Implementation report Umeå
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### 1. Progress summary visualization table

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- **In progress**
- **Done**
- **Go decision**
- **Pending decision**
- **N/A** Not applicable
2. Executive summary

Smart city thinking is at the core of the City of Umeå’s overall vision for urban development and builds on the city’s commitment to have a climate neutral energy system by 2030. In RUGGEDISED, Umeå will focus on implementing nine solutions in the University District situated to the east of the city centre, which is the largest workplace in northern Sweden with more than 50 000 employees. Umeå is a fast growing city. The average age of the nearly 123 000 residents of Umeå is 38. The goal is to pass 200 000 inhabitants before 2050.

The need to prepare for future demands on the City has been one of a number of drivers pushing forward the City’s commitment towards sustainable growth and subsequent involvement in RUGGEDISED. Other drivers include:

- environmentally aware citizens who put pressure on the city to be progressive;
- active participation in international networks like the Union of Baltic cities, URBACT and CIVITAS;
- involvement in national and international projects;
- and signing and embedding the Aalborg commitments into the overall urban vision.

Through the RUGGEDISED project, Umeå is implementing nine smart city solutions (U1-9) to ensure the City achieves two, often divergent, goals: population growth and a lessening of its environmental impact. The solutions are currently in different phases of implementation, an overview of which is provided in the visualisation table.

Often when trying to optimise energy use, the general approach has focused around supply chains and building logistics. Umeå has put a strong focus on its end users - or citizens who have been ranked as part of the 2014 European Smart City benchmarking by the Vienna University of Technology as some of the most active and environmentally aware citizens in Europe. But, there is still room for improvement! And the technology that is implemented is only as effective as its users. Therefore, a key aim is to encourage behavioural change, through gamification (U4A), as part of enabling a broader social shift in the adoption of more sustainable habits to all aspects of life.

Smart building management (U4B) connected to the energy demand management system (U9) of different buildings in the University District, for which over 500 additional sensors have been installed, have been used to gain a better understanding of power consumption and to lessen the level of unnecessary energy use. On a district level, Umeå has developed different business models (U1, U3) to enable buildings to share excess renewable energy and has implemented a system that makes it possible for buildings to store excess heat produced in the wider district. Work here has been useful in developing a more holistic view of the often complex business landscape of energy supply systems – local and distributed – and has provided the opportunity to pinpoint bottlenecks, and find ways of mitigating them.

To make sure what follows the increase in population is not traffic jams and lower air quality, Umeå has implemented an innovative approach to parking (U7) for the more central parts of the city making it attractive for employers to support sustainable mobility. This, together with the installation of photovoltaics to power electric vehicles (U6) without adding burden to the overall energy system and a new climate-smart bus stop (U5), are the approaches for better urban mobility tested in Umeå, and have a high potential for replication in other cities.

While data is a universal language, translating it into local climate action remains a challenge. Umeå has developed an open-data decision platform (U8) allowing both city officials, outside experts and citizens to access, and visualise, different data from the City. Market research into an out-of-the-box solution, considering a process for presenting data consistently, making sure the portal is sufficiently populated to be useful, and ensuring developers of the future are aware of this data source are some of a number of actions that Umeå has taken to ensuring that urban data is being used to achieve more sustainable, liveable cities.
Umeå’s Smart Solutions

u1 & u3: climate smart business model for 100% renewable energy supply
u2: smart peak power control
u4a: gamification – influence behavioural patterns
u4b: intelligent building control and end user involvement
u5: climate smart bus station
u8: smart city open-data decision platform
u6: e-charging hub
u7: smart business model for flexible parking
u8: smart city open-data decision platform
u9: demand side management
Smart city thinking is at the core of the City of Umeå’s overall vision of continued social, cultural economic and environmentally sustainable growth

3. Preparation, Analysis and Prioritisation

The current period in which we live is characterised by rapid technological development, strong globalisation of (social and economic) activities, a need for protecting our living environment and ensuring social stability. In the European-funded Smart City project - RUGGEDISED, three lighthouse cities of Rotterdam, Umeå, and Glasgow together with a number of partners from academic, business and consultancy backgrounds will develop and test the know-how to exploit and explore opportunities that smart solutions offer in sustainable urban development.

The three overall aims of RUGGEDISED are:

1. Improving the quality of life of the citizens, by offering the citizens a clean, safe, attractive, inclusive and affordable living environment.

2. Reducing the environmental impacts of activities, amongst others by achieving a significant reduction of CO₂ emissions, a major increase in the investment and usage of renewable energy sources and an increase in the deployment of electric vehicles.

