RUGGEDISED
Designing smart, resilient cities for all

Factsheets on
Smart thermal grids

ROTTERDAM . UMEÅ . GLASGOW

Intelligent use of thermal energy by planning, installing and enlarging smart thermal grids

This also includes peak load management, monitoring and contractual needs.

CONNECTING SMART THERMAL GRIDS TO EXISTING SYSTEMS

WORKING WITH STAKEHOLDERS TO MAKE EXISTING GRIDS SMART

CONTEXT DEPENDENCIES IN UPSCALING SMART SOLUTIONS

About the publication

This factsheet booklet is one of four in a series that focuses on particular aspects of the smart city approach and how to tackle common challenges faced by cities and communities across Europe. The list of challenges is not intended to cover all complexities for a succesful Smart City project, but provides key output from the RUGGEDISED project on specific issues. The thematic challenges found in this booklet on smart thermal grids have also been covered in various ways through the many public deliverables available on RUGGEDISED.EU/Publications.

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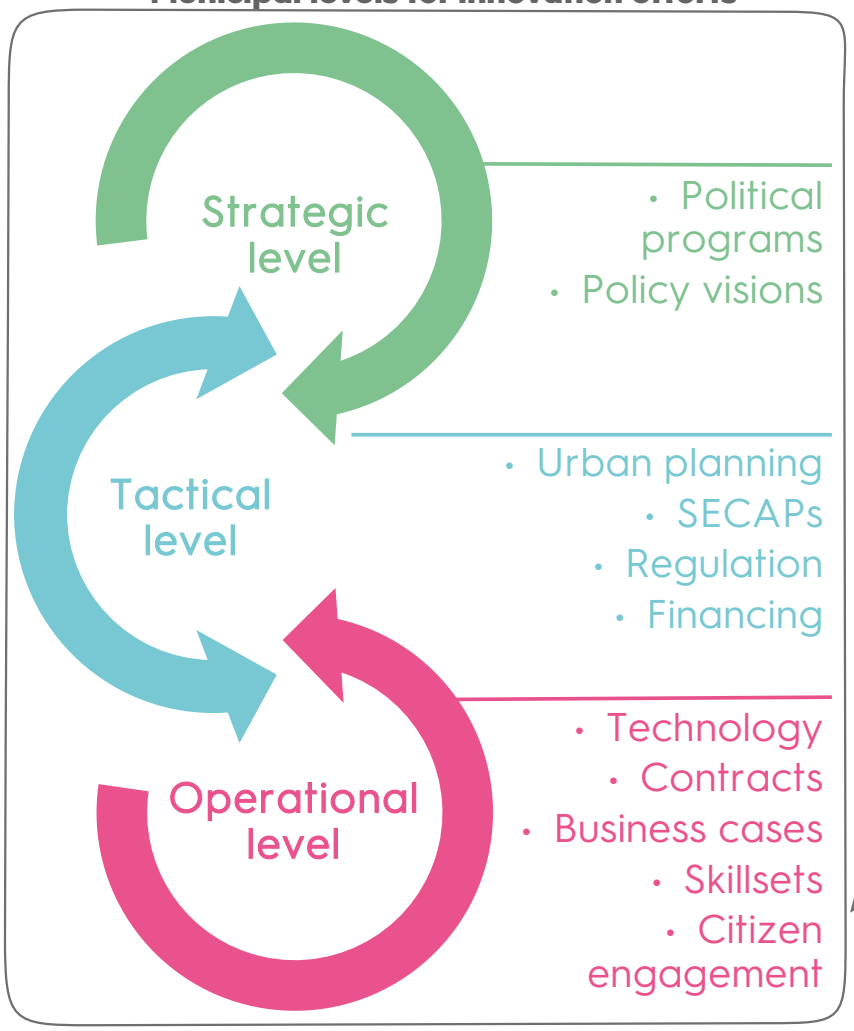
Embedding smartness in city structures

In large scale projects involving city innovation and urban development, municipalities (and their partners) have to deal with more than just deploying the infrastructure needed. To successfully implement solutions connecting mobility and energy into their urban environments, Smart City projects have to approach this challenge from different levels. In RUGGEDISED, partners have identified these levels as: operational, tactical and strategic.

