



Piotr Kalbarczyk, Dilay Kesten Erhart, Valerie Bahr

CITyFiED Innovation Management Guide

**A case study on the exploitation of smart city
solutions in the European Smart Cities and
Communities Project CITyFiED (Replicable and
Innovative Future Efficient Districts and Cities)**



Piotr Kalbarczyk, Dilay Kesten Erhart, Valerie Bahr
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Preface

*“If I had asked people what they wanted,
they would have said faster horses.”*

Henry Ford

This famous quote by Henry Ford implies that finding the best answer to a problem is a critical issue for a disruptor. In order to address the new and ever more complex climate-change and urban sprawl related challenges, cities must adapt. Simple improvements applied to existing solutions are often neither desirable nor possible. To create a value and to place social outcomes at the core of policy making, many municipalities started transforming their systems. A high degree of effectiveness and efficiency in delivering citizen-dedicated services is necessary. Only in this way, the quality of life in a given city can be improved, while the metropolis itself becomes future-proof.

In order to succeed, being creative is not enough. Cities and their partners have to understand how to lay the right foundation for innovation – within and across their environments. The ability to identify a challenge and to translate an idea into a project is required. Moreover, it is important to recognise the processes and structures supporting and accelerating innovation.

Innovations are closely related to networking activities because networks are capable of transforming inputs (ideas, technologies, funds, patents, skills, etc.) into marketable outputs (new products, services, companies, jobs, profits, etc.). New types of collaborations enable the emergence of new ecosystems such as global innovation clusters, intelligent hubs, intelligent agglomerations or Living Labs. If coordinated wisely, these networks integrate the knowledge distributed on various spatial levels and skills dispersed among the society. Recent evidence advocates that international collaborations and global knowledge flows are a pivotal source of creativity and innovativeness.¹ **Smart Cities and Communities** projects with their local consortia covering multiple stakeholders from municipality, industry and research organisations, embedded in a

1 For more information see: Komninos, N. (2015). *The Age of Intelligent Cities*. London: Routledge, p. 40.

large international consortium, have shown to be an additional form of **innovation hub** with high potential at a local and an international level.

In many European cities, Smart Cities and Communities demonstration projects have been set up to test new, innovative and sustainability-oriented technologies. Having formed the appropriate partnerships and being financially supported by the European Commission, numerous municipalities engage in the projects eagerly.

The results of such piloted and implemented projects shall be disseminated and exploited system-wide. Unfortunately, many projects fail in terms of turning their valuable results into exploitable components or marketable utilities. However, the reason behind it is not the lack of potential. It is rather a high level of complexity as well as uncertainty characterising the innovation implementation environment. Addressing these factors is considered a major challenge to overcome.

Based on its perennial experience in providing expertise in **innovation management (including financing, commercialisation, related policy analysis, etc.)**, **Steinbeis-Europa-Zentrum** developed a **functional exploitation strategy** to tackle this challenge. This strategy has been successfully applied to create links with the other European Smart City projects for a mass-market deployment and the long-term capitalisation beyond the project's lifespan. Using the European Smart Cities project "**CITYFiED**" as a case study, the main assumptions of the strategy are explained and exemplified in this guide. Moreover, it presents a selection of results such as products and services developed in the course of the project.

This guide is dedicated to all the stakeholders involved in publicly funded, innovation-oriented smart city projects that are in line with the quintuple helix innovation model – be it representatives of governments, business sectors, academia, civil societies or NGOs. It provides the reader with a set of tools and recommendations to help maximise the impact of their projects' outcomes. This is, for example, achieved by using the results in further research, in developing, creating and marketing new products, processes, services or in standardisation-related activities.

1 Introduction

Smart cities are multi-layered, territorial systems of innovation. Their structure consists of knowledge-intensive activities, digital spaces and **innovation-oriented institutions**. The latter provide a framework supporting activities in different fields such as research and development (R&D), collective intelligence, innovation funding, technology transfer, etc. Transformation-led and knowledge-based urban development became a popular model, which municipalities try to adopt and adapt to their specific circumstances. Factors playing a crucial role in this process are institutional effectiveness, a high level of trust, efficient collaborations and **knowledge spill-overs within the community**.² A Smart Cities and Communities demonstration project is the perfect tool to achieve these goals.³ It decreases the time a technology needs to make its way from the development phase (prototype) to implementation and the general availability for the commercial users.⁴ While testing its workability, such projects demonstrate the usability of the innovations to potential beneficiaries under real operational conditions. From the economic perspective, if well executed, **the demonstration project eventually leads to a higher level of additional investment (financial leverage), job creation, production of economic and innovation outputs and results commercialisation**.⁵

The projects prove the technical, commercial and environmental feasibility of an innovation, reduce risks and costs (components, building, operating, maintenance, etc.), develop public awareness and introduce an institutional framework for societal change. The following taxonomy of the project results purposes exists: learning (to be fed back into technical development), open-

2 Komninos, N. (2015). *The Age of Intelligent Cities*. London: Routledge, p. 24.

3 E.g. European Smart Cities and Communities Lighthouse Projects. They aim at improving urban life through more sustainable integrated solutions. Projects address the city-specific challenges from different policy areas such as energy, mobility and ICT. It builds on the engagement of the public, industry and other interested groups to develop innovative solutions and participate in city governance. (https://ec.europa.eu/info/eu-regional-and-urban-development/topics/cities-and-urban-development/city-initiatives/smart-cities_en)

4 Lefèvre, S. R. (1984). *Using demonstration projects to advance innovation in energy*. Public Administration Review, 44(6), p. 483–490.

5 More details and quantified data in: European Commission (2017). *Assessment of the Union Added Value and the economic impact of the EU Framework Programmes (FP7, Horizon 2020)*. [ebook] European Commission. Available at: http://ec.europa.eu/research/evaluations/pdf/archive/other_reports_studies_and_documents/assessment_of_the_union_added_value_and_the_economic_impact_of_the_eu_framework_programmes.pdf [Accessed 25 Feb. 2019].

ing the markets (higher societal acceptance, addressing institutional barriers), building the actors networks.⁶

The complexity of these demonstration projects lies not only in their multipurpose nature: besides technological challenges, a variety of economic, societal and environmental issues must be addressed. Demonstration projects require carefully structured, precise processes. Moreover, a division of content-related and administrative responsibilities must be developed between public agencies, private stakeholders and other partners. Conflicting interests and concerns regarding the intellectual property of results must be addressed and settled. A proper management structure is needed to resolve these bottlenecks. Based on the experience of Steinbeis-Europa-Zentrum⁷, a knowledgeable facilitator can be very helpful, i. e. an entity able to improve the way the consortium identifies and solves problems and makes decisions. Knowing the existing procedures, having structured the interactions and deploying the right processes led to an exceptional performance of the CITYFiED consortium.

The literature distinguishes between two phases of a demonstration project. The first phase is about communicating information and promoting the new technology to opinion leaders and early adopters (diffusion / replication). The second phase is about reaching a broader scope of adopters making use of the results (exploitation).⁸ Especially the exploitation is a subject of further and careful examination in this guide.

This chapter provides key definitions (section 1.1.) and a general description of the CITYFiED project (section 1.2). Chapter 2 presents the exploitation phenomenon in a broader context of the European Research & Innovation (R&I) programmes. The holistic exploitation process and its journey from early approaches to business ideas, developed by Steinbeis 2i GmbH, is outlined in chapter 3. The undertaken actions, based on the example of the CITYFiED project, are then reported in detail in chapter 4.

6 Klitkou, A. (2017). *Role of demonstration projects in innovation: transition to sustainable energy and transport*. [ebook] Nordic Institute for Studies in Innovation. Available at: <https://www.researchgate.net/publication/314624529> [Accessed 25 Feb. 2019].

7 WP 6 Exploitation, Market Deployment and Replication activities of the CITYFiED project started under the Steinbeis Europa Zentrum and have been taken over by its spin-off Steinbeis 2i GmbH in 2016.

8 Macey, S. M., & Brown, M. A. (1990). *Demonstrations as a policy instrument with energy technology examples*. Knowledge-Creation Diffusion Utilization, 11(3), p. 219–236.

1.1 Key definitions

In order to provide a unified terminology, to explain the natural progress of the phenomenon under investigation and to present an integrated way of looking at the issue, the authors provide the following conceptual framework:

1. Project results

As Project results, we understand any tangible or intangible **output** of the action such as data, knowledge or information, whatever their form or nature is, independent of whether or not they can be protected. In other words, results are the output generated during the project, which can create impact during and / or after the funding. Reusable and exploitable entities (inventions, products, services) or their necessary components / by-products (knowledge, technology, processes, networks).⁹

2. Communication

Communication is a strategically planned process that starts at the outset of the action and continues throughout its entire lifetime, aimed at **promoting** the project, its actions and its results. Communication requires strategic and targeted measures to inform about the action and its results, reaching a multitude of audiences, including the media and the public, possibly engaging in a two-way exchange.¹⁰

3. Dissemination

Communication is a public **disclosure and sharing** of the results via appropriate means (other than resulting from protecting or exploiting the outcomes), including scientific publications in any media. Dissemination denotes a **transfer** of knowledge and results to specialised groups that can make further use of it (e. g. scientific community, industrial partners, policymakers, etc.).¹¹

9 Scherer, J. (2018). *Making the Most of Your H2020 Project Boosting the impact of your project through effective communication, dissemination and exploitation*. [ebook] European IPR Helpdesk, p.10. Available at: https://iprhelpdesk.eu/sites/default/files/EU-IPR-Brochure-Boosting-Impact-C-D-E_0.pdf [Accessed 8 Feb. 2019].

10 Ibidem.

11 Ibidem.

4. Exploitation and the EU obligation to exploit the Project results

Each beneficiary must take measures aiming to ensure the **further utilisation** of the project results (up to four years after its completion, either directly or indirectly, in particular through transfer or licensing) by:

- reusing them in further research activities (outside the action),
- developing, creating or marketing a product or process,
- creating and providing a service,
- using them in standardisation activities.

The goal is to effectively make use of the project results through scientific, economic, political or societal exploitation routes aiming to turn the general research and innovation means / actions into concrete values and impacts for society (notion not restricted to commercial use only).¹²

5. Business model

A business model is a conceptual structure supporting the viability of a product / service and explaining how a solution provider / owner operates, makes money and how it intends to achieve its goals. It describes the rationale of how the owner of a product / service creates, delivers and captures the value in a given economic, social, cultural or other context.¹³

6. Market deployment (uptake)

Market deployment (uptake) is understood as a transfer of the solution into a commercial product intended for market launch.

7. Replicability

The replicability refers to transportation of the approaches from a pilot case to other geographical areas. If a pilot was proven to work in one community or region, it can be exported to others (taking into account that the boundary conditions may differ from those in the piloted community or region).

