IRIS
smart cities

March 2023

INSIDE SMART CITY SOLUTIONS

Stories from the IRIS Smart Cities project

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 774199.

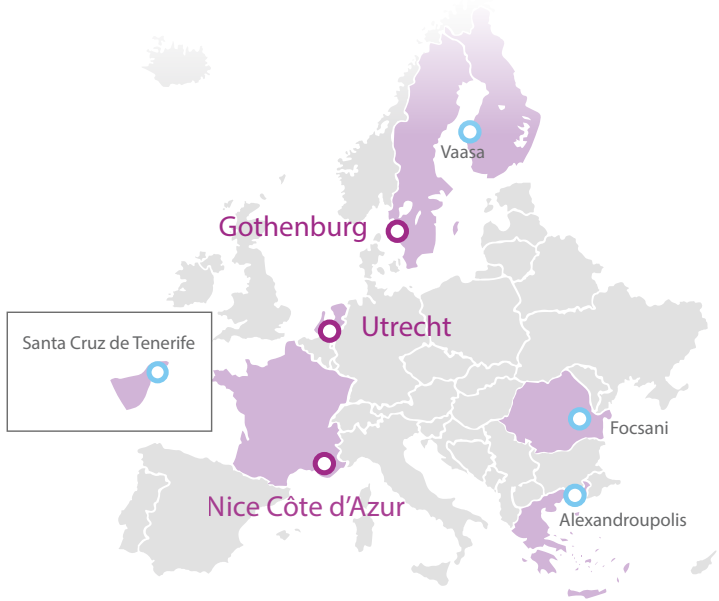
Introduction

Over five years ago, in 2017, a large group of people from all over Europe embarked upon an innovation journey to make their cities more sustainable and improve the quality of life of their fellow citizens. They wanted to provide solutions to significantly increase their cities' overall energy and resource efficiency through actions addressing the building stock, energy systems, mobility, and air quality as well as informing and engaging with their inhabitants on their proposed solutions. Through the EU funded IRIS Smart Cities project, three cities — Utrecht, Gothenburg and Nice — also known as "Lighthouse cities", would work together to realise these goals. Another four cities — Vaasa, Alexandoupolis, Santa Cruz de Tenerife and Focsani — also known as "Fellow cities" would take close notes on what the Lighthouse cities were doing, figuring out how their proposed innovations could be also implemented in their local contexts as well as share some sustainability tips of their own.

The IRIS Smart Cities Magazine chronicles some of the highlights of this journey: inside you will find descriptions and testimonials of the experiences from the people who participated in this project: from snapshots of the key technologies developed such as vehicle-to-grid charging, second life batteries, building retrofitting and innovative mobility services, to examples of young citizens taking the lead in making their neighborhoods safer and cleaner, to a look at how European collaboration takes place, the challenges it can present, and what lessons can be learned from this experience so that managing city innovation in future can become a bit easier for everyone.

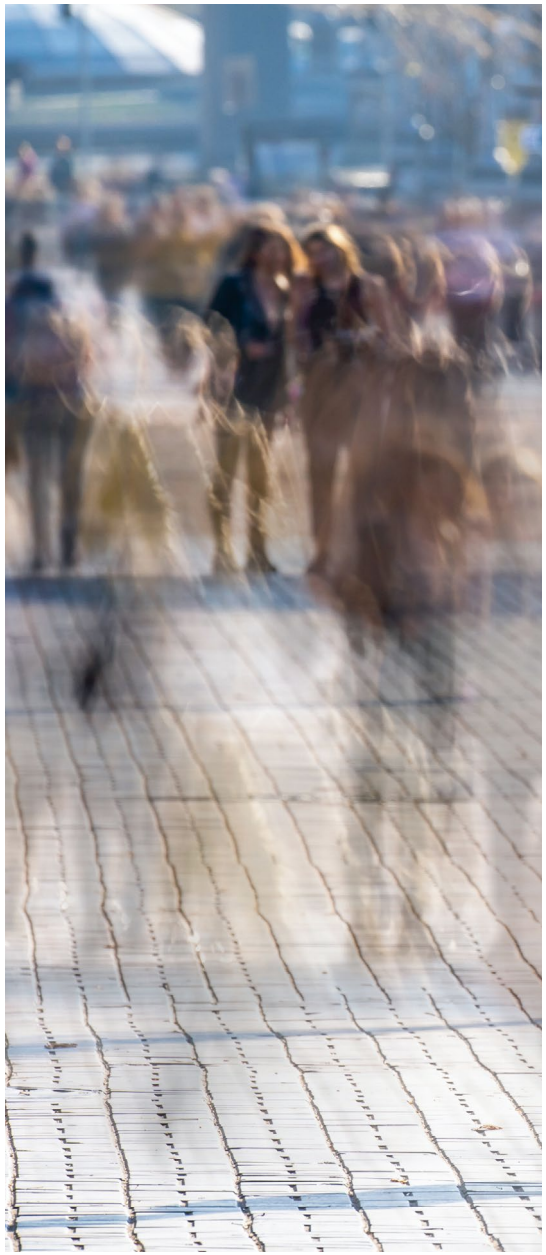
We first tour the lighthouse cities, finding out how Utrecht, Gothenburg, and the Nice Côte d'Azur region are using innovative solutions to redistribute energy to where it's needed, reduce emissions, and transform apartments into nearly zero-energy buildings. We then see how these solutions are being replicated in the follower cities of Alexandroupolis, Santa Cruz de Tenerife, and Focșani. Following this we look at how our project flourished at the continental scale in the European Collaboration section, and at the local scale with Citizen Engagement. There are key lessons for the future in City Innovation Management and we the discuss the fun (yes, fun!) of European Collaboration projects. Finally we finish with how the project changed how we investigate smart cities and how the IRIS project will live on.

We hope you will enjoy this read, follow up on the many hyperlinks / QR codes within, and take inspiration from our experiences, technologies and ideas presented.



The IRIS Smart Cities project consortium (March 2023)

showcase.irissmartcities.eu



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Utrecht

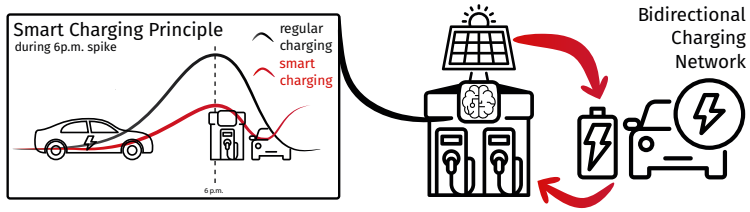
Transforming into sustainable neighborhoods

For more Utrecht demonstration results

V2G EV Charging Network

Utrecht is the first city world-wide to implement the vehicle-to-grid (V2G) technology on a broad scale. Bidirectional V2G charging enables electric cars to both charge and deliver energy from car batteries back to the grid. This way car batteries become buffers for renewable energy and can help cope with congestion by balancing the grid. The IRIS project supported the upscaling of bidirectional charging as an integrated mobility solution, resulting in a city-wide network of 500 bidirectional charging stations and 200 shared electric cars.

King Willem-Alexander at the launch of We Drive Solar



"We can use solar power not only when the sun is shining, but also when the sun is not shining"
– Robin Berg (We Drive Solar)

Back in 2014, it all started with entrepreneur Robin Berg experimenting with his own solar panels and his Nissan Leaf. Soon after, network operator Stedin and the city of Utrecht defined an experimental area for V2G charging, denoting their support for the promising technology. In 2018, Robin's e-car sharing company 'We Drive Solar' procured the public vehicle charging contract commissioned by the municipality of Utrecht. At the time, the V2G technology was considered a 'bonus'. Since then, increasing electrical demand has pushed the Dutch energy grid closer to network congestion, prompting the municipality to upscale V2G city-wide. Now, V2G is considered a 'must have' to balance the grid and avoid expensive grid reinforcements.

Alongside bidirectional V2G charging, smart charging was also developed. Smart charging optimizes charging times according to electricity costs, vehicle type and grid conditions, decreasing the pressure on the grid. We Drive Solar was ideal to test charging techniques as car availability is known through their booking system. The recent sharp increase in energy price accelerated the roll-out of smart charging, resulting in all 500 public charging points now using the smart charging technology.

The system needs a bidirectional car. We Drive Solar initially partnered with Renault to prototype a bidirectional Renault ZOE. This was the first implementation worldwide of AC bidirectional charging based on the ISO standard 15118-20.

In 2022 Hyundai joined the ambition of Utrecht, generating the world's first V2G-enabled production e-car: the Hyundai IONIQ5. The bidirectional option on the IONIQ5 was launched in April 2022 in Utrecht, again a world first.

Another important step in the worldwide success of V2G is compatibility. Development of a universal charging language started in 2019 and ensures that all manufacturers will produce compatible bidirectional cars and charging points. The ISO15118 standard was formally established in 2022, making the worldwide upscale of V2G charging possible.

At the end of the IRIS project, there is a city-wide EV network that allows the use of renewable energy to aid net congestion. With the addition of bidirectional production e-cars and the established universal ISO15118 standard, the bidirectional V2G EV charging network is ready for worldwide implementation, bringing us closer to a greener, safer environment.

VEHICLE 2 GRID TIMELINE

IRIS Utrecht

2014
An individual entrepreneur called Robin Berg, started to experiment with his own solar panels, a bidirectional charging pole and a car

Stedin and Utrecht City defined experimental areas for vehicle to grid, including the area Robin was experimenting in

2017
Start IRIS

NOVEMBER 2018
We Drive Solar, Robin's company, wins the first procurement "Public Vehicle charging" for Utrecht City. At this point V2G capability was still seen as a 'bonus'

An universal ISO standard is under development for V2G technology

MARCH 2019
First V2G charge station installed. The steel casing is not approved intitially. Fortunately, the plastic replacement enables smart meter readout!!

SEPTEMBER 2019
Utrecht city decides to scale-up V2G to whole city

JUNE 2020
Renault decides to disengage from V2G pilot

MARCH 2020
Start COVID-19

MARCH 2021
Second procurement Utrecht city with V2G capability as requirement (700 charging stations)

APRIL 2021
Hyundai replaces Renault in V2G pilot

DECEMBER 2021
Sharp increase energy prices destroys V2G business model *

Accelerated roll-out of smart charging on all stations **

APRIL 2022
First live V2G demo with production cars from Hyandai (using draft ISO software)

MAY 2022
ISO standard 15118 for V2G is formally established

NOVEMBER 2022
Substantial changes in pilot software due to final ISO changes

Due to net congestion V2G is now a MUST have instead of a Nice to Have as in the beginning of IRIS

2023
End IRIS
ISO Standard embedded in software, cars and charging stations

* The V2G business model for We Drive Solar was based on fixed pricing for the charging and flexible buy-in of electricity. The exceptional increase in energy proces was detrimental. Fortunately, a constructive solution between Utrecht and We Drive Solar was found.

** Smart charging is a way of charging electric vehicles that involves using advanced algorithms and communication technologies to optimize the charging process. This can involve using data on electricity prices, vehicle usage patterns, and grid conditions to determine the most costeffective and energy-efficient times to charge the vehicle. By using smart charging, it is possible to reduce the demand on the electric grid and avoid peak pricing periods, which can save money and help to support the integration of renewable energy sources into the grid.

Vehicle-to-Grid (V2G) is a technology that allows electric vehicles (EVs) to not only consume electricity from the grid, but also to supply electricity back to the grid. This allows EVs to be used as a source of distributed energy storage, which can help to improve the efficiency and stability of the electricity grid. Utrecht City, together with We Drive Solar, Hyuandai, Renault and other partners built a large and succesful V2G eco-system in Utrecht.

Zero-emission bus transport and smart charging

Utrecht is aiming for emission-free bus transport by 2028. Public transport operator Qbuzz was one of the first and in 2022 had already 37.6% of all timetable hours driven emission-free. This makes Qbuzz one of the most sustainable carriers in the Netherlands.

According to Qbuzz, emission-free driving is technically feasible on a regional scale in 2023. Development of new technology regarding electric buses and chargers is important to enable the transition to completely emission-free public transport. The technology is developing fast and becoming a more mature technology. However, the electricity supply in the Netherlands is starting to present a problem. This is where smart charging comes in. By deferring charging sessions to favourable times, the power grid is spared at peak times.

Qbuzz developed a model with Utrecht University to calculate different charging strategies of electric buses. Smart charging of buses resulted in halving peaks in electricity demand leading to less load on the power grid and lower energy costs. Therefore, Qbuzz scaled up smart charging to all Qbuzz e-bus depots. Two smart charging strategies, 'delayed charging' and 'peak shaving', were used. During the implementation Qbuzz experienced a lot of practical challenges, especially on technical aspects. At the time, the number of e-buses was also rapidly expanded to a fleet of now 55 electric buses that are fully data-monitored.

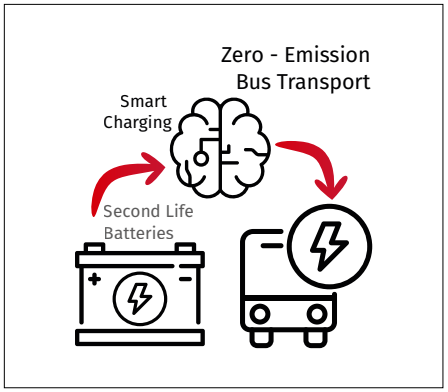
Qbuzz will investigate buying electricity through other energy markets, such as day-ahead or imbalance markets. Last step is to supply electricity back to the grid, either from bus batteries by discharging buses (also known as vehicle-to-grid (V2G)), or from static 'stand alone' battery packs. Qbuzz's battery packs of used bus batteries no longer have enough capacity for buses, but can serve as energy storage. Currently, Qbuzz has about 300 battery-electric buses running in the Netherlands so there is a lot of storage potential there. The data can be used for research and preparing business cases for scaling up battery storage with 'second life' batteries.

Early on in the IRIS-project, the importance of data and monitoring became apparent and impacted almost all facets of Qbuzz's operations. Now, Qbuzz has an entire team dedicated solely to data procurement and monitoring. One of the lessons learned is the importance of controlling the data yourself. That way you can switch faster and innovate.

Sessions with the other international partners within IRIS revealed that many countries are still in the process of tendering the buses. It is important to keep in mind that it is not just about the procurement, but that there is a change in maintenance, bus drivers' behaviour and data-driven management involved.

