syn.ikia

Sustainable plus energy neighbourhoods

WP6 Innovation Management, Exploitation, Market Uptake and Business Models

D6.2 AN EXPLOITATION STRATEGY FOR SYN.IKIA PARTNERS AND SYN.IKIA INNOVATIONS

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3. Executive Summary

Syn.ikia's **exploitation strategy** comprises both project lifetime and post-project measures to protect and extract value from syn.ikia's project results and to contribute to the 5D impact areas i.e. Decentralisation, Democracy, Decarbonisation, Digitalisation and Design. Project lifetime measures should create a pattern and the best position for post-project measures, which include both short-to medium term objectives and long-term objectives. For the syn.ikia project, the short-to-medium-term goal is to maximise the utilisation of the project results by relevant market actors to actively speed up the development of technologies for energy efficiency, RES, storage and energy flexibility. The long-term objective is to accelerate the mainstreaming of sustainable plus energy homes and neighbourhoods (SPENs).

The scope of this report summarises the work effort in the first part of syn.ikia's project lifetime measures for exploitation, which is pursued on two fronts: (i) focusing on each of syn.ikia's foreseeable project results to outline all possible exploitation pathways and (ii) spotlighting each of syn.ikia partners to delineate all relevant exploitation activities to plan for a wider uptake of results.

This aim of this report is three-fold, to:

- provide an overview of the possible **exploitation pathways** of syn.ikia innovations and the planned **exploitation activities** of syn.ikia partners,
- identify some **key considerations** for further work on the **final plan for exploitation and dissemination of results**,
- outline a **series of actions** for the rest of syn.ikia's project lifetime measures that contribute to syn.ikia's overall exploitation strategy.

The current portfolio of 14 syn.ikia innovations span a wide range of features and functionalities, comprising a number of instructions, processes, softwares, systems, technologies and tools to address the different kinds of challenges arising from the different phases involved in the planning, development and implementation of sustainable plus energy neighbourhoods. With focus on multi-storey apartment buildings and neighbourhoods in urban contexts as the point of departure, syn.ikia's results are subject to a multitude of exploitation pathways (Chapter 9).

At the same time, the syn.ikia consortium comprises a range of actors representing various nodes in the built environment value chain and the residential energy value chain, providing a variety of services to a diverse clientele (such as SMEs, public authorities, social housing developers, private investors etc.) Partners in the consortium are spreading the concepts and solutions based on their best efforts. A range of exploitation activities have already been identified by each partner (Chapter 10).

Based on the planned exploitation pathways of syn.ikia innovations and the planned exploitation activities of syn.ikia partners so far, several considerations stand out to guide the development of the final plan for the effective exploitation and dissemination of results (Chapter 11). These concern:

- communicating syn.ikia innovations,
- identifying existing actors with new roles and emerging actors for SPENs,
- networking and creating synergies with other Plus Energy projects, and

- positioning the concept of SPENs among analogous terminologies.

Returning to syn.ikia's project lifetime measures for exploitation, the central aim would be to ensure the exploitation pathways are correlated with the development of innovations to ensure a market-based approach where the solutions are practical, economically attractive and user-friendly. The objective is to increase the **chances of uptake** of syn.ikia's key exploitable results.

A series of actions are therefore outlined for the rest of syn.ikia's project lifetime measures for exploitation (Chapter 12):

- Gather inputs from respondents about their experiences and opinions to further classify innovations (for instance using different phases of SPENs, commercial vs. non-commercial)
- Run Exploitation workshop for plenary discussions involving all partners to prioritize exploitation pathways and activities
- Map SPEN's key actors to better understand the multi-stakeholder networks
- Assess target users and needs in potential markets, develop suitable value propositions, and identify relevant market-oriented activities

This report "An exploitation strategy for syn.ikia partners and syn.ikia innovations" can be seen as an **intermediate version** of the plan for exploitation and dissemination of results required by all Innovation Action projects. The **final plan for exploitation and dissemination of results** should be included in the report **D6.4 Measures and strategies to achieve market uptake of 10% plus energy neighbourhoods within 2030** (due in Month 54).

Finally, several syn.ikia activities and findings will have an influence on developing the final plan for exploitation and dissemination of the results. These are listed in chronological order of delivery so that the reader has an overview of the relevant work.

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4. Roles and Responsibilities

Name	Role	Responsibility
NTNU	Project coordinator Results Owner Partner in consortium	Provide input in the planning of the task and the aim and structure of the content of this deliverable. Contribute to outlining the exploitation pathways for the following envisaged innovations: • Integrated Energy Design Process • Business models for sustainable plus energy neighbourhoods Contribute to outlining the individual exploitation activities as partner in syn.ikia consortium
DTU	Results Owner Partner in consortium	Contribute to outlining the exploitation pathways for the following envisaged innovations: • Syn.ikia Grey Box models • Syn.ikia Flexibility Functions • Syn.ikia Flexibility Index Contribute to outlining the individual exploitation activities as partner in syn.ikia consortium
BPIE	Reviewer Results Owner Partner in consortium	Quality assurance of the report Contribute to outlining the exploitation pathways for the following envisaged innovations: • Neighbourhood scale user engagement Process • Innovative policy development tools Contribute to outlining the individual exploitation activities as partner in syn.ikia consortium

Name	Role	Responsibility
SINTEF	Task leader, Exploitation lead and content creation Partner in consortium	Task leader for T6.2 Exploitation Management Contribute to outlining the individual exploitation activities as partner in syn.ikia consortium
Housing Europe	Partner in consortium Dissemination lead as WP7 leader	Contribute to outlining the individual exploitation activities as partner in syn.ikia consortium Dissemination advice (change of strategy regarding online SPEN Community and its implications for syn.ikia's exploitation strategy)
IREC	Results Owner Partner in consortium	Contribute to outlining the exploitation pathways for the following envisaged innovations: • Evaluation Framework for SPEN • Urban Simulation Tool at the Neighbourhood Scale Contribute to outlining the individual exploitation activities as partner in syn.ikia consortium
AREA	Partner in consortium & Demo lead	Contribute to outlining the individual exploitation activities as partner in syn.ikia consortium
INCASÒL	Results Owner Partner in consortium & Demo lead	Contribute to outlining the exploitation pathways for the following envisaged innovation: • Integral energy management Contribute to outlining the individual exploitation activities as partner in syn.ikia consortium
TNO	Results Owner Partner in consortium	Contribute to outlining the exploitation pathways for the following envisaged innovation: • Neighbourhood Scale Digital Twin Contribute to outlining the individual exploitation activities as partner in syn.ikia consortium
ENFOR	Results Owner Partner in consortium	Contribute to outlining the exploitation pathways for the following envisaged innovation: • syn.ikia Digital Cloud Hub Contribute to outlining the individual exploitation activities as partner in syn.ikia consortium
ABUD	Results Owner Partner in consortium	Contribute to outlining the exploitation pathways for the following envisaged innovation: • Guidelines on how to create energy communities Contribute to outlining the individual exploitation activities as partner in syn.ikia consortium

Name	Role	Responsibility
SIR	Partner in consortium & Demo lead	Contribute to outlining the individual exploitation activities as partner in syn.ikia consortium
ARCA NOVA	Partner in consortium & Demo lead	Contribute to outlining the individual exploitation activities as partner in syn.ikia consortium

5. Introduction

Background and context

Syn.ikia's implementation plan is aligned to the SET-Plan ACTION n°3.2 "Smart Cities and Communities" which aims to support the planning, deployment and replication of 100 'Positive Energy Districts' by 2025 for sustainable urbanisation. The **Sustainable Plus Energy Neighbourhood (SPEN)** concept **focuses on multi-storey apartment buildings in urban contexts**, where the syn.ikia project aims to significantly increase the overall energy efficiency, enhance energy flexibility, and integrate technologies for energy generation from renewables (photovoltaics, geothermal heat etc.) in a cost-effective way. Hand in hand with the "energy" aspects of neighbourhoods, the SPEN concept also pays equal attention to social aspects, aiming at supporting environmental-friendly, healthy, resilient and sustainable living environments, promoting healthy lifestyles and consumption behaviour, and contributing to the development of an equitable, inclusive and trusted society. The SPEN notion is a progression of nZEB/Plus Energy Buildings, where significant gains can potentially be made at the neighbourhood level.

Syn.ikia's concept relies on the interplay between novel technologies at the neighbourhood scale, energy efficiency and flexibility of the buildings, good architectural & spatial qualities, housing affordability and citizen engagement.

Syn.ikia will deliver a blueprint masterplan, including technical, financial, legal and social issues, for the development of SPENs in different contexts, climates and markets in Europe. Through the 5D impact areas, we will significantly contribute towards environment-friendly, healthy, resilient, secure, safe, and affordable living places and communities. These 5D impact areas are Decentralisation, Democracy, Decarbonisation, Digitalisation and Design and are elaborated in Table 1.

Table 1 syn.ikia's 5D impact areas

5D impact areas	Description of impact
Decentralisation	Neighbourhoods as flexibility providers that enable more renewable energy sources to enter the grid and allow for flexible management of energy demand and generation.
Democracy	Engaged, empowered and conscious users that have access to affordable and high-quality neighbourhoods.
Decarbonisation	Climate neutral, highly energy efficient neighbourhoods with a surplus of energy from renewable sources.
Digitalisation	Big data-based neighbourhoods and smart networks that provide well-managed housing for the citizens.
Design	Integrated energy, architectural and spatial design that improve attractiveness of energy-efficient housing and its market uptake.

Four co-creation hubs creating impact

The four syn.ikia co-creation hubs in the Netherlands, Spain, Austria and Norway will demonstrate the functionality of the SPEN concept for the rest of Europe. The SPEN concept embodies a number of strategies, processes, technologies, systems and tools that will be showcased in the design, construction and operation of SPENs in each of the four climatic zones in Europe. These are syn.ikia's envisaged innovations.

Syn.ikia's envisaged innovations

The current portfolio of 14 syn.ikia innovations comprises a *wide range of features and functionalities* to address the different kinds of challenges arising from the planning, development and implementation of plus energy neighbourhoods. It is syn.ikia's ambition to deliver innovations in energy and construction as well as social, policy and business model innovations to bring about the mainstreaming of SPENs. These innovations encompass new designs, tools, methods, and processes which will enable large deployment of SPENs and have already been classified into a dashboard under three categories, namely Configuration-type, Offering-type and Experience-type[1] (see Figure 1).

- Configuration-type innovations are focused on the innermost workings of a business system. Examples include profit models, procedures and processes. Syn.ikia's innovations that can be classified as configuration type innovations are denoted on the left side of Figure 1.
- Offering-type innovations are focused on enhancing or extending an enterprise's collection of products or services. Syn.ikia's innovations that can be classified as offering-type innovations are denoted in the middle of Figure 1.
- Experience-type innovations are focused on more customer-related elements of an enterprise and its business system. Examples are services, channels as well as customer engagement. Syn.ikia's innovations that can be classified as experience-type innovations are denoted on the right side of Figure 1.

[1] Report D6.7 A systematic approach to development, registration and reporting of innovations (M24)

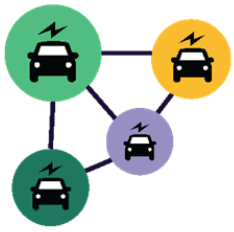
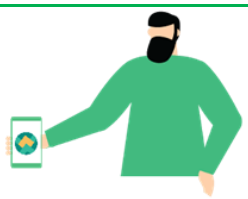
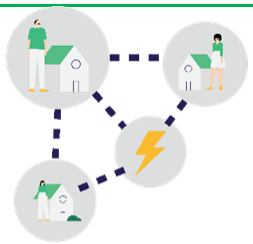
CONFIGURATION-TYPE INNOVATIONS	OFFERING-TYPE INNOVATIONS		EXPERIENCE-TYPE INNOVATIONS
 Integrated Energy Design Process at Neighbourhood Scale	 Syn.ikia Digital Cloud Hub	 Digital Twin[N] Neighbourhood Scale Digital Twin	 EF[N] Evaluation Framework for SPEN
 Business Models for Sustainable Plus Energy Neighbourhoods	 Syn.ikia Grey Box Models	 Smart Charging of Vehicles at Neighbourhood Level	 UST[N] Urban Simulation Tool at the Neighbourhood Scale
 Integral Energy Management	 Syn.ikia Flexibility Functions		 Neighbourhood Scale User Engagement Process
 Agent Based Modelling of an Energy Community	 Syn.ikia Flexibility Index		 Innovative Policy Development Tools

Figure 1 Dashboard of envisaged syn.ikia's innovations[2] – updated Sep 2022

[2] Report D6.7 A systematic approach to development, registration and reporting of innovations (M24)

Exploitation strategy

Exploitation concerns efforts to effectively use project results through scientific, economic, political or societal pathways aiming to turn research and innovation actions into concrete value and to generate impact for the society. To be more specific, exploitation is defined as the **utilization of results** in further research activities other than those covered by the action concerned, or in developing, creating and marketing a product or process (commercial purposes), or in creating and providing a service or in standardization activities (public policymaking)[3].

Syn.ikia's **exploitation strategy** comprises both project lifetime and post-project measures (see Figure 2) to protect and extract value from syn.ikia's project results and to contribute to the 5D impact areas.

Figure 2 Exploitation strategy: Project lifetime and post-project measures for exploitation

Exploitation needs to be seen in conjunction with communication and dissemination as the three are highly interrelated[4] . While communication only lasts during the project lifetime, dissemination and exploitation continue beyond the project. Exploitation is aimed at longer lasting measures to create the benefits and generate the impacts for the society.

As mentioned, the current portfolio of 14 syn.ikia innovations comprises a *number of strategies, processes, technologies, systems and tools* to address the different kinds of challenges arising from the planning, development and implementation of plus energy neighbourhoods, going beyond the building level. As Figure 2 shows, the short-to-medium-term objective of exploitation is to maximise the utilisation of the project results by relevant market actors to actively speed up the development of technologies for energy efficiency, RES, storage and flexibility. The long-term objective of exploitation is to accelerate the mainstreaming of sustainable plus energy homes and neighbourhoods (SPENs) in Europe.