¹² Ibidem.

¹³ Geissdoerfer, M. (2017). *The Cambridge Business Model Innovation Process*. *Procedia Manufacturing*, p. 262–269.

1.2 The CITYFiED project

The CITYFiED project has been funded under the 7th EU Framework Programme (topic: *Energy.2013.8.8.1 – Demonstration of optimised energy systems for high performance energy districts*). Its ultimate goal is to develop a replicable, systemic and integrated strategy for a gradual adaptation of European cities (their urban ecosystems) to existing smart city sustainable trends. It focuses on lowering energy demand, reducing GHG emissions and increasing the share of renewables in the overall energy consumption. Within the project, innovative technologies and methodologies have been developed and implemented to raise the efficiency of a smart grid and district heating networks together with their ICTs, mobility interfaces and building renovation processes and outcomes. The project started in April 2014 and has been finalised in March 2019.¹⁴

Achieved project results and implemented actions cover:

1. Large scale demonstrations

CITYFiED chose three cities for the demonstration sites – Laguna de Duero (Spain), Soma (Turkey) and Lund (Sweden). Specific districts had been selected and holistic renovations have been conducted. As a result, innovative and cost-effective technologies have been deployed in order to achieve much higher energy efficiency and a relevant reduction of the environmental impact.

2. Replication potential maximisation

To maximise the replication potential of its results, the project created a cluster of cities. The cluster represents a community of eleven cities, following closely the project's activities and learning based on the actions deployed by the CITYFiED consortium.¹⁵ The CITYFiED consortium evaluated and presented the results of its actions e. g. during the cluster workshops. Additionally, it formed a Community of Interest. The community constitutes a second replication layer of (more than 40) cities acting as potential future replication sites. The

¹⁴ Find out more at: www.cityfied.eu.

¹⁵ Cities Cluster: Borås (Sweden), Firenze (Italy), Izmir (Turkey), Ludwigshafen (Germany), Malaga (Spain), Napoli (Italy), Rovereto (Italy), Salerno (Italy), Udine (Italy), Valladolid (Spain), Värmdö (Sweden).

purpose of this community was also to create an integrated, urban community to network, learn and exchange good practices.¹⁶

3. Innovative and cost-effective planning methodologies and procedures

CITYFiED implemented energy efficiency oriented retrofitting actions that have also been replicated. It furthermore deployed modern Heating, Ventilation and Air Conditioning (HVAC) facilities. The goal was to lower energy demand and to generate zero emissions districts and cities.

4. Development of relevant business models

The existing business models have been adjusted and new business models applicable to cases of large-scale investments in the innovative, near-zero energy districts have been developed. CITYFiED mainly focused on Energy Service Companies (ESCO) and Public Private Partnerships (PPP).

5. Dissemination and exploitation of project results

The outcomes of the project have been disclosed, using all appropriate means such as media and scientific publications. The idea behind it is to inform the stakeholders (researchers, experts, citizens, etc.) about the actions taken, about the benefits of energy efficiency and about the further needs for addressing complementary issues the complementary issues and the exploitation of the project results. Hence, it contributes to a higher degree of sustainability and to the environmental awareness building process. Figure 1 presents the fundamental, initial assumptions regarding the directions of the project development.

16 A complete list of the cities belonging to the community of interest can be found at <http://www.cityfied.eu/community-of-interest/community-of-interest.kl>.

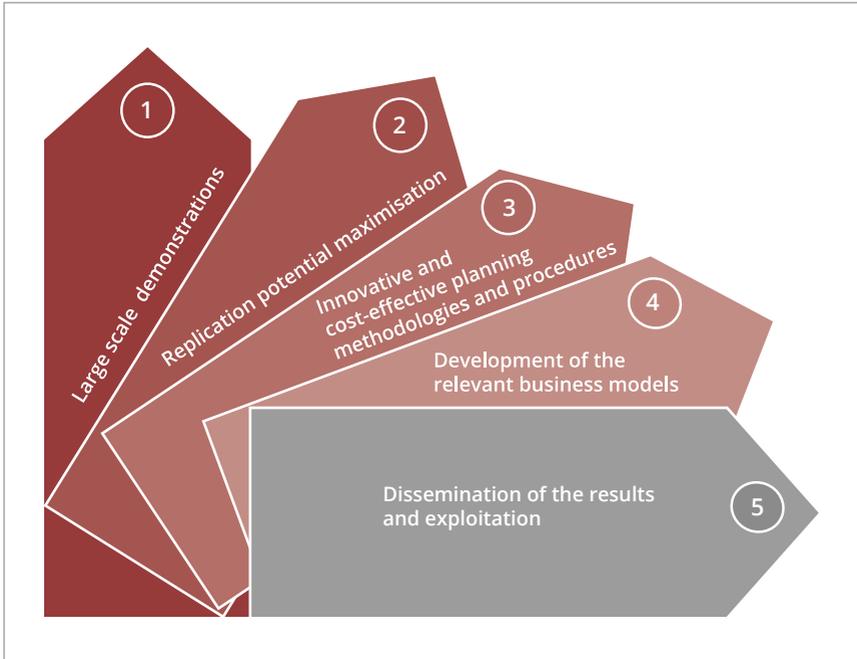


Figure 1: The five pillars of the CITYFIED project (Source: Own illustration).

To maximise the opportunities of smart cities as an important innovation hub and to boost the impact of the project results, a holistic exploitation approach was necessary. Such an approach has been set up to ensure the effective deployment, exploitation and replication of the results on a broader scale. This guide presents the elementary assumptions of the approach.

2 Exploitation in the general context of EU R&I programmes

The 7th Framework Programme (FP7; 2007–2013) is the predecessor of the Horizon 2020 Programme (H2020; 2014–2020). Both Research and Innovation (R&I) programmes intended to facilitate and foster the growth and competitiveness of the European economy. The idea of FP7 (continued by H2020) was also to focus on delivering an added value to European citizens. European R&I programmes offer a multitude of funding schemes supporting not only activities resulting in new knowledge, products or services, but also inspire and promote a non-technological innovation (e. g. social, environmental, educational, etc.). The H2020 Rules for Participation clearly emphasise the project beneficiaries' obligation to **exploit** the results of the funded actions. Thus, an effective plan for communication, dissemination and exploitation is a requirement for successful project evaluation. European R&I programmes place a growing focus on operations demonstrating and maximising the societal and economic impacts of R&I funding. Successful communication and promotion as well as dissemination of the project and finally exploitation of the results should thus be a key component of each project funded under FP7 / H2020.

2.1 Exploitation, dissemination and communication

There is a strong interplay between exploitation and dissemination. Although they both could be a subject of independent analysis, they tend to be examined in conjunction. A **disclosure** and **sharing** of the results (dissemination) facilitates their **utilisation** (exploitation), while utilisation contributes to the **transfer** of knowledge and results to the individuals, being able to make the best use of it. That in turn often leads to market uptake. Activities such as demonstration, prototype development, data and open access as well as knowledge and innovation management, Intellectual Property (IP) protection and active

stakeholder engagement are all examples of factors even further pronouncing the dependencies between these two notions.

Similarly, there is a large overlap between communication and dissemination activities. For example, a publication such as a brochure promoting the project and written for communication purposes, when read by a stakeholder outside of the consortium can trigger interest in applying the results. Hence, the initial communication tool evolved into a dissemination instrument. This illustrates how certain measures oscillate between the categories of communication / dissemination, depending on the target group and the uptake of its content (see Figure 2).

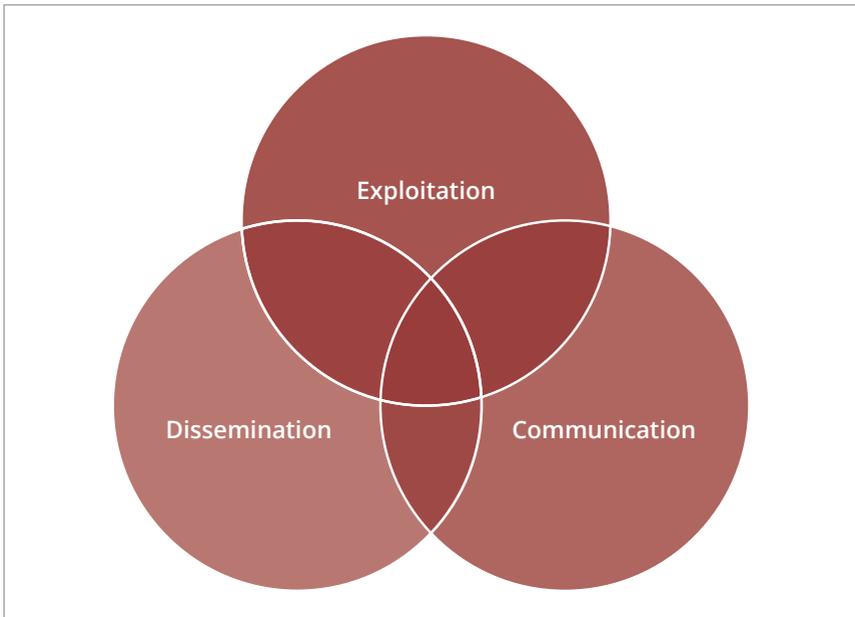


Figure 2: Interdependencies between communication, dissemination & exploitation (Source: Own illustration).

Thus, even though this **guide has been intended for exploitation purposes mainly**, it may happen that (because of the above-mentioned overlaps), dissemination and communication measures will be referenced as well.

Below, in Figure 3, the benefits of a well-designed exploitation strategy are contrasted with the risks of not having such a strategy implemented.¹⁷

Benefits ☺ of the proper exploitation strategy and the effective exploitation:	Risks ☹ of not having the proper exploitation strategy in place:
▪ improves proposal's chances for success,	▪ low prospects of success for the proposal,
▪ increases the visibility of the project's actions and efforts,	▪ recognition and reputation of work remains limited,
▪ helps to gain future support (potential partners', investors', employees' attention, etc.),	▪ limited return on investment of public findings,
▪ stimulates the knowledge transfer and allows that knowledge to be built upon,	▪ little awareness of the needs and significance of the actions on the policy level,
▪ attracts potential results' users (researchers, educators, policy makers),	▪ untapped potential of the project results and the data,
▪ contributes to uptake and commercialisation of novel technologies,	▪ missed commercialisation opportunities,
▪ strengthens the European research and innovation landscape.	▪ uphold barriers preventing others from accessing new research publications etc.

Figure 3: Benefits and risks of (in)effective exploitation strategies in Smart Cities and Communities projects (Source: Own representation, based on Johansen, A. (2015). Why is it difficult to exploit opportunities in projects?¹⁸).