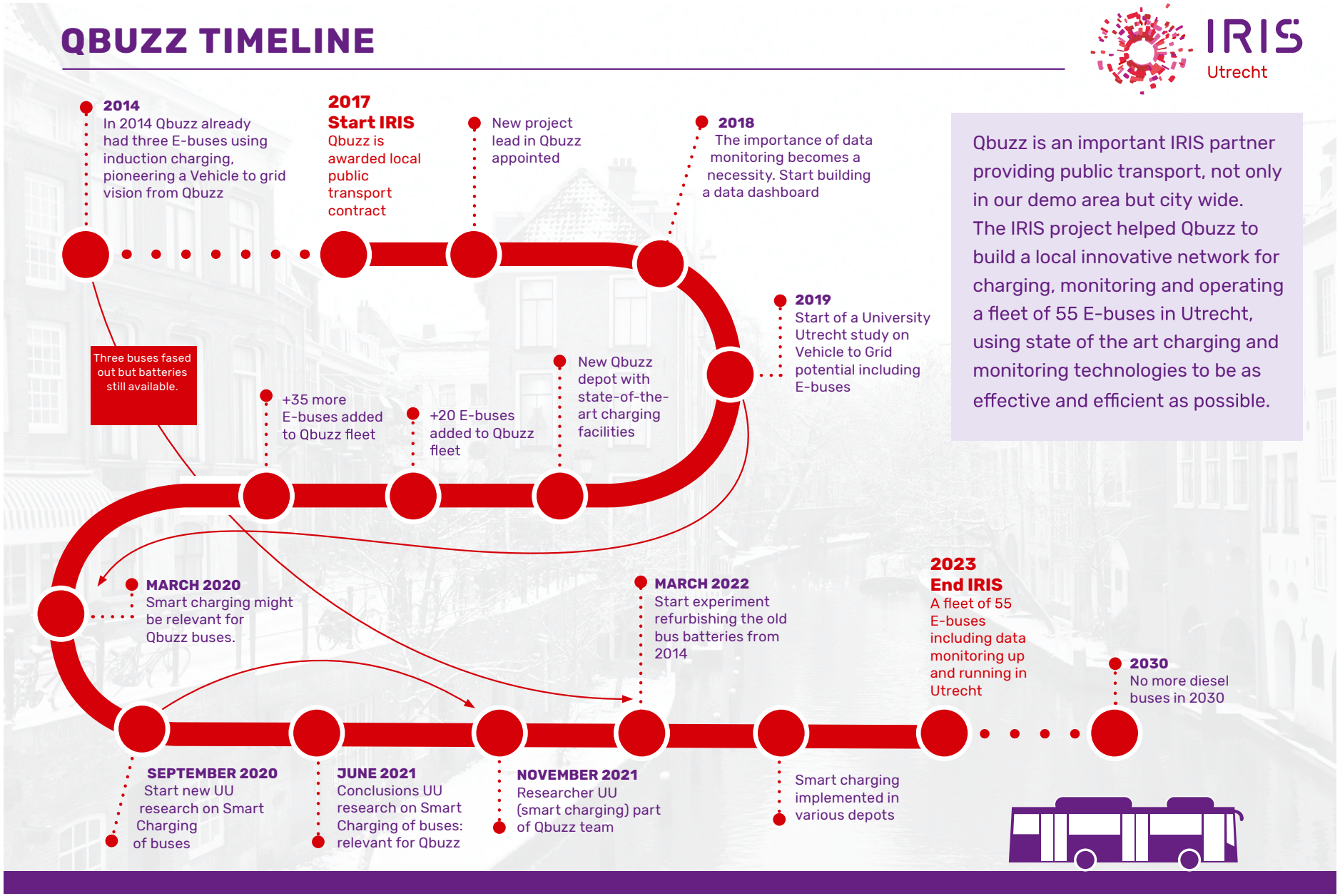
Zero-emission bus transport is tackled in Utrecht by the implementation of an e-bus fleet. At e-bus depots, smart charging is applied as a network congestion solution. Second life bus batteries, no longer suitable for use due to reduced capacity, form flexible energy storage. In due time, bidirectional charging is also employed where energy stored in second life batteries and in batteries of active e-buses (V2G) can be delivered back to the grid to balance congestion.

One of the 300 battery-electric buses operated by Qbuzz



QBUZZ TIMELINE

IRIS Utrecht



Qbuzz is an important IRIS partner providing public transport, not only in our demo area but city wide. The IRIS project helped Qbuzz to build a local innovative network for charging, monitoring and operating a fleet of 55 E-buses in Utrecht, using state of the art charging and monitoring technologies to be as effective and efficient as possible.

Nearly zero-energy building (nZEB) transformation

As part of the Paris agreement (2015) the carbon footprint of houses must be decreased to become carbon neutral. Therefore, the IRIS project aimed for energy positive districts through nearly zero energy building (nZEB) transformation. Social housing corporations renovated their housing stock in cooperation with tenants. Depending on the characteristics of the building and the wishes of the tenants, this could include insulating walls and roofs, replacing window frames and glazing, and installing hybrid heat pumps and PV-panels. Social housing corporation Bo-Ex planned to transform twelve low-energy apartment buildings during the IRIS project in the urban district of Kanaleneiland in Utrecht.

The first planned building transformation in 2019 came to a halt when only 68% of the tenants consented to the renovation (legally it must be 70% or higher to get a formal status of a reasonable plan). The setback inspired Bo-Ex to innovate tenant engagement together with IRIS partners. Personal approaches were applied, considering the tenant's perception and occasionally dealing with social issues. Tenants were also more involved in the renovation decision-making process through a tenant committee. Since Kanaleneiland is culturally diverse, multilingual information was offered in spoken and written form when possible.

Bo-Ex applied the new engagement approach to the second apartment building. Tenants were offered a smart thermostat for free before the renovations. This allowed Bo-Ex to connect with tenants to discuss the renovations. When tenants were asked to vote, more than 70% consented to the renovation and activities could proceed as planned.

Most tenants enjoyed their transformed new home, leading to tenants from other buildings becoming open to their own building's renovation. In the third building 75% of tenants agreed to the renovation. While the process was started in other buildings, the first building was revisited in 2022. This time, the required consent threshold was reached. It seems that the innovative engagement approach resulted in more support from tenants for renovation activities.

Up to now, four apartment buildings have been transformed, accounting for a total of 192 homes. The building transformations will continue after the IRIS project, bringing us closer to a comfortable, carbon-neutral living standard in Utrecht!

"A renovation is like a small move. Many residents are not keen on that. But once the dust settles, most are happy with their new home".
- Martijn Broekman (Bo-Ex)

Arno Peekel
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The near-zero energy building transformation will result in energy efficient buildings.

Two people working in the garden of complex 3

REFURBISHMENT TIMELINE

IRIS Utrecht

2016
In a successful pre-pilot the full refurbishment of a almost carbon neutral housing complex (48 households) had been demonstrated and tested.

2017
Start IRIS

JULY 2019
IRIS complex 1 (48 households) hit a bump when 67% of the tenants agreed versus the legal threshold of 70%

We decided to install smart meters in complex 2 to better engage with tenants ahead of full consent. And field test a novel engagement approach (with HKU/USI/ Eneco/Bo-Ex)

Highlights of this approach:
- Independent chair for the tenant committee
- individual talks with all households
- tailor made information brochure

Second round of smart meter instalments in complex 3 ahead of full refurbishment

To compensate for the planning adversity, new households were added to the IRIS portfolio

After initial rejection, complex 1 met the 70% threshold in the second attempt.

Adding complexes in different neighbourhood to the mix (58 households) and an additional 354 households

MARCH 2020
COVID-19 outbreak hampers operations and citizen interactions

FEBRUARY 2021
The required 70% of tenants in IRIS complex 4 agreed putting complex 4 in motion

A positive spill-over effect of earlier refurbishments is notable in new tenants in the IRIS complexes

The sudden rise in energy prices helps gaining support with tenants for installing energy measurements

2023
End IRIS

Continuation IRIS complexes 5 - 12

Third round of initial smart meter instalments in complex 5,6 and 7 ahead of full refurbishment

SEPTEMBER 2021
The required 70% of tenants in IRIS complex 3 agreed putting complex 3 in motion

MAY 2022
After initial failure, the required 70% of tenants in IRIS complex 1 now agreed putting complex 1 in motion.

A large part of the UTRECHT IRIS demo consisted of the full refurbishment of eight buildings of 48 households and four buildings of 65 households each to make them almost carbon neutral (NZEB). Housing corporation Bo-Ex was in the lead. By law, in each complex at least 70% of the tenants had to formally comply with the proposed plans. This proved to be a challenge. In close collaboration within the Utrecht consortium this challenge was overcome, and from that moment all following complexes met the 70% threshold.

Sweden

Gothenburg

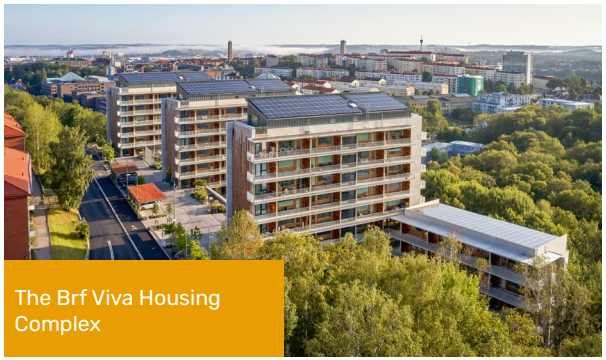
Sweden's most sustainable housing project

For more Gothenburg demonstration results

Testing innovative sustainable housing and urban development: the Brf Viva story

Located in central Gothenburg, Housing Association Viva was built as a flagship for the initiative Positive Footprint Housing. The initiative is a multidisciplinary platform where housing company and IRIS-partner Riksbyggen together with academic and public partners, aim to push the boundaries of sustainable buildings and living including social and economic and ecological sustainability.

Viva was inaugurated in 2019 and and many of its solutions were developed within IRIS. Here we have chosen to focus on three of those: the mobility service, the second-life battery storage and the cooling connection to a nearby office building.



The Brf Viva Housing Complex

The Mobility Service EC2B

In Viva, Riksbyggen decided to not offer residents any private parking spaces.

"Building a house that was car-free was an important part of our sustainability ambition and something we made very clear to potential apartment buyers from the beginning," said Charlotta Brolin, sustainability expert at Riksbyggen, *"We never experienced that the lack of private parking spaces was a big issue for them, maybe because we also communicated that there would be alternative mobility solutions."*

Instead, the transport consulting company Trivector and its subsidiary EC2B Mobility have developed the EC2B concept, which provides mobility options through an app available to Viva residents. In a large bicycle room, electric bikes are available to the residents for free through the EC2B booking system. Keys are kept in a digital key box that also opens through the app. The app is also connected to the electric car-pool with three cars parked in front of the building. Residents pay for the time they use the cars. The EC2B concept also allows users to buy tickets for public transportation.

Surveys show the residents of Viva appreciate the mobility service and have to a large extent changed their mobility habits, but far from all have totally given up their private cars.

"One of the most interesting results is that not only are car trips shifted from private (conventional) cars to shared EV:s, but we also see that car usage in total is almost halved compared to the average for Gothenburg," said Lennart Persson, CEO of Trivector's subsidiary EC2B Mobility. *"This shows the potential for shared mobility solutions based in accommodation to contribute towards system change."*

One of the bikes available through the EC2B mobility service

MOBILITY SERVICE TIMELINE

IRIS Gothenborg

2015
Positive Footprint Housing initiative starts

Pilot study on mobility by Trivector and Riksbyggen

2016
Building of Brf Viva starts

2017
Start IRIS

Trivector starts EC2B subsidiary

2018
First dialogue with Brf Viva residents to encourage new mobility habits. All residents offered personal mobility advice and demo of the MaaS Vehicles

2019
Launch of EC2B app that allows easy access to all vehicles included in the service as well as public transport tickets at a discounted price (during the first couple of months)

First residents move in to Brf Viva and get access to the mobility service

First dialogue with property owners and employers in preparation for second demonstrator which aimed to evaluate EC2B application to work related transport

Travel survey shows that kilometers travelled by car are reduced almost by half among Viva residents compared to the average in Gothenburg

Second demonstrator for work related mobility installed at the campus of Chalmers University of Technology

2020
EC2B expands to more sites in Gothenburg and Lund

2021
End of the second demonstrator with low results because of the Covid-19 pandemic, but with valuable insights into what is needed in complex structures with many different stakeholders.

EC2B to be implemented in two new mobility houses in Uppsala

2023
End IRIS

The mobility service EC2B has shown to be attractive and appreciated among users, it is scalable and replicable and has attracted great interest from real estate owners. Main results show that in the Viva complex, MaaS usage is high, both for e-bikes and e-cars and satisfaction ratings from users are high. Private car ownership among Viva residents is significantly lower than the city average.

Sharing is caring: the Viva building cooling connection

Local energy systems where different buildings can share their energy surplus are an important part of future smart and efficient energy systems. Through IRIS, the energy system of the Viva apartment complex has been connected to that of Chalmers University of Technology and the office building, Chalmers Teknikpark office building.

"The connection will mean that Viva's geothermal heating facility runs more efficiently and thus draws less electricity. The conditions are special here in that Brf Viva is so close to an office building, which has a greater need for cooling, especially in summer," said Matilda Kjellander, project manager for Viva at Riksbyggen.

In practice, pipes have been laid between the housing association's boreholes and Chalmers Teknikpark, located about 200 meters away. The office building's cooling system can fetch cold water from the boreholes, which saves the building's own heat pumps. When this water circulates in the building, to cool the indoor temperature, it in turn absorbs the building's heat and the water temperature rises a few degrees before it is sent back up to Viva's borehole.

Water from Teknikparken keeps 10-15 ° C to heat the boreholes and delivers warm water to the radiators and faucets of the apartments, while sparing the system's heat pumps. In other words, the excess heat from the offices is transferred to Viva and recharges the boreholes instead of being lost in an energy-intensive cooling system.

This type of collaboration between different property owners, in this case Chalmersfastigheter and Housing Association Viva, are still unusual, but they are increasingly being presented as an important part of a more energy-efficient society. By taking advantage of the different needs of heating and cooling of two nearby buildings, synergetic relationships can be established between them, so that they meet their needs without straining the city-wide network.

"If this solution works as we believe it will, it could reduce the office building's cooling needs and increase the efficiency of the residential building's geothermal system, and thus reduce both the amount of purchased district heating and electricity from each network, but above all reduce the peak power requirements, which is where the greatest climate benefit lies," said Peter Selberg from Johanneberg Science Park, who coordinates the cooling connection within the framework of IRIS.

The Chalmers Teknikpark in Gothenburg, Sweden

COOLING CONNECTION TIMELINE

IRIS Gothenburg

2015
Positive Footprint Housing initiative starts

2016
Building of Brf Viva starts

2017
Start IRIS

Brf Viva initiates collaboration with property owner of office building Chalmersfastigheter

2018
Budget issues were identified - the cost was higher that expected.

Residents move in to Brf Viva

Agreement with the housing association at Viva reached

2020
Budget issues were solved by adjustments in the IRIS budget

All contracts signed between IRIS and property owner Chalmersfastigheter

2021
Cooling connection installed

2022
Results show better transmission capacity than expected - 109 MWh delivered in first year

Cooling connection is part of a larger energy system (also used as a testbed) at the campus of Chalmers University of Technology

Cooling delivery was higher than expected making the office building's boreholes too cold. They will solve this issue by adjusting the management system.

