transitions are provided. By optimizing the use of EVs, renewable energy sources and smart Information and Communication Technologies (ICT) in six different operational pilots, SEEV4-City demonstrates how electric vehicles can support the energy transition in cities.

The systems experimented during this project reflect a variety of city situations representative for Europe as a whole. The problem has a common nature; the tailor-made solutions are inspiring a wide audience of cities in Europe struggling with this common challenge. The pilots have different operational environments and levels of smart charging or V2G integration: Vehicle2Home (V2H), Vehicle2Business (V2B), Vehicle2Street/Neighbourhood (V2N) and Vehicle2City (V2C).

In addition to demonstrate new technology, the SEEV4-City project is developing commercially and socially viable business models to integrate EVs and renewable energy, while embedding its application into urban planning through an Sustainable Urban Mobility and Energy Plan (SUMP to SUMEP). The innovative nature, context and ambitions of the SEEV4-City Operational Pilots are further presented in this booklet.

The pilots vary from:

A single household with solar energy, storage and an electric vehicle.



Buildings with multiple electric vehicles and larger renewables.

A large ‘power-parking’ or a soccer stadium acting as ‘energy hub’.

Large scale smart charging in public charging solutions in the city.

Loughborough, UK

Loughborough ‘Living Lab’

This operational pilot is the smallest in the range of applications, demonstrating the added value of Vehicle-to-Grid (V2G) and additional storage for optimised energy generation and consumption in households.

A single household was progressively equipped with ‘smart’ technologies, beginning with solar panels and an electric vehicle and later adding stationary battery storage and a bespoke V2G charging unit. The incremental addition of smart technologies has enabled the true impact and value of each to be assessed both individually and in combination, giving a better idea of how the technologies interact and whether they compete or complement each other. This will enable future home owners to identify the best technology combinations to meet their needs.

The V2G unit is a research prototype, but it is intended that the learning from this project will support the future development of commercially available domestic V2G units. While the EV was parked at home, the V2G unit enables the vehicle to charge using excess solar generation and return the power to the home when it is required.
The V2G charger can also vary the response to match household’s electricity demand and the solar energy production forecast. As a result, it is expected that the distance travelled by the EV using zero emission PV generation will increase, while minimising the homes overall demand.

Responsible parties	
Building Owner	Householder
Vehicle owner	Cenex
Distribution Network Operator	Western Power Distribution
V2G Provider	Potenza Technology
Battery Storage Provider	Moixa
V2G & Battery Storage Management	Moixa

The house in question is the home of ‘Steve’ and his family. Steve is an employee at Cenex. This was done as it allows the system to be monitored and exercised more readily than in a normal commercial trial and it enables equipment to be tested prior to going through full CE testing. This also provides a number of additional advantages including easy access to user feedback on the system, and the collection of contrasting views from different family members with different needs and expectations of the system. According to Steve “Being part of this trial has been a real eye opener and helped me see the value of the different technologies. I’ve really enjoyed knowing that I’m getting the most out of my PV”.

Overall this ‘Living Lab’ experiment has enabled the trialling of cutting edge systems in a safe, monitored environment, while also allowing collection of high quality data which will be invaluable in the future development of domestic V2G systems.

Kortrijk, BE

The city depot of Kortrijk

The Belgian city of Kortrijk, ambitious in the field of energy, strives to be the first city in Flanders to become energy neutral. Within 15 years, Kortrijk wants to minimise the city's influence on the environment & climate, to become a true Climate City. The city of about 76,000 inhabitants mobilises their citizens, companies, schools & associations to all contribute to this common goal.

A big step in that process is making the water, electricity and gas utilisation by the city facilities totally sustainable through smart management. To further achieve their goals, Kortrijk, joined by KU Leuven, decided to participate in the SEEV4-City project.

The operational pilot of Kortrijk, although a rather small test case when compared to the other pilots, offers an unique set of circumstances to share practical experience in achieving a more sustainable city energy system. Consisting of municipal sport facilities, a depot for city services, a PV-installation the size of 3/40 of a football field (yearly producing enough green energy to provide 22 families all year long), a smart charging station and currently one Nissan E-NV200, an electric delivery van, the pilot aspires to become a small power plant. The energy produced by the PV-installation is used by the depot and sport facilities, but any excess energy will be injected into the EV, stationary battery or e-bikes on site to be used when necessary.