2.2 How to boost the impact

Already in 1990, researchers classified the factors facilitating or hindering a successful deployment of demonstration projects. According to Macy and Brown (1990), **user involvement** is crucial at all stages of demonstration projects as it triggers information exchange and learning. Regarding the project itself, the **design should not be rigid** (to allow user input and modifications for a better effectiveness). **Careful planning** is necessary to take market readiness and user

17 Scherer, J. (2018). *Making the Most of Your H2020 Project Boosting the impact of your project through effective communication, dissemination and exploitation*. [ebook] European IPR Helpdesk, p.10. Available at: https://iprhelpdesk.eu/sites/default/files/EU-IPR-Brochure-Boosting-Impact-C-D-E_0.pdf [Accessed 8 Feb. 2019].

18 [ebook] Conference Paper. Available at: <https://www.researchgate.net/publication/278677467> [Accessed 4 March 2019].

participation into account. Finally, **dissemination of the results and evaluation information** should be considered and included in the project design.¹⁹

The basic conditions for the financing of H2020 projects are defined in the European Commission Grant Agreement. Signatories of the Grant Agreement are the European Commission (as the EU's representative) and the project coordinator. By signing an EC Grant Agreement, project members agree to **promote the actions and their outcomes**. Ideally, they should provide targeted information to a broad and diverse audience, while being engaged in a two-way exchange. Moreover, participants shall **disseminate the results** by taking multiple, appropriate measures (including e. g. scientific publications). Dissemination materials need to be open access (free of charge, online access to any user). Finally, during the project and up to four years after official completion of the project, the necessary steps to ensure the most **effective exploitation of results** shall be ensured.

The H2020 work programme specifies explicitly that already the project proposals shall include a draft of what is called a **Plan for the Exploitation and Dissemination of Results** (PEDR).²⁰ An exception to this rule may be established under some of the H2020 calls.

2.3 Exploitation and dissemination measures

During the draft PEDR preparation, it is recommended to follow the structure and the explanations given in the project proposal template (applicable for their specific call under the relevant work programme).

Project proposal evaluation in H2020 has been based on three criteria – **excellence, impact and quality / efficiency of the implementation**. The PEDR is

19 Macey, S. M., & Brown, M. A. (1990). *Demonstrations as a policy instrument with energy technology examples*. Knowledge-Creation Diffusion Utilization, 11(3), p. 219–236.

20 HORIZON 2020. Work Programme 2014–2015. 19. General Annexes Revised. (2013). [ebook] p.5. Available at: http://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/annexes/h2020-wp1415-annex-ga_en.pdf [Accessed 11 Feb. 2019].

assessed as part of the impact section, which serves as a consistency check. It is expected that the applicants demonstrate that their **goals and the expected outcomes are in line with the mission and the topics addressed** by the given H2020 call and its work programme. Furthermore, the proposed measures to build a **sound intellectual property management system and the results' dissemination and exploitation strategy** will be examined as well. It is highly important that, through the chosen measures, the innovation capacity will be enhanced and the new knowledge will be integrated and spread. Successful proposals stress the link between proposed dissemination and exploitation measures (implemented during and after the project) and the expected impacts of the project. Exploitation and dissemination tools should be targeted towards the end-user. Generated results can be further applied in the processes such as **research and development, policy making, educational trainings, standardisation or commercial exploitation**. In case of commercial exploitation, a business plan as part of the proposal could help the applicants delineate the distinct and firm economic impacts of the project activities.

As mentioned earlier, a well-designed **plan** of action should define the **clear objectives** (adapted to the relevant target groups) and set up a concrete **protection, exploitation and dissemination strategy**.

At the proposal stage of the project, a detailed description of the activities and tasks to be completed by the applicants is not required. An overview of the key elements is, however, necessary. The choice of these elements depends on the type of action and the call regulations. Generally speaking, the first analysis should cover the following:

- geographical coverage and size (potential) of future dissemination and exploitation markets,
- end-users, competitors and competitive advantage identification and analysis,
- state of the art analysis (descriptions of planned developments and factors differentiating the results from other existing products),

- intellectual property analysis and presentation of new knowledge / inventions,
- facts and figures about exploitable results, areas of application and the initial IPR strategy (e. g. trademarks, design rights, copyrights or contractual mechanisms such as non-disclosure agreements, etc.),
- exploitation roadmap and business model,
- planned dissemination actions.

Additionally, intellectual property related issues, such as the challenging problem of the results' ownership, need to be addressed separately and in detail. Usually, this will be done as part of the Consortium Agreement.

Unfortunately, the effective dissemination and exploitation of the project results is often hindered by a list of variables. No diffusion and exploitation efforts should lead to a situation where the knowledge / results do not leave the project's framework. If this is the case, it becomes impossible to process or further develop the results within the future research or market uptake process. Threat of so called 're-invention of the wheel' is posed – an anti-pattern occurring while a unit being unaware or contemptuous of the already existing project results invests time and effort to solve problems which have already been solved. Thus, a low value for public investments is delivered. According to the European Commission, the most popular barriers contributing to this problem arise from:

- confusion between communication, dissemination and exploitation,
- perception of the above mentioned as a tick box with little importance for the project,
- limited consideration of the project's valuable key results,
- lack of reflection and joint discussions with the consortia,
- excessive focus on implementing and validating technical objectives and not aligning actions with the needs of users and stakeholders,

- lack of skills / interest to effectively consider the value and benefits of the key results outside the “typical” community,
- lack of knowledge of dissemination and exploitation risks and opportunities, alternative channels, routes, stakeholders, competing solutions and strategies.²¹

A broad spectrum of actions is available for communication, dissemination and exploitation purposes. The significant part is to stay coherent and consistent with the strategic plan of the project. The selected activities should suit its objectives. A regular progress assessment plan is an additional, valuable tool.

21 Ala-Mutka, K. (2019). Dissemination and Exploitation in Horizon 2020. [ebook] The European Commission. Available at: http://ec.europa.eu/research/participants/data/ref/h2020/other/events/2017-03-01/8_result-dissemination-exploitation.pdf [Accessed 11 Feb. 2019].

3 Steinbeis 2i GmbH exploitation guide

Sometimes, a project-related uncertainty can also be an opportunity. It is common that the word opportunity (used in a project-related context) may have more than one interpretation. According to some researchers, the project itself (the desired change, deployed solution or effect on the stakeholders) is what we should consider an opportunity. Another perspective may be that the opportunities are all the factors, alterations and circumstances making the project outputs better than originally planned. Hence, it is possible to perceive an opportunity as a certain result (a solution), initially not taken into consideration, not foreseeable and independent from the consortium, but still beneficial to the project.²² To maximise the positive impacts of a project and to create favourable framework conditions for both – planned and new opportunities – Steinbeis 2i GmbH developed the exploitation strategy which is explained in this chapter 3. The specific results achieved through application of the CITYFiED project strategy is explained in chapter 4.

3.1 Holistic process

It is crucial to start the strategic planning of the exploitation activities already at the proposal stage of the project. Once designed, the exploitation activities should accompany the research and innovation activities until the very end of the project. Dissemination and exploitation operations should continue even after the project's termination. Since the results are usually created throughout the course of the project, and not only towards the end of it, it is crucial to **trigger, capture, monitor and manage the outputs** carefully and adjust the exploitation strategy accordingly. This helps to keep track of the project's progress and to identify its initially unforeseen results. The latter shall be evaluated precisely in order to define their potential for further exploitation.

22 Johansen, A. (2015). *Why is it difficult to exploit opportunities in projects?* [ebook] Conference Paper. Available at: <https://www.researchgate.net/publication/278677467> [Accessed 4 Mar. 2019].

Since the key exploitable results that are ready to be further deployed are most often delivered at the very end of the project duration, a viable plan for their post-project dissemination and exploitation is necessary. Especially then, the results must be promoted, ideally resulting in an **increased audience's awareness** and **market entry**. This will additionally boost the future exploitation of the results.

The **initial stage** (proposal preparation phase) requires an in-depth examination of how the project and its outcomes will be exploited. Structured assessment of expected exploitation success factors, considering elements such as **the market analysis, regulatory considerations** and **customer identification**, should be carried out. The above-mentioned process demonstrates how the project will generate **economic** value and present its benefits. Moreover, it enables the applicants to plan all the relevant exploitation activities accordingly. The analysis needs to be further developed and updated during the project's lifetime.

Strategic research and arrangements are a major part during the proposal stage. Once the project funding has been granted, however, **implementation** is brought to the forefront. Putting the concepts into practice goes hand in hand with monitoring and evaluation. Stakeholder interests evolve and so do the market needs. The variables, which have been unknown before may occur. This process requires a detailed review and constant adjustments of the plan. It is important to note that the respective communication and dissemination actions must be carried out simultaneously. Hence, an integrated, holistic and horizontal approach is necessary.

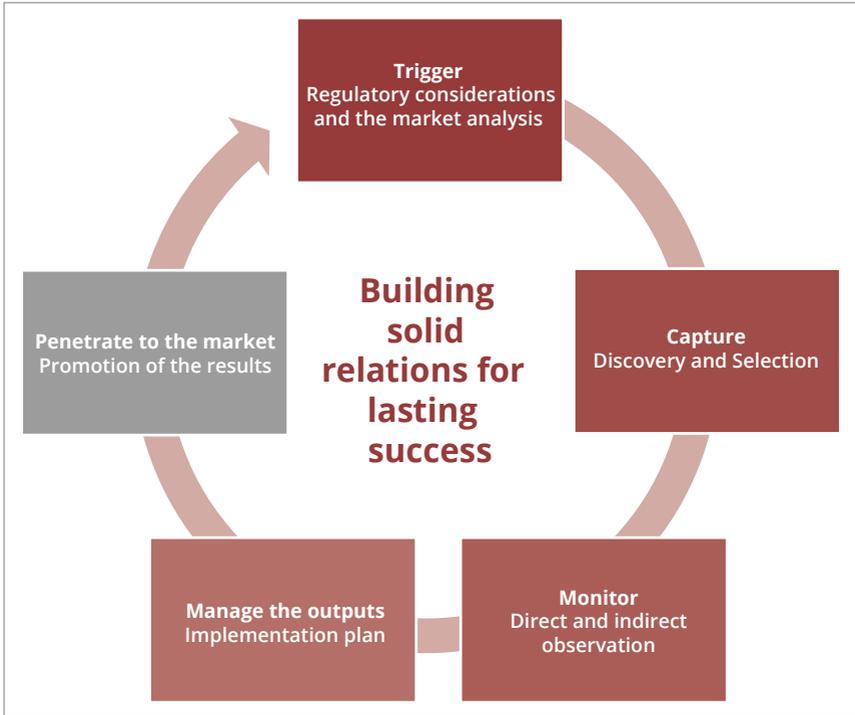


Figure 4: The holistic exploitation process (Source: Own illustration).