2023
End IRIS

The aim of the seasonal energy trading was to connect the energy systems of Viva to an adjacent office building using insulated pipes. This enables:

- the free cooling from the boreholes to cool the comfort system in the office building
- the excess heat from this comfort cooling system to heat the boreholes in Viva and in turn make the geothermal heat pumps more efficient

Both facilities could then potentially meet their heating and cooling demands by using less electricity.

Giving buildings energy storage through second-life batteries

Volvo Group wanted to explore if used bus batteries could be used as energy storage in residential buildings. Johanneberg Science Park connected two collaborative flagship projects – ElectriCity , running an electric bus line through Gothenburg and Positive Footprint Housing. A demonstration project was created and accepted as part of the IRIS project.

In the summer of 2018, 14 batteries from the Volvo-produced buses were installed in a specially designed room in Viva . When the batteries no longer have power to serve the buses, it still has about 80 percent of its capacity left. While too limited to efficiently propel a bus, it is more than sufficient for the static use of energy storage of solar energy in an apartment building, for example.

After the pilot in Viva, Volvo Group has taken several steps towards commercialisation of the second-life concept. At the end of 2019, the company started a cooperation with Stena Recycling subsidiary, Batteryloop , where the bus batteries become part of a business cycle. Because of an expected global increase of used bus batteries, along with the potential of second life batteries, the Volvo Group launched the new business area Volvo Energy in early 2021.

"The research project in Viva was the basis for us taking the next step with Stena and Batteryloop. The third step into a new business area really shows that there are high expectations for the commercial potential of second-life batteries," says Stefan Widlund, City Mobility Director at Volvo Buses.

"A lot of knowledge has been gained in Viva," said Ylva Olofsson System Design Engineer at Volvo GTT, Powertrain Engineering. *"For example, the batteries in the storage are ageing slower than expected which is positive. But safety issues make it expensive to build the storage within the building itself. Later installations put the storage in a separate building. We also learnt a lot about the contracts and agreements that were needed when many stakeholders are involved"* she said.

"This is an example of how the demonstration phase is important to gain knowledge and experience, but it doesn't stop there – it is only when scaled up that these innovations can benefit society by both creating economic growth and using natural resources more efficiently. We have also contributed to building new networks and connections and who knows what new synergies can come out of that" said Eva Pavic, project manager for IRIS Gothenburg at Johanneberg Science Park.

The batteries are installed in a specially designed room in the building

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2ND LIFE BATTERY ENERGY STORAGE TIMELINE

IRIS Gothenburg

2015
Positive Footprint Housing initiative starts

2016
Building of Brf Viva starts

Collaboration initiated between Riksbyggen, Volvo, Johanneberg Science Park and Göteborg Energi on energy storage

2017
Start IRIS

Related project initiated to further investigate possibilities of second-life battery storages

2018
Second Life bus batteries installed

Residents move in to Brf Viva and are able to use more energy produced by the solar panels on the roof

2019
Operational issues due to communication difficulties between systems

Volvo Group Initiates cooperation with BatteryLoop fostering the scale up of 2nd life battery installations

2021
Results show that the 2nd life battery storage at Brf Viva has not been as efficient as expected, largely due to problems with the communication between software, interfaces and organizations. On the other hand the batteries did last longer than expected storing 100-150 kW, just short of the original target of 200 kWh, showing promising market potential.

Volvo Group starts business area Volvo Energy

2022
BatteryLoop has moved on to install 2nd life batteries in more residential and office buildings across Gothenburg. Volvo Energy is pushing the use of 2nd life batteries forward on a global level. Johanneberg Science Park with partners leads new projects to further investigate the use of 2nd life batteries and is raising knowledge about battery installations among property owners.

2023
End IRIS

The objective has been to demonstrate a Positive Energy District (PED), a district that annually produces more electricity and heat than it consumes. To achieve this, a combination of energy-saving measures, energy storages, renewable energy sources and energy management systems have been designed in the housing cooperative Viva. One of the solutions implemented is an energy storage using 2nd life batteries from Volvo's electric buses.

France

Nice Côte d'Azur

Data-driven sustainability

For more Nice demonstration results

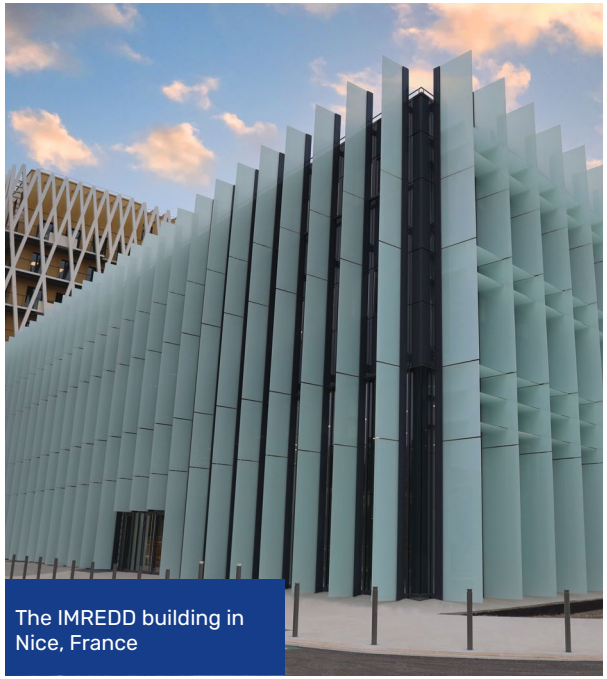
How to build a Smart Building (IMREDD): challenges and opportunities

The energy transition requires buildings to become smarter when interacting with people, the environment, and consuming energy. The IRIS project's Nice demonstrator 'smart' building is designed to benefit from and adapt to the local environment. For example, side fins made of opaque glass prevents direct sunlight heating the building in summer.

The building is also constantly monitored and controlled. Electric vehicle charging points are controlled by 'smart charging' algorithms that limit the overall power. Smart lighting and ventilation systems only get activated when needed, or when people have been detected nearby.

The Nice demonstrator building also includes solar PV panels, a small wind turbine and flexibility assets such as a first life battery, a second life battery from an electric vehicle, and an electric vehicle V2G enabled. These flexible assets are controlled in real-time by an Energy Management System (EMS) that uses modern AI forecasting and optimisation methods to minimise the environmental impact of the building's energy consumption and energy bill. Data such as power consumption, power production, air quality or the presence of people is collected in real-time, stored in Nice's City Innovation Platform that uses Fiware's NGSIv2 data standard, and displayed in IMREDD building's Smart City Innovation Center.

But there are still challenges to this. Although most of these smart building technologies are mature, our experience from the Nice Smart building shows that it still requires considerable and continuous effort to ensure that all these assets work properly and together. Technical challenges and the requirement to understand software, electronics and electrical engineering to commission and operate smart building solutions make it difficult to democratise access to smart buildings. All this means that Smart Buildings will only become more accessible when all-in-one plug-and-play solutions are available.



The IMREDD building in Nice, France

In smart buildings, connectivity is key. If it loses connection to the internet, sub-systems cannot send and receive data from their proprietary server. This would stop the service they were meant to provide.

The data generated in a smart building could also rapidly exceed the data storage space that a building would normally dedicate to its operation. Data storage strategies should aim to reduce the environmental impact of digital technologies by reducing to the minimum the amount of data and computing power required for an efficient operation.

Finally, smart building technologies face a long return on their investment. For example battery technologies used for self-consumption will not be profitable within the 10 years of batteries lifetime, which strongly affects the incentives to investors.

Despite these challenges, alternative solutions exist for those willing to invest in decarbonised technologies. For example, developing energy communities allows prosumers to sell energy at a higher cost than current Feed In Tariffs. Consumers access energy at a lower price than the grid. This win-win situation could be the evolution of smart buildings towards Smart Local Areas, in which communities reduce their environmental impact at a lower cost.

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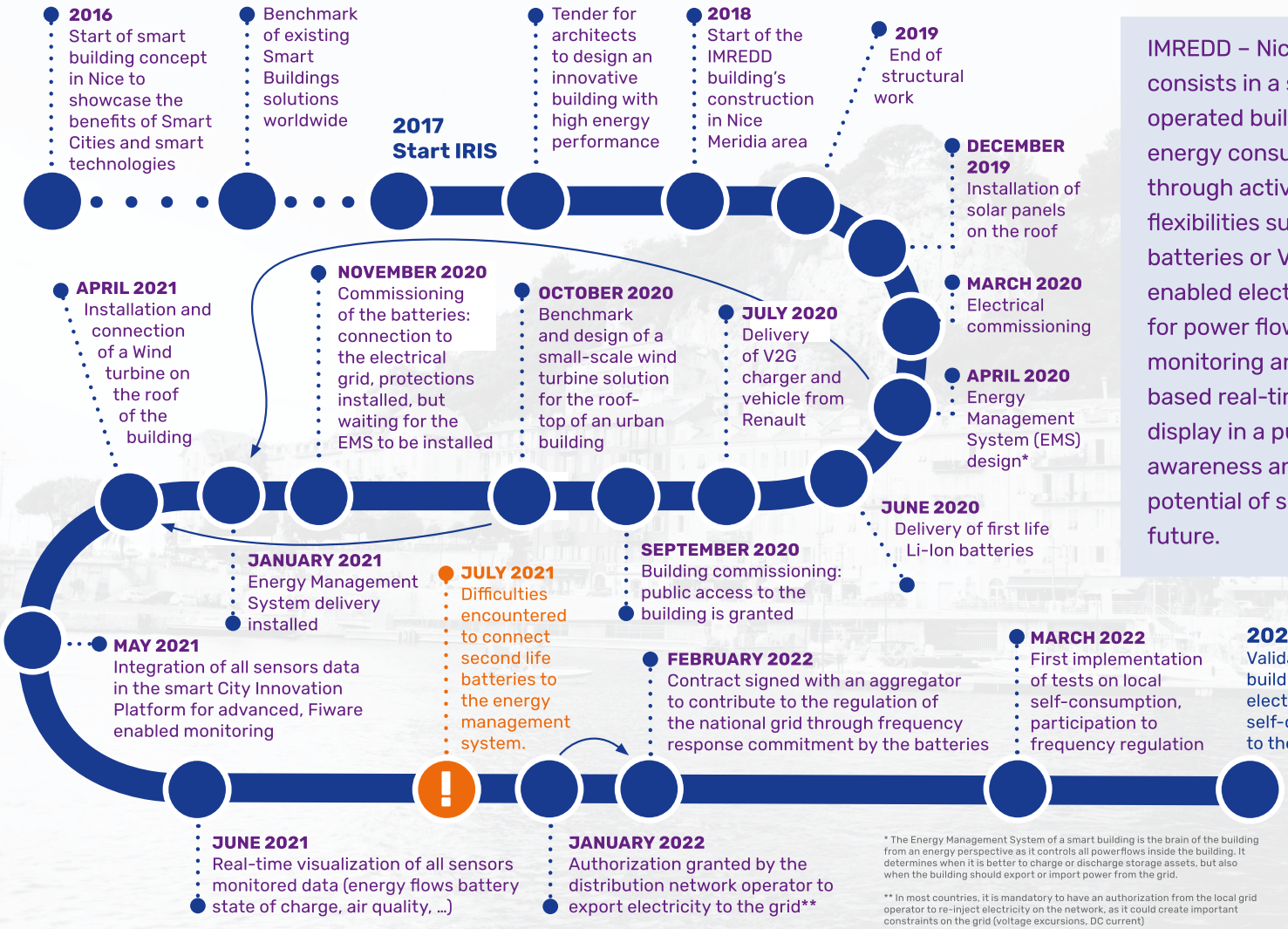
NICE SMART BUILDING TIMELINE

IRIS Nice Côte d'Azur



IMREDD – Nice's Smart Building consists in a smartly designed and operated building that optimizes its energy consumption and production through activation of local energy flexibilities such as electrochemical batteries or V2G (Vehicle to Grid) enabled electric vehicles. All sensors for power flow and air quality monitoring are providing Fiware based real-time data used for local display in a public open area, raising awareness and demonstrating the potential of smart buildings in the future.

* The Energy Management System of a smart building is the brain of the building from an energy perspective as it controls all powerflows inside the building. It determines when it is better to charge or discharge storage assets, but also when the building should export or import power from the grid.

** In most countries, it is mandatory to have an authorization from the local grid operator to re-inject electricity on the network, as it could create important constraints on the grid (voltage excursions, DC current)

A City Innovation Platform to facilitate data transmission CIP

A City Innovation Platform (CIP) collects, manages and exchanges data to monitor the IRIS demonstrations and develop new applications and services. The platform manages large volumes of data and information from domain-specific solutions, like waste collection, air quality, and other data sources. Based on a common reference architecture and a Data Governance Plan, the cites of Utrecht, Gothenburg and Nice deployed a local instance of the CIP. The dual purpose of the IRIS CIP was to provide an infrastructure for collecting data to calculate the project's Key Performance Indicators and to support various use cases/data services.

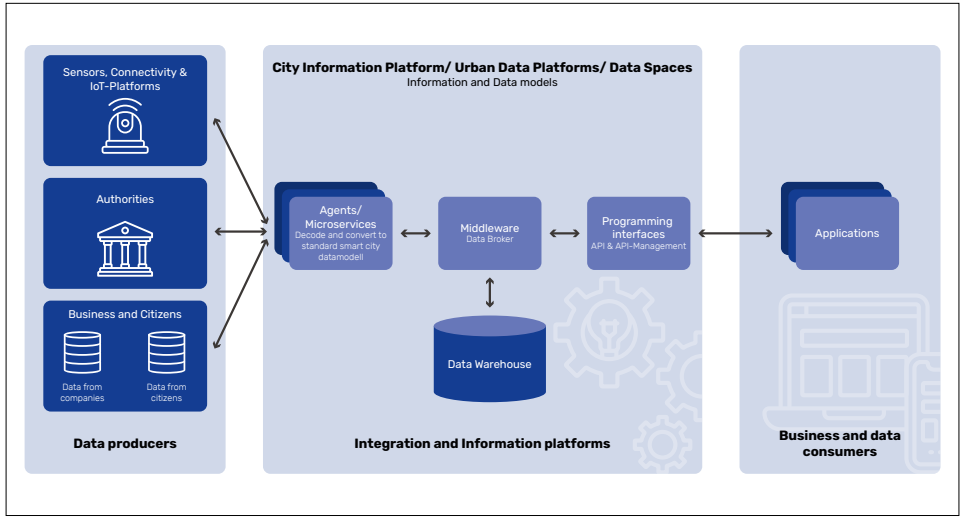
During the IRIS project, the CIP supported several solutions including the fight against energy poverty in Utrecht, where tenants of housing corporation Bo-Ex had better control and understanding of their energy bills. This led to reduced energy bills and increased tenants' disposable income. In Gothenburg, the CIP helped to provide real-time information on water temperature in lakes using sensors so swimmers can be informed of any dangers. In Nice, sensors collected data on pollutants in the air and gave a near real-time forecast of the city's air quality so citizens could, for example, exercise outside at optimal times.