Municipal levels for innovation efforts



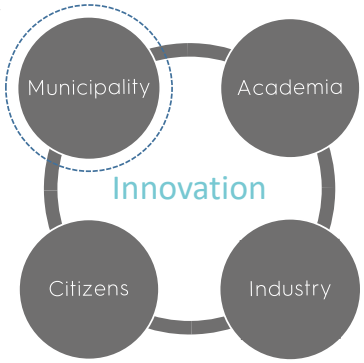
Local Governments should embed highly innovative psojects in all three levels of their organisation

These three levels are similar for all truly innovative projects regardless of the content of deployment, but the particulars of what should/should not be included in each level differs depending on how much integration is necessary between the solution and existing city systems. In RUGGEDISED, partners have worked with 'e-Mobility and Smart Electricity', 'Energy Management' and Connections' and 'Urban Data Platforms', in addition to the content of this factsheet-booklet on 'Smart Thermal Grids'. RUGGEDISED partners have covered the overall conclusions regarding the positioning of Smart City projects within city administrations in the 'Guide on RUGGEDISED Innovation and Implementation of Smart Solutions'.

The specific work related to Smart Grids in RUGGEDISED has centred on external city actors from the operational level (in terms of current grid capacity, energy consumption by citizens and industry, etc.) and the tactical level, in relation to the cooperation between various city departments and key external players on the planning undertaken to achieve the overall policy goals (strategic) put forth by local (and sometimes national) leaders.

In an ideal Smart City project, the work with external actors should take place in a so-called "quadruple-helix", where innovation actions take place in unison following cooperation between all actors represented in the quadruple helix.

External partnerships



The Quadruple helix cooperation model for innovation projects

Smart thermal grids in the Lighthouse Cities

Rotterdam

In Rotterdam, the RUGGEDISED partners have improved a local Smart Thermal Grid connected to several large buildings in the area 'Heart of South', most notably the venue Rotterdam Ahoy. The Smart Grid uses thermal energy from new sources through aquifer wells underground.

The grid, supported by Geothermal heat pumps (R1), can extract energy from wastewater (R2), surface water (R3) and thermal energy through tubes installed in asphalt (R4). Rotterdam has also conducted several studies on the economic feasibility of different solutions for the smart thermal grid.

Umeå

In Umeå, partners are working on an innovative approach to energy storage in which buildings are used to store thermal energy (U2). The purpose of this is to better manage peak loads and to make the buildings serve as potential thermal energy storage when the production of renewable energy is high. During peak periods of energy use in the city, less heating/cooling will then be required for the buildings.

Partners are also working with innovative business models for the exchange of heating/cooling (U1-U3), which draws on a geothermal energy storage facility delivering a total of seven GWh heating energy and five GWh of cooling energy per year.

Glasgow

In Glasgow, work has focused on exploring the contracts required to allow the connection of producers and consumers to district heating networks (G1). In cooperation with local producers of excess heat, Glasgow has investigated various ways of utilising the energy locally in smart thermal grids.

This has led to a detailed business model allowing buildings to sell surplus heat to each other through a contractual model for implementation. This has been agreed upon by all stakeholders to enable more informed contract negotiations between generators and consumers of heat, and facilitate easier establishment of heat connections in the future.

Connecting Smart Thermal Grids to existing systems

By implementing Smart Thermal Grids, cities are intervening in existing urban (physical) infrastructures and services, i.e. interventions at systemic level. **The key to having impact at this systemic level, is to understand the interconnection and interdependencies** of the various parts that the system comprises. However, in-depth knowledge on these connections is inherently scattered among urban (public and private) partners. To succeed in this, the RUGGEDISED cities focused on both contractual matters and the physical installations of pipes and heat pumps.