[3] Article 28 – Obligation to exploit the results. See H2020 Programme Annotated Model Grant Agreement Version 5.2 dated 26 Jun 2019.
[4] Boosting the impact of your project through effective communication, dissemination and exploitation (European IPR Helpdesk, 2018)

Scope of this report

During syn.ikia's project lifetime, the activities for project lifetime measures for exploitation have been structured in three main parts (see Figure 3).

Figure 3 Syn.ikia's project lifetime measures for exploitation indicating the scope of this report

This report summarises the work effort in the first part, which is pursued on two fronts: (i) focusing on each of syn.ikia foreseeable project results to outline all possible exploitation pathways and (ii) spotlighting each of syn.ikia partners to delineate all relevant exploitation activities to create opportunities for a wider uptake of results.

6. Objectives

This aim of this report is three-fold, to:

- provide an overview of the possible **exploitation pathways** of syn.ikia innovations and the planned **exploitation activities** of syn.ikia partners,
- identify some **key considerations** for further work on the **final plan for exploitation and dissemination of results**,
- outline a **series of actions** for the rest of syn.ikia's project lifetime measures that contribute to syn.ikia's overall exploitation strategy.

7. Structure of the report

The report is structured as follows:

Chapter 8 describes the approach and methodology applied in the preparation of this report.

Chapter 9 provides an overview of the possible **exploitation pathways**, including commercialisation opportunities, of syn.ikia innovations, depending on the type of value creation it generates.

Chapter 10 shifts the focus to planned **exploitation activities** of syn.ikia partners, outlining how each partner from industrial/ commercial to research/ academic sectors, can create synergies to grow and expand their business or core activities and at the same time contribute to the further use of syn.ikia innovations based on their roles in the combined built environment value chain and the residential energy value chain.

Chapter 11 identifies some key **considerations for further work on the final plan for exploitation and dissemination of results.**

Chapter 12 concludes with a **series of actions** that contribute to syn.ikia's overall exploitation strategy for the short/medium term and the long term. These aim to increase the **chances of uptake** of syn.ikia's key exploitable results.

8. Approach and Methodology

For the preparation of this report, we relied on various approaches and methodologies.

First, to make concrete syn.ikia's project results, we used aspects of the Intellectual Asset Methodology (IAM) to **classify the results by knowledge asset categories**. We relied on syn.ikia's results register which has been in place since the project's inception and finetuned at annual intervals under the Innovation Management task[5].

Second, to guide individual partners in outlining possible and realistic exploitation opportunities, we developed a **general exploitation pathways framework tailored for syn.ikia's results**. This framework helps to provide a holistic view and make concrete all possible potential exploitation pathways, including commercialisation opportunities, for the array of syn.ikia results.

Third, to obtain an initial picture of the potential target user groups for the application and uptake of results, we embarked on a preliminary **stakeholder mapping for each of the four demonstration sites**. This represents a first effort, using an actor-oriented approach, to identify the local stakeholders in each syn.ikia co-creation hub.

The overall approach is summarised in Figure 4.

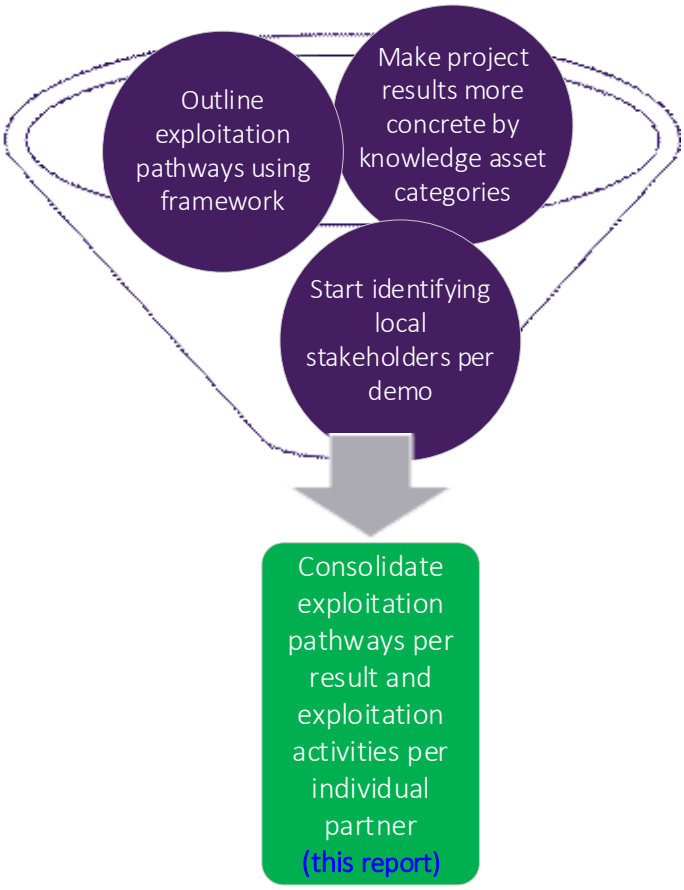


Figure 4 Approach and methodology to prepare for this report

[5] The innovation management task develops a systematic approach to registering, reporting and developing innovations for the syn.ikia consortium. Two reports have been completed under this task:

- Report D6.1 A systematic approach to development, registration and reporting of innovations (M12) and
- Report D6.7 A systematic approach to development, registration and reporting of innovations (M24)

In addition, in **Appendix A**, we also provide a short description of the different activities to provide the reader with an indication of how we have organised the data collection process for this report.

8.1 Knowledge asset categories to classify results

While the term "project results" refer to all results generated under the project, **Key Exploitable Result (KER)** means something more specific. A KER can be defined as a result that has been selected due to its high potential to be "exploited" (or more simply "used") beyond the syn.ikia project period. A KER will constitute an innovation once it proves itself successful in practice and is being used and turned into an economic, social or environmental benefit (see **Figure 5**).

Figure 5 Distinguishing project results, Key exploitable results and innovation

The syn.ikia's KER register has been in place since the project's inception and finetuned at annual intervals[6]. It is now monitoring 14 results, and these are expected to be revisited and revised as the consortium learns together and works towards ensuring that the solutions are viable and realistic for exploitation in the coming months. In May 2022, aspects of the Intellectual Asset Methodology (IAM) to classify the results by knowledge asset categories were introduced to the consortium (See Appendix A).

Knowledge is inherently difficult to manage because it is diffuse, subjective and elusive. Project outputs are valuable intellectual assets. It has been suggested that to turn knowledge into manageable intellectual assets, eight categories[7] (see Table 2) can be used to categorise them:

Table 2 Eight categories of knowledge assets[8]

	Knowledge asset categories	Definition	Examples
1.	Data	Potentially very useful but unprocessed, raw information which can serve as a source for future insights or solutions.	• Measurement or test data • Results • Experiments • Notes and journals
2.	Database	Structured and searchable data, which is collected, ordered and accessed in a systematic way.	• Electronic databases (MS Excel and Access files, etc.) • Matrices

[6] Please see Report D6.1 A systematic approach to development, registration and reporting of innovations (M12) and Report D6.7 A systematic approach to development, registration and reporting of innovations (M24)

[7] According to White Paper IAM (Based on research at Chalmers University of Technology and University of Gothenburg): https://www.konsert.com/insight/intellectual-asset-management/ (Haldorson, 2015)

[8] Lecture on 2022 05 06 See Appendix A

	Knowledge asset categories	Definition	Examples
3.	Data correlation	Conclusions derived from analyzing empirical data or databases such as problem insights, design and process parameters.	• Optimizations • Trends and ranges • Cause/effect and connections • Dependencies • Findings
4.	Theoretical framework	Generalized theories explaining technical phenomena, causes and effects.	• Models • Theories • Understandings and realizations • Abstractions • Schemes
5.	Technical solution	Solutions to technical problems and core and unique underlying ideas of new technologies.	• Methods and processes • Devices, units and apparatuses • Compositions and designs • Configurations and systems • Technologies, inventions and solutions
6.	Visualisation and simulation	Static or dynamic visual representations which go beyond typical drawings by being valuable in themselves.	• Designs, drawings and sketches • CAD/CAM and prototypes • Diagrams, graphs and photos • Simulations, models and demonstrations
7.	Instruction	Instructions providing concrete directions to execute a specific procedure, e.g. a technical operation.	• Algorithms, routines and procedures • Guidelines, manuals and SOPs • Recipes • Recommendations
8.	Software	A computer-implemented and organized collection of data and automated operations, performing specified tasks.	• Systems, suites, and platforms • Programs, applications, clients/servers • Drivers, plug-ins, engines and GUIs • Libraries, algorithms and scripts

Using these knowledge asset categories to characterise syn.ikia results would facilitate identifying opportunities to utilize and create business value from it. The ambition is to make concrete the envisaged syn.ikia results for the purposes of communication (internally within the consortium and externally).

8.2 An exploitation pathways framework tailored for syn.ikia innovations

Syn.ikia's KERs have the potential to be commercially exploited as products or services. To guide individual partners in outlining possible and realistic exploitation opportunities, we developed a general exploitation pathways framework tailored for syn.ikia's results. This framework tries to provide a holistic view and make concrete all possible potential exploitation pathways, including commercialisation opportunities, for the array of syn.ikia results.

We outlined five main exploitation pathways tailored for syn.ikia innovations (see Table 3).

Table 3 An exploitation pathways framework tailored for syn.ikia innovations

	Exploitation pathways	Type of value creation	Examples of outcomes	Target audience
1.	Further research	Scientific value	Journal articles, conference papers, research proposals	Academic and research community in the field of energy efficiency, energy flexibility and RES
2.	Commercialisation	Economic value	Popular science, practitioner-oriented reports Licencing Spin-offs	Business actors & investors
3.	Standardisation/ Harmonisation	Scientific + Technological value	Alignment of PED definitions; harmonisation of KPI frameworks)	Researchers, especially those in respective research networks focused on Positive Energy Districts (PEDs), and practitioners
4.	Skills and education training; informing managerial practice	Social value (societal)	Courses at tertiary institutions, Inhouse employee training courses	Students, Practitioners in the built environment value chain and the residential energy value chain
5.	Policy making	Policy value	Informing the policy debate about how policy instruments and financing programmes can contribute to SPENs. Policy impact can be achieved at the EU level, the national level and the local level.	Local, national and European policymakers in the field of energy efficiency and RES

This framework (Table 3) is not exhaustive, but provides a discussion tool among consortium partners in syn.ikia to outline all possible exploitation pathways, including commercialisation opportunities.

8.3 Actor-oriented stakeholder mapping for multi-stakeholder networks of SPENs

Sustainable Plus energy houses and neighbourhoods are expected to involve a plethora of actors since they are pushing a number of solutions and technologies that are crossing the boundaries of the building and the energy sector. To better understand such multi-stakeholder networks, stakeholder identification is a necessary first step.

From existing literature, many tools are widely available to conduct a stakeholder analysis/ mapping. For example, we considered the influence-interest matrix, the RACI matrix and the Power-Legitimacy-Urgency framework. The influence-interest matrix (Olander & Landin, 2005; Rolstadås et al. 2014) looked at power and dynamism and was aimed to be applied for environmental scanning. Stakeholders were put into four categories: Key players, Keep satisfied, Minimal effort and Keep informed. The RACI (Responsible, Accountable, Consulted, Informed) matrix characterised stakeholder roles and uses interest and influence to classify stakeholders through a "responsibility assignment matrix". The RACI model distributes authority, making power dynamics explicit by defining roles in a task, project or management activity. The Power-Legitimacy-Urgency framework suggested by Mitchell et al. (1997) outlined seven kinds of stakeholders- Dormant, Discretionary, Demanding, Dominant, Dependent, Dangerous and Definitive out of the three attributes.

However, the above methods may not be optimal or effective for analysing the multi-stakeholder networks of planning, constructing, and operating a SPEN. The influence-interest matrix focuses a great deal on determining the importance of the stakeholders by positioning and comparing them with each other in terms of their influence and interest on the project, without considering the interconnectedness and interdependency among these actors. The RACI chart focuses much on identifying appropriate responsibilities (Responsible, Accountable, Consulted or Informed) for each stakeholder in a given task. Although useful for project management, it also cannot provide an overview of the complex multi-stakeholder network environment of SPEN. While the Power-Legitimacy-Urgency framework model is elegant and sophisticated, it is difficult to operationalize in an empirical setting.

To identify an approach that is suitable for analysing the multi-stakeholder networks of planning, constructing and operating a SPEN, we had to return to the concept of a stakeholder. Stakeholder is a concept that can be defined in a narrow sense or a wide sense. In a wide sense, a stakeholder is any group who can affect the achievement of a firm's objectives or who is affected by the achievement of a firm's objectives. In a narrow sense, a stakeholder is any identifiable group or individual on which the project is dependent for its continued survival. At this end of the spectrum (that is, in the narrow sense), instead of a faceless entity, stakeholders can be interpreted as full-faced actors in that they can affect or are affected by the development of the SPEN.

To prepare for the work of systematically analysing target user groups for the uptake of syn.ikia project results going forward, we used actor-oriented stakeholder mapping tool (see Figure 6) to facilitate a systematic analysis of the **web of relational actors** by categorizing eight major groups of external actors with whom the owner of the driver of the SPEN can, or must, interact.