The design, development and operation of CIP in the three Lighthouse cities offered many lessons. From the technical perspective, a CIP should be interoperable with components coming from projects and venders that use and promote open-source software so that it is easier to implement upgrades as they become available. A CIP should also ensure compatibility with existing IT infrastructure and pay attention to security aspects.

But CIP is more than an IT issue. It is also a business development issue. Businesses should be on board right at the start of CIP implementation to assign information owners, balance competing interests, and ensure the willingness to pay for the service. Data sovereignty is essential as data is the most valuable raw material. The challenge is to ensure that the data is handled correctly and is accessible and owned by the correct parties. Federated solutions can address legal issues by separating data and accessing it through a federated interface with well-defined contracts.

There are multiple open standards available for use to support a CIP. However, few of them are actively developed and used for collaboration between cities. Within IRIS we have seen that FIWARE offers an extensive collection of generic enablers for CIP functionality. The FIWARE Smart Data Models allow for the harmonisation of APIs and data models and compliance with Minimal Interoperability Mechanisms of the Open and Agile Smart Cities Association.

In Nice, the 3Vs (volume, variety, and velocity) are defining properties of a CIP and posed challenges in handling data. The platform needed be able to manage the large volume of data and handle its variety and quick velocity. To meet these challenges, the CIP architecture had to be scalable and able to standardise data and have monitoring tools to ensure data quality and availability. The biggest challenge in moving from a demonstrator to an operational platform is ensuring high availability and organising the technical and maintenance teams to maintain its operational condition.



DEVELOPMENT OF THE CIP

IRIS
Nice Côte d'Azur

2017
Start IRIS

JUNE 2018
Baseline definition for the ICT systems in each Lighthouse city

OCTOBER 2018
Technical specifications of the CIP components are defined

MAY 2019
Creation of the reference architecture for CIP technical components

DECEMBER 2019
Implementation of the core components of CIP

MAY 2020
Methodology and practical guide to implement a data Governance Plan in a CIP Architecture

JUNE 2020
1st round of use cases: Injection of Air Quality data, parking spots data, etc.

MARCH 2020
Full CIP implementation in the IRIS Lighhouse cities

MARCH 2021
2nd round of use cases: Injection of Thermal Energy production and consomption data, weather observation and forecast data.

MAY 2021
Implementation of CIP Data Governance in IRIS

JUNE 2021
Implementation of CIP supervision and monitoring tools

SEPTEMBER 2021
3rd round of use cases: Injection of streetlighting data, bathing water temperature data, parks' solid moisture data, EV charging stations data, etc.

SEPTEMBER 2022
Continuous updates and expansion to support new use cases

2023
End IRIS

The CIP implemented in the framework of the IRIS project is based on an open architecture and standards ensuring the interoperability and replicability of proven solutions in each city. It connects and integrates with existing ICT platforms within and between cities. This is essential to ensure openness, data protection and replicability.

Increasing air quality awareness among citizens

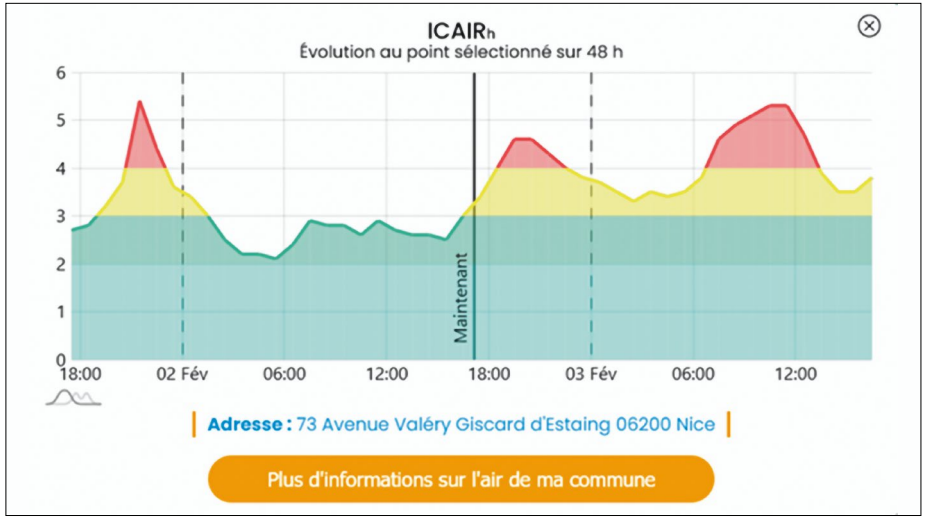
Exposure to polluted air is a leading contributor to the development of several medical conditions including asthma, respiratory infections, heart disease and more. IRIS partners at AtmoSud, together with the Métropole Nice Côte d'Azur, decided to develop a new air quality mapping tool that citizens could use to determine the ideal time for their outdoor activities.

Traditional air quality indexes are based on one pollutant and usually propose a daily forecast. In contrast, AtmoSud worked to collect and combine data on four pollutants (nitrogen dioxide, ozone and PM10 and PM2.5 particles) as well as other territorial data (such as peak road traffic times) using micro-sensors and the City Innovation Platform. They then applied this data to generate a high-resolution hourly mapping system for air quality called the "the ICAIR-h index", which can provide near real time, dynamic information on pollution at street level throughout the day.

Air quality indices such as these enable the citizens of Nice to adapt the time and the location of their outdoor activities. For example, in the figure below, one can see that on Avenue Valery Giscard d' Estaing it is better to do sport or walk your dog before 6pm. The tool also doubles as a decision-making tool to identify local phenomena impacting air quality.

To complement the development of the new index, the Métropole Nice Côte d'Azur developed a broader awareness raising campaign on air pollution, focusing on the positive steps that citizens could do to favour better air quality in their city, such as using a bicycle or using public transport instead of cars.

On the 24th of January 2023, AtmoSud finally implemented the ICAIRh index on its website. Communication campaigns integrating the ICAIR-h index are planned to make air quality monitoring accessible to all. The activities of AtmoSud within IRIS show what goes into making a city "smart", from integrating measurement by micro sensors, engineering and expertise for modelling all the way up to communication and awareness raising. The next step will be for AtmoSud to integrate recommendations on what activities can be considered safe to carry out in terms of air quality, directly onto the graph.



Fellow Cities

Solution replication is more than “copy-paste”

The IRIS “Lighthouse cities” have developed and implemented different demonstration projects linked to the smart city concept. The IRIS ‘Fellow cities,’ then prepared replication plans of these demonstrators and went even further by developing and implementing smart city projects of their own.

The first insight came rather quickly in the project; replication is not copy-paste, it is much more complicated than that.

When helping the Lighthouse cities replicate smart city solutions, the Follower cities noticed that a big part of the replication process required remodeling the governance structures and innovation management in their local ecosystems, while technical challenges were secondary.

There was a need to map and include local stakeholders and experts to study and evaluate the demonstrations, but also a need to build an ecosystem that was able to plan and implement replication projects.

A positive note was discovering that technical solutions from different climate zones, and implementation cultures, were compatible for the fellow cites when taking local factors into consideration.

Understanding the stories behind these demonstrations turned out to be as important as understanding their technical specifications, and to be able to create their own story that could prepare a foundation for developing smart city solutions suitable for the Fellow city.

Alexandroupolis

The city of Alexandroupolis is an emerging energy hub for Europe. The city joined IRIS in 2017 with the ambition to prepare for a smooth, efficient, and innovative transition to a sustainable, green municipality. The journey of the city is paved by the experiences of IRIS Lighthouse cities and other EU smart city projects, while also creating a strong political and social enthusiasm towards the ultimate target of an energy resilient smart city.

The journey started with actions and activities to support energy transition and climate change mitigation locally and evolved to include the implementation of smart city solutions. The development of a new geothermal district heating network (DHN) is a flagship project for the city and includes two phases. With phase A, renewable geothermal heat will be delivered in municipal buildings, social housing, and greenhouses, while phase B includes the expansion of the DHN to approximately 1,000 homes. The city also aims to develop a positive energy neighborhood using sea-water heat pumps, innovative DHCN and photovoltaics. Other replication projects include electrifying local buses, creating a shared e-bike scheme, and the digital transformation of the city.

The smart city journey of Alexandroupolis has just started, but valuable lessons have been learned. Personnel is the biggest enabler for us. Creating a strong team comprising of political representatives, municipal employees, local experts, and stakeholders is important. Relying on the strong sectors and performing a thorough baseline analysis are important for successful smart city strategy development. Citizen engagement has proved to be a more difficult activity than in other EU cities. We want to do more in this, and it's never too early to start communication activities, since they are integral to successful implementation of smart city projects.

Recommendations for smart cities in South-eastern Europe

- Create a strong, multidisciplinary local team comprising political representatives, municipal employees, local experts, and stakeholders and network with other cities
- Create a baseline of the city highlighting specific needs and challenges, as well as specific competences.
- Familiarize with smart city solutions by investigating best practices, participating in webinars and workshops and by organizing study visits
- Design and execute citizen engagement activities at the very beginning of the project.
- Prioritize the smart city interventions by selecting first the "easiest" ones. A smart city measure can be considered as "easy" when the solution's implementation can be supported technologically, financially, and regulatorily.
- Continuous mapping of the available funding opportunities.

The port of Alexandroupolis

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Watch our Video highlight on Geothermal energy in Alexandroupolis

Santa Cruz de Tenerife

The smart city journey of Santa Cruz de Tenerife (SCT) started with acknowledging the needs for affordable and sustainable resources and making people more satisfied with city infrastructure. The city is changing its approach to mobility, producing and transporting energy, information and data management, and citizens' engagement. SCT's replication plan was the first step in this direction and is supported by the experience of the IRIS Lighthouse cities. The smart city concepts that SCT has pursued are intended to improve the citizens quality of life, considering the economic feasibility of the IRIS solutions and their replicability across the rest of the city. Smart City Solutions have not been concentrated in a specific area of the city so as to implement different solutions where they will be of more benefit, either due to their best yield or better representability.

"A participatory process with local ecosystem and citizenship established the roadmap to design IRIS replication actions in the city with Mobility revealing itself as a top concern for people and companies."

IRIS mobility replication solutions lay at the core of the city's Sustainable Urban Mobility Plan. Launching the first infrastructure for cycling and Personal Mobility Vehicles in the city center was the first step. This measure was coordinated with the implementation of the Low Emissions Zone, which helped to boost sustainable mobility in the city center.

Increasing pedestrian mobility and safe school paths are also part of the new mobility strategy in the city, with a pilot running in the city center serving as the new mobility model for the rest of the city. For instance, there will be a set of segregated bike-lanes to connect all neighbourhoods, and it is planned to develop safe school paths across all public schools.

Public transport is also crucial in sustainable mobility. SCT currently counts on 19 hybrid buses, and four completely electric buses with 11 new e-buses on their way. The goal is to attain a 65% electric fleet in the municipality by 2030. Local bus companies are developing the required infrastructure to cope with this new demand, and preparing the necessary photovoltaic back up to cut off the associated carbon footprint.

In this regard, the municipality already has 50 electrical charging stations for citizens or for public vehicles and it is planned to double it in three years.

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Watch our Video highlight on Mobility in Santa Cruz de Tenerife

SCT currently has 19 hybrid buses and four fully electric buses

Recommendation for cities in Macaronesia region

- Develop a deep understanding of the city challenges and struggles by combining citizen's engagement, local ecosystem and public employees. Invite politicians to participate too.
- Prioritize the objectives accordingly with the previous exercise and counting with the same actors. Limit the number of objectives accordingly with its importance. Let's focus on them.
- Align the smart city goals with the city strategy.

Vaasa

The city of Vaasa is an energy frontrunner. The mid-sized coastal university city in Finland is committed to becoming carbon neutral by 2030. The region is known for its global energy cluster, Energy Vaasa (www.energyvaasa.fi), a technology world leader. With the help of the city strategy, the energy and climate program and the IRIS Smart City replication plan, the city is working towards its sustainability goals.

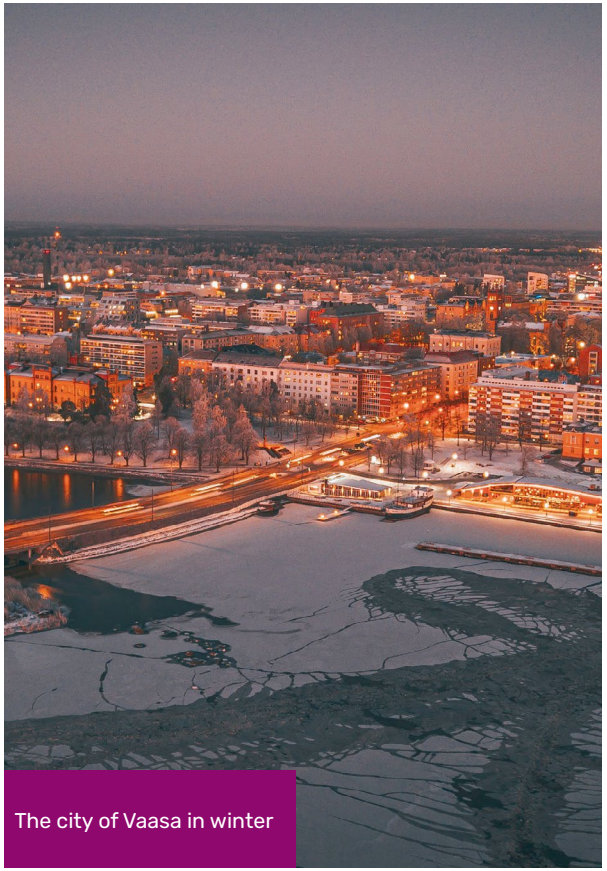
One example is the city's district heating / heat recovery project. The city-owned electric utility Vaasan Sähkö Oy operates a district heating network in the Vaasa region and aims to be carbon neutral by 2030. The utility's heat generation assets are being transformed. As of 2021, 55% of the heat was produced by recovering heat in a waste incineration plant. During the summer, the heat load of the district heating network was almost fully covered by the waste incineration plant.

In addition, a heat recovery project is being developed with the sewage plant in the city. Heat will be recovered with a heat pump from the discharge of treated water. This provides both energy to the district heating network and promotes the local marine life by lowering the temperature of the discharged water. Vaasan Sähkö has established a sector coupling between the electricity and the district heating businesses through a heat only boiler (HOB) producing heat when electricity market prices are low. Since low market prices correlate with a surplus of low-cost renewable energy, mainly from wind power, the HOB is a way of transforming clean and renewable energy from the grid into heat.