3. Creating a stimulating environment for sustainable economic development, by generating more sustainable jobs, stimulating community involvement in smart solutions (as consumers and as producers) and to boost start-up and existing companies to exploit the opportunities of the green digital economy and Internet of Things.

Smart city thinking is at the core of the City of Umeå’s overall vision of continued social, economic and environmentally sustainable growth, and is outlined annually by the City Council. Umeå is growing fast and in order to secure a sustainable growth, the city is assessing known economic, social and environmental challenges faced by larger cities and seeking to manage them before they occur in full scale in Umeå. Building on the city’s commitment to a climate neutral energy system by 2030, coupled with rapid urban growth, puts a focus on ‘smart innovation’ to curb energy use as part of the city planning.

In RUGGEDISED, Umeå focuses on an Innovation District situated immediately to the east of Umeå city centre, the University City area. The need to prepare for future demands on the energy market, both from changing consumption patterns, but also changes in the legislation around power distribution has been one of the drivers are outlined in the joint strategy developed by partners in the innovation area of the University City.
The University City area is the largest workplace hotbed in northern Sweden, and has both local, regional, national and international relevance. More than 50,000 people enter the area daily, but only around 3,000 live in the area. Thus, there is a mobility challenge. Reducing CO₂ from transports is a strong driver for the city. The innovation area is characterised by its young, student-influenced population and makes the University City an interesting district for new smart solutions and business models that are more dependent on prevalent sustainable mobility options.

**Implementation drivers to embark on RUGGEDISED**

Umeå is one of the fastest growing cities in Europe, with a strong focus on research and development. Businesses, but especially citizens of Umeå are famous for their active involvement in Umeå’s sustainable development, confirmed in the 2014 European Smart City benchmarking by Vienna University of Technology ranking the Umeå citizens Europe’s most environmentally aware citizens. They put pressure on the city to be progressive, bold and to put forward new green solutions. The city of Umeå is also very active in several international networks, and currently holds political positions as first vice-President for the Union of Baltic cities and is a member of the CIVITAS Political Advisory committee. It has been involved in and managed several national and international projects including ex. Green citizens of Europe (Life plus), Sustainable Ålidhem (Swedish Delegation for sustainable cities, awarded EU Sustainable energy awards – Living category 2013). It is also signatory, since 2008 of the Aalborg commitments, which underpins the six strategies which drive Umeå’s urban development.

**The Aalborg Commitments**

Ten years after the release of the Aalborg Charter, the 4th European Conference on Sustainable Cities & Towns was again held in Aalborg (2004). The purpose of the event was to develop a common understanding of sustainability, and as a consequence to develop a framework to be used at the local level that would better articulate how to embed sustainability across municipality sectors. The Aalborg Commitments were agreed on by consensus of the conference participants, including organisations such as Association of Cities and Regions for Recycling (ACRR), Climate Alliance -Klima-Bündnis -Alianza del Clima,V, Council of European Municipalities & Regions (CEMR), Energie Cités, EUROCITIES, ICLEI - Local Governments for Sustainability, Medcities, Union of Baltic Cities (UBC) and the World Health Organisation (WHO) - Healthy Cities.

The commitments encompass a list of qualitative objectives organised into 10 holistic themes. Whereas the charter was declaratory, the commitments signify a more structured and ambitious approach. At the same time, the holistic nature of the commitments allows decision-makers to adapt them to meet their own local conditions.

So far over 700 cities and towns have signed the commitments.
Various plans shape Umeå’s smart city vision, context and ambition, among which are the Sustainable Energy Action Plan (SEAP), a City Masterplan and an In-depth Masterplan for the campus area. In the City Master Plan. The six development strategies, introduced below, are based on the Aalborg commitments and Umeå’s City Council objective of sustainable growth to 200,000 inhabitants by 2050 (from 125,000 today).

1. The 5-kilometre city - The dense city! Growth should be concentrated within this radius from the city centre and the University area

2. More city! – Complementing as a vitalizing force, merging the city to a more coherent urban landscape

3. Create high density in new districts. New adjoining blocks strengthen and develop services and urban life

4. Growth in public transport corridors and conversion of traffic throughways. New dense block development planned alongside alleys benefitting public transport

5. Invest in public spaces and parks! In the dense city, the public spaces should be attractive, safe and full of experiences, with room for recreation and greenery

6. Everybody shall participate! All planning must be imbued with openness, democracy and gender equality

In the same way, the in-depth Master Plan of the University City outlines a vision of a district with education, research, health care and area-related business development at the highest international level, where the following objectives are emphasised:

- City-life promoting activities at street level with entrances along the main passages/corridors.
- Prioritised passages for education and health care in cooperation, along with research-related business development.
- Clear urban structure with mixed use: business, housing, service and retail.
- Urban block structure in a coherent street network – improved orientability around the main entrances to the regional hospital.