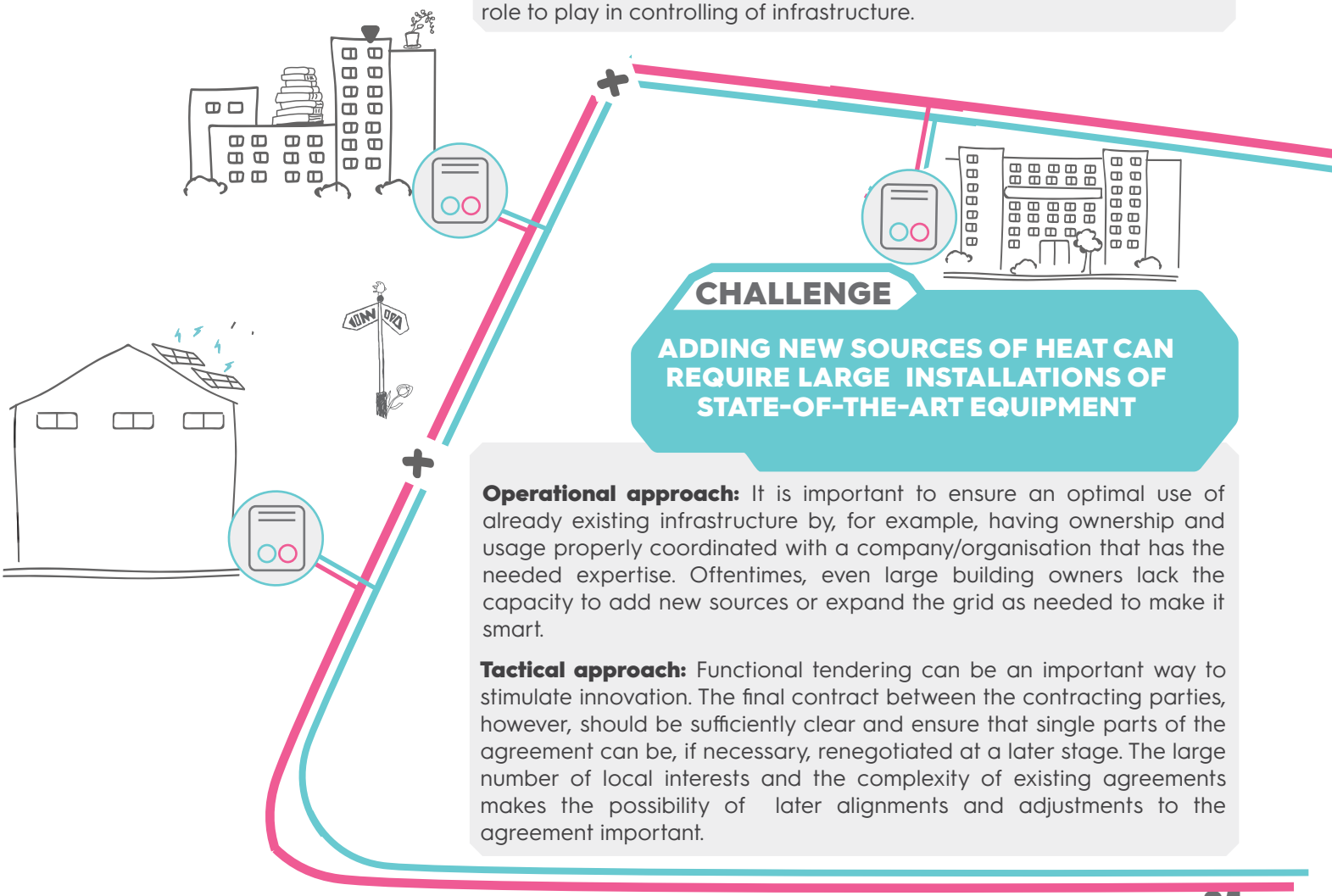
CHALLENGE

A POTENTIAL SUPPLIER OF EXCESS HEAT MAY SEE CONNECTING TO A SMALL LOCAL GRID AS A RISK

Operational approach: Allow for a limited supply commitment in combination with a Key Performance Indicators regime, where poor service (i.e. supply glitches) may lead to reductions. Other back-up facilities are then financially viable for the consumers and the supplier will share the incentive to keep a steady supply.