Enabling the shift from dispatchable heat production into decentralised and more volatile heat production is a buffer for balancing supply and demand. In Vaasa this buffer is an underground heat storage commissioned in 2020. Two old oil caves from the 1970s were refurbished to hold up to 9000 MWh of heat using water as the heat carrier. The energy storage enables the integrating of renewable energy sources and waste heat into the district heating network. The storage increases flexibility and security of the energy supply, and financial revenues of the district heating company.

Recommendations for cities in the Nordic region

- Set goals for climate neutrality, create a roadmap and a smart city plan.
- Engage stakeholders and citizens.
- Benchmark and investigate smart city solutions that could be suitable for your city.
- Take into account the climate and seasonal changes, legislation and taxation, and technology used.
- Use the "North-Eastern Europe Implementation Guideline" for inspiration and help in your work toward climate neutrality.



The city of Vaasa in winter

Mauritz Knuts
(former) Replication Manager

Watch highlight on District Heating in Vaasa

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Focșani

Focșani is a medium sized city and the capital of Vrancea County. Together with its citizens, the key stakeholders and urban utilities' providers, the municipality is focused on several initiatives. For example, increasing building energy efficiency and living standards, developing an eco-smart public transport, and implementing an ICT decision-based management tool to develop a transparent and efficient public administration process, among others. The IRIS project's objectives had many parallels with Focsani's sustainability goals and, therefore, could greatly contribute to city sustainable development. The Municipality of Focsani realised that it can take great advantage of being part of the IRIS project like connecting with other EU cities that implement sustainable development concepts, replicating projects already implemented elsewhere, knowledge exchange and capacity building \ with help from the Lighthouse cities.

Through the IRIS project the Municipality of Focsani prepared a replication plan for a number of projects to be implemented in different city areas including on:

- Mobility where a reshaping of the streets infrastructure and a Traffic Management Centre would support and prioritise bus and bike lanes as well as the implementation of electric bus transportation and two intermodal centres at the north and south ends of the city.
- ICT where a new IT platform open to citizens would support multiple public services
- Buildings and housing with Near Zero Emission Buildings for young people and increasing energy efficiency in public buildings like schools

"We learned how to do it better and learned how to avoid some of the problems, like the connection to the grid for electric bus charging stations and we learned the importance of new projects, such as NZEB. We will definitely promote the knowledge we gain from IRIS to our colleagues from all the other regions."

One of the initiatives is to increase the energy efficiency of buildings.

Recommendations for cities in the south-central European region

- Prepare a strong SMART City Strategy and identify all possible financing opportunities
- Citizen's engagement and them support is very important in all projects
- Improve knowledge about innovative city mobility and raise citizen's awareness of its advantages.
- Increase citizen's awareness of energy efficiency effects on entire community.
- Involve all local and national stakeholders, learn from other entities experience

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Watch our Video highlight on traffic management system powered by ICT

European Collaboration

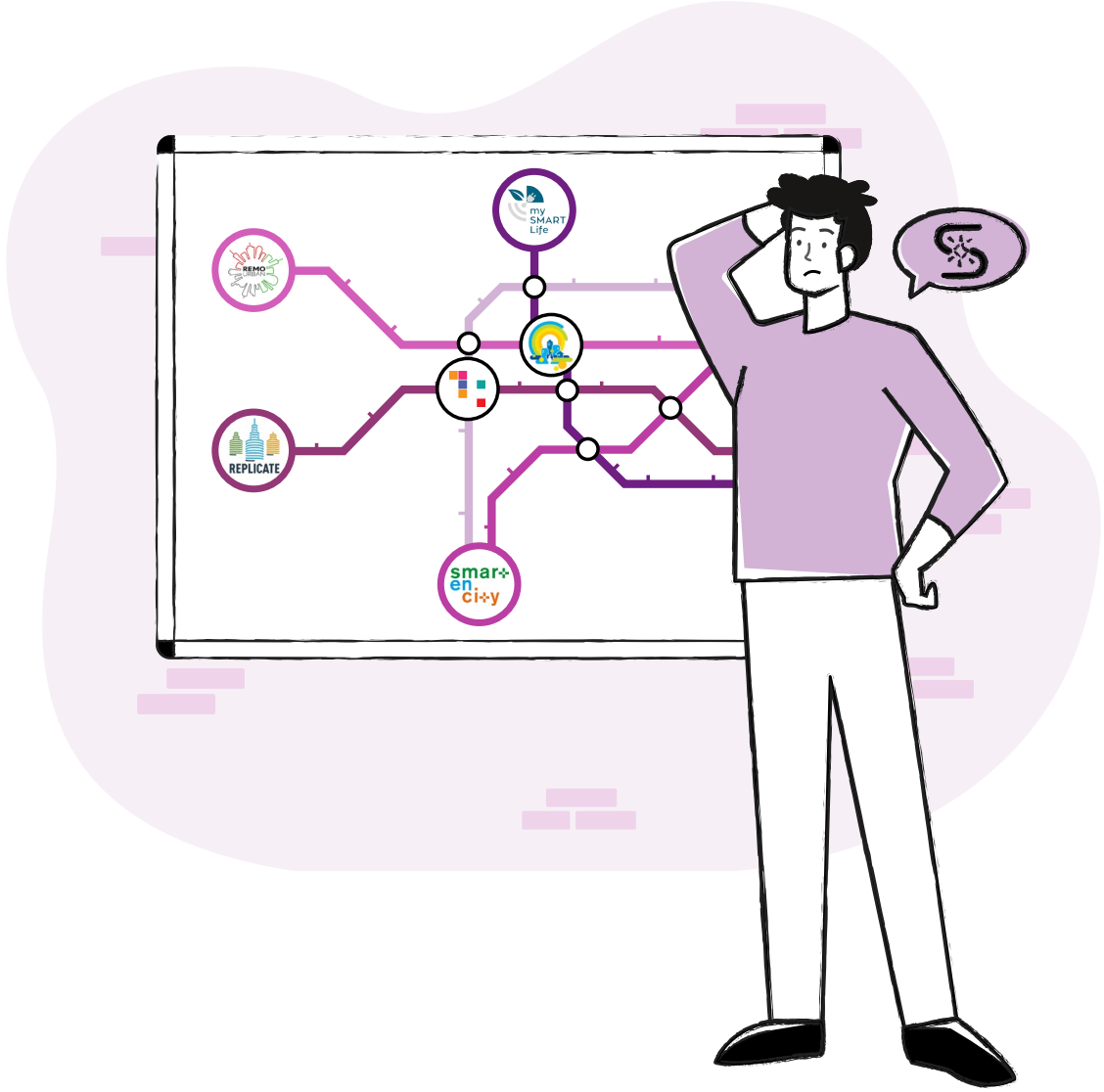
How to make the best of it?

Understanding the EU collaboration network

When we conceived the IRIS project in 2016-2017 there were nine Lighthouse projects, with the European Innovation Platform on Smart Cities and Communities (EIP-SCC) as the dedicated platform for collaboration. By the end of IRIS in 2023, the Lighthouse projects had doubled to eighteen and the Smart City Market Place (SCMP) and the Smart City Information System (SCIS) consortia had been established as second and third collaboration platforms. After this, EIP-SCC and SCIS were incorporated in the SCMP consortium, while the Scalable Cities consortium was established in support of the Board of Coordinators (BoC) of the 18 Lighthouse projects (including the BoC's five Task Groups). Several new projects were selected under the Horizon Europe Mission on Smart and Climate-Neutral Cities to also support selected cities in scale-up and replication of smart solutions for climate neutrality.

This evolution in collaboration towards a 'network of networks' while presenting many new great collaboration opportunities, also made it more challenging for IRIS partners to keep informed on the latest details and openings. The sheer number and the interconnectedness of the possibilities seemed to lead some IRIS partners to shy away from what they called "a collaboration congestion".

We needed to jump forward and be at the heart of the "collaboration congestion" if we wanted to keep track, contribute, and make the most of the opportunities. In 2018 the IRIS Task Group on Replication met with the EU in Brussels to discuss barriers and drivers for scale-up and replication. Inspired by this meeting, IRIS chose to become chair of the Task Group Replication in 2019.



We saw that both the collaboration landscape, and the discourse on successful replication was evolving.

Instead of finding answers to our questions on scale-up and replication, we heard the same questions everywhere else. A shift in focus appeared: from collaboration on replication results to collaboration on replication research. What makes or prevents replication? What exactly needs to be replicated? What research is needed to answer that question, and get meaningful results? It seemed at the birth of the Lighthouse projects family, no-one really knew the questions yet, let alone the answers.

Replication turned out not to happen by copy-pasting integrated solutions, or by adapting integrated solutions to local circumstances. Replication appeared to require a perfect storm of explorers, shapers, and deal-makers (or, in IRIS language, boundary spanners, knights, and champions), creating together a local innovation ecosystem. But how to replicate a perfect storm at a given time and given place? IRIS, as chair of the 18 Lighthouse projects' Task Group Replication, has contributed extensively to the exchange and collaboration between the Lighthouse projects and related initiatives on what replication entails, and to research needed to generate the impact sought with replication. Eventually culminating in recommendations to the Scalable Cities study on systemic changes in governance, equipping local governments and many others to accelerate their journey towards climate neutrality.

Replication requires people with competences, connections, and awareness of shared interest. This can be considered the latent innovation ecosystem: present, but needing particular conditions to become active, develop, and scale-up. European collaboration not only brings together people able and willing to share and learn about project results, but also develops the skills of partners to identify and work in innovation ecosystems, preparing also to enter into new partnerships. This could be called replication: translating a solution that works well elsewhere to your own local and regional context in collaboration with your own local/regional/European innovation ecosystem.

At the SmartCity Expo World Congress 2022

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Creating a new language for unlocking electric car batteries onto the electricity grid

The International Standard ISO15118-20 for Vehicle-to-Grid (V2G) communication is a cornerstone for the upscaling of smart and bidirectional charging. The standard was developed by the International Organization for Standardization (ISO) to standardise the communication protocols between electric vehicles (EVs) and the grid. It was developed through a process of consensus building, by a committee of experts from various countries and industries, including car manufacturers, power companies, and government agencies. It specifies necessary protocols, a universal "language" for communication between electric vehicles, charging stations and the grid. The electric vehicle industry is now quickly picking up this standard to scale up V2G and other charging innovations.

In 2019, the Municipality of Utrecht was the first to request the use of ISO15118-V2G (as we will call it) in a large tender for public EV AC-charging stations, signalling a strong interest in the standardisation of smart charging. This has resulted in the largest living lab for V2G charging worldwide and in a large boost for V2G charging development.

Renault, Hyundai, Kia, Volvo, Polestar and Sono Motors are among the first car companies to implement draft versions of AC V2G charging based on ISO15118-V2G in their electric cars, with many others following. This is a significant step towards achieving the full potential of V2G technology, as the standard allows for precise determination of how EV batteries can be used for balancing the sustainable energy system that is needed in the future.

To further test the application of ISO15118-V2G in real-life scenarios, tests are taking place in Utrecht using about 700 V2G charging stations and a fleet of We Drive Solar e-cars in Utrecht. This is providing valuable experience into how the ISO15118-V2G standard enables 'clicking' car batteries into the electricity grid, so that they can actively be used to balance the future sustainable energy system and to facilitate the integration of large-scale renewable energy sources. Based on years of development, the final version of the ISO15118-V2G standard was approved by April 2022, and We Drive Solar and partners are now working on implementation and large-scale roll-out of V2G operation by end of this year.

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Launch of the ISO15118-V2G enabled Hyundai IONIQ5 in Utrecht

The fun of European collaboration projects

Being part of an international tribe: how to participate in an EU project?

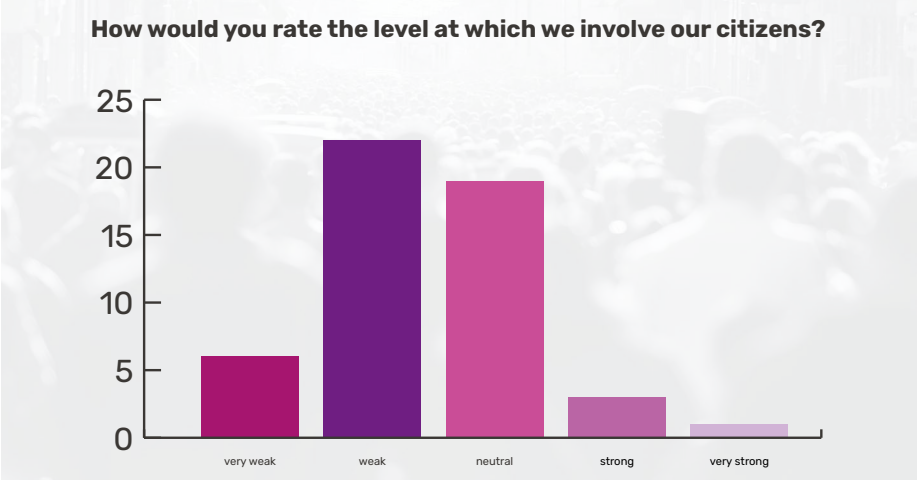
If you are reading this magazine, there is a high likelihood you have some experience in collaborative European projects. The international dimension and long-term duration of projects can be tough, but you will probably also acknowledge the positive personal experiences. To be part of a multi-cultural project dealing with societal challenges over multiple countries is a rewarding and valuable experience. Informal exchanges at lunches, dinners, study-visits or online meetings shapes how you work together. Over the years a "European" bond forms. You become part of an international "tribe". The "IRIS tribe" blossomed into a strong cross-European community and some of the key learnings from the coordination point of view are shared here.

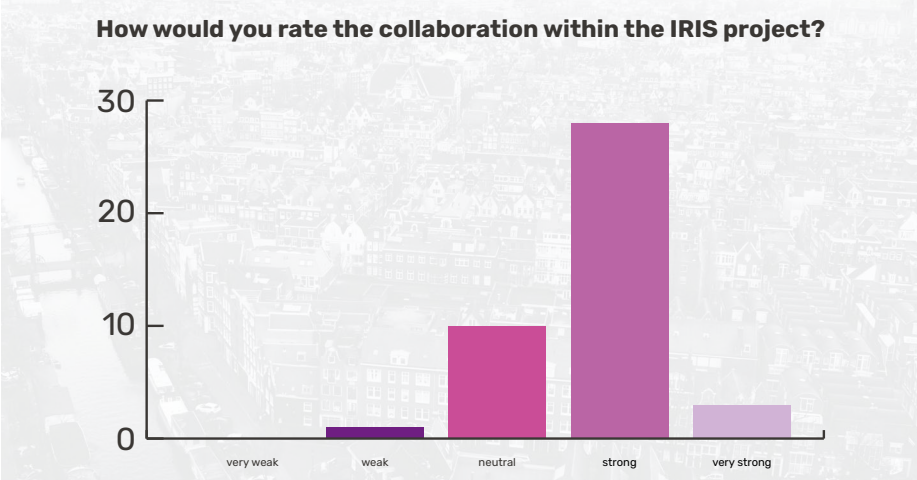
A transparent collaboration environment: "our collaborative approach"

The IRIS project involved over 60 innovation projects, 115 reports, 20 milestones, 7 cities and 45 partner organisations. The innovation projects were developed, tested and evaluated in real-life circumstances providing extensive learnings on applying innovations in practice. Not everything can and will go as originally planned. This is also the beauty of such projects because it leads to valuable lessons that are part of innovation transitions. The key here is to be flexible when implementing and managing the project. This was underpinned by an open learning approach that highlighted and stimulated learning across the consortium.