**Linking Umeå’s vision to RUGGEDISED**

The city of Umeå is constantly growing and is expected to pass the 200,000 inhabitants mark by 2050. Never have so many new homes been built in the city and the goal to have a 100% renewable energy system and a fossil free transport system by 2030, makes innovation projects like RUGGEDISED vital for the city to continue the growth without compromising the sustainability goals.

To engage in the project, both the city planning and mobility departments had to be brought together in joint innovation work, as well as the energy-, mobility-, housing- and real estate companies. By engaging in the RUGGEDISED project partnership, the cooperation between the partners became formalised. As we have been working together, the partnership has become permanent and many other collaboration-projects and business deals have developed. Some partners have their main interest in the Lighthouse innovation area, but most partners have the whole city as their target area. This has resulted in similar, extended Smart City collaborations with new actors.

The positive results shown by the RUGGEDISED-project, that may be derived from the close cooperation between partners, has also attracted a substantial part of the large estate- and housing companies in Umeå, to engage in liaisons together with the city as well as energy- and mobility companies in the planning procedure of new large housing areas to be built in Umeå.

**Umeå smart city vision**

“A world-class neighbourhood for education, research, health care and business development. An attractive city that lives around the clock with a mix of activities, housing, services and trading environments that invite movement in everyday life and that can contribute to better health.”

**4. The Smart City embedded in Umeå’s vision**
5: Description of Smart Solutions

Solution U1 & U3: Climate smart business model for 100% renewable energy supply

General description: The purpose of the U1 and U3 solutions is to develop a new business model to make it possible to share excess renewable energy between stakeholders in a value chain and ensure better usage of geothermal storage. The overarching goal is to help the stakeholders reduce their climate impact and lower the costs of energy. Three different business models were tested and applied to nine ways of optimising energy use in the Innovation Area and evaluated to show how value creation might occur in the different scenarios.

Figure 1 shows the technical model describing the energy supply infrastructure of the testbed area. The project has analysed the demand and supply data of the different buildings and production facilities of the area.

The model was designed in VBA (Visual Basic for Applications) Excel, using data from 2017 of all production units both local and distributed energy. A scorecard using emission factors, costs of different fuels and investments, was created to assess the cost and benefits of different scenarios.

Expected impact: The business models are expected to have three impacts: Firstly, they will through the extensive energy analysis explore have set the baseline the optimal steps towards realising a 100% renewable energy supply between stakeholders. Secondly, the solutions will introduce a new value proposition to the current business model, and have provided an insight into how the transformation process must be done. Thirdly, U1 and U3 will have made conclusions and an agreement of the suitable steps forward.

Current implementation stage: The solutions have now reached the final stage of the implementation phase, this is to conclude all the energy analyses, business model innovations and cash flow analyses. The project team have reached a consensus around a letter of understanding, which shows the pathway of steps forward.

Innovation: The in-depth energy analyses combined with business model innovation have given a holistic view of the often complex business landscape of energy supply systems - local and distributed - and it has given the project both the opportunity to pinpoint the bottlenecks, and find ways of mitigating them.

Connection to other smart solutions: The business model/-s developed through U1 and U3 effectively support the practical application of the U2 technical solution ‘Smart peak power control’, which aims to reduce peak loads and subsequently CO₂ emissions. The team are connecting the solutions on a holistic level in order to find the value proposition, which promotes the synergies between the solutions.

Connection to existing urban system and citizens/users: The solutions U1 and U3 are innovations based on the existing energy systems of district heating and cooling, heat pumps and geothermal storages. By integrating software with traditional energy systems, the solutions may be able to help reducing the climate impact of the energy systems.

Figure 1. Schematic system hook-up. (model)
Solution U2: Smart Peak Power Control

**General description:** The solution is based on an automated peak load management system which uses buildings as thermal energy storage hubs, so that stored energy can be used at peak periods when the need for energy is at its highest. Through this approach, it becomes possible to even out peak loads and reduce the use of fossil fuels, in order to secure a consistent heat supply throughout the city.

All buildings have a thermal mass that can be used to store energy. Heavy buildings (e.g. concrete) work better than light buildings (wood) for this purpose. It is feasible to install a smart control unit that assesses both outdoor and indoor temperatures in most existing systems (see figure 2). The system analyses weather data and predicts the coming heat load based on which it can constantly optimise the buildings energy demands, while keeping the indoor temperatures in check. The benefits of this system are twofold – it saves energy for the property owners and reduces the peak loads of the district heating grids.