The regular driving hours of the mailman and his daily predetermined trajectory provide clear boundaries to implement smart charging algorithms. Once the researchers of KU Leuven find an optimal way of distributing the energy & implementing the resulting algorithms, they can look to the final impact of their efforts.
They expect a rise in energy autonomy and a yearly saving of 33.4 tons of CO_2-emissions. These numbers will only increase when more EV's will be purchased by the city of Kortrijk. Plans for expansion to other city service buildings are already being considered and fit in the ambitious plan of being the first Flemish energy neutral city.

Responsible parties

Building Owner	Stad Kortrijk
Vehicle owner	*Lease contract*
Distribution Network Operator	Eandis
V2G Provider	-
Battery Storage Provider	KU Leuven
V2G & Battery Storage Management	KU Leuven system *(smart charging & BMS)*

Leicester, UK

Charging at Leicester City Hall

The operational pilot in Leicester is a Vehicle to Business pilot, located in the UK. The project demonstrates controlled and bi-directional charging at the office of City of Leicester.

The City of Leicester, located in the UK, has joined the UK 100 group of cities and towns in pledging a transition to clean energy sources by 2050. To do this, City of Leicester has installed solar panels, to provide a local, cheap source of renewable energy for houses and council premises. At their own City Hall, they installed 90 solar panels on the roof. These generate energy, which the office uses to turn on their lights, computers etc,. In total they provide 2,5% of the office building's energy consumption. The electric vehicles can also be charged with the energy coming from the roof. Leicester is undertaking a gradual replacement of the diesel cars and small vans in its fleet, with electric equivalents. Four electric vehicles are now based at City Hall, used by staff to support a range of council services.

The Electric Vehicles can charge without using energy from the grid. To improve the energy autonomy and to avoid grid investments, City of Leicester uses two storage elements; a static storage and batteries in the EVs. By using these elements, the EVs can charge and discharge day and night at the office of City of Leicester.
This allows the City to avoid grid investments 24 hours.

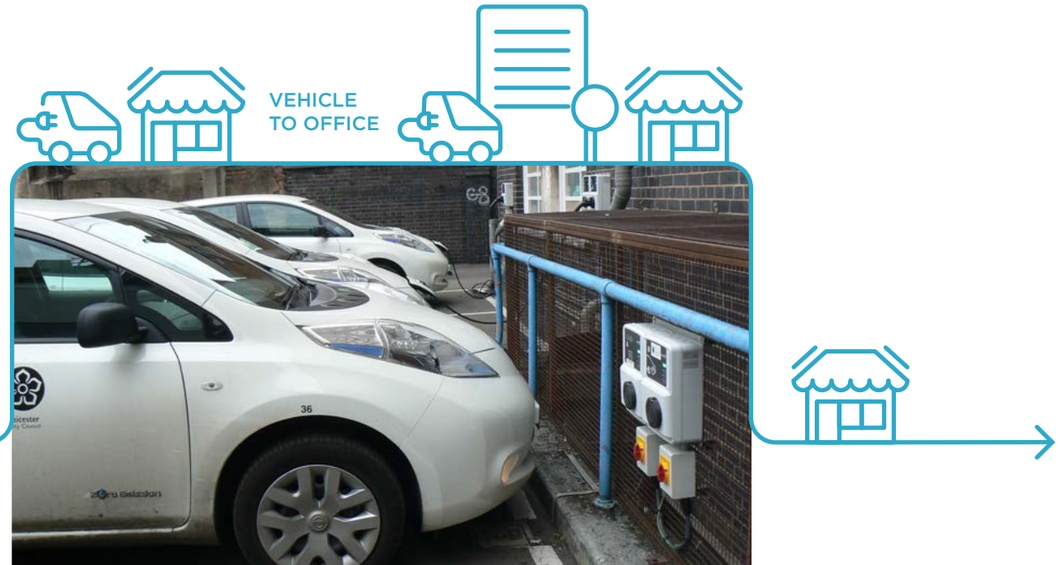
An installed system then prioritises if the solar energy will go into one of the electric cars, go into the office, go back to the grid or go into a static storage system. Controlled and bi-directional chargers take account of when the charging is happening in terms of grid capacity and associated energy costs.

Prioritising PV generation for EVs will lead to an increase in ultra-low emission kilometres, powered by a locally produced renewable energy source. For instance, between June 2016 and June 2017, the EVs used 2,996 kWh, which equates to 15% of the annual solar production.

The system is considered as highly replicable, with applications identified at several locations: at other city offices, but also at bus stations, multi-storey car parks or park & ride sites. As well, the pilot contributes to the development of a commercial business case for bi-directional charging.