Operational/tactical approach: The existence of an ESCO - Energy Service Company – can help alleviate concerns from the suppliers' side and encourage their participation. Public sector leadership in promoting an ESCO – even for limited purposes in the local grid – can help to catalyse the initial projects.

Strategic approach: Decarbonisation challenges cities to reconsider whether or not they are up to the tasks they face. Moreover, RUGGEDISED shows that (technological) innovations, such as Smart Thermal Grids, change the already blurred boundaries between public and private interest. Culture and the role of government are often implicit and hard to change. Urban innovation requires city governments to reflect on the prerequisites that should be fulfilled for them to take a position on what role to play in controlling of infrastructure.



CHALLENGE

ADDING NEW SOURCES OF HEAT CAN REQUIRE LARGE INSTALLATIONS OF STATE-OF-THE-ART EQUIPMENT

Operational approach: It is important to ensure an optimal use of already existing infrastructure by, for example, having ownership and usage properly coordinated with a company/organisation that has the needed expertise. Oftentimes, even large building owners lack the capacity to add new sources or expand the grid as needed to make it smart.

Tactical approach: Functional tendering can be an important way to stimulate innovation. The final contract between the contracting parties, however, should be sufficiently clear and ensure that single parts of the agreement can be, if necessary, renegotiated at a later stage. The large number of local interests and the complexity of existing agreements makes the possibility of later alignments and adjustments to the agreement important.

Working with stakeholders to make an existing grid smart

Many cities, especially in northern Europe, have well-functioning and wide-reaching District Heating & Cooling (DHC), delivering energy to more than 70 percent of buildings. However, while the networks are efficient, they are rarely smart and mainly address peak-demand periods by burning fossil fuels. **To address this issue of peak-demand,** energy companies can use Smart Thermal Grids allowing them to manage peak loads using renewable energy.

CHALLENGE

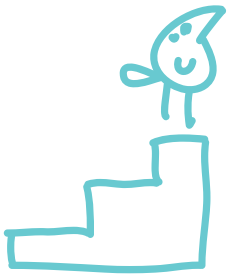
LACK OF COOPERATION BETWEEN END USERS AND ENERGY PROVIDERS COMPLICATES SMART SHARING

Operational approach: Set up clear contractual guidelines for exchange and sharing of thermal energy. RUGGEDISED has developed contractual models, achieving transparency for future projects by developing clear contractual guidelines that allow companies and other entities to exchange surplus heat energy from one entity to another.

Tactical approach: Involve large stakeholders (businesses, hospitals, municipality, etc.) in a close partnership with energy providers. This allows for a more comprehensive implementation and integration of smartness and helps build the needed trust. One way to build this trust is by setting up →Innovation Platforms.

CHALLENGE

THE HUMAN FACTOR IS DIFFICULT TO PLAN FOR AND MUST BE TAKEN INTO ACCOUNT



Operational approach: Utilise concepts such as Gamification and User Experience Design to potentially add value to smart systems. Based on the premise that the best technology used inthe wrong way willl not support cities in reaching their goals, RUGGEDISED partners in Umeå are testing how citizens react to solutions or utilise apps.

Operational approach II: Plan the engagement of users early to not just ensure optimal use, but also optimal installation. Train, educate and explain to users how to benefit from, and also support, any smart solution installed. Ideally, involve users before beginning work and prepare to adjust the project following feedback throughout the process.

Context dependencies in upscaling smart solutions

Much can be gained, both in terms of CO2 savings and cost reductions, by upscaling/replicating the solutions tested in RUGGEDISED Lighthouses, Fellows and other cities across Europe. Some of the solutions have been demonstrated in residential housing, others in large civic buildings and some in districts with mainly large private companies. As such, the RUGGEDISED districts represent different kinds of urban areas.