**Expected impact:** Installation of the peak load management system is expected to save up to 10% of energy and to shave peaks with around 15-50% in peak heat power usage. In order to make an impact, it would be preferable to scale the technology up and install units on a larger number of buildings. The aggregated benefit would be the possibility to mitigate peak loads on a city level. This could lead to less use of peak load boilers and hence reduced climate impact of the production. The challenge is to find a sustainable business model of value sharing.

**Current implementation stage:** The smart peak power control on a small number of buildings in Umeå. The ones included in RUGGEDISED are a health centre and an office building. The health centre is used almost constantly and the office only during daytime. Alongside these buildings, apartment blocks were added to increase the peak load shaving capacity of the tests. It all works fine and is easily scaled up if needed. Discussions are currently being held with project partners on potential upscaling of the technology.

**Innovation:** The innovation here is to use buildings as a virtual energy storage. All buildings have a thermal mass, which is bigger for heavier buildings like concrete or brick buildings. This fact means the heating supply of a building can be turned down for a while, without the indoor temperature dropping noticeable. A maximum half-degree down is a lot of energy saved, but the inhabitants will not notice it at all. This innovation means energy can be stored when demand is low and used when demand is high.

**Connection to other smart solutions:** The use of weather forecasts in combination with heat buffering in building constructions, along with peak power controls, is smart.

**Connection to existing urban system and citizens/users:** By using buildings as thermal energy storage hubs, in the way hot water tank storages are currently used means district heating providers can avoid using peak load units, which helps to protect the environment and save money.

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**Figure 2. Display of system hook up for space heating.**

**Figure 3. Heat load over different weekdays in Umeå.**

1. Outdoor temperature
2. Smart energy system
3. Redistributed heat
4. Power control unit - turns down the heat
5. Building store heat
**Solution U4a: Gamification – influence behavioural patterns**

**General description:** Often when trying to optimise energy use, the general approach has focused around the supply chains and buildings. This solution is different and aims rather to involve the tenants to achieve a more sustainable behaviour towards energy usage and other parts of their day-to-day lives.

The idea is to use gamification methods to encourage tenants to alter their habits and behaviour. Through an App produced as part of the RUGGEDISED project, participants will be provided with information designed to inspire them to rethink their behaviour, this includes:

- providing challenges to encourage them toward particular actions;
- enabling continuous feedback to provide results of their actions;
- and holding group events to engage a larger number of participants generating a bigger combined effect and a sense of accomplishment within the community.

Requirements of the consumption data extraction has been completed and the initial data compilation for the baseline is in progress.

**Innovation:** It is quite common for projects centred around energy optimisation to mainly focus on technical solutions covering supply chains and the actual buildings. In this case the project aim is to study whether the energy use may be lowered by encouraging behavioural change of tenants through gamification and involvement in local events. Taking a broader, more holistic approach towards sustainability rather than just focusing on one element in isolation, like energy use, is intended to result in a broader social shift in the adoption of more sustainable habits to all aspects of life.

**Connection to other smart solutions:** The full solution will be linked with another App used for monitoring and controlling lighting, heating and other devices connected to the “Smart Home”.

**Connection to existing urban system and citizens/users:** The application is not intended to be directly connected to other urban systems, at least not at this stage. However, it will have an indirect impact on the way citizens engage with a range of different systems through the anticipated shift towards a more sustainable way of living.

At the start of the annual testing period, a baseline of consumption data (electricity and heating) will be extracted for the selected building. The test group is then introduced to the App and provided with a package used to manage the control of their devices, lighting and heating patterns. During the test period, the App will serve as a campaign to influence the behaviour and habits of the test group on sustainability while collecting the corresponding consumption data for comparison and analysis. In addition, user interviews and feedback session will be conducted regularly with the test group throughout the period. The test period will be set up and managed in collaboration with representatives from the real estate company responsible for the selected buildings.

**Expected impact:** If the campaign is successful, the expectation is to see a change in behaviour and habits concerning sustainability and energy use. An additional aim is to increase awareness of the impact one individual can have on energy use and CO₂ emissions by making small adjustments in their behaviour. As a long-term consequence, the hope is that this will result in reduced costs for both tenants and real estate companies, as well as reductions in CO₂ emissions.

**Current implementation stage:** A mock-up was constructed at the end of 2018 and tested on external users. Results from this initial test were fed into the construction of the prototype as baseline requirements. The prototype was built and tested on a group of users during the summer months of 2019. Feedback and findings resulting from the test are currently being compiled and analysed. The development of the full application is in progress and is intended to include corrections and feature requests based on the prototype testing.