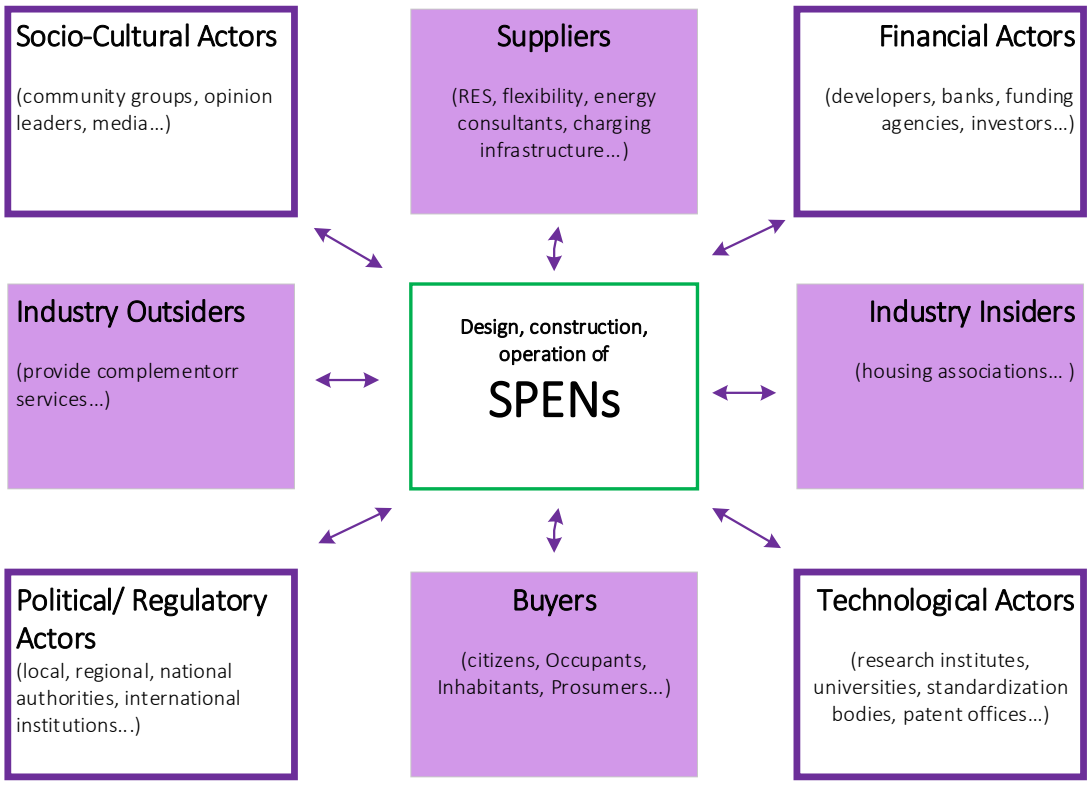


Figure 6 Actor-oriented stakeholder mapping for multi-stakeholder networks of SPENs (adapted from Cheng et al. 2022)

This tool facilitates a systematic analysis of the web of relational actors relevant for the design, construction and operation of a SPEN. Among these eight major groups of actors, a distinction can also be made between industry and contextual actors. **Industry actors** are those entities that perform value-adding activities or consume the outputs of these activities while **contextual actors** are those entities whose behaviour, intentionally or unintentionally, sets the conditions under which the industry actors must operate.
In particular, studies have suggested paying attention to the phases of development of SPENs as stakeholder roles might shift (Cheng et al. 2022). In addition, new actors are emerging and are not limited to prosumers, investors in energy efficiency and distributed generation, building developers, municipalities and communities, grid operators and utilities, and building owners and so on. This tool also helps to keep in view that SPENs are developed for the ultimate users which are citizens, occupants, inhabitants, or prosumers.

Industry actors are represented by the shaded boxes in Figure 6 – suppliers and buyers (here being the citizens, occupants, inhabitants, or prosumers) and also industry insiders and outsiders. Contextual actors are depicted in the non-shaded boxes, referring to the financial, technological, political/ regulatory actors and the socio-cultural actors. Identifying the industry actors can be tedious but doable since their business interests, capacities and agendas are more or less recognizable. Identifying the contextual actors is often complex and the work to map them out is difficult since in-depth local knowledge is required to understand contextual actors.

In order to better understand the multi-stakeholder networks of SPENs, a stakeholder map has started to take shape for each demonstration site (see **Appendix A**). Stakeholder identification is not a one-time activity but the outputs should continually be used for decision making or to review priorities especially in a multi-stakeholder environment when stakeholder roles can shift and new relations between stakeholders can emerge.

9. Possible exploitation pathways of syn.ikia innovations

In this chapter, we present an overview of the exploitation pathways, including commercialisation opportunities, of each of the 14 syn.ikia KERs, depending on the type of value creation it generates.

The significant gains to be made at the neighbourhood/ district level is evident to transition to a low carbon-built environment and energy system. But there are a multitude of challenges to overcome – from technical, financial, legal to social issues.

The current portfolio of 14 syn.ikia key exploitable results (KER) comprises a *wide range of features and functionalities* to address the different kinds of challenges arising from the planning, development and implementation of SPENs.

Each of the KER is presented with its current TRL and lead partner in the following pages, outlining in particular:

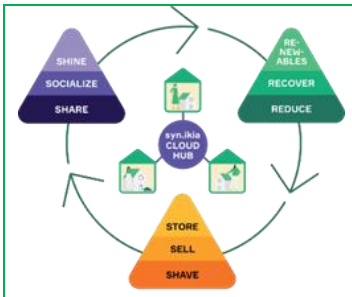
- the challenges it is trying to address in the planning, development and implementation of plus energy neighbourhoods
- its novelty elements
- how it can be communicated to non-experts, and finally
- how the results can be utilized beyond syn.ikia project

Following the order in Figure 1, the key exploitable results (KER) are organised as follows:

- Integrated Energy Design Process at the neighbourhood scale
- Business models for SPENs
- Integral Energy Management
- Agent-based modeling of an Energy Community
- syn.ikia Digital Cloud Hub
- syn.ikia Grey Box Models
- syn.ikia Flexibility Functions
- syn.ikia Flexibility Index
- DigiTwin^{N} Neighbourhood Scale Digital Twin
- EF^{N} Evaluation Framework for SPEN
- UST^{N} Urban Simulation Tool at the Neighbourhood Scale
- Neighbourhood Scale User Engagement Process
- Innovative Policy Development Tools

Each sub-chapter has relied heavily on the input from all results owners.

9.1 Integrated Energy Design Process at the neighbourhood scale

<table>
<tr><td> 

Integrated Energy Design Process at Neighbourhood Scale</td><td colspan="3">Syn.ikia's Integrated Energy Design Process at the neighbourhood scale (IED^N) guideline promises to enhance the traditional process of integrated energy design (IED)[9] for low energy buildings to the neighbourhood scale. IED^N will include more stakeholders in the design process, to contribute to a more effective design process, ensuring that all SPEN goals are met to deliver a high performance of the neighbourhood. The use of advanced performance prediction tools from the early design and throughout the process is also part of the guideline.

Based on the traditional process of integrated energy design (IED) for low energy buildings, the syn.ikia team will develop and test a new process for integrated design of sustainable plus energy neighbourhoods, IED^N. Similar to the IED process, the IED^N process also involves multi-disciplinary actors and the application of advanced simulation tools from the early design phases, but applies optimization on the neighbourhood scale instead of at the single building level. In addition, the IED^N process involves a wider range of design issues than the traditional IED process.</td></tr>
<tr><td>• Knowledge asset category</td><td colspan="3">Instruction (Guidelines) - ref. Table 2</td></tr>
<tr><td>• In the planning, design, construction and operation of SPENs, what kind of challenges will this result solve?</td><td colspan="3">- Improve inter-disciplinary cooperation
- Facilitate more efficient planning and design process
- Ensure all issues that are important for SPENs are integrated into the planning and design at an early stage, and followed-up throughout the process
- Ensure high-performance SPENs</td></tr>
<tr><td>• How is this solution new/ better than current solutions? Highlight what's novel about it.</td><td colspan="3">• IED process guidelines only deal with single building projects; IED^N involves more design issues, starting earlier in the planning process (municipal/strategic level), better performance prediction, and involving more actors early in the process (municipalities, energy utilities, etc.)</td></tr>
<tr><td>• How can this result/innovation be communicated (who is interested in the results?</td><td colspan="3">• Seminars / workshops for practitioners
• Publications
• Courses at university
• Online guideline</td></tr>
<tr><td>• How can this result be used beyond syn.ikia?</td><td colspan="3">The IED^N guideline is intended to assist architects, engineers, clients, and developers in designing sustainable plus energy neighbourhoods. It can also guide municipalities and energy utilities.</td></tr>
<tr><td>• TRL (as of Oct 2022)</td><td>TRL5</td><td>• Lead partner</td><td>NTNU
Norwegian University of Science and Technology</td></tr>
</table>

[9] The traditional process of Integrated Energy Design provides guidance to clients and designers stressing the importance of clear goals, integration of systems, multi-disciplinary cooperation, and performance documentation to achieve well-functioning zero emission buildings. See Andresen, I., & Hegli, T. (2017).

9.2 Business models for SPENs

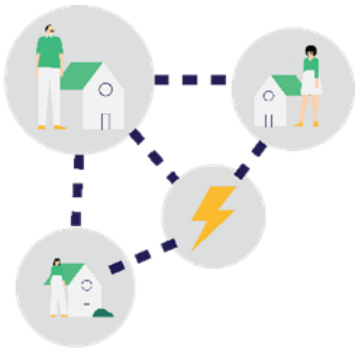
	The business models for SPENs proposed in syn.ikia will assess the more profitable options and **note the factors driving it in different climate zones and national contexts**. New business models will be identified to capture and demonstrate the value of reducing energy demand and to ensure that all players involved (utilities, building owners, developers, and investors) achieve meaningful returns on investments and reach sustainable socio-economic and environmental benefits.		
• Knowledge asset category	**Instruction (Guidelines)**		
• In the planning, design, construction and operation of SPENs, what kind of challenges will this result solve?	- Identify financial incentives for the development of SPEN - Increase the economic viability of SPEN - Reduce costs or identify new sources of revenues - Create new ecosystems to include new stakeholders - Increase the interest of SPEN outside the "traditional" stakeholders - Increase the market uptake prospects for SPENs		
• How is this solution new/ better than current solutions? Highlight what's novel about it.	The business models will be calculating and assessing the advantage of SPENs compared to more conventional situations, such as production/exchange/storage of energy, efficiency measures		
• How can this result/innovation be communicated (who is interested in the results?	Publication in research journals and practitioner-oriented reports targeting Building owners, municipalities, local energy operators, Building Developers, Energy companies, ICT companies and new actors.		
• How can this result be used beyond syn.ikia?	Learning from testing the business models in the syn.ikia context is likely to move the research forward. syn.ikia business models can be taught in universities across Europe (i.e. NTNU)		
• TRL (as of Oct 2022)	**TRL to be reported in Dec 2022**	• Lead partner	NTNU Norwegian University of Science and Technology

9.3 Integral Energy Management

	Integral Energy Management refers to the centralized management of domestic hot water and heating in a rental building by an energy manager who controls and optimizes production and consumption. In the case of the syn.ikia's Spanish demo at Santa Coloma de Gramenet, Integral Energy Management is introduced as a new procedure in the operation phase of the building where heating and hot water systems are centralized, which improves the efficiency. In addition, Integral Energy Management is necessary to control and optimize the behavior of the Renewable Energy Self-consumption Community constituted by the INCASÒL public residential buildings and ICS (Institut Català de la Salut; Catalan Institute of Health) buildings.
• Knowledge asset category	**Instruction (Procedures)**
• In the planning, design, construction and operation of SPENs, what kind of challenges will this result solve?	The energy manager as a professional resource can help solve challenges such as: - Incorporate social housing to the energy market as a prosumer - Assess and optimize the energy sharing between equipment and housing (different uses and schedules). - Control the charge of the electric car, acting as a recharging manager - Optimize the energy balance and offer a competitive price to both the user and the developer, acting as an investor, and acting as an aggregator - Manage the relationship between the SPEN and the electric trading companies so that they provide the energy manager with the conditions to achieve a positive balance. - Receive and process data concerning the external buildings integrated into the Self-consumption Community.
• How is this solution new/ better than current solutions? Highlight what's novel about it.	The novelty is in terms of control, generation and distribution of demand. Novelty elements: - Energy management in operation phase at building and neighbourhood level - Enabling the sharing of energy between two public buildings of different uses and schedules and belonging to different ministries - Digitalization in social housing as a key for knowledge and control, generation and distribution of demand. The case of Santa Coloma de G. will be a reference example for the management of the energy community between 2 public buildings and also an example of an administrative agreement between two different ministries.
• How can this result/innovation be communicated (who is interested in the results?	These results can be communicated through specialized forums and publications (IREC) and through local and international conferences on housing and energy, the communication channels of INCASÒL and Generalitat de Catalunya (Government of Catalonia) via web, Press, Twitter).

• How can this result be used beyond syn.ikia?	Results will be of interest to housing developers and city councils, as well as the Generalitat of Catalonia (Government of Catalonia) which plans to cover the roofs of all its buildings with photovoltaic panels where there will be surpluses that will have to be shared with other nearby buildings.		
• TRL (as of Oct 2022)	TRL5	• Lead partner	INCASÒL Institut Català del Sòl

9.4 Agent-based modeling of an energy community

 Agent Based Modelling of an Energy Community	Designing an energy community is a hard task, due to the uncertainty of the behavior of different actors at a complex system level. Agent-based modelling helps in decision making and design of energy communities, with the ability to model emergent behaviour of various actors based on description of individual agents.
• Knowledge asset category	Instruction (Decision support tool)
• In the planning, design, construction, and operation of SPENs, what kind of challenges will this result solve?	This proposed solution addresses three challenges: - Currently, most countries provide one choice for people that produce energy. There is a need to identify other possible ways for the consideration of policymakers and infrastructure providers. - At present, it is difficult to decide who should and who should not participate in an energy community. This agent-based modelling can analyse economic and other aspects of adding new participants to the energy community. This can also potentially inform municipality officials on zoning for new buildings. - It is also challenging to determine fair pricing between consumers and prosumers. This agent-based modeling can optimize pricing in all timesteps. For example, it can calculate maximum collective savings and maximize self consumption.
• How is this solution new/ better than current solutions? Highlight what's novel about it.	- Prevailing calculations are done with assumptions of non-reactive behaviour. Agent-based approach will allow for analysing impacts of reactive behaviour of actors and thus allow for more accurate results and better understanding of complex behaviour. - Current methods tend to not account for macro factors as their overall effect is hard to assume. In Agent-based approach, the behaviour is easily adjustable (by allocating how certain factors affect one entity) and multiple scenarios can be analysed.
• How can this result/innovation be communicated (who is interested in the results?	This result will be important for various stakeholders: - Energy communities can decide how to expand / invest / price their own energy - Policy makers can better understand benefits of P2P trading, and to compare with alternative solutions. This can inform zoning for new buildings. This result should be communicated as a decision support tool for the creation of energy communities.