Responsible parties

Building Owner	Leicester Council
Vehicle owner	Leicester Council
Distribution Network Operator	Western Power Distribution
V2G Provider	To be decided
Battery Storage Provider	n/a
V2G & Battery Storage Management	n/a
Static storage	Not yet confirmed



Amsterdam, NL

The Amsterdam ArenA

The Amsterdam ArenA is already one of the most sustainable, multi-functional stadiums in the world and is realizing even more inspiring smart energy solutions for the venue, it's visitors and neighbourhood.

The Amsterdam ArenA presents a complex order of magnitude for innovative energy services, with a consumption of energy comparable to a district of 270 households. Thanks to the 1,128 MWp solar installations on the roof of the venue, the Amsterdam ArenA already produces around 12% of the energy it needs, despite the high-power consumption during major sport events and concerts for up to 68.000 visitors. The other share of electricity is generated through certified regional wind energy.

The Amsterdam ArenA has invested in energy storage and V2G applications, which will be realized in the summer of 2018. The vast renewable production ensures a massive supply of clean energy to charge EVs, which translates into an increase in clean kilometres for their visitors. The Energy Storage System is unique; as it's the first time different applications are combined in one system. Currently, all systems are single purpose applications either focusing on building support or grid services.

Responsible parties

Building Owner	Amsterdam ArenA
Vehicle owner	Various (visitors, employees)
Distribution Network Operator	Liander
V2G Provider	EV-Tech
Battery Storage Provider	Eaton
V2G & Battery Storage Management	TMH

The Energy Storage System of the Amsterdam ArenA will address several applications in parallel. Replacing traditional energy plants is the main emission reduction contribution along with load management, peak shaving, back-up services and V2G support. The solar panels, the energy storage system, the new main distribution panels and up to 8 bi-directional EV chargers are connected to the Energy Storage System which means in the future electric vehicles can power events and be charged with clean energy through the Amsterdam ArenA's Energy Services. These and other experiences and results can serve as a development model for other stadiums worldwide.

Oslo, Norway

Vulkan Real Estate Building

Vulkan is one of the largest and most advanced EV charging garages in Norway and Europe. With over 100 EV chargers, quick chargers and additional battery storages for smart charging, Vulkan is an embodiment of the expected fusion between building, energy and transport sectors.

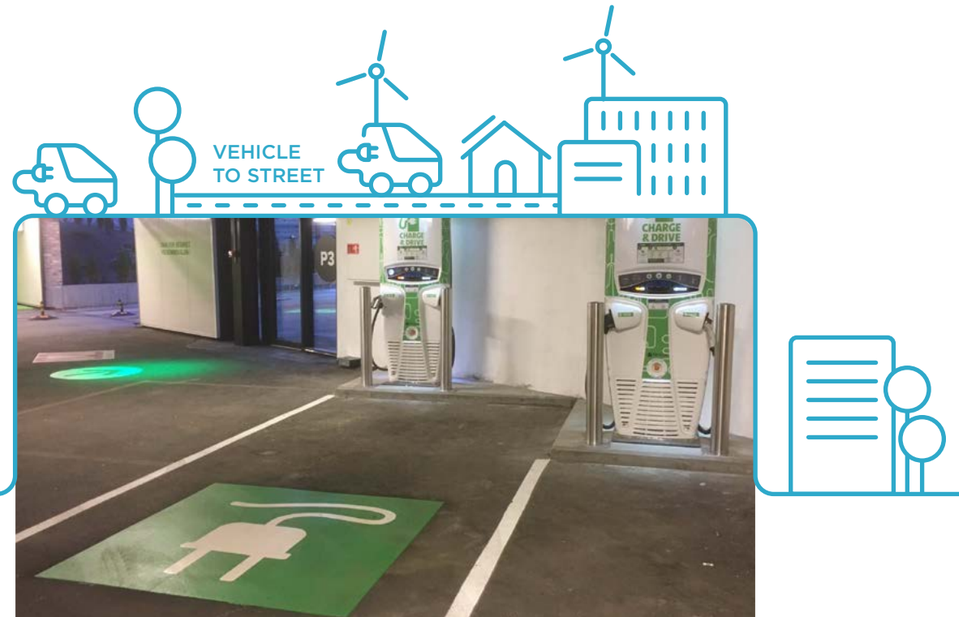
The City of Oslo wants to have more than 200.000 electric vehicles on its streets by 2020. In order to reach this ambitious environmental goal, Oslo needs to make sure that everybody can charge their electric vehicle, both private and professional users of electric vehicles. A fusion between the building- and transportation sector is needed.