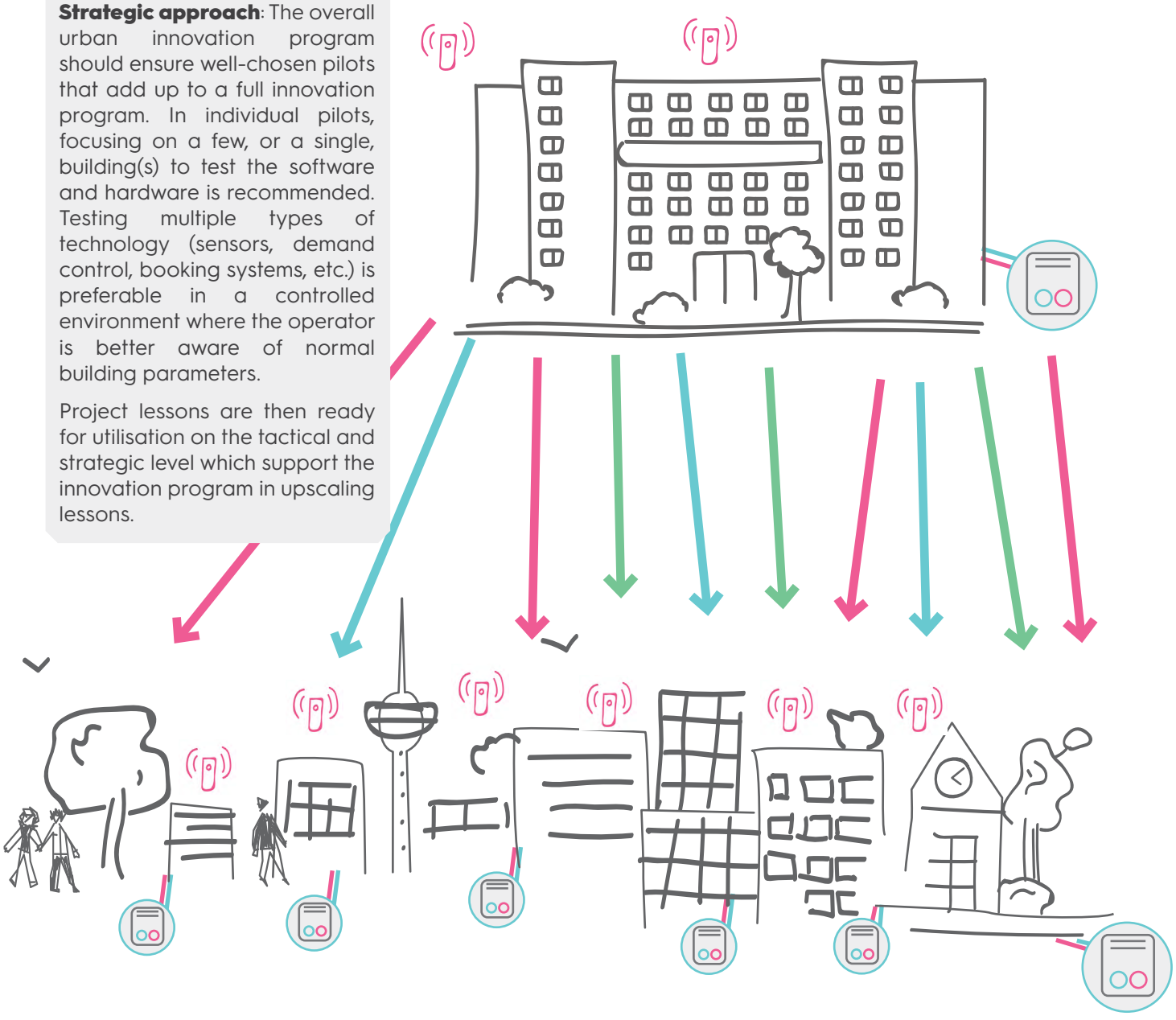
CHALLENGE

COMBINING DIFFERENT TECHNOLOGIES IS NECESSARY TO MAKE IT 'SMART' BUT IT COMPLICATES THE VALIDATION OF RESULTS

Operational/tactical approach: Advanced modelling can be used to provide input for designand decision making from the outset, and also to validate the final results. RUGGEDISED has developed a prototype Smart Energy District Planner, allowing the Lighthouses and Fellow Cities to do just that (→Find the Smart Energy District Planner).