• How can this result be used beyond syn.ikia?	Commercial exploitation activities can involve: • Connecting to urban energy modelling tools • Connection to decision making tools This result can also assist policy makers to compare legacy and new decentralized energy systems on cost / carbon footprint basis.		
• TRL (as of Oct 2022)	TRL4	• Lead partner	ABUD Advanced Building & Urban Design

9.5 Syn.ikia Digital Cloud Hub

	The syn.ikia digital cloud hub is the core of digitalization, ensuring the accessibility of data produced, enabling data exchange, data evaluation and flexible control. Syn.ikia digital cloud hub enables the exchange of data between building systems, occupants, and external cloud applications. It provides storage for monitoring data, allows efficient evaluation of data, and flexible building control (through hosting the algorithms).
• Knowledge asset category	**Technical solution** Electronic databases
• In the planning, design, construction and operation of SPENs, what kind of challenges will this result solve?	Operation phase: Syn.ikia will develop a digitalization hub (cloud hub) that enables the exchange of data between the building systems, the occupants and external cloud applications, breaks "silos" of data and provides storage for all monitoring data, which will allow efficient evaluation and utilization of this data. That will act as an enabler for other innovations, (Grey Box models, Flexibility Function, Flexibility Index). It could also host user interfaces for occupants, operators, building owners, and other stakeholders.
• How is this solution new/ better than current solutions? Highlight what's novel about it.	The impact described here embodies the value created by other syn.ikia results, i.e. Grey Box models, Flexibility Function, Flexibility Index, and plays the role of the enabler, the system that can make all other innovations work together. Taking that into account, together they will: • Increase integration of RES and avoid of curtailment. • Enhance energy security. • Discover and deliver demand flexibility to the operatives/ aggregators, which enables them to shift to times of cheap/green generation and decarbonization of the EU energy system. • Design higher level system yet with a human-centric aspect focusing on user health and comfort.
• How can this result/innovation be communicated (who is interested in the results?	Publication in research journals and practitioner-oriented reports and direct meetings with potential customers • Facility Managers, • Developers, • Building owners, • Aggregators • Energy Companies, • ICT companies
• How can this result be used beyond syn.ikia?	○ Commercial activities (note the role of Cloud hub as enabler[10]) ○ Energy Companies, Aggregators

[10] ENFOR has made a strategic company decision that, based on core competences and resources, it will not make any plans for commercialization of the Digital Cloud Hub.

	○ Utilize demand flexibility: ▪ Enable shifting to times of cheap/green generation, ▪ Reduction of RES curtailment ▪ Decarbonization of energy system ○ Developers, Facility Managers, Building owners, ICT companies ○ Intelligent building energy management that will achieve all the above but with positive impact on user health and comfort aspects		
• TRL (as of Oct 2022)	TRL5	• Lead partner	ENFOR

9.6 Syn.ikia Grey Box Models

 Syn.ikia Grey Box Models	Within syn.ikia, we will develop and use grey box models to perform model predictive control to optimize the performance of syn.ikia. neighbourhoods. These models will be based on existing research on using grey box models performed by other project partners. The syn.ikia grey box models will take into account physical characteristics of buildings and energy systems, weather forecasts, as well as monitoring data based on occupant behaviour and actual weather data from the demonstration sites.		
• Knowledge asset category	Software		
• In the planning, design, construction and operation of SPENs, what kind of challenges will this result solve?	The neighbourhood scale Grey Box model resolves challenges in the operation of SPENs. Those include: - Performance check (EPG, comfort deviation, etc.) - Optimisation of energy flows from and into the single units (e.g. Apartments) forming the SPEN - Enabling MPC		
• How is this solution new/ better than current solutions? Highlight what's novel about it.	syn.ikia solution: While current solutions typically focus on a single component or a single unit, such as a house or an apartment, within syn.ikia, the Grey Box models of the different units are Interconnected and interdependent models. In this way, we enable a SPEN-level optimisation.		
• How can this result/innovation be communicated (who is interested in the results?	Those developments are particularly interesting for both universities and for AI-based ESCOs. The learnings and developments of such models could become a game changer in controlling SPENs. We foresee the following as main communication channels: • Journal papers • Conferences • Scientific magazines		
• How can this result be used beyond syn.ikia?	At research level, the development of Neighbourhood Scale Grey Box Models (GB^N) can lead to further developments with optimisation beyond the classical buildings borders, e.g. Including EV charging and discharging and the use of stationary batteries. At a commercial level, spin-off companies of the universities could bring GB^N to the market.		
• TRL (as of Oct 2022)	TRL6	• Lead partner	DTU Technical University of Denmark

9.7 Syn.ikia Flexibility Functions

<table>
<tr><td> 
Syn.ikia Flexibility Functions</td><td colspan="3">Based on Neighbourhood Scale Grey Box Models (GB^N), the syn.ikia team will develop Flexibility Functions (FF^N) and forecasts to unlock the flexibility potential of plus energy neighbourhoods. The Flexibility Functions are prerequisites for dynamic optimization of buildings and their HVAC systems in different climates and future price/ tariff scenarios.</td></tr>
<tr><td>• Knowledge asset category</td><td colspan="3">Software</td></tr>
<tr><td>• In the planning, design, construction and operation of SPENs, what kind of challenges will this result solve?</td><td colspan="3">The neighbourhood scale FF^N resolves challenges in the planning and in the operation of SPENs, in particular allowing:
- Predictive optimisation of energy flows from and into the single units (e.g. apartments) forming the SPEN
- Certifying (before and after construction) flexibility of the combinations of:
- Control algorithms
- Technical installations</td></tr>
<tr><td>• How is this solution new/ better than current solutions? Highlight what's novel about it.</td><td colspan="3">syn.ikia solution:
Compared to standard solutions that refer to a single unit (as for the standard grey-box models), within syn.ikia the FF^N will be able to work with multiple users (apartments). Also, a multi-objective optimisation approach (Energy and price, or energy and CO_2 footprint of energy sources) will be implemented.</td></tr>
<tr><td>• How can this result/innovation be communicated (who is interested in the results?</td><td colspan="3">Mainly, the following entities will be interested in the FF^N:
• Universities
• AI-based ESCOs
• Engineering/planning companies

Communication:
• Journal papers
• Conferences
• Scientific magazines</td></tr>
<tr><td>• How can this result be used beyond syn.ikia?</td><td colspan="3">As for the GB^N, also the FF^N could go beyond the typical borders of buildings, and include EV charging cycles and stationary batteries.

Also in this case, spin-off companies of universities could bring the FF^N development framework to the market.</td></tr>
<tr><td>• TRL (as of Oct 2022)</td><td>TRL6</td><td>• Lead partner</td><td>DTU Technical University of Denmark</td></tr>
</table>

9.8 Syn.ikia Flexibility Index

Syn.ikia Flexibility Index

	Based on the Neighbourhood Scale Grey Box Models, GB^N, we will develop a Flexibility Index, FI^N, for different climate zones, that will provide inputs to regulatory bodies on how to design future taxes, tariffs, and markets, to help promote sustainable plus energy neighbourhoods. In relation to this, the syn.ikia team will also use forecast algorithms for predicting the renewable energy production and the use of energy in the demo cases. Flexibility Index is a single value that indicates the benefit of using flexibility function in controller design.		
• Knowledge asset category	Software		
• In the planning, design, construction and operation of SPENs, what kind of challenges will this result solve?	The neighbourhood scale Flexibility Index FI^N. The flexibility index indicates the improvements resulting from applying flexibility function in the control design. It shows the enhancement in minimization of cost, energy usage or CO_2 emissions.		
• How is this solution new/ better than current solutions? Highlight what's novel about it.	Considering multi-objective optimization, a flexibility index for each object is going to be proposed, which highlights the control design capabilities compared to the existing approach.		
• How can this result/innovation be communicated (who is interested in the results?	This single value represented by the Flexibility Index on a neighbourhood scale (FI^N) is easier to interpret for end-users and legislative bodies. Thus, it can be utilized for marketing purposes as well. Who is interested: - Universities - Engineering/planning companies		
• How can this result be used beyond syn.ikia?	For scaling up the flexibility models to the European level, the syn.ikia team will use virtual demo cases combined with sensitivity analyses to show the effect of different energy prices, legislation, climate changes, as well as social and technological developments. Providing an indicator to compare control designs can help improve the controller design and tuning standards. The FI^N can be utilized both for marketing and for standardisation purposes, since this single value is easier to interpret for end-users.		
• TRL (as of Oct 2022)	TRL6	• Lead partner	DTU Technical University of Denmark

9.9 DigiTwin^{N} Neighbourhood scale Digital Twin

	DigiTwin Neighbourhood scale makes a digital twin of an apartment complex which is a simulation of the building and installation complex. This enables assessment of performance and control of the installations.
• Knowledge asset category	**Software (Model)**
• In the planning, design, construction and operation of SPENs, what kind of challenges will this result solve?	Operational phase The DigiTwin^{N} aims to help with performance checks, optimization, monitoring and control of a neighbourhood. It leads to better use of RES, lower peak loads and avoid congestion of the electricity grid with model predictive control on building level.
• How is this solution new/ better than current solutions? Highlight what's novel about it.	The application of digital twins to enable the energy efficiency and flexibility **at the neighbourhood level** is new. Occupant behaviour shows to be a major factor in the energy demand of a building, and therefore it is essential that the consequences of behaviour on the energy use can be predicted by the model. As a consequence, the prediction model will adapt itself continuously to reflect these changes. TNO names this simulation environment SirinE which is a hybrid predictive digital twin model for buildings and combines a physical building model which solves the heat flow balance equations, and a data-driven occupant model which models the interaction of the occupants with the building components (e.g. thermostats, windows, electric appliances, etc.) and the building.
• How can this result/innovation be communicated (who is interested in the results?	A video[11] has been made by TNO to communicate the functionalities of the result – where all the building's data are entered into a BIM model, which can be used to create a predictive twin of the building: • ESCO, companies offering energy services for neighbourhoods • Maintenance (building services) companies • Housing corporation, building owners (Housing corporation are active in digitalisation of their building stock, the DigiTwin can add value in performance assessment and optimalisation.) • Energy agents • Smart building systems and building control • Project developers • (Local) government • Building users • Energy coaches

[11] https://youtu.be/My0RZzjsUBU; TNO website, Hendriks Coppelmans' website.

• How can this result be used beyond syn.ikia?	This result can be applied in other domains such as mixed function and utility buildings. In terms of commercialisation, it can be explored to integrate SirinE in software for balancing of energy in a building cluster, maintenance software and in monitoring and control platforms for dwellings. Model predictive control and performance check can function as a service for current software platform to enable performance contracting (for example, BeNext, which is a supplier in the field of Smart Home and IoT technology) Standardisation efforts can also be possible: CEN TC 442, Building Digital Twin Association		
• TRL (as of Oct 2022)	TRL5	• Lead partner	TNO innovation for life

9.11 EF^{N}Evaluation Framework for SPEN

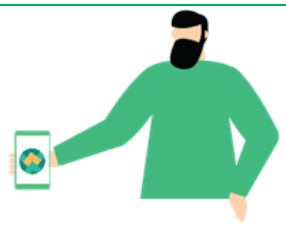
 EF^{N}Evaluation Framework for SPEN	A joint framework for the evaluation of the performance of positive energy buildings and neighbourhoods, providing guidance for further implementation of the syn.ikia demonstration projects. It includes Key Performance Indicators (KPIs) for Social and Economic factors, beyond the traditional energy indicators.		
• Knowledge asset category	Theoretical framework		
• In the planning, design, construction and operation of SPENs, what kind of challenges will this result solve?	When the positive energy balance assessment moves from a single building to neighbourhood scale, new considerations need to be made, including integration of urban and energy planning as well as the evaluation of the overall energy performance. The SPEN concept includes more profound integration and interoperability with the grid and infrastructures, as well as governance. The neighbourhood scale is expected to foster: • Economic sustainability (e.g. some economies of scale) • Aggregation synergies (e.g. efficiency deployment, flexibility, integration) • Governance in distributed resources • Considerable involvement of stakeholders and communities.		
• How is this solution new/ better than current solutions? Highlight what's novel about it.	The Evaluation Framework for Sustainable Plus Energy Neighbourhood: • Adapts the existing methodologies for the evaluation at neighbourhood level, including a multidimensional analysis. • Achieve a common understanding about what is a SPEN and how can be evaluated.		
• How can this result/innovation be communicated (who is interested in the results?	The common Evaluation Framework will be useful to help Urban Developers, Users, Policy Makers and energy operators to: • Quantify and improve the design of SPEN, in both design and operational phase. • Evaluate the evolution of a SPEN towards their objectives.		
• How can this result be used beyond syn.ikia?	• Standarisation / Contributing to common frameworks at EU level Harmonization of categories and KPIs		
• TRL (as of Oct 2022)	TRL5	• Lead partner	IREC Shaping Energy for a Sustainable Future

9.12 UST^N Urban Simulation Tool at the neighbourhood scale

 UST^N Urban Simulation Tool at the Neighbourhood Scale	The Urban Simulation Tool will be a design and decision support tool focused on the interaction between the building, the on-site electricity generation and the low-voltage grid. The impact of the exported energy and the flexibility strategies in terms of grid interaction will be analysed. The tool is a piece of software performing coupled simulations of a number of dynamic building models of different typologies, on-site DERs and a LVGrid of the neighbourhood.
• Knowledge asset category	Software
• In the planning, design, construction and operation of SPENs, what kind of challenges will this result solve?	Traditional methods based on single direction power-flow scenarios are no longer appropriate. This solution provides support to the development of bidirectional distribution grids to: - Determine expected peak power loads. - Forecast the necessary level of grid enhancements. - Provide experimental data that is not easily obtained for such bidirectional distribution grids. It aims to develop a flexible tool that allows to simulate different scenarios (type of buildings, users, renewable energy, flexible control strategies…).
• How is this solution new/ better than current solutions? Highlight what's novel about it.	• Co-simulation allows to simulate such complexity • Integrated models linking specialized tools for each key element: – Low Voltage (LV) distribution grid – LV grid equipment – communication and control devices – Every connected building with its unique energy profile. • Analysis of shared infrastructures (PV systems)
• How can this result/innovation be communicated (who is interested in the results?	○ Urban planners ○ Developers ○ Energy Companies ○ Distribution System Operators The tool will become a very specialized software package, adaptable to any neighbourhood and modifiable by technical staff to support planners, engineers and decision makers.
• How can this result be used beyond syn.ikia?	This result can be used to further elaborate on a design and decision support tool focused on the interaction: – Building – On-site generation – LV grid. In addition, the result can be used in consultancy projects to analyse the impact of the exported energy and the flexibility strategies in terms of grid interaction.