Arena for sharing our strong and weak points: "A look in the mirror"

To nurture an open collaboration environment we had periodic "IRIS – a Look in the Mirror" at each consortium meeting, where we asked ourselves key questions concerning our project progress. This enabled discussion on our weak and strong points, which were also used in our review meetings with the European Commission. This approach nurtured peer-2-peer exchanges based on honest feedback and in discussions with our sister projects and critical friends. One partner explained *"IRIS was a safe-space to experiment and to give all the best you have in a good-working environment without being judged on your failures"*





Playful interaction methods putting the human at the center

Another approach we used to support collaboration in the project was the way we designed our interaction methods. Ludodidactics[2] experts from the HKU University of the Arts Utrecht created playful interaction methods that supported conversation, knowledge sharing and mutual learning. For instance the "Bears and Victories" role-based learning game focussed on bringing practical insights on challenges and successes to the table to enable mutual learning in the project, making a lasting impact on the deeper level of exchange within the project colllaboration.

[2] Ludo Didactics | HKU
www.hku.nl

VIP

You are the guest of honour und will be interviewed on your Bear or Victory

Journalist

Your task is to interview the VIP and get good answers on the Canvas items

Victory

A Victory is a current (or future!) result that made you proud already or that would make you proid in the future

Bear

A Bear is a current (or future!) roadblock that hampers you in creating success in the IRIS project.

The main take-aways from being part of a European collaboration project that I take with me in new collaborations are:

- Nurture a collaborative community that focusses on learning rather than on success;
- Create a safe-space for partners to experiment rather than finishing a predefined project plan
- Use design expertise to create playful methods to identify hidden stories of failure and success

Citizen Engagement

The energy transition inspires cities to find alternative sustainable solutions. The transition is about technological advancements and equally about people. Brilliant solutions may fail due to a lack of support in the community. This makes citizen engagement a crucial part of more sustainable cities.

Awareness and individual behavioural change are needed for lasting transformation. Altering people's views and behaviours is a challenging task, especially in neighbourhoods where the energy transition is not a priority. Daily livelihood struggles create different priorities for these citizens. Such challenging neighbourhoods were the arena for the IRIS-project.

Over a five-year period, IRIS developed an innovative way of better engaging the public. Partners used flexible design thinking methods to engage citizens when making decisions. The design-driven approach is unique as it is tailored to the audience. Acting from a place of empathy can open citizens to change. It also creates a common ground, increasing the chance that the community embraces new technologies. To further ensure citizen commitment, cyclical design methods centered on iterations of research and prototyping should be considered.

Overall, the IRIS experience with citizen engagement was eye-opening. The success stories portray various levels of engagement. Involving citizens early in the process proved important. Experiences in Utrecht with the nearly zero-energy buildings transformation underline that. But what truly enabled citizens to own the innovations was helping to define both the problem and the solution. In a co-creation project trialed in Utrecht, citizens and the local authority decided which solution would serve the community best.

The younger generation also played an important role in sustainable change. In Focșani, children learned about sustainability in school and relayed the information to their parents, changing public opinion. Every city involved in IRIS had similar experiences. In Gothenburg, an adaptation of the popular game Minecraft aided sustainable urban planning. In Utrecht, kids became Energy Detectives in their home, resulting in an interactive game to sustainably transform their neighbourhood.

Ultimately, citizen engagement is at the core of lasting change. It is imperative to allocate more funds towards engaging citizens to ensure a smoother transition towards greener city living. The four short stories that follow provide a view from the child's perspective, as educating the youth increases awareness in the wider community.

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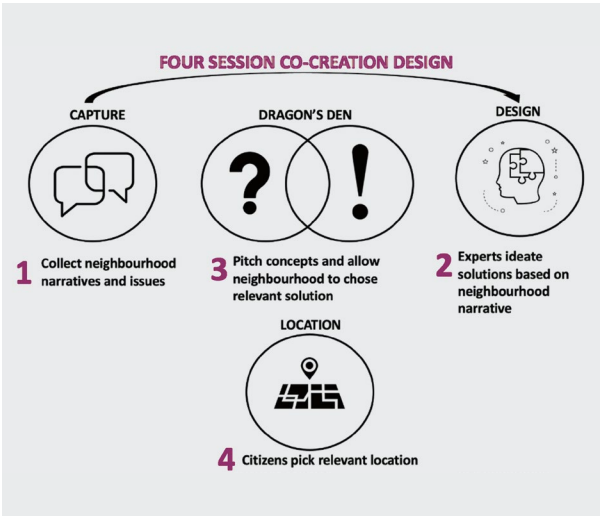
Children invest in road safety through smart street lighting

In 2018, nine-year-old Mohamed Amine and his parents attended four co-creation sessions in Utrecht's Kanaleneiland district. Residents like Mohamed's parents shared issues they encounter in their neighbourhood. Experts then proposed nine feasible technological advancements. The innovations were pitched in a Dragon's Den fashion. As a decision-making incentive, the resident Dragons were encouraged to put their fake money on the best idea and the best location. Mohamed and his sister acted as trusted treasurers, overseeing the process, and announcing the winning solution: a smart pedestrian crossing.

Two years later the smart pedestrian crossing was implemented by the Municipality of Utrecht as part of the pilot project Smart Street Lighting Utrecht. The crossing increases road safety as it lights up in the dark, warning vehicles of approaching pedestrians. The smart light poles are implemented with tests for sustainable lighting and can monitor air quality.

Upon completion, Mohamed was interviewed about his involvement . He was very proud of coming up with the idea and contributing to a safer neighbourhood. His excitement and total ownership towards the innovation is the embodiment of a fully engaged citizen. In the future we hope to hear more stories like Mohamed's.

Mohamed Amine presenting his ideas



Mohamed Amine at a local event

Teenagers as city administrators

The 1st of June is Children's Day in Romania, which is always a challenge for the local administration. IRIS partners in Focsani tried hard to prepare amazing activities dedicated to children, but we had a huge handicap – we were not thinking like they do!

Their solution was to have children in the local administration or, rather to have a 'children's local administration.'

They promoted a Local Council Decision, creating a volunteer organisation named the Focsani Youth Local Council (FYLC). They contacted teachers, directors and volunteers to organise the first elections for the FYLC. Every child from 14 to 18 years old could vote for College representatives. For the election campaign the local administration provided all the logistics.

After the election, the representatives were presented to the Local Council to decide among themselves who will be the Youth Mayor, Vice mayor and General Secretary for the next two years.

The Local Council allocated an annual budget for FYLC for different projects. They received training and support to prepare and manage projects.

Of course, their first projects project was celebrating International Children Day and they prepared it well, with lots of fun events with the support of many volunteers.

Impressions of the Children's Day organised by the Children's Local Administration

Making children urban planning experts with Minecraft

In spring 2020, Gothenburg's City Planning Office held urban development workshops at a school in Lärjeskolan, using Minecraft to collect students' thoughts and ideas on their ideal living environment. These ideas would help develop Hjällbo, a socially deprived area in Gothenburg.

"In Minecraft, kids can move around their neighbourhood at eye level and build spatial environments where they can better appreciate the scale of the created environments," said Anna Reuter Metelius, the project manager for the Hjällbo development program and local citizen engagement in IRIS. She says that a model building can be easy to understand, but too abstract to experience the rooms that are created. *"It was clear that the students could easily connect the real everyday environment to the environments they built in Minecraft,"* she said.

The team leading the project concluded that the in-game spaces were more tangible compared to renderings, floor plans or sketches. The videogame's play/explore aspect also made it easier avoid the "school effect" – when children perceive that there is the 'right' answer that the questioner wants to hear. *"The child can be the expert both in their living environment and with the tool, which benefits the conversation"* said Anna.

Susanne Ollila, professor of organisational behaviour, developed the theoretical frame of reference for the Minecraft project. According to Ollila, Minecraft offers a reverse logic where knowledge about the habitat is gathered from citizens who are not usually heard, unlike the usual expert logic.

Minecraft was used to gather students' thoughts and ideas about their ideal living environment.

The urban development workshop at a school in Lärjeskolan

Children take climate action at Les Moulins in Nice

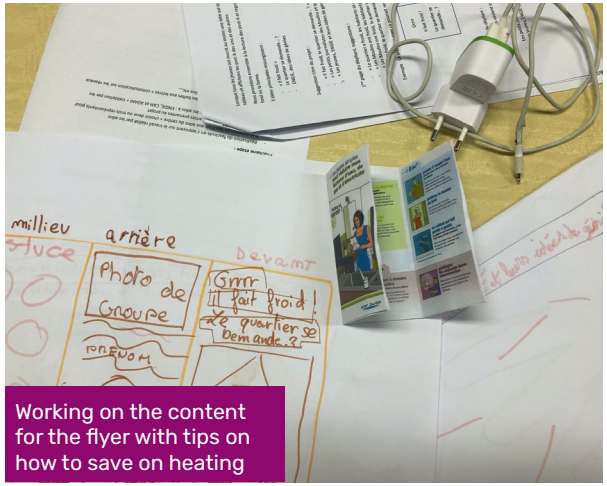
The Les Moulins district in Nice faces many challenges. The poverty rate is 45.7%, twice as high as the 20.2% municipal average. The district has many social housing units and its inhabitants usually speak little or no French. Two-thirds of adults do not have an education beyond secondary school.

Understandably, people here are more concerned about their jobs and income rather than the energy transition even though IRIS activities were happening there. To change this trend, IRIS collaborated with ADAM - a local association focused on family welfare, social integration and eco-citizen mediation, to foster citizen engagement through information and communication campaigns lead by local children and teenagers on energy concerns in the area.

At the association's leisure centre, over 20 teenagers were encouraged to become "eco journalists" interviewing Les Moulins inhabitants at the weekly market about their energy concerns about energy as well as meeting up with local technicians who take care of the heating infrastructure in the neighbourhood.

The teenage eco-journalists produced a flyer with tips on how to save on heating and distributed it to over 2400 households. At the same time, a group of young children also created posters on recycling themes and eco-actions, creating a positive feedback loop to proud parents and relatives involved who learned about energy saving from their kids.

Example of the posters on recycling themes and eco-actions



Working on the content for the flyer with tips on how to save on heating


The young eco-journalists of the Les Moulins district

Monitoring & Evaluation

Under the hood: the complexity of using KPIs in European Smart City Lighthouse projects

The IRIS project tested about 60 different pilot measures in three distinct lighthouse cities. It's important to monitor and evaluate their implementation for their environmental, social and economic impacts. The usual practice in European research & innovation projects is to establish a Key Performance Indicators(KPIs) at the start of the project and monitor and evaluate the measures throughout the project.

But KPIs are rarely that simple. Obtaining meaningful and trustworthy measurements and conclusions comes with challenges:

- Allow enough time for all demonstration and monitoring partners to speak to each other throughout the project. Be aware of the challenges of choosing and formulating KPIs and that this process will continue over time. Monitoring and evaluation should be fully weaved into project workflow.
- Smart city projects are implemented in real-life circumstances. Reliable datasets require two or more years of data to identify inaccuracies that hamper the interpretation. When demonstrations are delayed due to unforeseen issues, this influences the data collection. Make sure to allow enough time in KPI deadlines to compensate for these delays or inaccuracies.
- Calculation methods and data are crucial for the replicability and comparison of solutions. It also makes any assumptions transparent. When aggregated at the city- or project level the results need to be presented together with this information (see boxed example).
- KPIs are designed to track specific and measurable outcomes, which may exclude the broader narrative and qualitative aspects of the measurement. As a result, using KPIs alone can result in a narrow and oversimplified view of the impact of the initiative. It's therefore recommended to supplement KPIs with qualitative data, stakeholder feedback, and other forms of information that can provide a more complete and nuanced understanding of the impact of the initiative.

In close collaboration with all Lighthouse project partners, a broad foundation of 78 Key Performance Indicators (KPIs), a monitoring program to obtain all data and an online KPI-tool to collect, calculate and visualise our results was set up and implemented. You can find an overview of the results here in our online KPI-Tool.

Report on evaluation and impact analysis for integrated solutions

Visit our online KPI-Tool

Impact of CO2 emission reductions by producing electricity with PV.

Figure 1 shows the amount of PV electricity production within the IRIS project. All three cities contribute with roughly the same amount of electricity to the total PV-production, which in 2022 exceeded 900 MWh. This electricity corresponds to ~570 EU citizens average annual use of household electricity (Eurostat 2022 values).

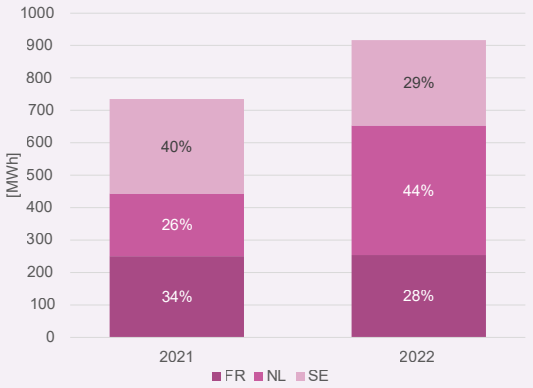


Figure 1: Total PV-production from the IRIS project and the share of the contribution for the three cities.

The resulting reduction of emissions depends on the difference between the emissions associated with PV-generated electricity and the grid electricity it replaces. These emissions

vary per country due to a different mix of energy production facilities. Because of this, one kWh of PV production in the Netherlands has an impact 20 times higher than the same kWh produced in Sweden. When considering an interconnected European electricity grid, what do these results mean for IRIS?

Therefore, we have decided to use different emission factors for calculating KPIs. In this example we showcase two factors:

- IRIS standard: A national factor considering only emissions of production within the country, this factor was initially used for making the project proposal
- EU27: A EU wide emission factor for electricity, which takes imports and exports into account.