Operational/Tactical/ Strategic approach: The overall urban innovation program should ensure well-chosen pilots that add up to a full innovation program. In individual pilots, focusing on a few, or a single, building(s) to test the software and hardware is recommended. Testing multiple types of technology (sensors, demand control, booking systems, etc.) is preferable in a controlled environment where the operator is better aware of normal building parameters.

Project lessons are then ready for utilisation on the tactical and strategic level which support the innovation program in upscaling lessons.



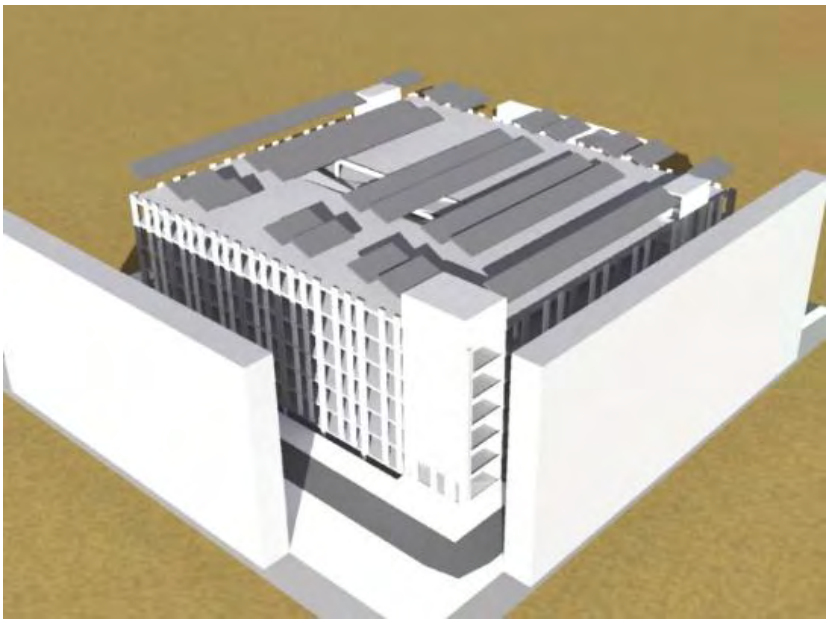
...Context dependencies in upscaling smart solutions

CHALLENGE

ANALYSING THE POTENTIAL OF UPSCALING CAN BE COMPLEX AND VARIES FROM CITY TO CITY

Operational approach: Use RUGGEDISED'S 'Prototype smart energy district planner' which allows cities to plan the smart energy transition in their own urban environments. RUGGEDISED partners in Umeå and Glasgow have made a combination of modelling tools and processes that can assist a city team in making well-informed design decisions based on data from a suite of modelling tools.

The tools include some licensed software, however, a freely accessible building energy simulation program for the integrated modelling of building energy performance is only available through RUGGEDISED partners.



Model of a Glasgow Smart solution (solar canopy) in the ESP-r model which is being used in the prototype energy planner

Tactical approach: Allow several factors to influence the decision of a specific smart city solution to avoid decision-making based only on one criteria. Using multi-objective evaluation allows for factors such as power, energy, thermal comfort, emissions and lighting data to be included.

Due to the large amount of stakeholders involved in a true smart city connection, it is important to thoroughly evaluate the costs/risks and gains/benefits for each partner involved. It is critical that these evaluations are consulted and contribute to the city's plans, such as the Sustainable Energy and Climate Action Plan (SECAP).

CHALLENGE

THE COMPLEXITY OF SMART URBAN INNOVATION COMPLICATES COOPERATION AND CAN CREATE COLLECTIVE KNOWLEDGE GAPS

Strategic approach: Create a shared vision at the start of the urban innovation program, based on the values that each partner would like to pursue and the goals that each partner would like to achieve. Search for collective values and goals, but also appreciate differences and openly discuss conflicting interests. Updating and discussing the shared vision is a continuous task.