• TRL (as of Oct 2022)	**TRL to be reported in Dec 2022**	• Lead partner	IREC Shaping Energy for a Sustainable Future

9.13 Neighbourhood Scale User Engagement Process

 Neighbourhood Scale User Engagement Process	FeedMe is a feedback app for the assessment of satisfaction from the indoor environment by building users. It is a mobile phone app that will be mainly used by tenants and building managers in each of the syn.ikia demos and will be translated in the local languages.
• Knowledge asset category	Software
• In the planning, design, construction and operation of SPENs, what kind of challenges will this result solve?	This innovation is related to the operational phase of syn.ikia project as it aims to involve the tenants from each demo. The Feedme app aims to overcome and solve: - lack of communication between tenants and building managers, - lack of awareness on how plus energy buildings operate.
• How is this solution new/ better than current solutions? Highlight what's novel about it.	The app is specifically tailored for the syn.ikia demos – so it will engage users by giving specific information on the building and by sharing energy savings tips. In the long run, the app should help tenants be more aware of factors such as indoor air quality, humidity, noise, temperature and light; and should serve as a tool to 'nudge' people's behaviour so they can make better decisions to manage all these factors and have an optimal experience inside their flats. It will allow residents to share their feelings and concerns about their homes (indoor air quality, thermal comfort, lighting and acoustics environment) in just a few clicks. (what is the temperature like? Is it too hot? too cold? How do you feel?). The goal is to **raise awareness amongst tenants about the importance of energy efficient homes** and SPEN in general. Residents will be able to contact building managers if they have recurring complaints. Novel elements: • User friendly app, 'quiz-like' tool which is intuitive, not too many steps or sections • Easy way to collect user feedback • Building managers can take action if they detect recurring issues
• How can this result/innovation be communicated (who is interested in the results?	In the short term, this innovation will be communicated to tenants and building managers (main targets) through engagement campaigns in the neighbourhoods. Workshops/events could be organised with building managers and tenants to share information and promote the app. Towards the end of the project, we will share a survey with residents, produce an infographic, a video and a short guidebook based on the results. In the long term, and depending on the success of the app, it could be communicated to a wider group of stakeholders working on user engagement in PEB/PEN and in general smart buildings. The best way to reach the target audience will be considered: events, workshops, webinars etc. (tbd).

• How can this result be used beyond syn.ikia?	Growing interest in considering user feedback in monitoring tools for building efficiency (example of the Smart Readiness Indicator). The technology now is based on Bluetooth beacons, and now is the chance to develop technology to use it for residents without Bluetooth, which could open new markets. Depending on demos interest, Climify could maintain the app after the project. If successful, it could continue to be developed with residents in other social housing companies across Europe.		
• TRL (as of Oct 2022)	TRL6	• Lead partner	BPIE

9.14 Innovative Policy Development Tools

 Innovative Policy Development Tools	This multiple benefits tool aims to valorise the potential non-energy benefits of plus energy houses and neighbourhoods, and to increase the understanding and ascribed value of SPENs.
• Knowledge asset category	**Instruction**
• In the planning, design, construction and operation of SPENs, what kind of challenges will this result solve?	The web-based calculation tool enables: • Cost-Benefit Analysis during design and planning • Evaluation of wider benefits for feasibility assessments • Return on investments calculations • Attract investments from financial institutions • Make SPENs attractive for industry actors
• How is this solution new/ better than current solutions? Highlight what's novel about it.	How much SPENs are worth - to residents, policy makers and investors • Conceptualizing quantification and monetization of wider benefits –immediate, medium and long-term • Assessing multiple benefits on the neighbourhood level
• How can this result/innovation be communicated (who is interested in the results?	The target group could be split in two main categories: • **Policy makers**: city-level governments, national governments and the EU-level policy makers. Policy recommendations can be provided to policy makers at EU and national level, who can use this instrument to build a convincing case for plus energy neighbourhoods. • **Investors**: project developers, banks, and private investors. Other beneficiaries could be: utilities, energy companies, manufacturers and suppliers
• How can this result be used *beyond* syn.ikia?	Available to wider industry stakeholders as a mobile-based application; Open access tool for further adaptations and contextualisation. BPIE's website will host the multiple benefits tool after syn.ikia's project lifetime.
• TRL (as of Oct 2022)	**TRL to be reported in Dec 2022**
• Lead partner	BPIE

10. Exploitation activities of syn.ikia partners

The syn.ikia consortium provides a variety of services (from research, engineering, electricity retailer, certification and verification, consulting etc.) to a diverse clientele (such as SMEs, public authorities, social housing developers, private investors etc.) Syn.ikia project outcomes are expected to be incorporated within the services of the partners beyond the project. Partners in the consortium are spreading the concepts and solutions based on their best efforts[12]. In this chapter, we shift the focus to individual **exploitation activities** per partner, outlining how each of the industrial/ commercial/ research/ academic partners can create synergies to grow and expand their business and at the same time contribute to the further use of syn.ikia KERs based on their roles in the built environment value chain and the residential energy value chain.

Each sub-chapter has relied heavily on the input from all partners in the consortium.

10.1 Norwegian University of Science and Technology, NTNU

Logo	Type of organisation / Role in consortium	Exploitation activities	
NTNU Norwegian University of Science and Technology Norway	Coordinator, educational institution	Research activities	Research activities to understand further feasibility of innovative energy solutions, tools, and models at neighbourhood level and to trigger further research activities linked to citizen engagement.
		Education, advisory, and consulting activities.	Education of future engineers and designers, IED course within the International MSc program of Sustainable Architecture, MSc theses and PhDs. Consulting activities on how to plan, design, construct and operate SPENs.
		Training and Knowledge transfer activities	Advancement in skills for building actors working on new developments or existing building energy renovation process through the consulting activities, different workshops, trainings, seminars, or conferences. Improving existing programs and curriculum and connecting students to technical innovations.
		Networking	Partnerships will allow us to deliver more effective responses to common challenges and possibilities to disseminate the KERs.

[12] Article 28 – Exploitation of Results. Best effort obligation means the beneficiaries must be proactive and take specific measures to ensure that their results are used (to the extent possible and justified). See H2020 Programme Annotated Model Grant Agreement Version 5.2 dated 26 Jun 2019.

10.2 Danmarks Tekniske Universitet, DTU

Logo Country	Type of organisation/ Role in consortium	Exploitation activities	
DTU Technical University of Denmark Denmark	Educational institution The main focus of DTU Compute is to analyse data, find realistic models and design advanced controllers. Linear and nonlinear modelling and control of different parts of HVAC system are the topics of most recent research activities at DTU.	Research activities	DTU is enhancing its own data-driven digital twins (linear and nonlinear modelling of buildings and HVAC components), and further developing flexible control methods of single buildings and SPENs in national and international research projects.
		Consulting activities	Cooperation activities in the topics related to statistical data analysis, stochastic dynamical systems, grey-box modelling, and nonlinear and adaptive control methodologies. Consulting activities on how to obtain flexibility in the energy grid.
		Training and education	Various seminars, conferences, workshops, long and short-term classes related to modelling and control of thermal dynamics are held in DTU. Among them are the conference BuildSim Nordic 2022, a Modelica course for energy system modeling and simulation, and a summer school on grey-box modeling.

10.3 Buildings Performance Institute Europe, BPIE

Logo	Type of organisation/ Role in consortium	Exploitation activities	
BPIE Belgium	European leading independent think tank on energy performance of buildings. BPIE's vision is a climate-neutral built environment, aligned with the ambition	Research activities	BPIE will extend the knowledge base and will develop a methodology for the calculation and quantification of multiple benefits of energy efficiency in PENs. This methodology can serve as a starting point for future research related proposals and projects.
		Consulting activities	The development of the multiple benefits methodology will be supported through interaction and collection of feedback of relevant stakeholders. Once the methodology is developed and validated, it can be used to create policy recommendations at EU level related to the implementation of SPENs.

	of the Paris Agreement and in support of a fair and sustainable society.			Further consultation of financial institutions and investors can be exploited.
			Standards/ Harmonisation	The multiple benefits methodology can provide inputs for the development of future standards of cost benefit analysis for SPENS
			Policy making	BPIE will provide policy recommendations at EU and National level aiming to enable policy makers to develop innovative policies for SPENs. BPIE can further use the methodology on the quantification and monetisation of multiple benefits to build a convincing case for plus energy neighbourhoods through policy recommendations. These recommendations can be shared in various ways: through BPIE's website, social media, various media portals. BPIE keeps on engaging in EU events (WSED, EUSEW, eceee, C4E etc).

10.4 SINTEF (Stiftelsen for industriell og teknisk forskning)

Logo	Type of organisation/ Role in consortium	Exploitation activities	
SINTEF Norway	SINTEF is one of Europe's largest independent research organisations. Emission-free buildings and neighbourhoods and smart cities are SINTEF's key research areas. Innovation management and exploitation leader.	Research activities	SINTEF will extend the knowledge base for the design and implementation of SPENs towards acquiring new collaborative research projects within the topic of PEDs at the national, European and international levels. The innovation management system developed is also adaptable to similar innovation-oriented projects.
		Consulting activities	SINTEF expects to deepen our understanding of the tools and solutions that can contribute to the design, construction and operation of positive energy homes and neighbourhoods, which will expand our range of consulting services and technical advice towards industry customers as well as municipalities and other public authorities in Norway.
		Standards/ Harmonisation	SINTEF will actively disseminate syn.ikia results and learnings • by means of Open Access publications • via our involvement in the IEA EBC Annex 83 Positive Energy Districts[13] (Co-

[13] The IEA-EBC Programme is an international energy research and innovation programme in the buildings and communities field. It enables collaborative R&D projects among its 26 member countries. It works to provide high quality scientific reports and summary information for policy makers.

			leader of Subtask A PED Definitions and context) and participation in COST action CA19126 - Positive Energy Districts European Network[14] (PED-EU-NET Working Group 1 member), in particular towards the alignment of a PED definition and harmonisation of a KPI framework.

10.5 Housing Europe (European Federation of Public, Cooperative & Social Housing)

Logo	Type of organisation/ Role in consortium	Exploitation activities	
HOUSING EUROPE Belgium	Dissemination, communication and stakeholder engagement leader. Transferring the know-how and learnings from social housing demonstrators in developing SPEN to foster replication and market uptake in HE wider European network. HE is a network of 43 national and regional federations in 25 countries (representing 43.000 public, social & cooperative housing providers and 11% of existing	Research activities	HE will broaden the knowledge base of **Housing Europe Observatory** – the research branch of the Federation and point of reference for facts, figures and key trends in the field of public, cooperative and social housing across Europe. HE will use the results of the project to expand its data base and inform the research agenda of the HE Observatory.
		Advisory	The insights and knowledge of the project will be used to provide continuing support in the form of innovative best practices and blueprints for the roll-out of sustainable energy efficient social housing districts across HE's network.
		Training and education	Upskilling and capacity building of HE members and interested housing providers from the design, construction and monitoring processes of the project. HE strives to provide housing providers' staff with new skills to face the manifold challenges of the social and affordable housing sector including: environmental sustainability, affordability and availability of homes.
		Policy making	Assessing how the EU policy framework can support or hinder the roll-out of SPENs in social and affordable housing. Provide EU level recommendations that are important for the affordable housing sector in developing SPENs.

[14] A COST Action is an interdisciplinary research network that brings researchers and innovators together to investigate a topic of their choice for 4 years. COST Actions are typically made up of researchers from academia, SMEs, public institutions and other relevant organisations or interested parties.

	dwellings in the EU.)		Translate recommendations to HE well-established influence network in the EU institutions (ex. European Commission; European Parliament)

10.6 Fundació Institut de Recerca en Energia de Catalunya (Catalonia Energy Research Institute), IREC

Logo	Type of organisation/ Role in consortium	Exploitation activities	
Spain	The Catalonia Institute for Energy Research (IREC) is a publicly funded institution created in 2009 based in Barcelona that conducts innovative research over a wide range of disciplines within the science and technology energy field. Collaboration in the IED (Integrated Energy Design) in the demo in Spain. Research and Innovation activities linked to implementation of SPENs, including simulation tools	Research activities	Use the knowledge generated in new research projects at the national, European and international levels in SPENs
		Consulting activities	Consulting Services and joint activities with private and/or public bodies related to the implementation of SPENs, which includes local and regional Pubic administrations for regulations and policies.
		Open dissemination & Harmonisation	Dissemination of results obtained within the project by means of Open Access publications and participation in International Activities (e.g, IEA-EBC Annex 83 – Postive Energy Districts) with the objective of harmonisation of concepts at national / international level and make proposals for new standards, if it is the case

10.7 Woningcorporatie Area (Area Housing Corporation), AREA

Logo	Type of organisation/ Role in consortium	Exploitation activities	
area Netherlands	Area rents approximately 8.500 homes in Uden, Veghel and the surrounding villages. AREA is the case owner and developer of the syn.ikia Dutch demo in Uden in the southeast of the Netherlands.	Research activities	The outputs of the syn.ikia project are relevant Dutch research activities in different field of net balancing, energy efficiency and sustainability.
		Business development activities	Area is a non-profit organization. Our main focus is to share the project results with partners in the Dutch housing sector. Employee training will be given in-house as well as to other housing associations.
		Policy making	The outputs can be integrated in the own company policy regulations and can be disseminated to other housing associations as well as to Aedes. Outputs can be discussed with local municipalities to implement in local policy making. In the national level, the outputs needs to be discussed with Aedes who has contact with Dutch policy makers.