Figure 2 shows that the EU27 emission factor is several times larger than the local factors for Sweden and France, while it is about 20% smaller for the Netherlands. This has a large effect on the impact of this KPI as is illustrated in XX. When national emission factors are used, CO2 emission reduction ranges from 100 tonnes in 2021 to an IRIS total of almost 200 tonnes 2022. The majority of this reduction is accounted for by Utrecht (80 – 90%). When an EU27 average emission factor is chosen, the impact of 2022 increases with 55% and the impact of 2021 has more than doubled. The distribution of the impact per country is again directly related to the PV production. Using national emission factors, the reduction corresponds to the annual emissions of 30 EU citizens while the EU27

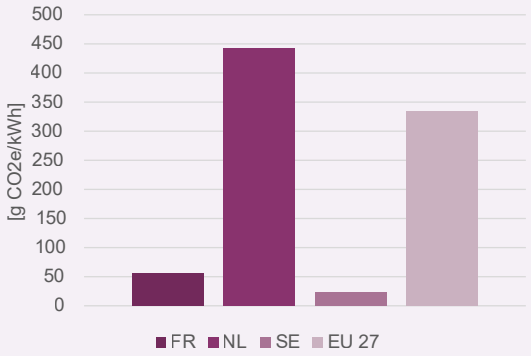


Figure 2: Emissions in in grams per kWh electricity used to establish CO2 emission reduction. The national factors only take emissions related to electricity production in that country into account while the EU27 factor also includes the emissions associated with import and export of electricity in the EU27.

factor corresponds to 45 citizens emissions (based on Eurostat values of 2019).

These estimates still have limitations. For example, the emissions of PV production were disregarded. Life cycle analysis indicates a range from 35-50 g CO2/kWh and including these emissions will impact the results, especially for Sweden and France. Besides that, the emissions of the electricity grid are influenced by geographical boundaries and by the time of use. A sensitivity analysis is included in the final deliverable (D9.7) where the effect of using hourly emission factors instead of annual averages is investigated.

Our efforts to disclose calculation methods and acknowledge the impact of assumptions taken aim to highlight the complexity of generalising project outcomes but also to serve as an inspiration for future EU projects.

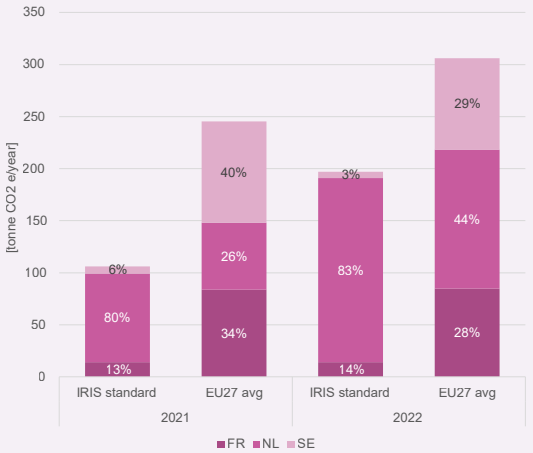


Figure 3:CO2 emission reduction for PV-production in the IRIS project established using different assumptions on grid electricity.

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City Innovation Management

Key factors for a city to enable scale-up and replication

1. A city should both **name and explain the goals** in its city innovation management roadmap report. In IRIS Smart Cities all seven cities entered the project with specific impact goals. When a city expands a solution to other districts it becomes clear to other cities that it is worth replicating.

2. **Identify which city administrators will have the mandate** to decide on the innovations to replicate, and how to manage them. The base for all this is the Innovation Strategy, so make sure to nurture a culture of innovation.

3. **Establish a timeline** for the roadmap and preferably also a district-by-district sequence to advise local businesses on upcoming new quality criteria.

4. **Research the investment costs**, and discuss them with the city that already has implemented the solution you are interested in.

5. **Investigate suitable funding** – make a financial roadmap that clearly shows how you intend to finance the implementation of the solution. . It is often a prerequisite to continue developing the solutions and to allow up-scaling and replication activities. Methods facilitating the proposal process are presented in the Report on Financial instrument.

6. There should be a common understanding between participants about their roles and **how different parts of the value chains of the integrated solutions are related to each other**. Understanding the full picture makes it easier to create long relationships and efficient business models linked to each other.

7. **Plan to identify and overcome national regulatory and legal framework barriers** – sometimes what is written can be re-interpreted. Organisational and political setups differ in each city, as do cultures and individuals. Benchmarking tools can help a city to become aware of challenges and best practices. This helps to better understand, create and implement an innovation strategy.

8. **Involve citizens** – learn from cities already implementing the solution and listen to their citizens description of the problem – which is key for being able to deliver better, smarter, more sustainable and attractive services to the locals.

9. **Monitor and evaluate** – identify how the city would like to measure its' innovation management process.

Why do we need value chain design for replication and growth of smart city solutions?

An IRIS integrated solution is a joint result of several participants and their business models with individual value propositions, key activities along a joint value chain. For example, in mobility services one business supplies the building owner with an IT-platform and an interface for the tenants to book mobility services. Other businesses that operate services such as bicycles and car sharing are connected to the IT-platform and convert bookings into mobility.

By using a value chain design approach, smart cities can continuously support scaling up developed and demonstrated integrated solutions. Some integrated solutions require a city authority to be in the value chain. Other solutions only require an individual building owner to be the actor, without depending on any external district or city infrastructure on district.

The city authorities can monitor the scale up of a solution and take strategic actions to support its district-by-district entry to the market. For example, the city authority could make sure that there are no regulatory barriers and that the necessary physical and digital infrastructure to support the solution is available. It can also promote the solution through a communication campaign to make sure citizens are informed and understand the advantages of the solution and of the changes taking place in the city.

By stating in official policies what the future will look like, and by making sure this is followed up with actions, the market will understand where to make their investments. The integrated solution will then be considered as a worthy investment. Presenting an integrated solution with a value chain perspective also helps replication to other cities as it presents a broader market context, highlighting important actors and how markets can be stimulated by local city authorities.

Example: IRIS integrated solution value proposition: Positive energy building and Peak power shaving

Enablers: > 200 kWh electricity storage in 2nd life automotive (bus) batteries powered by 140kW local PV and a energy management software

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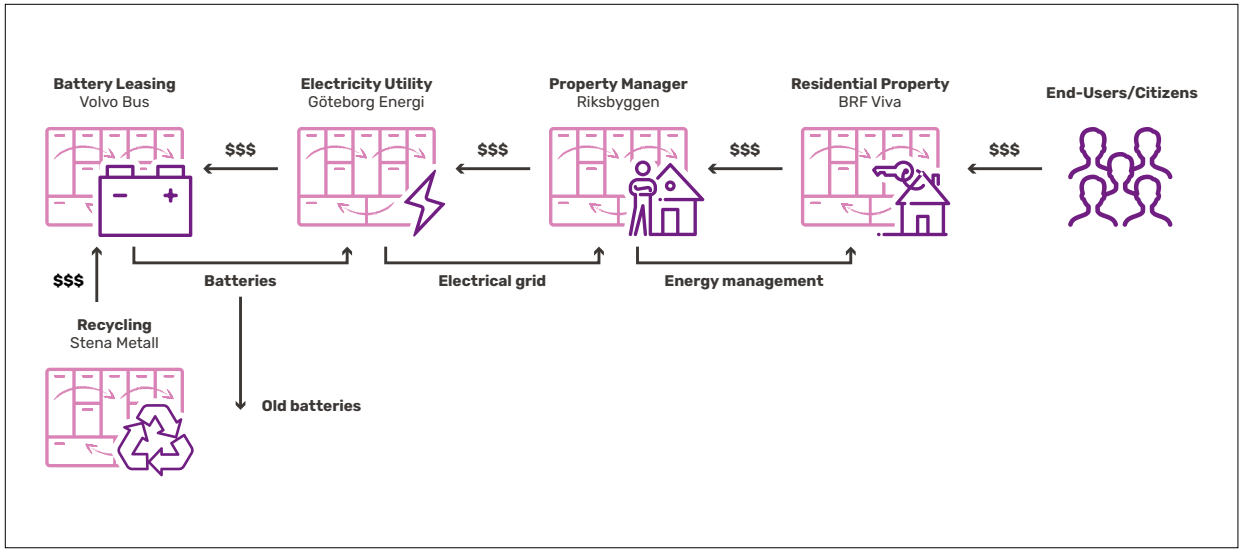


Smart city incubation programmes: the IRIS “cookbooks”

Throughout the IRIS project, project partners in Lighthouse cities worked with local communities and municipalities to develop smart city solutions.

For example in Sweden the Gothenburg Smart City Challenge brought together student teams from the local Chalmers University of Technology to develop digital innovations and an accompanying business model. In total, 100 Chalmers students in their third year at the Industrial Economics program worked in 18 teams to develop and present ideas over eight weeks. Ideas included reducing food waste, improved mobility and air quality, water use management, a student accommodation platform, waste sorting and connected urban farming.

Smart city solutions can also be found in other communities. In autumn 2019, FIWARE organised a digital hackathon to find new smart solutions. In the hackathon the goal was to use the open source FIWARE technologies, which are open-source tools which aim to aid developers in developing smart solutions. Their technologies could have four aims, one of which was to improve sustainability in European cities. Participants received this information online and were given several weeks to come up with a solution. Winners of this category were announced at the FIWARE Global Summit in Berlin.

In the Netherlands, the US-inspired ‘Startup in Residence’ concept challenges entrepreneurs to come up with solutions to social issues in different Dutch regions. The municipality of Utrecht ran a Startup in Residence challenge in 2017 at the start of the IRIS project. This led to startup entrepreneurs pitching new solutions to the municipality of Utrecht, who then chose the best ones. The selected startups then worked on the solution in an incubation program, guided by experts and civil servants. The municipality then decided whether to purchase the final product or service.

Elsewhere in the city the municipality of Utrecht, Economic Board Utrecht, and students from two universities and a vocational college formed mixed teams to tackle the city’s congestion. They were asked to think about new and smart solutions for this problem, guided by practitioners and experts to ensure relevance. In the end, teams pitched their ideas to a jury, who could choose multiple winners. Winning teams got the opportunity to work with stakeholders and companies to put their idea into practice. Some students also received study credits for their participation.

A small selection of the IRIS “cookbooks”

HERE ARE MORE WE MADE EARLIER :

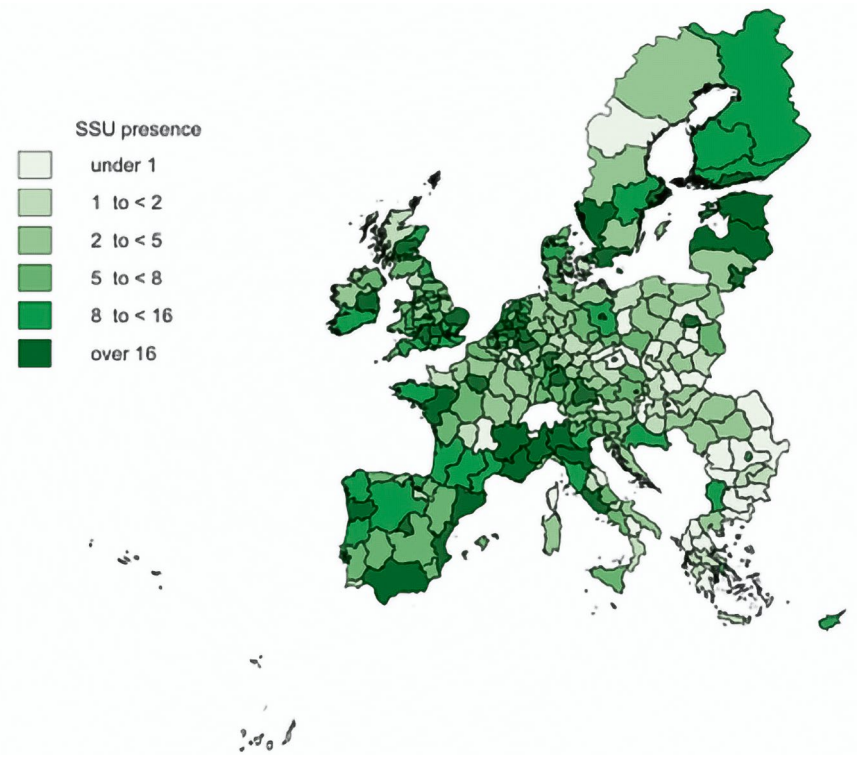
- FIWARE (Digital) hackathon
- Startup in Residence Utrecht
- ChangeU Student Hackathon
- Citizen Innovation Challenge
- Energy Poverty Challenge
- Gothenburg Smart City Challenge
- Smart Lighting Challenge
- Utrecht Mobility Challenge

How (and where) sustainable entrepreneurship can flourish

Supporting sustainable entrepreneurs can help IRIS cities become smarter and more sustainable because they introduce new technologies and business models. Cities and regions need to understand and improve the conditions that encourage new sustainable start-ups.

The 'entrepreneurial ecosystem' literature identifies ten elements that influence where start-ups are founded. We combined scores for these ten elements in an index for 274 European NUTS-2 regions. Of the IRIS regions Utrecht is the top performer, both in the ecosystem index and with 686 as the number of start-ups. The second is Gothenburg (Västverige) with 281 start-ups. Sustainable start-ups are different than regular start-ups. They are influenced by four additional elements. For the IRIS cities Utrecht, has the highest number of sustainable start-ups with 26, followed by 22 in Gothenburg (Västverige), 11 in Nice (Provence-Alpes-Côtes d'Azur), and 5 in Vaasa (Länsi-Sumoi). The difference between the two top regions, Utrecht and Gothenburg is much smaller here and Gothenburg (7.8%) even has a higher share of start-ups that are sustainable than Utrecht (3.8%) and also the European average (6.2%). The number of sustainable start-ups in each region are shown in the map on the right.

To improve the conditions for sustainable entrepreneurship in each region requires time. Use the data as a starting point. Sit down with all relevant actors and discuss which weak elements are recognised, its causes, and how it could be better. Are there different opinions? How can we improve this region together? This dialogue can deepen the diagnosis and convert it into points for improvement. Then design the interventions to improve, again, based on this dialogue. Don't jump to conclusions but use research to start the conversation.



The sustainable start-ups (SSUs) in European NUTS-2 regions

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Investigating Smart Cities through a different lens

Moving from solutions to system change

The Smart Cities and Communities Lighthouse program, which was launched in 2014 and is now known as Scalable Cities, has made significant strides in deploying over 500 smart city solutions across 120 cities in over 20 countries. However, scaling up these solutions to create a systemic change in cities remains a challenge. To understand why, an event was organised by IRIS Smart Cities in Utrecht to bring the Scalable Cities community together and answer the question: Is it time to replicate success factors and enabling conditions instead of solutions?

Key players from across Europe come together to explore the untold stories, triggers, and conditions that enable cities to move beyond the mere replication of technological solutions and advance city innovation in a more systemic way. Keynote speakers shared success stories from their city, followed by breakout sessions where the audience was invited to investigate, through specific lenses, the underlying success factors and explore the reality of smart city projects.