Overall, the holistic and horizontal **process** is necessary to effectively perform exploitation activities (Figure 4). Such an approach enables the applicants to **define and monitor the project's outcomes, choose the right tools to inform about and spread the results, as well as manage the open access and define the right IP protection strategy**. Such an approach promotes the project on many levels reaching both experts and a broader audience, while simultaneously exploring the best exploitation options.

Like dissemination and communication, exploitation is a horizontal process and therefore requires a horizontal management approach. It follows and complements the other project activities within its lifecycle and is necessary to maximise the expected impact of the project.

3.2 Exploitation journey: from early approaches to business ideas

The present section provides an overview of the innovation management strategy developed, tested and approved by Steinbeis 2i GmbH. It serves to maximise the impact of the developed results in demonstration projects such as Smart Cities and Communities projects.

This shared **expertise** has been based on the company's **profound experience** in coordination of exploitation activities in multiple European collaborative projects. It has been built with the help of an **in-depth examination** of commonly available exploitation tools used in various H2020 projects, eight **exhaustive interviews** with professional communication, dissemination and exploitation managers as well as an **online survey** (Figure 5).

As a consequence, **five groups** of tools and practices, called **actions**, have been identified. Actions **I–IV** are dedicated to exploitation and market deployment, whereas action **V** relates to dissemination.

It is important to note that the choice of the suggested instruments depends heavily on a given context. **The means presented below are described at a meta-level and usually consist of multiple sub-processes.**

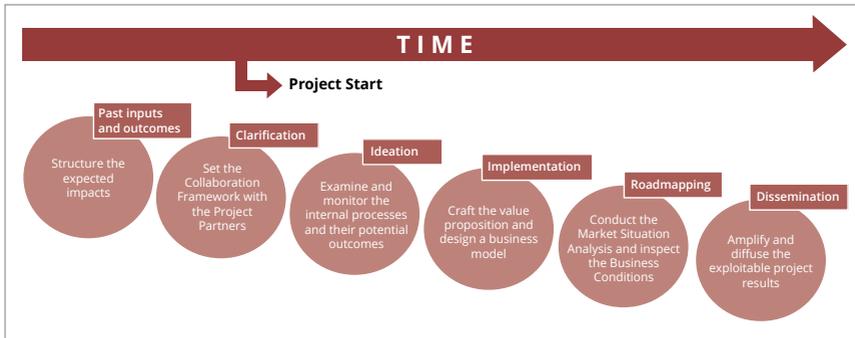


Figure 5: Steinbeis 2i GmbH exploitation journey to enhance impact in Smart Cities and Communities projects' innovation (Source: Own illustration).

3.2.1 Action I: Set the collaboration framework with the project partners

The Collaboration Framework provides a skeleton to support planning and service delivery. The framework outlines the shared commitment and principles reinforcing the common goal of collaboration. It can be helpful to successfully manage various personal and situational factors influencing the common “inter-professional” cooperative practices. The latter result in project outcomes and affect the attitudes towards further collaboration. This first step serves the **initial approach and clarification of the rights and duties implied by the exploitation of the project results**. Three principal components are recommended:

- **Consortium Agreement** – an internal agreement establishing the rights and obligations of the partners within the project. It has been signed in about 90 % of the projects analysed for the study (mainly FP7, FP6 and CIP projects) and is mandatory in the majority of H2020 projects.
- **Intellectual Property Management Guidelines** – a written document examining the market and the existing patents. It is a review of the background knowledge (information held by beneficiaries, owned or controlled by project partners and brought to the project). It usually needs to be updated in the course of the project.

- **Exploitation Actions Plan** – an initial version of the draft plan for dissemination & exploitation of the results, that needs to be updated in the course of the project.

A fast-paced business environment forces partners to collaborate efficiently in order to conduct the projects in a competitive manner (under the dynamic, constantly evolving circumstances), in accordance with the European Union requirements. An appropriate Collaborative Framework facilitates and simplifies such collaboration by:

- providing a baseline for the common understanding about the project results, IPR and exploitation,
- clarifying and presenting the idea of the Intellectual Property flow (background knowledge – project results – ownership claims – exploitable results),
- raising awareness of partners' interests, concerns and uncertainties,
- facilitating networking opportunities and achieving mutual understanding.

3.2.2 Action II: Examine and monitor the internal processes and their potential outcomes

The following actions have been defined for the analysis of the project results in terms of the related IP and Intellectual Property Rights (IPR) of the respective project partners, as well as the exploitation actions aiming at the market deployment.

When it comes to the **intellectual property related issues**, it is highly advisable to:

- identify contributing partners,
- link their background knowledge with the predicted exploitable results,
- define the partners' exploitation claims such as commercialisation, research, rights' transferring, consultancy, etc.,

- detect the owners of the results such as single ownership vs. joint ownership and the respective access rights,
- identify IPR conflicts and find the solutions.

Such a basic and formalised IP management structure allows the partners to harvest the benefits of their technological advances not only within, but also outside the consortium. Additionally, this approach triggers the identification and further development of **joint** exploitable results. Experience has shown that in case of a lack of such a formalised approach, joint exploitable results neither tend to be identified nor further addressed. In other words, the existence of an IPR strategy is both an enabler and an indicator of the technological advance. Since partners may be willing to disclose some of their most important background knowledge (also to their competitors) with the purpose of gaining reciprocal access to e. g. technology of their peers, it is important to have at least minimal regulations in place.

Recommendations related to the **exploitation and the market deployment** are listed below:

- identify exploitable results,
- determine potential customer segments, value proposition and key partners,
- set a **roadmap** for exploitation and market deployment (long term direct / indirect exploitation and market deployment activities).

A **roadmapping** process may serve not only during the product or process planning. It can also be applied while managing the capabilities, strategies, knowledge assets, etc. It requires the consortium partners to cooperate. It is a process where the knowledge of the partners (explicit or tacit) is combined and exchanged in order to create a viable and implementable plan. A major and practical challenge in this process is to exchange knowledge in a timely manner to create and evolve an agile roadmap.

The tools available for meeting the goals are e. g. multilateral meetings, workshops, interviews or questionnaires. Results of the Steinbeis 2i GmbH analysis indicate clearly that even though the background knowledge, intellectual property and the project results have been identified correctly, much less attention is usually paid to the exploitation potential evaluation and to the proper preparation of the exploitation strategies. A systematic review of possible IP conflicts has only been conducted in about a third of the examined projects.

The outcomes of the above-listed activities shall be **updated regularly**, since the new background knowledge or unforeseen project results may be identified in the course of the project.

3.2.3 Action III: Design the value proposition and design a business model

Creating and bringing the value proposition to perfection are critical issues to consider while planning the strategies. A fierce competition and rapid changes in both the markets and available technologies make sustaining a momentum very complex. Hence, focusing on the right value required by the customers is necessary. Various tools such as **Customer Value Creation** introduced by Plaster and Alderman exist for that purpose.²³ It builds a profitable growth platform for an organisation, based on creating and delivering the expected value to a customer. Designing the value requires identification of two types of value. One of them – **internal** – builds upon the shareholder’s perspective and denotes a profit. The other – **external** – is based on the customer’s perspective and means his or her satisfaction.

Osterwalder developed an ontology of important themes to address in order to do so. He also structured them further into what is known as the **Business Model Canvas**.²⁴ The order in which the canvas shall be discussed may differ and depends on the type of business to be developed.

23 Plaster, G. and Alderman, J. (2006). *Beyond six sigma*. Hoboken, N.J.: J. Wiley & Sons.

24 Osterwalder, A., Pigneur, Y. and Clark, T. (2015). *Business model generation*. Vancouver, B. C.: Langara College.

The consortia finding themselves in the process of business model design require a holistic approach, which eventually comes down to:

- understanding the process of a business model design,
- completing a Business Model Canvas,
- clarifying and testing business model assumptions,
- evaluating and updating business model documentation,
- developing comprehensive business models.

Our experience indicates that the most common actions usually implemented at this stage by the partners are:

- Value Innovation Analysis (a key principle of the blue ocean strategy),
- business case development,
- business model development,
- technology implementation plan,
- review of the funding opportunities and financing facilities (regional, national, international, public and private sources),
- risk assessment and contingency plan concerning the future exploitation of project results (e. g. as part of a business plan),
- internal mediation on IP issues within the consortium (e. g. to solve ownership or access right issues).

Specific actions related to e. g. a market entry and market deployment strategy are not necessarily relevant for all projects and therefore less commonly used. These are for example:

- efforts towards certification,
- comprehensive business plan (Unique Selling Proposition, competitive advantage, marketing strategy and financial plans),
- commercialisation roadmaps (for project results) and replication plan (project specific).

3.2.4 Action IV: Conduct the market situation analysis and inspect the business conditions

The market situation analysis is the first step in the design of a deployment strategy and marketing plan. It usually includes research and analysis of the target market, competitors, business challenges and the consortium's competitive differentiators. It should contain the best and clearest description of the current state of the marketplace.

A **market situation analysis** usually starts with a **market definition and analysis**, which consist of the following steps:

- location and definition of new product markets offering opportunities,
- evaluation of existing product markets to determine priorities,
- examining the environment and forecasting future trends.

Next steps are **market segmentation analysis** (identification of buyers' groups, within a product market whose needs are similar) and **competition analysis** (evaluation of competitors' strategies, strengths and limitations).

This in turn allows for the future **marketing strategy design** (market targeting and positioning, strategy choice in developing and positioning of the products) and development of the **market targeting and positioning strategy** (combination of the product, the channel of distribution, price, and promotion strategy).

At the same time, it is important to conduct research on **business conditions**, which can be determined by various factors such as **politics, regulations, economics** or the **natural environment**. These factors shall be examined in the multilayer context of a country, region or a city. The success or failure of a business can depend largely on a combination of these variables.

According to the data gathered by Steinbeis 2i GmbH, neither the **market situation analysis** nor the **business conditions** are systematically examined in

a comprehensive manner. The actions are often treated selectively. According to the company's research, the following activities are usually performed (listed starting from the most to the least common):

- existing standards / norms review,
- European regulations / directives review,
- technology watch / -scouting,
- market analysis (segmentation, size, trends, growth-rate, profitability, etc.),
- SWOT Analysis (Strengths, Weaknesses, Opportunities, Threats),
- technology roadmaps (trends & evolution),
- PESTLE Analysis (Political, Economic, Social, Technological, Legal and Environmental),
- patent survey.

Market situation analysis should be conducted on a **regular basis** after the strategy has been implemented. Doing so helps to determine the necessary mitigation and adaptation means.

3.2.5 Action V: Disseminate the project's results

As it has already been mentioned, dissemination is a set of activities with the aim of making the project results and especially the exploitable results available to the stakeholders interested in the solutions. Dissemination is essential for the use and take-up of project results and therefore directly linked to exploitation. The aim of dissemination activities is to enable and to boost the exploitation of the project results, also beyond its framework.