10.8 Institut Català del Sòl (Catalan Land Institute), INCASÒL

Logo	Type of organisation/ Role in consortium	Exploitation activities	
INCASÒL Institut Català del Sòl Spain	INCASÒL is a public body attached to the Catalan Ministry of Planning and Sustainability. Its mission is to develop the territory in a sustainable way, acting mainly on urban settlements, so as to improve the quality of life of citizens and promote greater social equality. INCASÒL is the project owner	Research activities	The implementation of the energy manager will lead to the development of a new centralized management methodology that will serve as a reference for the management of public housing. From here, lessons learned can be used to improve the model and make it extensive.
		Business development activities	This management model is the result of the centralization of the air conditioning and hot water systems. The objective is to use this management model to solve issues linked to the fact that the building is PEB and does not pursue a business model to obtain economic returns. It must be taken into account that we are in a social housing building.
		Standards	This management model can become a standard reference for other public and private buildings.
		Training and education	INCASÒL will use its dissemination channels as well as its participation in

	and developer of syn.ikia Spanish demo in the city centre of Santa Coloma de Gramenet.		conferences, workshops, seminars and other events to disseminate the model as well as the results.
		Policy making	Centralized monitoring and management will make it possible to have data and be able to evaluate management results. If we demonstrate that we improve with respect to a model with individualized systems, then it will be possible to influence and recommend new policies related to public housing management. At the same time, the energy and consumption balances can be weighty arguments to ask for adjustments in the current regulatory requirements in relation, for example, to the powers and simultaneity coefficients required of buildings and homes.

10.9 Netherlands Organisation for Applied Scientific Research, TNO

Logo	Type of organisation/ Role in consortium	Exploitation activities	
TNO innovation for life Netherlands	TNO is the research organisation of applied sciences in the Netherlands with more than 3000 researchers and staff. The BIM team at TNO is THE knowledge provider in the Netherlands for ICT integration in the construction industry sector by introduction of Building Information Models (BIM) and related concepts like GIS, LinkedData (LD) and BCF.	Research activities	Use the knowledge generated and new functionalities of the DigiTWin simulation environment in new research projects at the national, European and international levels in SPENs
		Business development activities	New cooperation with stakeholders who want to extend their consultancy maintenance and control tool kit with the DigiTwin building simulation environment.
		Standards	TNO will actively disseminate syn.ikia results and learnings via our involvement in standardisation initiatives (CEN/TC442 Building Information Modelling[15] (Working Group Building digital twin) and our membership in the Building Digital Twin Association[16].
		Training and education	Various seminars, conferences, workshops, papers, video's and publication to educate people of the insights gathered in syn.ikia.

10.10 ENFOR

Logo	Type of organisation/ Role in consortium	Exploitation activities	
ENFOR Denmark	ENFOR is a SME providing forecasting and optimisation solutions for the energy sector. Utilities, energy traders, transmission and distribution system operators use ENFOR	Research activities	Use experience as a basis for future research projects.
		Business development activities	Use the generated knowledge and experiences to offer relevant services to the sector.

[15] https://standards.iteh.ai/catalog/tc/cen/b0e05107-d6bf-4c1c-b222-54dd974f1a96/cen-tc-442
[16] https://buildingdigitaltwin.org/membership/

	solutions for forecasting of wind power, solar power, electricity and heat demand as well as optimisation of district heating systems. In Syn.ikia, ENFOR will provide weather dependent energy forecasts, as well as the digital cloud hub.	

10.11 Advanced Building & Urban Design, ABUD

Logo	Type of organisation/ Role in consortium	Exploitation activities	
ABUD Advanced Building & Urban Design Hungary	ABUD is an SME company based in Budapest, Hungary, a member of Paulinyi-Reith and Partners, one of the biggest Hungarian architectural studio, founded in 1987, counting 4000 projects as references. ABUD is specialized in consultancy and R&D in the field of sustainable building and urban design	Research activities	The knowledge gained from syn.ikia will be used as a basis for further research.
		Business development activities	ABUD will use the collectively generated knowledge to offer relevant services in the region for municipalities, real estate developers, architectural firms and also new entities (such as energy communities).
		Standards	Dissemination and harmonisation results from syn.ikia in COST action CA19126 - Positive Energy Districts European Network Working Group 1 and Working Group 2 where ABUD is an active participant.
		Training and education	Creating training and educational materials for dissemination of newly generated information about SPENs for universities and the general public.

10.12 Salzburger Institut für Raumordnung und Wohnen, (Salzburg Institute for Regional Planning and Housing, Department of Municipal and Regional Development), SIR

Together with SIR, Heimat Österreich and Energy Consulting Austria are also members of the consortium.

Logo	Type of organisation/ Role in consortium	Exploitation activities	
SIR Austria	SIR is a public body responsible for regional urban and energy planning. SIR is is the project owner and developer of syn.ikia Austrian demo for Gneis District in Salzburg.	Research activities	The syn.ikia outputs are relevant for the Austrian research activities in the field of regional energy planning. This new discipline combines the classic regional planning with energy related topics. One element is Plus Energy Neighbourhoods.
		Business development activities	SIR is a service point for communities and will disseminate the project outputs via this platform. The main focus is to bring research outputs from the fields of energy, regional planning and housing into practice and make them as a standard.
		Standards	The outputs can be integrated in the Austrian Climate-Active[17] standard for neighbourhoods, as SIR is the national program leader.
		Training and education	SIR offers several seminars in the field of energy, regional planning and housing for municipalities, building developers and planners. The project outputs will be integrated in several courses and dissemination activities.
		Policy making	SIR is a 100% owned by the state of Salzburg and therefore involved in the further development of existing regulations. The project outputs will contribute to policy making directly.
HEIMAT ÖSTERREICH Austria	Heimat Österreich ("Homeland Austria") is a non-profit property developer. Social wellbeing is its focus.	Business activities	The project results will be used to implement innovative concepts within the cost framework to develop more efficient sustainable settlements.
		Training and education	Lessons learned will be used directly for the internal training and education of the employees.
		Policy making	HÖ is a representative in the Austrian Federation of Limited-Profit Housing Associations from the local housing

[17] The aim of the climate-active initiative is to reduce greenhouse gas emissions by increasing the market share of climate-friendly technologies and services of high guaranteed quality. The use of RES is to be intensified, the energy efficiency of buildings, technical processes and devices increased and sustainability promoted. More info at https://www.klimaaktiv.at/gemeinden/qualitaetssicherung/Siedlungen.html

			associations and responsible for the further development of existing regulations. The project results can therefore be discussed in the Austrian Federation of Limited-Profit Housing Associations (GBV)[18].
Austria	ECA (Energy Consulting Austria) is a SME based in Austria providing monitoring, visualisation, measurement and optimisation services.	Business activities	The project results will be used for the development of new innovative energy solutions.

10.13 Arca Nova

Logo	Type of organisation/ Role in consortium	Exploitation activities	
Norway	Arca Nova is a private property developer established since 1998 focused on sustainable building materials and BIPV. Arca Nova is the project owner and developer of syn.ikia Norwegian demo for Verksbyen in Fredrikstad.	Business development activities	Arca Nova has high sustainability targets. The main focus is to implement learnings from syn.ikia in the demo project Verksbyen, and to contribute to and be updated on the latest research and innovations on SPEN developments in order to reinforce their business and be able to build more SPENs.

[18] Österreichischer Verband Gemeinnütziger Bauvereinigungen – Revisionsverband https://www.gbv.at/english/

11. Key considerations for further work on the final plan for exploitation and dissemination of results

The current portfolio of 14 syn.ikia key exploitable results (KER) span a wide range of features and functionalities, comprising a number of instructions, processes, software, systems and tools to address the different kinds of challenges arising from the different phases involved in the planning, development and implementation of plus energy neighbourhoods. Given their diverse nature, syn.ikia's results are subject to a multitude of exploitation pathways. However, they can also be difficult to communicate across a wide audience.

At the same time, the partners in the syn.ikia consortium are engaged in a variety of expertise and networks interacting with a diverse clientele (from public authorities, social housing developers to dedicated research communities). Partners in the consortium have the potential to spread the concepts and solutions for wider uptake of the results. A range of exploitation activities have already been tabled by each partner.

Based on chapters 9 and 10, some key considerations emerge for further work on the final plan for exploitation and dissemination of results. These are:

- communicating syn.ikia innovations,
- identifying existing actors with new roles and emerging actors for SPENs,
- networking and creating synergies with other Plus Energy projects, and
- positioning the concept of SPENs among analogous terminologies.

11.1 Communicating syn.ikia innovations

It is easy to assume that projects demonstrating positive energy neighbourhoods would automatically appeal to members of the business community or the general public. Syn.ikia innovations address different kinds of challenges arising from the different phases involved in the planning, development and implementation of plus energy neighbourhoods, involving many different disciplines.

A project like syn.ikia is interdisciplinary. Interdisciplinary is not the same as multidisciplinary which means multiple disciplines have to come together to investigate a single problem (i.e. planning, designing and operating SPENs) but do so as if each were working within their own disciplinary settings. Interdisciplinary means integrating knowledge and methods from different disciplines, using a real synthesis of approaches. Inherent in interdisciplinary research itself is the challenge of effective communication between experts from different disciplines in order to create a level playing field amongst (project) participants that enables them to negotiate ideas and perspectives (van Wees et al. 2022). This challenge of effective communication is compounded further when trying to communicate to non-expert audience (such as investors, public actors, practitioners in the construction sector and energy sector, or housing provider employees for example) for uptake of ideas, solutions and measures.

Communicating syn.ikia innovations to non-experts is therefore a key consideration. Efforts have already been made in syn.ikia to classify the innovations using the Ten Type Framework (Keeley et al., 2013). A syn.ikia innovation dashboard (see Figure 1) has been developed to try to distinguish the innovations that are closer to innermost workings or customer-related elements of an enterprise. There are additional opportunities to systematize the innovations to better communicate them.

- Clearly, some innovations are more relevant to certain phases of the development of SPEN, for example the Integrated Energy Design Process at the neighbourhood scale is for the planning and design phase; Grey Box Models is for the operation of SPENs. Yet some innovations could be relevant for both design and operation phases, such as the Evaluation Framework for SPEN. The different phases of designing, constructing and operating a SPEN would be a relevant dimension in organising syn.ikia innovations for external communication.
- In addition, some innovations may also be bundled. For example, the role of the Digital Cloud Hub is an enabler; on its own, it cannot be commercialised.
- Currently, efforts are being made to pinpoint the type of knowledge asset embodied in each syn.ikia innovation. However, it is possible that more categories of knowledge assets could be applicable within each syn.ikia innovation. Going through the innovations to ensure that all knowledge asset categories are being accounted for, would be a necessary step. This is also helpful to the task of distinguishing between commercial and non-commercial innovations.

The innovations and measures that collectively establish and comprise a SPEN cover different domains, for instance, ranging from the installation of batteries for energy storage to motivating residents to establish an energy community. They require integration and interaction of different systems, infrastructures and buildings, as well as users. They need to be adapted to different local contexts such as climate conditions, energy habits and not to mention, markets. In the development of the final plan for exploitation and dissemination of results, communicating syn.ikia innovations to non-experts needs to be planned out and prioritised.

11.2 Identifying existing actors with new roles and emerging actors for SPENs

It has been described that the potential markets for plus energy homes are crossing the boundaries of the built environment value chain and the residential energy value chain. These potential markets are taking shape beyond the so-called traditional Architectural, Construction and Engineering (AEC) market and *are not limited to*:

- Providers of Smart Cities and Smart Buildings Technologies
- Data management and Data analytics providers
- Providers of Urban Planning Software
- Providers of Energy efficiency technologies
- Monitoring and maintenance service providers
- Providers of RES technologies
- Energy Trading Platforms
- Flexibility and Demand Respond service providers
- Energy Management and ESCOs
- Electric and Plug-in Vehicles (EV and PIV)

Rather than "potential markets" with imaginary boundaries, the realization of sustainable plus energy neighbourhoods can also be understood to involve **multi-stakeholder networks** of building developers, housing associations, investors, and occupants/users, where existing actors take on new roles and where new actors are still emerging.

These are complex networks that are challenging to understand and mobilise as these networks are still in formation. As working on the preliminary stakeholder maps of each of the four demos in **Appendix B**, identifying the most important actors in the planning, design, construction and operation of SPENs is not a straightforward exercise.

With regards to uptake of syn.ikia innovations, the target user groups comprise diverse actors – existing actors with new roles and emerging new actors, from investors to standard-setting bodies etc. The construction and operation of every SPEN will always involve a large number of actors, each of which will have their own ambitions, agendas, interests and constraints. Identifying existing actors with new roles and emerging new actors in the different "potential markets" and understanding their diverging ambitions and interests will therefore be a key consideration.

The success of implementing the pioneering concept of SPENs will not only depend on developing solutions and technologies, but also on mobilizing social, political and business commitments. The development of SPENs is a complex process that requires a high degree of coordination due to the multi-stakeholder environment. To analyse effective ways to expose and promote innovations from syn.ikia to attract interests and investors, a more fine-grained understanding of the local stakeholders will be helpful. In the development of the final plan for exploitation and dissemination of results, identifying existing actors with new roles and emerging actors for SPENs will be a necessary activity.

11.3 Networking and creating synergies with other Plus Energy projects

Syn.ikia has been funded under the research call dedicated to the development of the concept of "Plus Energy Houses"[19]. While syn.ikia is focused on erecting **multi-storey apartment buildings in urban contexts** to demonstrate the SPEN concept, it is also interacting with a large number of EU projects at the building level, district level and urban level (see https://www.synikia.eu/network/). Networking with other Plus Energy projects will facilitate more effective responses to common challenges by bringing together different perspectives and approaches to bear on syn.ikia solutions for the household level and community level. For example, 'sister' H2020 project Cultural-E provides insights to different energy cultures and various interventions designed to shift energy practices.