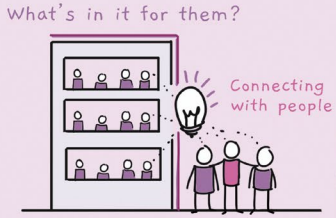
The aim of this exercise was to bust replication myths and reframe the innovation narrative regarding the scaling up of smart city solutions with the hope of advancing the smart city movement and creating more sustainable, liveable, and innovative cities.

Impressions from the event in Utrecht

TRANSITION TRACKS

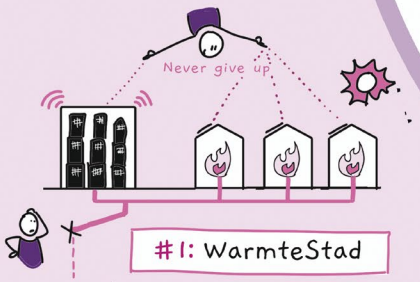
#3: Flexible Electricity Grids

Utrecht V2G Ecosystem: from an innovators backyard to a city-wide bidirectional energy system



#2: Deep renovation of buildings

Human factors in retrofitting projects



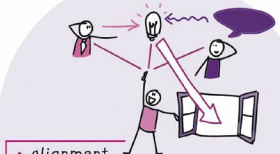
#1: WarmteStad

from market rule to public owned district heating company

6 ENABLING FACTORS

KNIGHT

CHAMPION

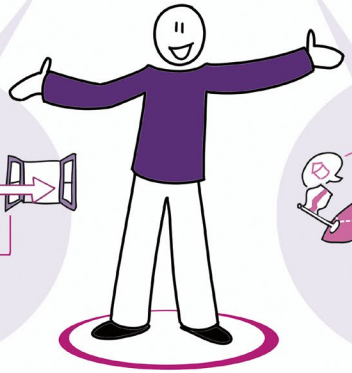


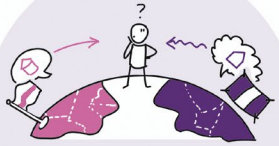
BOUNDARY SPANNER

When ideas come together

INFORMAL NETWORKS + EVENTS

TIMING + CHANCE

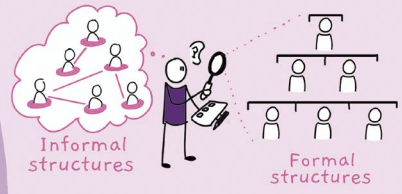




MEANING + CULTURE

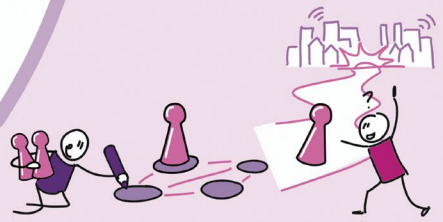
#4: Urban Data Platforms and Digital Twins

Connecting front- and back-end



#5: Citizen Engagement and co-creation

What if we bring social design into the mix?



#6: Innovation Governance

The role of innovation brokers in smart city innovation ecosystems: stories from the field

Building a transdisciplinary innovation team

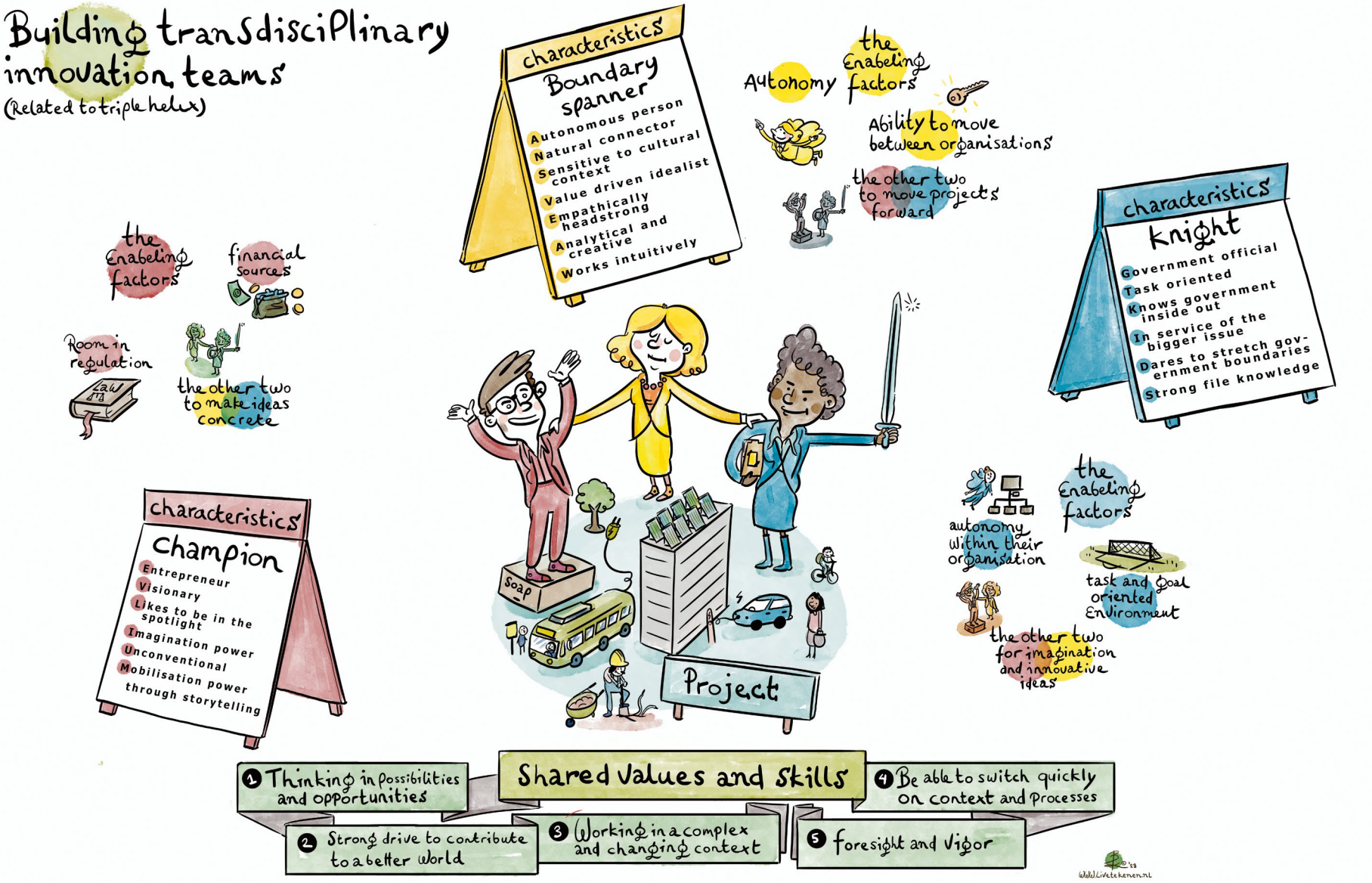
Further research exploring the lenses has led to new insights in the three lenses dealing with specific roles and capacities. Three characteristics sets were identified as critical parts of successful transdisciplinary innovation teams. Being labeled for this research project as the “Knight”, the “Champion” and the “Boundary Spanner” role. A role can be taken up by more than one person.

The three roles share a number of critical values and skills though they differ in position.

1. “Champion” characteristics in a team point to being a visionary leader with storytelling qualities. Access to financial resources and room in regulations to explore innovative solutions characterise the enabling capacity. These qualities rely on co-dependency with “Knight” characteristics.
2. Knights will be found in a governmental support role for innovation. This role is characterised by the capacity and willingness to change or influence rules, regulations and other governmental instruments to foster innovation with a ‘can do’ mentality. Both “Champions” and “Knights” rely on a third set of qualities in the “Boundary spanner”.
3. The Boundary Spanner combines connecting capabilities to build and unlock informal and formal networks. They are able to help champions and knights to navigate through complex problem spaces making use of timing, ideas, creativity, intuition, and cultural sensitivity.

When Knights, Champions and Boundary Spanners characteristics are embedded in a team, their mutual complementarity, trust and collaboration can be a strong impetus for success in innovation projects.

Impressions from the IRIS Final Conference (March 2023)


Building transdisciplinary innovation teams
(Related to triple helix)
characteristics
Boundary spanner
Autonomous person
Natural connector
Sensitive to cultural context
Value driven idealist
Empathically headstrong
Analytical and creative
Works intuitively
Autonomy
the Enabeling factors
Ability to move between organisations
the other two to move projects forward
characteristics
knight
Government official
Task oriented
Knows government inside out
In service of the bigger issue
Dares to stretch government boundaries
Strong file knowledge
the Enabeling factors
financial sources
Room in regulation
LAW
the other two to make ideas concrete
characteristics
Champion
Entrepreneur
Visionary
Likes to be in the spotlight
Imagination power
Unconventional
Mobilisation power through storytelling
Soap
Project
autonomy within their organisation
the Enabeling factors
task and goal oriented Environment
the other two for imagination and innovative ideas
Shared Values and Skills
1 Thinking in possibilities and opportunities
2 Strong drive to contribute to a better World
3 Working in a complex and changing context
4 Be able to switch quickly on context and Processes
5 foresight and Vigor
WWW.LIVETEKENEN.NL

How the IRIS story will live on

How the IRIS story will live on

Now, after more than five years, the story of the IRIS Smart Cities project is going to end. With only the final reporting and review to come it's time to write the final chapter. In this IRIS Magazine you've been able to read the key results, experiences and lessons that the IRIS community has learned and wants to bring forward. But this does not mean that IRIS has ended. The results of the project will live on.

We started the project to make urban environments better places for citizens and the planet. We tested innovative solutions, mainstreamed viable technologies and methods and explored policies, products and engaged with citizens and end-users to achieve this. Now the results of the IRIS project live on in the people that can use shared bidirectional electric vehicles, live in positive energy footprint buildings, have access to more efficient and cost friendly energy services. And also in education and training programs, digital games and solutions that make being sustainable an easy choice and thereby contributing to clean and climate neutral urban environments.

In the seven IRIS Lighthouse and Fellow cities local ecosystems of people and organisations have been nurtured and empowered. With the experience, networks and tools from the IRIS project, they are able to scale the results and carry on the torch of smart and sustainable urbanization. In all cities this has already led to new and exciting innovation projects, supporting cities to achieve their climate ambitions with more vigour and confidence through their real-life experiences.

With this final note I would like to thank all people (both working on the project directly, or supporting it) from all partner organisations, external stakeholders and our friends from the Scalable Cities, Lighthouse and Fellow Cities communities. I look forward to see the flowers from the IRIS project blossom.

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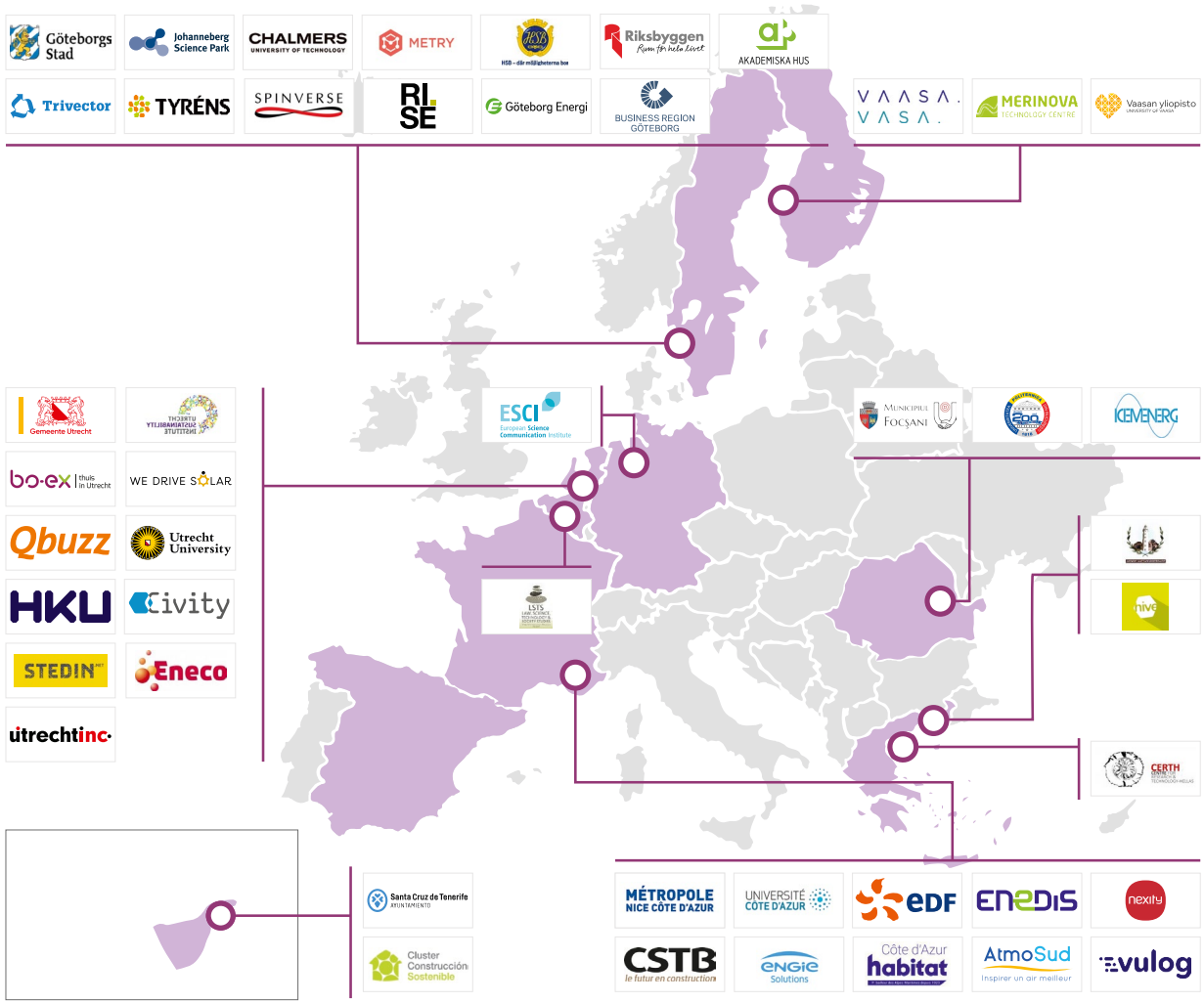
Acknowledgements

The editors would like to thank all the project partners who contributed to this magazine. Their cooperation throughout the writing and editing process were vital to creating a final product that everyone can be proud of.

Finally, a big thank you to all the city locals and administrators who worked with us to develop these smart city solutions and spread them to others.



For more information - see the public deliverables of the IRIS project

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