Innovation: It is quite common for projects centred around energy optimisation to mainly focus on technical solutions covering supply chains and the actual buildings. In this case the project aim is to study whether the energy use may be lowered by encouraging behavioural change of tenants through gamification and involvement in local events. Taking a broader, more holistic approach towards sustainability rather than just focusing on one element in isolation, like energy use, is intended to result in a broader social shift in the adoption of more sustainable habits to all aspects of life.

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Solution U4b: Intelligent building control and end user involvement

**General description:** Akademiska Hus AB, which owns and operates the university and college buildings for the Swedish State, will install automatic smart control equipment to control air flow, room climate and presence-activated lighting in 130 offices at the University area in Umeå. The solution is a major energy project in one of the large lab houses, the Physiology House, with includes both offices and laboratories and where ventilation is in operation 24 hours a day. The offices will be connected to a monitoring system where settings can be managed and the status reported and stored. The idea is that the air flow and lighting adjusts depending on the degree of occupancy – both current and expected – in the rooms. The occupancy-rate will be decisive for the total cooling effect and the heating power needed to maintain the desired climate.

The owner of the hospital in Umeå, VCC, is also installing automatic smart control equipment in office areas. In one place the system is built to be used for evaluation and as a testbed for personnel in order to optimise it further and learn how to connect it to other smart systems in the most optimal way.

**Expected impact:** By installing a smart system that regulates air flow, temperature and lighting based on the presence and number of people in a given room, optimised use of fans and lighting is expected to lead to a reduction in heating and electricity demand. Moreover, connecting the rooms to a monitoring system enables better control with the overall system. Finally, it is expected tenants will react positively to lower energy consumption.

**Current implementation stage:** For the moment the installation of the system is going on, as shown in figure 4. Sound absorbing ceilings have been installed with the purpose of reducing the noise from the installations. The installation of the solution was ongoing until October 2019 when the final inspection was held.

**Innovation:** Within the university area there are already several buildings which have smart control for air volume, but this solution integrates the lighting system with indoor climate with the purpose of climate control and energy saving. The innovation for the hospital is also to investigate how it works best with other systems and to learn the best way to operate it. Innovation-wise, installing the equipment is only one challenge, another is to make it work optimally and reach the highest targets in terms of energy usage.

**Connection to other smart solutions:** This solution contributes to the conditions for U2 ‘Peak load management’ and U9 ‘Demand side management’ by contributing to conditions.

**Connection to existing urban system and citizens/users:** Installing this solution enable use of the supply system in a smarter way.

**Replication assessment:** This is a solution that Akademiska Hus could use in further buildings in the university area where the ventilation load is variable to optimise the indoor climate and thereby lower energy consumption. Potentially, the solution could be easily applied to buildings far beyond Umeå operated by Akademiska Hus.
Solution U5: Climate smart bus station

**General description:** The climate smart bus station is a new type of bus stop that is expected, with its innovative design where technology, people and the environment interact with each other, to reduce the city’s environmental impact and its carbon dioxide emission. It is also a symbol for the Smart University District. The bus station is served by both electric and fossil fuel buses. Procurement was carried out as a design-and-build contract.

**Expected impact:** With its futuristic and unique design, the bus station establishes public transport as a modern mode of transport in the smart city. The design can potentially give passengers the opportunity to ‘rest and reflect’ while waiting for the bus. The design can also contribute to reduced boarding time and a reduction in CO$_2$ emissions.

**Current implementation stage:** The climate smart bus station is implemented and in service.

**Innovation:** The designers had to turn the feeling of “wasted waiting time” into “finding time to be, to reflect, to feel and to transform”. The challenge was to create a space that felt protected, but that could not be totally enclosed because of the different bus types (electric and fossil fuel) have the doors located in different places.

Innovations include:

- Hanging pods to create a micro-climate for the passengers, which can be turned in any direction by the wind or by choice from the traveller. The pods are placed in such a way so that the bus station, if necessary, can be ploughed with a snowplough.
- The meditative light- and soundscape connects to the real-time GPS-system for the buses. The GPS-system updates data every five seconds. Each bus route has its own colour and sound, and data for the incoming buses are displayed on a screen in the bus routes’ own separate colours. The light and sound makes the station more accessible for citizens with a visual impairment or hearing loss. Children who cannot read can learn the colour and sound of their bus.
- A separation of the waiting- and boarding zone to promote faster boarding, made possible by the light- and soundscape.