The innovative parking garage Vulkan, serves both residents and companies. During the day, Vukan operates as a 'Centre of excellence' for professional users of EVs as E-taxis, electric freight vehicles and EVs for craft & services. It provides opportunities for pre-booking of charging time, flexible charging, battery storage, and quick charging. At night, Vulkan offers free residential parking for people living in the neigh-bourhood. Besides the different day and night users, Vulkan is also a hub for EVs that use overnight charging at home, in combination with (semi-)quick charging during the day. This creates a flexible and cost-efficient site for the promotion of EVs.

Responsible parties

Building Owner	Aspelin Ramm Eiendom AS, Norwegian Parliament, Private Individuals
Vehicle owner	Postal, service and taxi companies
Smart grid owner and operators	Aspelin Ramm Eiendom AS and Fortum Charge & Drive
Charge point operator	Fortum Charge & Drive
Charge point owner	Aspelin Ramm Eiendom AS

More than 400 EVs are served on a daily basis. The turnover in terms of kWh per week has tripled since the opening in February 2017. The smart grid system at the site, shaves 20% electricity consumption during peak hours. The pilot already created a reduction of 8 tons CO_2 emissions in 2017. New professional users of EVs e.g. car sharing, cleaning company and craft and service vehicles, have started their operation from the site with very positive feedback. The next stage will be to include next generations super quick charges, using second-life batteries for shaving the peak and installing V2G, AC and DC.



Amsterdam, NL

Flexpower Amsterdam project

Amsterdam is preparing for an expected increase of electric cars and more and more locally generated renewable energy in the city. In March 2017 the city started a 'flexible charging' project with its partners Nuon, Liander, ElaadNL and HvA.

By steering the charge flow of electric cars, peak loads can be avoided and the demand can be matched to the availability of local produced sustainable energy.
The design of the current electricity grid has not taken into account the arrival of electric cars.
At this stage there is no direct problem, but an uncontrolled increase of chargers on the low voltage grid might lead to peak demands that exceed the grid capacity. Therefore, it is necessary to start testing how smart charging helps to overcome this.

The pilot begins with two hundred public charge stations with two sockets each in the center, the West, New West and South of Amsterdam.
The charging speed is adjusted on the basis of the use of the electricity grid. At the start of the test, the charging speed for electric cars is increased during 00.00 – 07.00 hours, 08.00 – 17.00 hours, and 20.00 – 24.00 hours (outside peak hours). This means they will be charged faster than normal at this time of the day. Only during peak hours (between 16.30 and 19.30), when other devices (such as devices in households) demand more power, the cars are charged slower and with less power.

Responsible parties

Building Owner	Multiple owners; neighbourhood level
Vehicle owner	Multiple owners; public
Local grid owner/operator	Liander
Charge point operator	NUON and Heijmans
Charge point owner	City of Amsterdam

With this method more e-drivers can use the same charge point and less public charge points are needed.

The goal of the project is to gain insight in the potential of smart charging and, even more important, what is needed to utilize the full potential of smart charging possible and what the restrictions are to implement smart charging on large scale. For the SEEV4city project, Amsterdam wants to look at the opportunity to outbalance supply and demand of renewable energy production on a local level on this FLexPower charging stations.

Goal

Making a huge step forward in green city development by a smart combination of electric vehicles, renewable energy sources and ICT solutions.

6 operational, long term pilots in 6 European cities aiming for:

- An increase in energy autonomy
- An increase of ultra-low emission kilometers
- Avoiding extra investments to make existing electrical grids compatible with an increase in electro mobility and local energy production
- A concrete and measurable reduction in CO_2 emissions for each operational pilot

The SEEV4-City is a North Sea Region Interreg project and realized in a consortium of Amsterdam University of Applied Sciences, City of Amsterdam, Amsterdam ArenA, CENEX, Leicester City Council, Northumbria University Newcastle, Catholic University of Leuven, AVERE, POLIS and Oslo Kommune.

SEEV4-City started in May 2017 and will be finished at the end of 2019. The goal is to make a huge step forward in green city development by a smart combination of electric vehicles, renewable energy sources and ICT solutions. All joining cities are aiming for an increase in energy autonomy, an increase of ultra-low emission kilometers and avoiding extra investments to make existing electrical grids compatible with an increase in electro mobility and local energy production.

Interreg
North Sea Region
SEEV4-City
European Regional Development Fund

EUROPEAN UNION

Amsterdam University of Applied Sciences

KU LEUVEN

AVERE
The European Association for Electromobility

City of Amsterdam

northumbria UNIVERSITY NEWCASTLE

AMSTERDAM ArenA

Leicester City Council

POLIS

cenex

Find us @
www.northsearegion.eu/seev4-city
& Twitter @SEEV4City
or h.niesing@hva.nl