Operational/tactical approach: Collaboratively map and discuss the information requirements and knowledge gaps. Note that knowledge on particular areas and urban systems is scattered among partners, and partners do not necessarily agree on each other's knowledge base. Articulate contradictions and information asymmetries. External partners can help to articulate knowledge questions, as it is often difficult to pinpoint what you do not know.

Recommended publications for expert info

RUGGEDISED SOURCES

Implementation reports from the Lighthouse Cities

These reports detail the work undertaken by the Lighthouse Cities of RUGGEDISED to implement the cities' smart solutions.

They are written by cities for cities and share the main considerations behind the strategies in Umeå, Rotterdam and Glasgow to support other cities in developing Smart City strategies and in implementing solutions.

Innovation platforms

These reports offer an introduction to the concept of Innovation Platforms and details the work done in RUGGEDISED cities. What is an Innovation Platform, how can it be set up and function, and what might a city or municipality gain from working this way?

The reports are written by RISE Sweden.

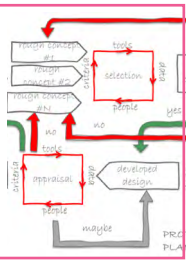
Guide on RUGGEDISED implementation and innovation of smart solutions

This report is the main output of lessons from RUGGEDISED's innovative solutions and details different approaches cities can take to solving complex challenges - exemplified through the smart solutions in the project.

The report was written by TNO.

Other RUGGEDISED material

The partners of RUGGEDISED have produced a large library of material relevant for all Smart Cities professionals. It will continue to be updated until the end of the project and covers everything from webinars to scientific publications on a wide range of issues - from European cooperation to the work done and planned in the Fellow Cities of Gdańsk, Brno and Parma.



OTHER SOURCES ON SMART THERMAL GRIDS

Guidance Packages and booklets from EU initiatives

The European Union is compiling lessons from the large Smart City Projects through the Smart Cities Marketplace. Find booklets specifically on Smart Thermal Grids and the potential for upscaling and replicating them on the website.

About

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About the project
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 factsheet booklet is one of four in a series to focus on particular aspects of the smart city approach and how these can help tackle common challenges faced by cities and local regions across Europe. find the rest on ruggedised.eu/factsheets

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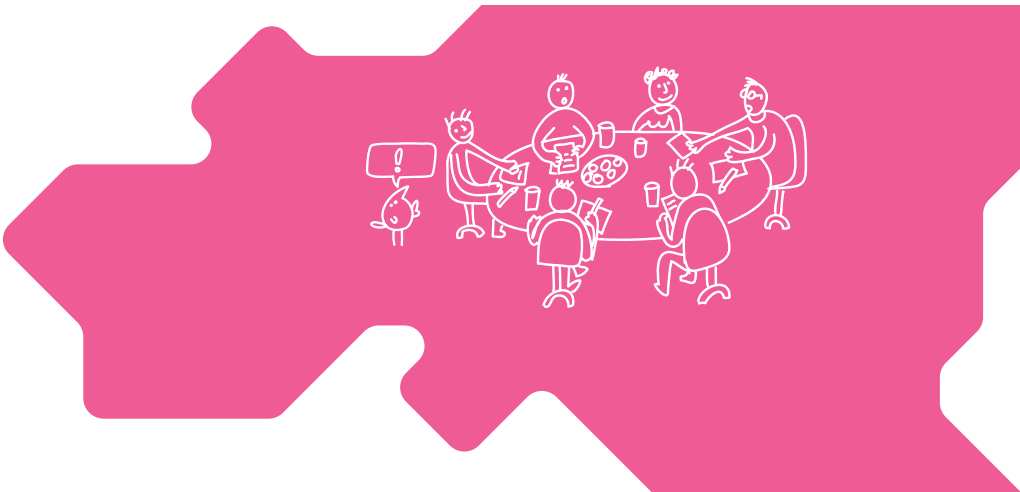
Partners



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