Two categories of dissemination actions need to be highlighted. The first is about establishing a dialogue with the potential users, therefore called a two-way communication. The second employs one-way communication: information moves in one direction, because time and space separates the sender from

the receiver. One-way communication is thus linear and limited. It serves to inform, persuade or command, whereas two-way communication includes a feedback. Both of them should be utilised effectively.

Usually, information about results is disseminated e. g. through the **project website, videos, interviews, articles, exhibitions, guided tours and conference presentations**. Results are made available for use e. g. through **scientific publications, roadmaps, trainings, workshops, webinars, final publications** and by being shared in **online repositories**.

The majority of means (>75 %) identified and used to support the dissemination process in the analysed collaborative projects are:

- dissemination plans such as internal tools – descriptions of dissemination actions and strategies set for the project’s lifespan,
- presentations and marketing materials distribution e. g. at thematic conferences, seminars and fairs,
- networking and exchange of good practices between similar projects,
- workshops, seminars, webinars, etc. for potential end-users.

Further tools and actions applied to amplify and diffuse the project results (used in about 30–60 % of the analysed cases) are:

- scientific and professional articles e. g. trade magazines, etc.,
- site visits and study tours to the demonstration sites,
- demonstrators and ambassadors,
- best practice brochures and handbooks,
- professional trainings for the end-users e. g. face-to-face trainings, webinars, etc.,
- project advisory boards,

- matchmaking events making use of tools such as speed dating, elevator pitches,
- partnership agreements.

The above-mentioned tools are sorted in descending order, from the most to the least popular one.

4 The CITYFiED project: Exploitation approach and results

4.1 Exploitation approach for the CITYFiED project

For the CITYFiED project, it was crucial to have a sound strategy for exploitation, market deployment and replication of the results achieved in the three demonstration sites. Therefore, the consortium led by Steinbeis 2i GmbH engaged itself to progressively define an exploitation and market deployment plan, starting from the beginning of the project and going on until its very end.

At the core of the CITYFiED exploitation methodology lies the **Steinbeis 2i GmbH exploitation strategy**.

Smart Cities and Communities projects are large collaborative projects with different interdisciplinary partners such as universities, public or private research organisations, large industry partners as well as Small and Medium-sized Enterprises (SMEs) or municipalities (see Figure 6). They all have varying mind-sets, different strategic objectives, Intellectual Property and exploitation interests and different interpretations of exploitation. Therefore, it is mandatory to agree upon a common understanding of the entire innovation management process within the project. An open and productive collaboration requires motivation and trust between the partners, which is precisely one of the aims of the exploitation activities.

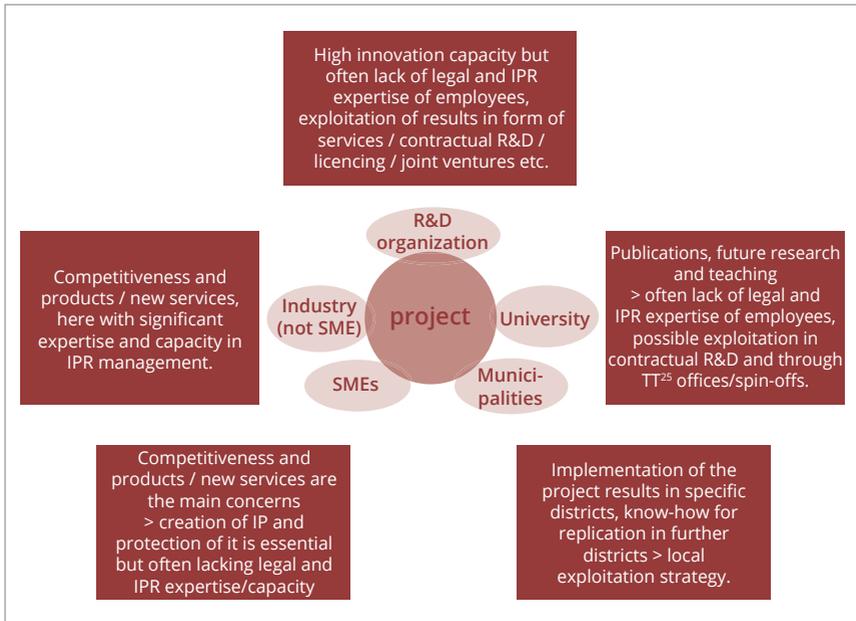


Figure 6: Stakeholder mapping in Smart Cities and Communities projects (Source: Own illustration).

As a first step, project partners were provided with a strategic alignment of interests and strategies. They were familiarised with **exploitation-related fields** and **definitions**. It is important that they are able to define their contribution, their **background knowledge** and the **linkages to the project results** to finally identify the **exploitable results**.

An exploitable result is defined as an outcome of the project (achieved or expected) that meets two conditions:

- It has commercial / social / academic relevance.
- It can be commercialised / exploited as a stand-alone result (product, process, service etc.).

Not all project results know-how is susceptible of being exploited. The diagram below, Figure 7, represents a distillation process and potential joint development (joint exploitable results) of exploitable results.

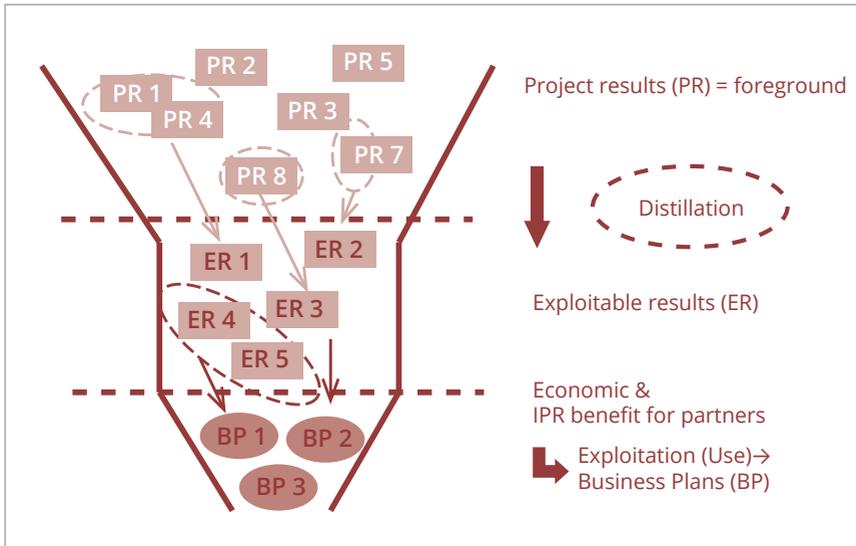


Figure 7: Potential joint development and distillation of the results (Source: Own illustration).

Afterwards, it is necessary to focus on **ownership issues** and **access rights**. The next workshop was therefore dedicated to the identification and definition of ownership and the rules/ conditions of getting access to exploitable results. **Exploitation claims** and the **protection of results** have been discussed previously. Moreover, the notions of a **value proposition**, **Unique Selling Proposition** and the **Business Model Canvas** were briefly introduced. The third step (and the third workshop) focused on an in-depth analysis of the processes related to the value proposition and the Business Model Canvas.

First sketches of the **business model** have been created. Consortium members touched upon matters such as baseline for business plans, funding options, cooperation models, market barriers and opportunities, etc. The subsequent step was to use the acquired knowledge and examine each of the developed,

exploitable results with respect to the ascertained categories while creating a **robust market strategy for the exploitation**. Figure 8 illustrates the process of characterising exploitable results by using Business Model Canvas and defining a joint deployment plan to reach the goals of the CITYFiED project partners.

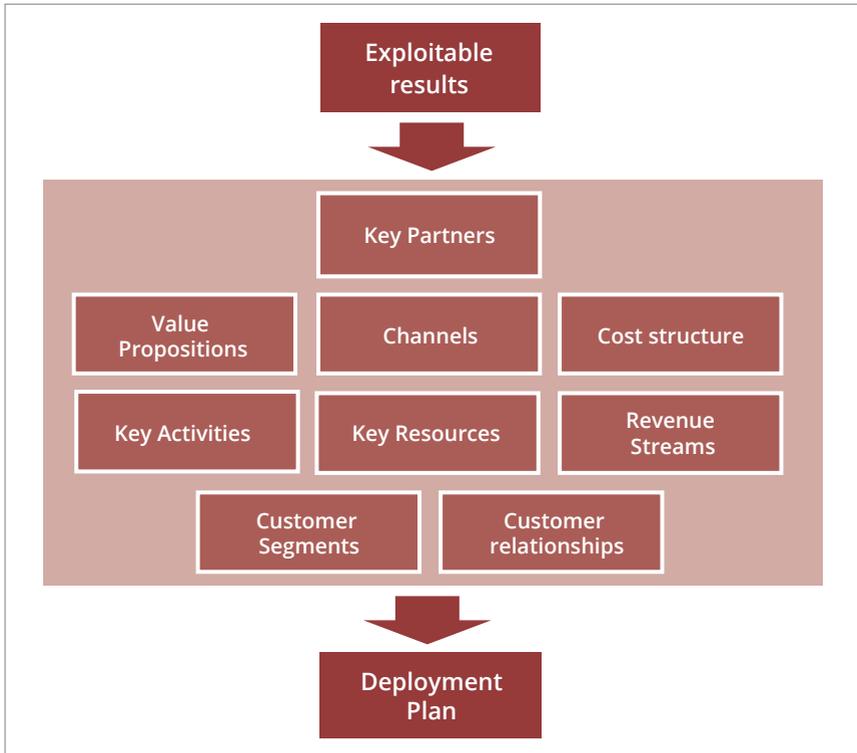


Figure 8: Use of Business Model Canvas in the CITYFiED project (Source: Own illustration).

4.2 Exploitable results of the CITYFiED project

Thanks to the applied methodology/ approach developed by **Steinbeis 2i GmbH**, the initial background and the project results have been turned into the exploitable results to subsequently evolve into economic benefits. On the process / science niveau, the **“CITYFiED methodology for sustainable urban**

renovation at the district level” has been developed, whereas on the product / service level “the **monitoring platforms, visualisation & Home Energy Management Systems**” and “**Low Temperature District Heating Systems for the residential buildings**” have been developed. Thus, new business opportunities and further research possibilities are available.

The CITYFiED project focused on a restricted number of exploitable results, to be based on the estimation of their exploitation potential, in particular their commercial potential, as well as on the expected barriers for exploitation. For the selection of the most promising exploitable results, the following decision criteria were considered:

- involvement of the partners in the development / exploitation of the selected results (including the interest in those results and their engagement in their exploitation beyond the project),
- focus on jointly developed products / services,
- market readiness (short time to the market),
- commitment for joint development of implementation plans.