**Results:** The bus station was taken into service on 5 September and with its beautiful design and innovative light- and soundscape it adds a great value to both passengers, the public transport system and to the smart city.

Umeå municipality has a goal that by 2022 at least 65 % of all travels are made by sustainable transport modes to reduce the city’s carbon dioxide emissions. The bus station contributes to that goal by giving public transport a modern and futuristic touch and giving passengers waiting for the bus a space to relax. More efficient boarding, made possible by the audio-visual system is good not only for the electric buses but also for the economy of the public transport system.

Feedback from passengers on the first day of service included: “Futuristic and aesthetic”, “exciting design”, “beautiful lights”, “surrounded by wonderful sounds”, “cosy leaning pods”, “fun”, “multiple senses”, “super with real-time notifications”, “it feels warmer in the pods than outside them”, “I don’t mind waiting for the next bus”, “awesome”.

**Connection to existing urban system:** The bus station is in service in Umeå municipality’s public transport system and connected to their real-time system. The station is connected to Umeå municipalities fibre net and electrical net.

**Replication assessment:** There are great opportunities for replication either as a full concept or in-part e.g. the design of the innovative pods and the meditative light- and soundscape connected to the Realtime GPS-system.

![Figure 7: Climate smart bus station](Source: City of Umeå)
**Solution U6: E-charging hub & charging infrastructure**

**General description:** Akademiska Hus will test a charging hub for e-vehicles (see figure 7) serving e-bikes, e-cars, and car-share. As e-vehicle charging adds strain to the power system, different batteries and storage solutions within this solution as well as a smart power control management-system, including a dynamic payment system for the charging, will be tested. Integration of small-scale photovoltaic (PV) installation within the overall system and how the battery storage can be upscaled will also be explored. The overall aim for the e-charging hub is to develop it into an “Energy-hub”. VCC will also install a charging hub in front of the hospital in Umeå.

**Expected impact:** The main aim of this solution is to find a smarter energy system solution with lower climate impact by integrating grid owners and involving end users to reach the objectives of a climate neutral energy system. This smart solution will provide smart energy to recharge electric vehicles from renewable energy sources.

By installing PV plants along with energy storage, advanced monitoring and governing systems, and charging points for electric vehicles within the innovation area, good results will be gained in terms of reducing building energy use, as well as systemic effects such as decreasing peak loads. One goal is to be able to draw scalable conclusions. With the experience from the charging hub, the aim is to be able to make assessments of the size of the battery plant that is optimal for different types of properties. The idea is to be able to draw conclusions on how use-patterns and loads affect the need for battery storage.

The EV-chargers built at the hospital entrance focuses on taxis, where the main goal is to see if, by giving them the possibility to charge while waiting for patients, whether taxi companies could be encouraged to invest in e-vehicles. Long term, this would lead to an improvement around the hospital with less noise from cars in the area, and better air quality.

**Current implementation stage:** The installation of the system began in the summer of 2019 and is complete (see figure below). After finalising the installation, the system is operational.

**Innovation:** The type of battery storage, the link between producing and consuming, and the evaluation of input to be able to scale up this solution are some innovations in this solution.

**Connection to existing urban system:** This solution is connected to the existing urban system by delivering the additional electricity from its PV-plants to the buildings.

**Connection to other smart solutions:** This solution is connected to U2 ‘Peak load management’, led by Umeå Energi, helping to decrease peak loads. This solution could also be a part of the U7 ‘Flexible green parking pay off’ led by the parking company Upab by being a very cost-effective sustainable mobility-measure measure for private property owners. We will also be able to supply data that may be useful for U7.

**Connection to existing urban system and citizens/users:** The application is not intended to be directly connected to other urban systems, at least not at this stage.

However, it will have an indirect impact on the usage of a range of different systems through the encouragement towards a more sustainable living.

**Replication assessment:** Akademiska Hus is aiming to be able to use the conclusions from this solution for upsaling in other buildings at the university area. The system is very simple to be connected to more properties and PV plants.

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**Figure 8: Charging hub. Source: Ferroamp**
Solution U7: Smart business model for flexible parking

**General description:** To help manage air quality in the centre of Umeå, the local authority has decided that no new workplace parking places shall be built in the central urban area. Property developers are therefore offered the possibility of alternative pay-off schemes for parking places through Umeå Parking, the municipal parking company, when they get planning permission.

In order to enable more sustainable travel to and from the building, property developers are offered the possibility of a reduced fee on the cost of the parking pay-off fee through the business model called “Green Parking Pay-off”. In this case, the developer signs an agreement with Upab in which they agree to implement measures to support sustainable travel for the users of the building.