More importantly, networking with other Plus Energy projects will create synergies and bring about more possibilities to disseminate syn.ikia's KERs. Networking activities in the form of joint workshops (on dedicated topics) can influence the exploitation pathways of syn.ikia solutions, speeding up the adoption of the required "Plus Energy Houses" technologies that is much needed to transform the building stock. In the development of the final plan for exploitation and dissemination of results, the synergies that can be created with other Plus Energy projects will be a key consideration.

11.4 Positioning the concept of SPENs among analogous terminologies

Recent research and literature have seen a lot of momentum in the development of concepts related to **positive energy districts** (Bossi et al. 2020; Lindholm et al. 2021), **zero emission neighbourhoods** (Wiik et al.

[19] https://cordis.europa.eu/programme/id/H2020_LC-EEB-03-2019

2022) and similar concepts of climate friendly neighbourhoods (CFNs). According to Brozovsky et al. (2021), at least 35 different terminologies for CFNs are in use, highlighting the lack of alignment in definitions and arbitrary use of terminologies. The definition of a SPEN is closely aligned with the PED concept and describes a group of interconnected buildings with associated infrastructure, located within both a confined geographical area and a virtual boundary (Salom et al. 2021).

A Sustainable Plus Energy Neighbourhood SPEN is a highly energy efficient and energy flexible neighbourhood with a surplus of energy from renewable sources.

Syn.ikia has focused on **multi-storey apartment buildings in urban contexts** to demonstrate the SPEN concept. Among the four co-creation hubs, there is also variety in demonstrating social housing versus owner occupied multi-storey apartment buildings. In the development of the final plan for exploitation and dissemination of results, another key consideration would be that target user groups have to grapple with many parallel terminologies to understand the SPEN concept, and its technologies, solutions and innovations.

12. Concluding remarks and further work

This report has provided an overview of the possible **exploitation pathways** of syn.ikia innovations and the planned **exploitation activities** of syn.ikia partners, now that the project is in its third year of operation. It has also identified some **key considerations** for further work on the **plan for exploitation and dissemination of results**.

Returning to syn.ikia's project lifetime measures for exploitation (Figure 3), the central aim would be to ensure the exploitation pathways are correlated with the development of innovations to ensure a market-based approach where the solutions are practical, economically attractive and user-friendly. The objective is to increase the **chances of uptake** of syn.ikia's key exploitable results (KERs).

For the remaining project lifetime in syn.ikia, we suggest the following series of actions with a suggested timeline outlined in Figure 7, (finetuning the initial approach shown in Figure 3):

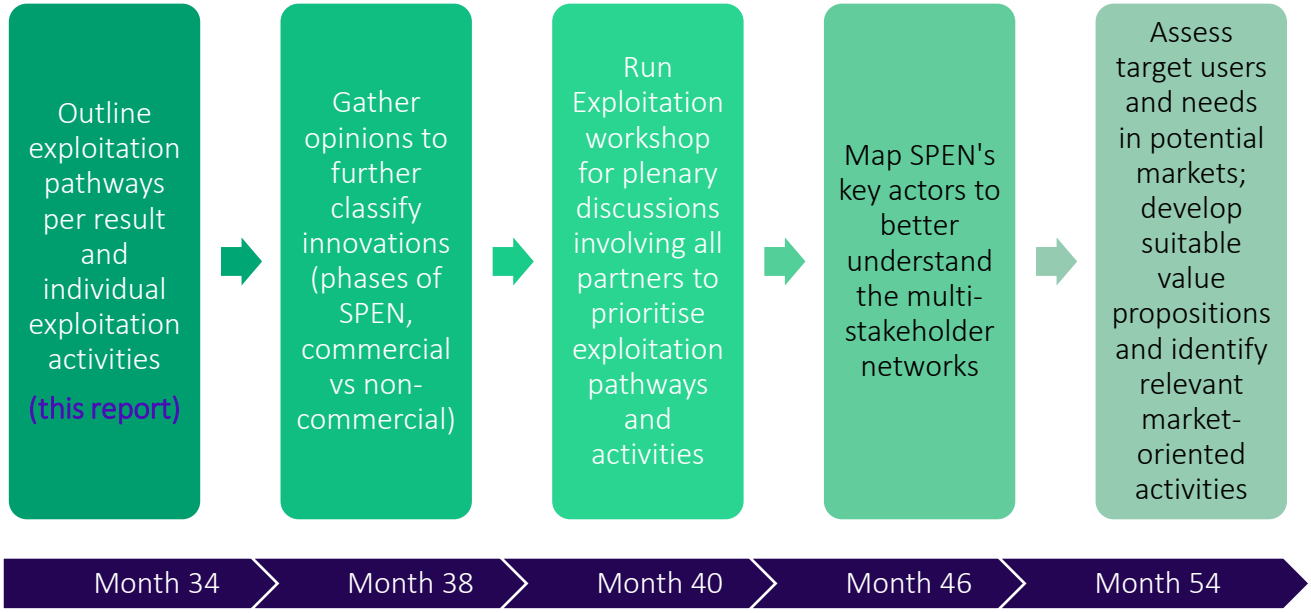


Figure 7 Syn.ikia's project lifetime measures for exploitation (finetuned)

- Support the formation of an Exploitation Committee by the Project Coordinator. With the help of their expert opinions, distinguish the portfolio of syn.ikia KERs between commercial and non-commercial results and group the KERs. Seek expert opinions in identifying potential target users and investors.

- Coordinate Exploitation Workshop for plenary discussions involving all result owners. Refine "offers" or bundles of results (e.g. Cloud hub on its own is not “exploitable”), identify and address "take-to-market" partners, review synergies in dissemination initiatives and exploitation activities

- Develop more fine-grained understanding of each demo's SPEN network with respect to key actors that will be main targets for exposing and promoting the innovations from syn.ikia and the potential financing actors, with each demo site. Build on the work of preliminary stakeholder mapping done in this report as point of departure to better understand the multi-stakeholder networks.

- Assess target users and needs in potential markets. The results owner will develop suitable value propositions and identify relevant market-oriented activities for interacting with the target users in potential markets. The best channels to reach the intended target users need to be identified. This may be coordinated with the task of Stakeholder engagement (WP7 Task 7.5) to maximise the exposure of the KERs, and to attract interests and investors.

13. Future updates

This report "An exploitation strategy for syn.ikia partners and syn.ikia innovations" can be seen as an **intermediate version** of the plan for exploitation and dissemination of results required by all Innovation Action projects. The **final plan for exploitation and dissemination of results** should be included in the report **D6.4 Measures and strategies to achieve market uptake of 10% plus energy neighbourhoods within 2030** (due in Month 54).

Several syn.ikia tasks will have an influence on developing the final plan for exploitation and dissemination of results due in Month 54. They are listed here in chronological order of delivery so that the reader has an overview.

- D6.3 Market analysis of each of the four demonstration cases (M36)

  This report will analyze the market potential of the concept of SPENs in each of the demo countries.

- D7.11 Dissemination and Communication Strategy & Plan (M36)

  This report will include updates on the change in approach to expose and promote innovations from syn.ikia to attract interests and investors.

- D6.6 Evaluation of existing business models as well as identification and design of novel business models (M42)

  This report will provide business cases for the long-term viability of sustainable plus energy neighbourhood (SPEN) concept, evaluating sources of revenues and identifying opportunities to capture value for customers.

- D6.5 An overview of financing opportunities and a strategy to link them to syn.ikia innovations and investors (M48)

  This report will provide an overview of financing schemes and mechanisms in close connection to syn.ikia innovations.

- D5.3 A report on the identified measurable benefits of sustainable plus energy buildings and neighbourhoods and their potential impact (M50)

  This report will consist of an overview of the multiple benefits of energy efficiency and a shortlist of the most relevant benefits for the pilot cities.

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15. Appendix A – Activities related to the task of Exploitation Management in 2022

In order to obtain insights from results owners and partners for their input regarding possible exploitation pathways of their results as well as their planned exploitation activities as a partner in the syn.ikia consortium, a number of initiatives have been arranged in 2022. Table 4 outlines the different activities with a brief description to provide the reader with an overview.

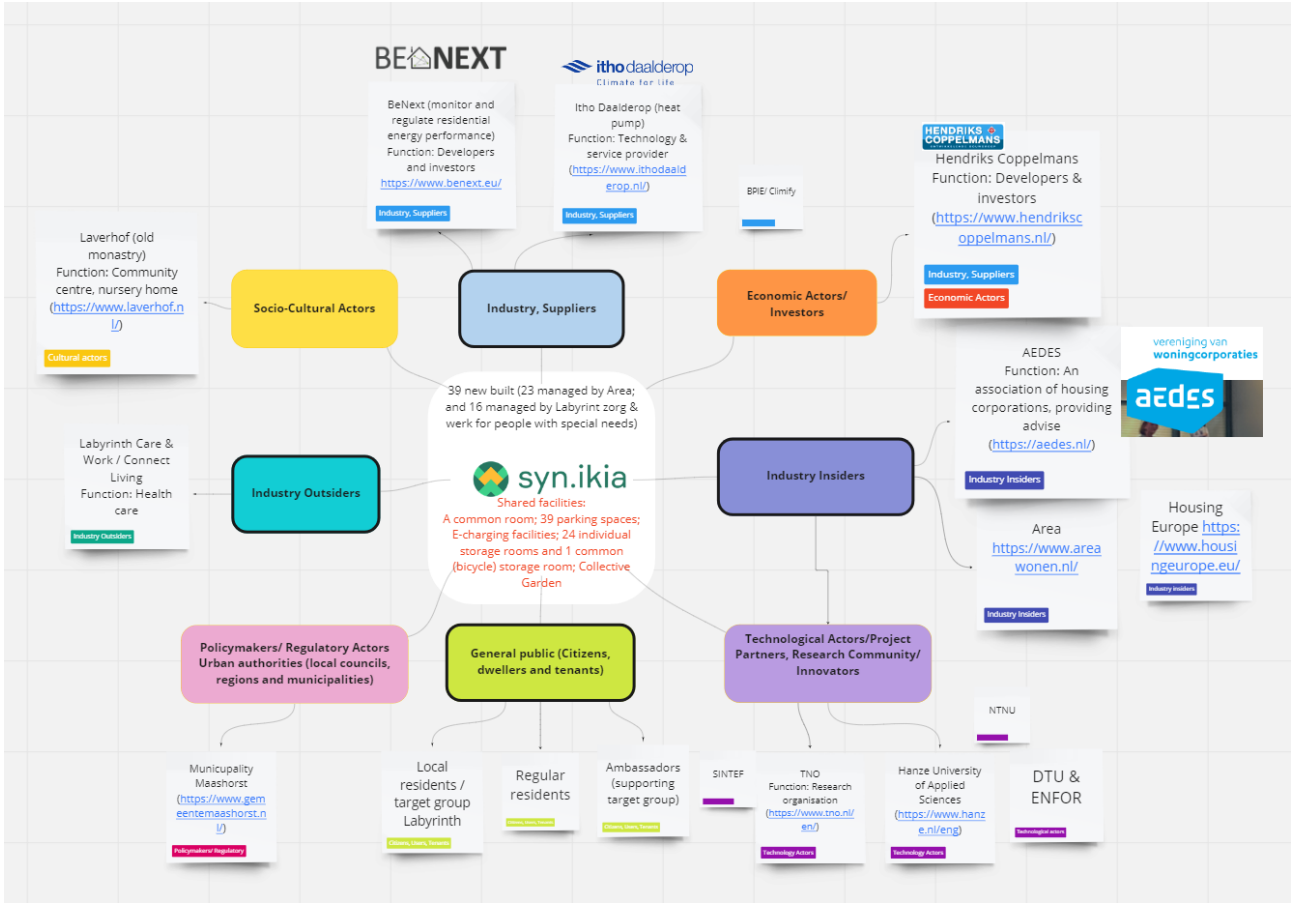
Table 4 Activities related to the task of Exploitation Management in 2022

	Name of activity	Date	Description
a)	Mini online lecture by NTNU Technology Transfer Office[20]	2022 05 06	The consortium was provided information about the usefulness of classifying results by knowledge asset categories and the eight categories outlined in Table 2.
b)	KER register updates	2022 05	All results owners reported the progress of their solutions at M29 using excel tables dedicated for each KER. A description of the fields of the register can be found in D6.7 A systematic approach to development, registration and reporting of innovations (M24).
c)	Online workshop via Teams	2022 09 09	All result owners were tasked to make a short presentation focusing on four questions related to exploitation of their results: • In the planning, design, construction and operation of SPENs, what kind of challenges will this proposed result solve? • How is this solution new/ better than current solutions? Highlight what's novel about it. • How can this result/innovation be communicated to non-experts? (Who is interested in the results?) • How do you envisage this result can be used beyond syn.ikia? Furthermore, each result owner was paired with another syn.ikia partner to provide feedback and input. In this way, we facilitate cross-fertilisation of ideas among the consortium focused on exploitation opportunities.