After taking the above mentioned steps, the selected exploitation results were grouped into “Solution Packs” (SP) by the themes and / or the market segment addressed, so that the (future) work on the estimation of the socio-economic impact, factors influencing exploitation, EU market analysis, market deployment strategy and recommendations for business plans can concentrate on well-defined areas. The Solution Packs can be seen in Figure 9. The goal is to be as specific as possible to avoid collecting market information that would be too general to be of use to the partners.

The CITYFiED SPs present the final results of the entire exploitation process applied within the project. These exploitable results have been identified and further investigated as part of the exploitation approach and are described in this guide.

Solution Pack 1 The CITYFiED Methodology for Sustainable Urban Renovation at District Level	Solution Pack 2 Monitoring Platforms, Visualisation & HEMS	Solution Pack 3 Low Temperature District Heating (LTDH) Systems for Residential Buildings
Methodology for City Renovation	Spanish Monitoring Platform	Low-temperature Radiant Heating and High-temperature Radiant Cooling Panels for Buildings
	Turkish Monitoring Platform	
Tools and Techniques for Evaluating the Retrofitting Impact of Demonstration Results	Overall CITYFiED Monitoring Platform	Pre-insulated Reinforced Thermoplastic Composite Pipes for LTDH Systems
	Turkish Monitoring Data	
Smart Cities Methodologies and Standardisation for Turkish Cities	Spanish Visualisation for Households	New District Heating Strategies to Improve Energy Performance
	Turkish Visualisation for Households	
Business Model for Retrofitting (decision making tool for companies, ESCOs)	Turkish Visualisation for Districts	
	Swedish Visualisation for Districts	

Figure 9: The CITYFiED Solution Packs: a catalogue of the selected CITYFiED exploitable solutions (Source: Own representation).

Since one of the goals is to facilitate new business and technology partnerships, the achieved project results have been positioned and **disseminated** respectively. After all, a partnership may be the best way to position a new business model for success. Combined efforts offer a host of complementary benefits, enabling the delivery of an unrivalled competitive advantage.

Thus, apart from using the standard on-line channels, each of the Solution Packs has additionally been characterised in a series of factsheets prepared and published by Steinbeis 2i GmbH. The factsheets contain relevant details on the applied innovative technologies (design, related strategies, models, application fields, etc.). They provide information about the advantages and innovative aspects as well as the current development stage, IPR status, type of the desired partnerships, the contact details of the project partner in charge, etc. These materials are available via the CITYFiED City Smart Space.²⁶ They have also been presented during City Cluster workshops, conferences, matchmaking and related “Business to Business” events.

²⁶ For further information see <http://www.cityfied.eu/city-smart-space/how-to/exploitation/objective.kl>.

The aim of the CITYFiED SPs is to help consortium members enhance their success in future collaboration (business, technological) opportunities. The partnering process begins with consortium partners looking for clients that are interested in cooperating on a national and/or international level. The factsheets, which are delivered as part of the SPs, are cooperation requests and offers. They summarise essential information about the nature of the offer or request, the client and the expected cooperation. The published SPs are publicly available and one of the key tools for the consortium to help clients find the right partner for their international activities. These profiles are therefore also available through the Enterprise Europe Network (EEN)²⁷ Database. Through this database, users can identify a potential cooperation partner that matches the requirements of a specific profile and subsequently send an expression of interest, which will ideally initiate a cooperation.

The CITYFiED exploitation approach has helped consortium to improve a variety of skills and resources. It helped the consortium members to accurately identify their contribution to the business and learn how to secure their intellectual property rights. Tools to create business models and possible business approaches have been presented and examined to help the consortium choose the best option. Self-awareness acquired by the partners reinforces the healthy business relationships and benefits the new customer base. Moreover, a successful market deployment of the exploitable results backs up the positive image and trust that each of the consortium members can obtain. That in turn allows associating their brands with other well-established brands to additionally boost the momentum. This is one of the main purposes that the CITYFiED Solution Packs serves. Overall, it has been created to pave the way for potential alliances, with great success and growth opportunities in customer reach.

The following sub-section gives an overview of the developed Solution Packs.

27 <https://een.ec.europa.eu/>

4.2.1 The CITYFiED Methodology for Sustainable Urban Renovation at District Level (Solution Pack 1)

The retrofitting of buildings is critical for the EU if it wants to meet its ambitious 2020 energy and climate goals (20 % energy efficiency improvement and 20 % Greenhouse Gases (GHG) reduction as compared to 1990).²⁸ Building stock accounts for 40 % of the total primary energy consumption and 36 % of GHG emissions in the region.²⁹ About 40 % of Europe's building stock pre-date the 1960s and 90 % pre-date the 1990s. The majority of it is in a direct need of renovation and will still be standing in 2050. As opposed to emerging economies where new buildings systematically arise, modern constructions in Europe represent only about 1 % of the building stock.³⁰

The CITYFiED methodology is a response to the need of further retrofitting actions. It offers a holistic approach for urban renovations at district level. It defines a set of processes aiming at a better understanding of the urban systems (its structures, needs, goals, capacities, etc.) in order to deliver a customised strategy paving the way for sustainable transformations and higher energy efficiency.

The main **functions of the CITYFiED methodology (SP1)** are:

- diagnosis of the city at city and district level,
- provision of a tools and solutions catalogue for district scale renovation (including BIM perspective),
- provision of tools and guidelines to facilitate the selection and prioritisation of the most suitable sustainable scenario (social, environmental and economic) and appropriate energy models,
- consideration of business model aspects, including financing options, stakeholders, contracts, etc.,

28 Find out more at: https://ec.europa.eu/clima/policies/strategies/2020_en

29 Energy – European Commission. (2019). *Buildings – Energy – European Commission*. [online] Available at: <https://ec.europa.eu/energy/en/topics/energy-efficiency/energy-performance-of-buildings> [Accessed 27 Feb. 2019].

30 The Economist (2013). *Investing in energy efficiency in Europe's buildings. A view from the construction and real estate sectors*. The Economist Intelligence Unit.

- provision of guidelines for implementing interventions,
- analysis of interventions' results and impacts,
- ensuring an effective dialogue between stakeholders.

Solutions being a part of the CITYFiED Methodology for Sustainable Urban Renovation at District Level (SP1):

Solution 1: Methodology for City Renovation³¹

The proposed process is divided into seven different phases (see Figure 10). During the process, an effective dialogue among all stakeholders is foreseen. The participation of an External Consultancy Group closely cooperating with the local authorities in order to facilitate the decision-making process is recommended. Additionally, tools such as performance indicators have been designed (City Level Indicators – level 1; Project Level Indicators – level 2; Impact Assessment Indicators – level 3).

31 The owner of the solution is ACCIONA Engineering (<http://www.accion-engineering.com>).

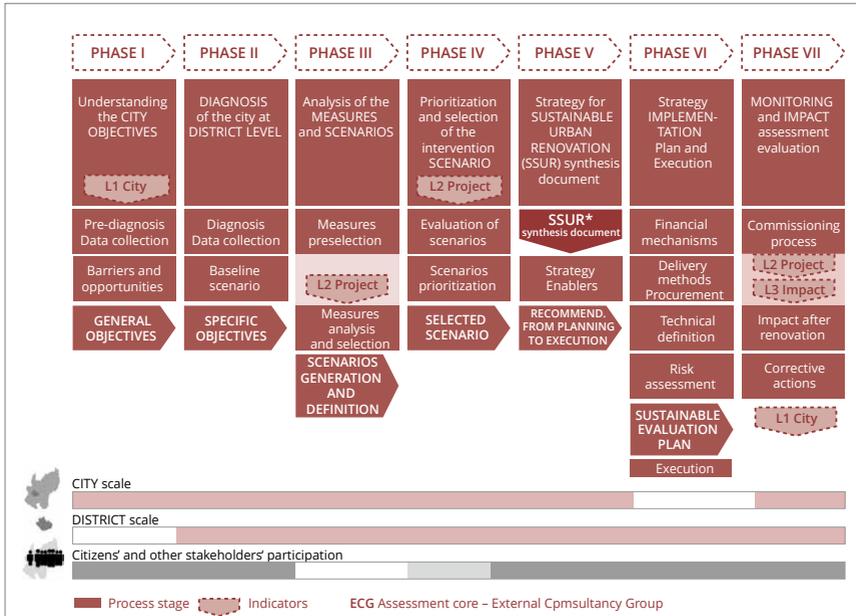


Figure 10: Methodology for the city renovation (Source: Own illustration, based on KPI-Driven Methodology for Urban Renovation at District Level. Sustainable Strategic Urban Planning. Cristina Criado, Estefanía Vallejo, Eneko Arrizabalaga, Ali Vasallo and Miguel Á. García-Fuentes³²).

Solution 2: Tools and Techniques to Evaluate the Retrofitting Impacts³³

The Impact Assessment Indicators (developed as a part of the *Methodology for city renovation*) have been applied. The following types of impacts have been quantified to cover the following categories: energy, environment, economic and benefits for SMEs.

32 Presented at Sustainable Places 2017 (SP2017) Conference, Middlesbrough, UK, 28–30 June 2017. URL: www.mdpi.com/journal/proceedings. Proceedings 2017, 1, 1114; doi:10.3390/proceedings1071114. Published: 21 March 2018

33 The owner of the solution is CARTIF (<https://www.cartif.com>).

Such a technique of impact evaluation covers the following steps:

- direct impacts calculation: results generated during the execution of interventions in the three **Demo Site districts** (Laguna de Duero-Valladolid, Lund, Soma-Manisa cities),
- potential impacts calculation: results associated to a possible implementation of the CITYFiED solutions **in other districts of the three Demo Site cities**,
- potential impacts calculation: results associated to a possible implementation of the CITYFiED solutions in the **11 cities**.

Solution 3: Smart Cities Methodologies and Standardisation for Turkish Cities³⁴

As the population of Turkish cities grows, it is necessary to control their energy demand. Besides having own supplies, Turkey is dependent on energy resources import. An Energy Efficiency Strategy developed by the government requires the decrease in energy consumption for all sectors (from industry to end-users). The Turkish government needs to analyse the needs, prioritise the actions accordingly and ensure an involvement of all relevant stakeholders.

The CITYFiED methodology can easily be tailored to the diverse needs and structures of the Turkish cities.

Solution 4: Business Models for Retrofitting (decision making tool for companies)³⁵

The main objective of the new business model is to reduce energy demand and to optimise energy production at district level. In order to define the concept of the new business model, five main categories have been examined: energy supply, roles and interventions carried out by the stakeholders, financial schemes, monitoring and assessment of the actions taken and enablers of the district renovations.

³⁴ The owner of the solution is DEMIR ENERGY (<http://demirenerji.com.tr/en/>).

³⁵ The owner of the solution is VEOLIA (<https://www.veolia.es/es/>).