**Expected impact:** Centrally located workplaces are attractive and the densification of urban space leads to more travel within a city. To ensure air quality does not decrease and indeed improves in the city centre, one solution is to keep down the number of car journeys in this area. As such, Umeå has made a political decision that no more workplace parking places in the city centre shall be built. It is not considered to be a viable option to develop the city centre and at the same time provide car parking for all employees. Instead, the parking spaces should be reserved for visitors and residents. To achieve this, Umeå municipality and Upab implemented a so-called parking pay-off scheme. The parking pay-off scheme means that property owners can buy parking spaces instead of building on their own property. The property owner then gets the parking solution at a lower cost since there are collective facilities, i.e. no fixed places and thus increased utilisation.

In order to further improve air quality in Umeå, a smart business model was developed and introduced focused on the Green Parking Pay-off. This new model allows the property owner to take responsibility for employee travel to and from the property in other ways than merely offering car parking according to the car parking standard. The property owners receive a reduced parking standard if they undertake to pay a fee to a mobility management fund, connect the property to car sharing and arrange heated bicycle parking areas with changing rooms for employees that commute by bike. Property owners thus get a reduced parking standard, more attractive facilities, participate in a better urban environment and strengthen their brand. Upab undertakes to reduce the car parking standard for the property, provide resources within mobility management on behalf of the property owner, produce a green travel plan and a communication plan for the property and arrange parking solutions for employees outside the city centre.

**Current implementation stage:** The business model was completed by May 2018. The municipality board agreed on the terms and criteria that the property owners have to fulfil in order to get the reduction on the parking space standards. The business model is now part of the overall “offer” and part of the comprehensive plan. This means that all property owners in Umeå that fulfil the criteria may now choose to benefit from the possibilities of the green parking pay-off.

**Innovation:** In June 2012, the pilot project “Effects of green parking pay-off – a future model for the dense and climate-smart city”, was funded by the Swedish Energy Agency. The project partners were Umeå Municipality, Upab and Balticgruppen AB. The project developed an evaluation method for green parking pay-off and the full energy efficiency and savings potential were calculated for where the pilot project was carried out.

Today, it is possible to use the green parking pay-off for businesses and housing within zone A, where conditions exist. The green parking pay-off primarily applies to new and additional buildings but a re-assessment to include older buildings may be relevant. Green parking pay-off provides incentives for the property owner to contribute to sustainable mobility patterns.

**Connection to existing urban system and citizens/users:** In order to reduce parking space needs, property owners must ensure that the property still fulfils its needs for mobility. This means having a car-sharing service, more parking spaces for cyclists and working with the City’s mobility management team to increase the use of public transport to and from the property.

**Replication assessment:** The business model has already become a permanent model in the city of Umeå. The idea of the business model has a high potential for replication in other cities.

**Results**

- Less traffic
- Improved air quality
- Enables further development

**Figure 9: Flexible parking concept in Umeå**
Solution U8: Smart City open-data decision platform

**General description:** The smart city open-data decision platform, aims to provide real-time visualisation as well as static data to show the impact of smart city interventions. It will also provide a way to quickly access and combine different data sets to examine results, and as such to enhance the possibility of quickly making well-founded decisions for the council as well as for citizens. Bringing together different data sets as part of one platform, enables a more uniform approach towards decision-making and the potential for a real impact on an improved quality of life.

By encouraging students at the university to use the platform where it was introduced different classes as a data source in, it is hoped that students become familiar with it and thus will engage in keeping it alive and use it, when stating facts in community discussions. Non-data "experts" can also browse the data and look at it by using intuitively designed maps and charts.

**Current implementation stage:** Since Umeå realised that neither the resources nor the time was available to build an open-data decision platform from scratch it was decided that one would be purchased to use as the foundation for it. The first step was to examine what could be found on the market today. Initial research found that none of the products delivered the ‘whole package’, so a procurement process was opened with a list of requirements.

**Innovation:** On the open-data platform, visitors will have the possibility to combine different data. Administrators can create dashboards to present/view specific data set combinations.

With this open-data platform, citizens are invited to use the collected data and share feedback on it. They can also combine data sets or analyse them to find the data they need to prove a point: “As I’ve always stated – there are more bike accidents in the area where the city decided not to make bike lanes”.

However, there will also be cases where data sets are combined that in reality have nothing to do with each other. To prevent this, it is crucial that the data owner, who publishes the data on the portal, also provides clear and distinct descriptions connected with the data e.g. if there is a unit “L”, what does it stand for? Is it Large/Little/litre/etc, there must be no room for different interpretations!