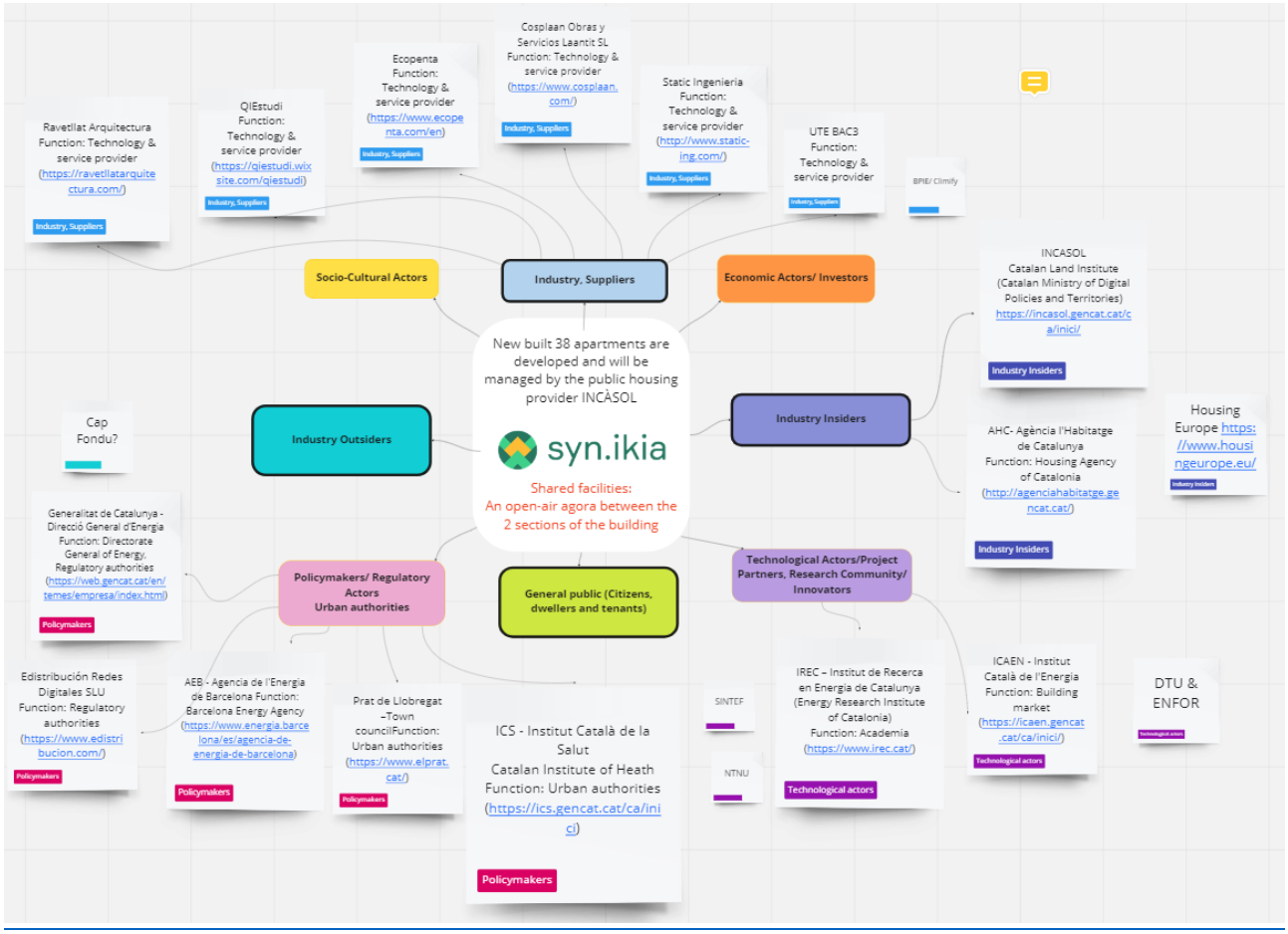
[20] NTNU will engage the expertise of NTNU Technology Transfer Office to analyse reported ideas and to develop commercialization strategy based on analysis of technology, market, partners, business models and financing (GA Section 3.2).

16. Appendix B – Preliminary stakeholder maps of each of the four demos:

Preliminary Stakeholder map (Dutch demo)

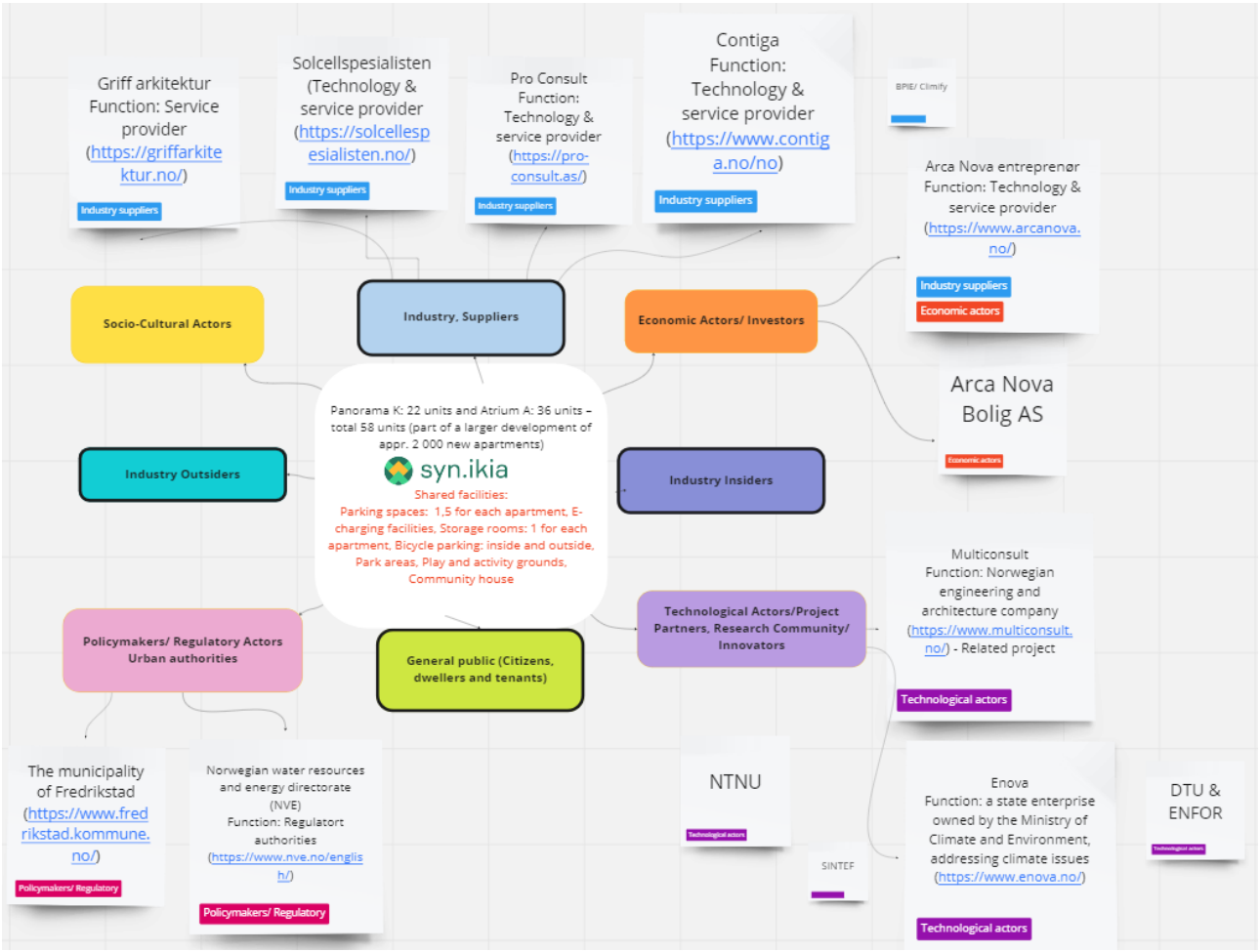


Preliminary Stakeholder map (Spanish demo)



Preliminary Stakeholder map (Austrian demo)

Preliminary Stakeholder map (Norwegian demo)



17. Appendix C – Glossary of Terms:

A glossary can help stakeholders interpret technical and non-technical terminology used in a requirements document (Abbreviations and acronyms)

Table 5 Glossary of Terms

Term	Description	Further references
Dissemination	Dissemination refers to the public disclosure of results by any appropriate means (other than resulting from protecting or exploiting the results), including by scientific publications via any Medium.	https://research-and-innovation.ec.europa.eu/strategy/dissemination-and-exploitation-research-results_en
Exploitation	The utilization of results in further research activities other than those covered by the action concerned, or in developing, creating, and marketing a product or process, or in creating and providing a service, or in standardization activities.	https://ec.europa.eu/info/funding-tenders/opportunities/portal/screee/support/glossary
Intellectual property (IP)	Intellectual property refers to the creations of the mind, such as inventions; literary and artistic works; designs; and symbols, names and images used in commerce.	https://www.wipo.int/about-ip/en/
Impact	Wider long-term effects on society (including the environment), the economy and science. Impact may be broadly defined as a change or a benefit to the economy, society, culture, public policy or services, health, the environment, or quality of life.	
IPR	Intellectual Property Rights. Legal rights granted to people to protect their ideas. These rights include industrial property rights (e.g., patents, industrial designs, and trademarks), copyright (rights of the author or creator) and related rights (rights of performers, producers, and broadcasting organizations).	https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/support/glossary
Outcome	Expected effects of the project fostered by the dissemination and exploitation measures. This may include the uptake, diffusion, deployment, and/or use of the project results by target groups	
Project results	Project results means any tangible or intangible output of the project, such as data, knowledge or information, that is generated in the project, whatever its form or nature, whether or not it can be protected, as well as any rights attached to it, including intellectual property rights.	https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/support/glossary

Term	Description	Further references
KER Key Exploitable Result	A Key Exploitable Result (KER) is an identified main interesting result which has been selected and prioritised due to its high potential to be "exploited" – meaning to make use and derive benefits- downstream the value chain of a product, process or solution, or act as an important input to policy, further research or education. Main criteria: a) degree of innovation, b) exploitability and c) impact.	https://ec.europa.eu/newsroom/informatics/items/689551/
TRL	Technology Readiness Level is a method used to assess the maturity of a technology. The TRL starts at phase one, where the technology is at an embryonic stage and the more mature stage is level nine, where the technology has been tested and launched. This tool provides a quick view of the maturity of the technology and helps management in taking decisions on the development and transition of a technology	https://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/annexes/h2020-wp1415-annex-g-trl_en.pdf and https://www.sciencedirect.com/topics/engineering/technology-readiness-level
SPEN	The syn.ikia definition of a Sustainable Plus Energy Neighbourhood (SPEN) follows a similar procedure as described for buildings, but the geographical boundary is expanded to the entire site of the neighbourhood development, A Sustainable Plus Energy Neighbourhood SPEN is a highly energy efficient and energy flexible neighbourhood with a surplus of energy from renewable sources.	An evaluation framework for Sustainable Plus Energy Neighbourhoods: Moving beyond the traditional building energy assessment, Energies, 2021, 14, 4314. https://doi.org/10.3390/en14144314

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Science and Technology


DTU
Technical University
of Denmark


BPIE


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INCASÒL
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& Urban Design


HEIMAT
ÖSTERREICH


SIR
SALZBURGER INSTITUT FÜR
RAUMORDNUNG & WOHNEN


ECA
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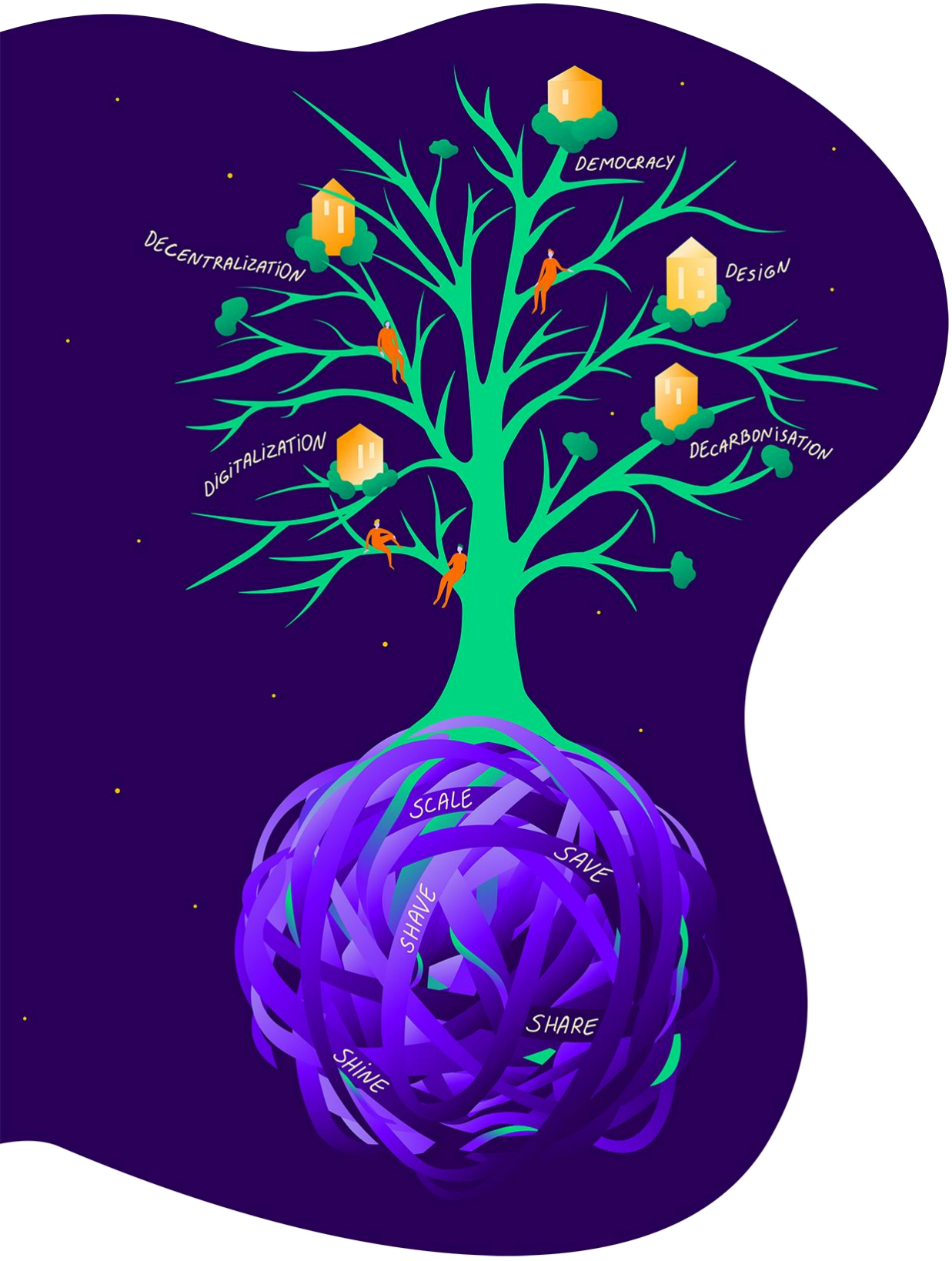
DEMOCRACY
DECENTRALIZATION
DESIGN
DIGITALIZATION
DECARBONISATION
SCALE
SAVE
SHARE
SHARE
SHINE