4.2.2 Monitoring Platforms, Visualisation & HEMS (Solution Pack 2)

The solutions presented in Solution Package 2 (SP2) have been designed to address the city energy monitoring at building and district level, allowing energy service companies, energy providers, local governments and even households to access different types of information on energy consumption.

The SP2 measures serve the following main purposes: data collection & storage, data analysis and data visualisation. The first purpose is about collection and storage of the data. The second purpose involves the processing of the collected data in order to generate an output (reports, warnings, recommendations, etc.). The third purpose consists of actions making the data analysis output available to various stakeholders in a customised way (residents, public authorities, energy companies, etc.).

Solutions being a part of the Monitoring Platforms, Visualisation & HEMS (SP2):

Solution 1: Turkish Monitoring Data³⁶

It is a cloud-based, Platform as a Service (PaaS), data analytics solution. Already collecting data from thousands of buildings in five different countries, the data science oriented Internet of Things platform employs machine learning algorithms and big data analytics in order to provide energy savings, operational efficiency and energy procurement optimisation.

Solution 2: Monitoring Platforms (Spain³⁷, Turkey³⁸)

Monitoring platforms are in charge of capturing data from District Energy Management Systems, Building Energy Management Systems and Home Energy Management Systems. Once data are gathered, they store them and

³⁶ The owner of the solution is REENGEN (<http://www.reengen.com>).

³⁷ The owner of the solution is MONDRAGON Corporation (<https://www.mondragon-corporation.com/en/>).

³⁸ The owner of the solution is REENGEN (<http://www.reengen.com>).

enable automatic calculations of the Key Performance Indicators. Besides all this, it provides reports on Key Performance Indicators (KPIs) for performance analysis helping stakeholders in making decisions based on real facts. The various modules support energy managers, policy makers, private users and project stakeholders turning the platform into a decision support mechanism.

Developers may decide to further exploit this result. In such case, they may need to collaborate with one of the European private enterprises having experience in IT product commercialisation.

Solution 3: The CITYFiED Monitoring Platform³⁹

The CITYFiED Monitoring Platform is a common repository for the collection of KPIs from the demonstration sites (see Figure 11). It gathers the KPI structural data information and provides the tools for uploading the indicators from the three local platforms. Furthermore, it shows the results and different indicators in visual reports allowing for comparisons between demo sites.

It has been developed as a result of cooperation between a research centre and a university, both having the expertise to develop IT solutions in areas such as energy efficiency and smart cities. If the partners decide to commercially exploit the solution, they may need to collaborate with a European private company having experience in business opportunities creation.

39 The owner of the solution is MONDRAGON Corporation (<https://www.mondragon-corporation.com/en/>).

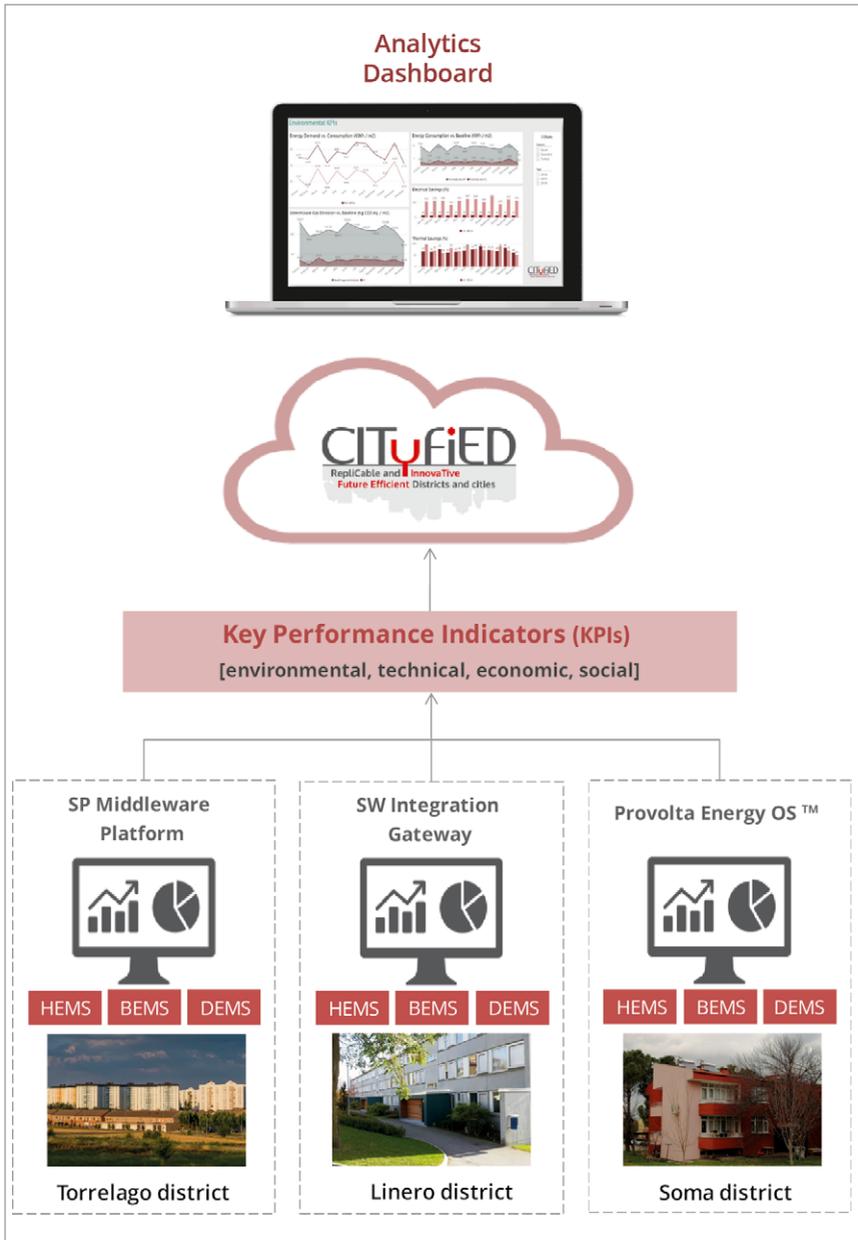


Figure 11: The Overall CITYFIED Monitoring Platform (Source: Own illustration, based on CITYFIED Project Work Package 2).

Solution 4: Visualisation Tool for Households (Spain⁴⁰, Turkey⁴¹)

The Spanish Visualisation Tool for Households is a web application allowing the residents to monitor and control their energy consumption (see Figure 12). It provides the tenants with recommendations to improve their energy performance without losing comfort. After integration with local monitoring platforms, the filtered data for residents become available via a mobile phone application. Web dashboards and mobile apps make it more practical to transform houses operations data into performance improvements. It saves money, enhances sustainability, raises the awareness and drives behavioural change. The tool has been developed by a university, which has a relevant background in the creation of apps for projects at EU level. If the institution decides to further exploit the solution, it may need a European partner with experience in business development to facilitate market replication.

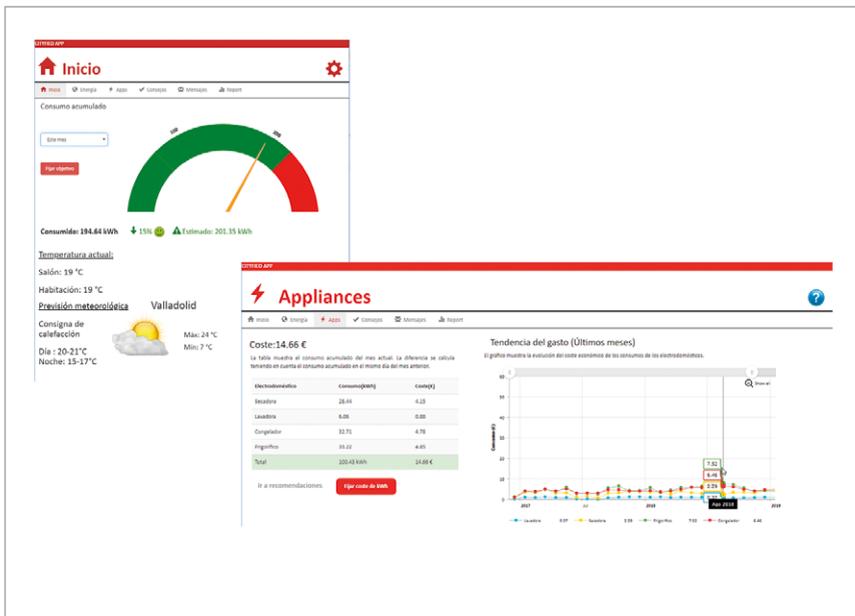


Figure 12: The CITYFIED Spanish Visualisation Tool for Households – user interface (Source: MONDRAGON Corporation).

40 The owner of the solution is MONDRAGON Corporation (<https://www.mondragon-corporation.com/en/>).

41 The owner of the solution is REENGEN (<http://www.reengen.com>).

The Turkish Visualisation Tool for Household (Figure 13), a solution of Provolta, Energy IoT Platform is a cloud-based PaaS data analytics solution for buildings. By collecting data from buildings at site, the data science-centric IoT Platform displays performance analyses for a better understanding of energy consumption. The infrastructure for the visualisation solution for residents is similar with details about the monitoring platform and visualisation tool up to the Data Collection Layer. The visualisation of data for residents is connected with mobile usage via a mobile app. The main aim is to engage residents to use this system and to increase their energy savings via feedback mechanisms.



Figure 13: The CITYFiED Turkish Visualisation Tool for Households – user interface (Source: Smartphone: Pixabay/REENGEN; Screenshots: Own source).

Solution 5: Visualisation Tool for Districts (Sweden⁴², Turkey⁴³)

The Visualisation Tool for districts is a cloud-based data analytics solution for buildings and facilities onsite allowing the monitoring of energy usage and electricity production within a given district (example from CITYFiED demo site in Sweden, see Figure 14). All modules support energy managers, platform users and project stakeholders. They constitute a decision support mechanism

42 The owner of the solution is Krafringen AB (<https://www.krafringen.se/>).

43 The owner of the solution is REENGEN (<http://www.reengen.com>).

and serve a purpose of performance benchmarking and demand management onsite throughout the whole cycle – from energy generation to consumption all-in-one platform. Performance analyses can be applied easily via rule scenarios. Connectivity of the Energy IoT Platform is advanced, since its connection to meters, systems, equipment, software, generators, storage units and charging stations provides a platform working in a one-for-all mode. Various degrees of specificity can be applied to make the tool appropriate for the project.



Figure 14: The CITYFiED Swedish Visualisation Tool for Districts (Source: Kraftringen AB).

Considering the present market offer, the energy data management systems for buildings and districts developed by CITYFiED are unique in their ability to provide simplified and optimised energy solutions. They offer a smarter way of gathering and analysing the data collected from spatially dispersed renovation sites.