There has been an open-data portal for Umeå before. However not one where the users can both download data and view it directly on the portal. The portal will offer both text with good descriptions of the data, tables for the data, a map (if there is a position in the data set), a chart (if data can be used in that way). In short – the portal can offer something to everyone, not only to developers looking for an API.

The other thing that will be new is the possibility to combine different data sets. It is this functionality that will truly make it a smart city open-data decision platform.

**Connection to existing urban system:** By collecting different data and providing the possibility for analysis of multiple data sets, the possibility for strategic planning in the city is enhanced. With this portal the aim is also to show data collected from different sensors in the city. However, to provide real time data to the portal, might prove a technical challenge.

By adding real time data for different services, opens up the possibility to monitor the impacts of different targeted interventions across the city.

**Connection to existing urban system and citizens/users** Stakeholders that published data on the old portal for open-data in Umeå will be contacted, if they have not already been. If their data is valid for publication, the aim is to publish that data on the new portal along with other data. Data collected by the Municipality should also “automatically” be evaluated for sharing on the portal. This will be a slow process; the current way of working must slowly be adapted to a new way. Once in place, the process for handling data should be relatively smooth and will be automatically be updated and managed.

To ensure citizen engagement in providing data to the portal, the latter has been presented to Umeå University, and specifically the department for computer science. They are planning to use it as a data source for their students, both to find statistical data, but also using the APIs provided in the platform.

**Lessons learnt:** A mistake in the procurement process was that some requirements we considered as self-evident e.g. an open data platform should not require registration in order to view the data. In hindsight, clearer requirements would have saved time spent on discussions with vendors who were unclear why they were rejected. In some cases, sharing HOW met requirements were verified more clearly would also have been beneficial.

The real challenge is to collect sufficient data on the platform, to convince stakeholders of the value of publishing and sharing data as open data. This is much easier with a portal which has a visually attractive user interface, so that contributors can see the data, and understand that the combination of different data set could be interesting. In some cases, they might even understand that citizens, when viewing data on the platform, could contribute with missing data. Another factor to consider is the time savings associated with being able to direct citizens directly to the platform rather than needing to respond to individual requests.

You can try Umeå’s Open data platform on: http://opendata.umea.se
Solution U9: Demand Side Management

**General description**: In this solution, the Demand Side Management system logs sensor data from different sources and aggregates it into one platform where the data will be used for a new type of analysis, showing the status of the building. Results from research will improve the tool in that case, for example, showing the optimal indoor climate, unnecessary energy use or true usage of the bookable rooms. The research will also contribute to improving the measurement method by studying the accuracy in the sensor when logging. While the solution will affect the buildings in terms of better managing energy use, people using the buildings are unlikely to notice a difference expect when visiting facility services. For planners, operating personnel as well as energy operating technicians the project will make difference.

**Innovation**: A wide range of different sources generates building data. Such data has traditionally been analysed separately. By aggregating and analysing building data simultaneously in a tool capable of incorporating different data sources, it is expected that new ways to improve the building’s energy efficiency, reduce the climate impact and improve the use of the building can be identified.

**Expected impact**: The overall goal of this solution is to find a model/tool for the demand side management to further reduce the energy usage and climate impact of a building. The tool will also help to optimise facility services such as cleaning and waste management, and to improve the use of bookable rooms. The ambition is to reduce the energy use between 5 and 30 percent. The property owner, Akademiska Hus, owns and manages about 3.2 million square metres of property in Sweden, and that, including the tenants’ use of energy, could be vital for reaching ambitious climate goals. In the future, the solution could potentially be used in any building.

**Current implementation stage**: Currently 500 sensors are installed within this Demand Side Management project. Those sensors are aggregated in one platform together with previously installed sensors, placed in smart heat and ventilation devices. It also includes a time-scheduling component and weather station data, to show the status of the building in a new way.

**Replication assessment**: The property owner owns and manages about 3.2 million square metres of property in Sweden, and that, including the tenants’ use of energy, could be vital for reaching ambitious climate goals. The goal is for the solution to potentially be used in any building in the future.
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RUGGEDISED is a smart city project funded under the European Union’s Horizon 2020 research and innovation programme. It brings together three lighthouse cities: Rotterdam, Glasgow and Umeå and three follower cities: Brno, Gdansk and Parma to test, implement and accelerate the smart city model across Europe. Working in partnership with businesses and research centres these six cities will demonstrate how to combine ICT, e-mobility and energy solutions to design smart, resilient cities for all.

About the publication
This is the first in a series of three implementation reports from the European Smart Cities and Communities Lighthouse City of Umeå. It details the work Umeå has done through RUGGEDISED to become an even smarter and more sustainable city.

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