4.2.3 Low Temperature District Heating Systems for Residential Buildings (Solution Pack 3)

Many of the currently existing district heating systems in Europe have advanced in the past years from being inefficient and based on fossil fuels to becoming more efficient and based on renewable energies. However, they are usually poorly maintained. While the energy costs increase, end-users have a limited decision-making capacity regarding their energy sourcing. Eventually, a significant number of customers prefers individual heating systems rather than being connected to the district heating (DH) networks.

The optimisation of DH networks and utilisation of multiple energy sources (multisource DH) enable the integration of different technologies, which would otherwise be difficult to manage in smaller facilities. One of the main solutions increasing the DH efficiency in residential buildings is the Low Temperature District Heating (LTDH) system. It reduces the temperature of a transfer fluid to the level of 50 °C–60 °C.

LTDH systems have additional advantages. Compared to traditional DH systems, they are aesthetic, compact and cause no airborne dust.

The goal of Solution Pack 3 is to offer a proper solution meeting the requirements of the LTDH systems. The assumption is that they must be applicable to the nature of the residential buildings.

Solutions being a part of the Low Temperature District Heating (LTDH) systems for the residential buildings (SP3):

Solution 1: Low-temperature Radiant Heating and High-temperature Radiant Cooling Panels for Buildings⁴⁴

Over 40% of the energy worldwide is consumed by building stock.⁴⁵ Low-energy radiant heating/cooling panels consume less energy than radiator-based conventional systems. The panels allow for the use of low-temperature sources (such as waste heat from industrial activities or solar panels, low-quality geothermal waters, etc.), also during the cold season. Moreover, it is possible to use relatively high-temperature energy sources (such as heat pumps) to be used for cooling in the warm season. To conclude, the solution allows lowering the energy costs and fossil-fuel usage (thus, contributing to decreased CO₂ emissions), while the indoor air quality and thermal comfort increase thanks to the reduced thermal stratification and airflow speed (see Figure 15).

Potential markets for the solution are: construction, Heating, Ventilation, and Air Conditioning (HVAC), renovation and architecture.



Figure 15: The CITYFiED Low-Temperature Radiant Heating and High-Temperature Radiant Cooling Panels (Source: Mir Araştırma ve Geliştirme A.Ş.).

⁴⁴ The owner of the solution is Mir Araştırma ve Geliştirme A.Ş. (<http://mirarge.com.tr>).

⁴⁵ Energy performance of buildings– European Commission. (2019). [online] Available at: <https://ec.europa.eu/energy/en/topics/energy-efficiency/energy-performance-of-buildings> [Accessed 22 May 2019].

Solution 2: Pre-insulated Reinforced Thermoplastic Composite Pipes for LTDH Systems⁴⁶

It is a market-ready (TRL9) product for heat transfer. The pipes consist of few layers to overcome internal pressure, prevent corrosion and reduce heat losses. The primary potential application field of the product is pressurised hot / cold water pipelines for district heating infrastructure. Pipe diameters range from 32 mm to 315 mm. It is possible to scale the size up or down depending on the project's requirements.

Solution 3: New District Heating Strategies to Improve Energy Performance⁴⁷

The technological innovation, specifically regarding the thermal insulation, makes it possible to progressively reduce the temperature level of the transfer fluid used in the DH system to reach a temperature level between 50°C and 60°C, which would be enough to heat low energy buildings. This decrease in the temperature level of the fluid offers many advantages, such as the reduction of heat losses, implementation of plastic pipes (which are cheaper than those made of steel), use of renewable sources of energy (which could not work with high temperature systems), thus consistently improving the energy efficiency of the DH system.

New control strategies and the use of smart thermostats and energy meters are other innovative aspects of these projects. This way, the temperature of each room can be controlled independently and the energy consumed by each radiator can be registered, which opens up the possibility to implement individual billing.

⁴⁶ The owner of the solution is Mir Araştırma ve Geliştirme A.Ş. (<http://mirarge.com.tr>).

⁴⁷ The owner of the solution is VEOLIA (<https://www.veolia.es/es/>).

4.3 Success stories

The CITYFiED project results have already been exploited to develop products or perform activities, resulting in tangible outcomes of the project. Here, we report some of the most successful stories:

- The CITYFiED was honoured to be recognised as a leading international example of “innovative and influential” work in urban transformation by a panel of global city leaders. The awards were set to take place at the Smart Cities Connect conference and expo, (26–29 March 2018 in Kansas City, Missouri). The project has been selected as a winner alongside prestigious North American and international initiatives in the energy category where the scale of CITYFiED’s renovation of more than 220,000 m² of living space and 2,200 dwellings impressed.
- On 11 December 2018, the CITYFiED project was nominated as Best Collective Building for its activities in the Torrelago district in Valladolid, which acknowledges the project’s commitment to inclusive and smart solutions for its cities. The award aimed at giving recognition to the projects, which are the best in integrating diverse sustainable solutions in buildings, by promoting new methods to improve the energy efficiency, while cutting down the negative environmental impacts such as GHG emissions and overexploitation of the natural resources.
- The innovative approaches, technical know-how and leadership across the CITYFiED community gained significant international recognition at the Euroheat & Power and International District Energy Association (IDEA) Global District Energy Climate Awards in Qatar, 24 October 2017. The Spanish demo site Torrelago took home the emerging market category prize. The Torrelago District Heating project in Laguna de Duero, Spain is central to the CITYFiED district renovation project with the heat network serving around 4,000 residents due to be completed in 2018. The renovation includes installation of a 33 kWe / 73.4 kWth micro-cogeneration system, smart control solutions and energy efficiency measures. The renovation is expected to reduce the district’s energy demand by 50 %.

Mir Arařtırma ve Geliřtirme A.ř. stated their satisfying experiences in being involved in the exploitation process. Their role in CItYFiED was to develop two innovative solutions for smart cities: Low-temperature radiant heating and high-temperature radiant cooling panels for buildings and pre-insulated reinforced thermoplastic composite pipes for LTDH systems. Both products are now ready for market and their spinoff Dizayn Building Solutions produces, sells and implements radiant heating/ cooling panels as a turn-key contractor. They see a considerable market potential for these solution packs especially in regions where low-valued geothermal sources or waste heat producers can be found. They also indicated that Steinbeis 2i GmbH, the partner in charge for exploitation, market deployment and replication tasks in CItYFiED project, helped them increase their awareness on technical and administrative weak/ strong points as well as the competitors of their products, so that they could better develop market strategies and technology improvement roadmaps. They clearly benefit from the reputation of this large scale smart city project for making further technological collaborations as well as commercial agreements both in a national and international area.

Authors

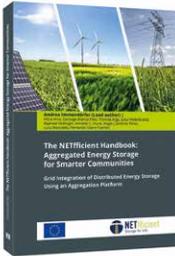
Piotr Kalbarczyk is a project consultant at Steinbeis 2i GmbH. Piotr Kalbarczyk has a Master's Degrees in Marketing and Political Counselling from the University of Warsaw (Poland, 2013) and in Environmental Governance from the University of Freiburg (Germany, 2019). Multiple exchanges and traineeships in an international environment (e.g. European Parliament, Polish Embassy in Switzerland, International Institute of Civil Society, higher education student exchange programmes, etc.) helped him to develop extensive intercultural competencies. Directly after graduation, he was responsible for supervising the process of the EU law implementation on the Polish market of rail transport at the Polish Ministry of Infrastructure. Furthermore, he has been working in R&D related to the sustainable use of environmental resources for companies such as Daimler A.G. and Fraunhofer IAO. His focal points were risk management and climate-related financial disclosure (Daimler A.G.) as well as innovation management (Fraunhofer IAO). Currently he works on the topics related to the sustainability oriented innovation and innovation implementation, market deployment and internationalisation. At Steinbeis 2i GmbH, he is responsible for supporting the smart city innovation projects.

Dr. Dilay Kesten Erhart is a project manager in the area of sustainable energy and has been working as a key member for international cooperation projects since 2013. She is a trained architect and has earned her degree in Architecture at the Technical University of Istanbul followed by a Master of Science of Environmental Control and Building Technology at the same university. Upon graduation, she was selected as an Early Stage Researcher for the Marie Curie Initial Training Network CITYNET European programme on sustainable energy management. She carried out her research at the University of Applied Sciences Stuttgart at the Centre for Sustainable Energy Technology and received her doctorate in Building Science in September 2012. She is the author of several scientific conference publications and international refereed journal papers. Dr. Kesten Erhart is currently working as project manager at Steinbeis-Europa-Zentrum. She works in EU Smart Cities and Communities projects (CITYFiED and SmartEnCity). Since September 2018, she has also

been working as a lecturer in the master programme “Smart City Solutions” at the University of Applied Sciences Stuttgart, giving lectures on “Optimised Facade Design – Energy Efficiency, Comfort and Daylight in an Urban Context”.

Valerie Bahr is a senior project manager since 2004 and a team manager since 2011 at Steinbeis-Europa-Zentrum, an independent economic entity within the Steinbeis Foundation. She provides consultancy in business development and innovation strategies to SMEs in the field of energy technologies with a special focus on Smart Cities and Communities. She supports organizations in international cooperation, cross-border technology transfer, conception and coordination of project proposals, IPR advisory services, and ensures the process of exploitation towards market deployment in EU projects, including technology-related analyses such as technology watch, market surveys, and feasibility studies – currently in EU Smart Cities and Communities projects CITYFiED, REMOURBAN, SmartEnCity, mySMARTLife and ATELIER and the meta project Smart Cities Information Systems (SCIS). From November 2010 to January 2014, Ms Bahr has coordinated the accompanying measure CONCERTO Premium that was assessing the results of the 22 projects covered by the EU initiative CONCERTO. The main goal was to market the CONCERTO sites as role models for using renewable energy sources, poly-generation and energy efficiency measures all over Europe. From May 2005 to May 2011 she has been the co-coordinator of the EU project POLYCITY, an Integrated Project (FP6) on renewable energies and energy efficiency. Ms Bahr is an active member in the sector group Sustainable Construction Energy of the Enterprise Europe Network (<http://een.ec.europa.eu>). Ms Bahr was trained in Biology at the Eberhard-Karls-University in Tübingen and at the Duke University in USA, where she obtained a Diploma in Biology.

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Understanding of how to lay the foundation for innovation is an essential condition for cities aiming to set up an efficient and effective urban transformation strategy. To ensure the successful exploitation of project results into marketable products, services and / or processes, Steinbeis 2i GmbH developed this CITYFiED Innovation Management Guide. It is based on the case study of the European Smart Cities and Communities project "CITYFiED". The project was funded under the EU 7th Framework Programme. Its goal was to develop a replicable, systematic and integrated strategy to adapt cities to the new smart city trends.

This guide describes a detailed exploitation approach that turns project results into long lasting benefits for all. It is relevant for all stakeholders involved in innovation-oriented demonstration projects.