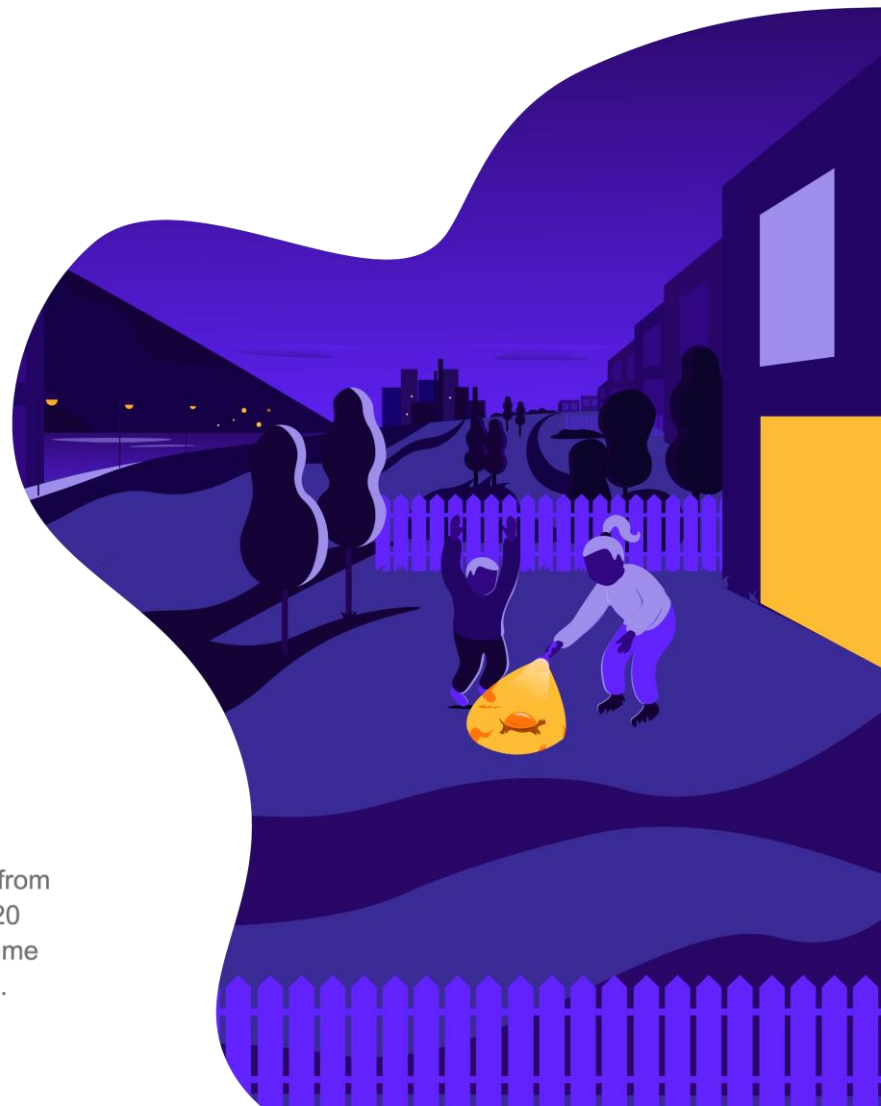


# WP2 – Development and Demonstration of Plus Energy Multi-Story Apartment Buildings in Four Climatic Zones

## D2.6 DEMONSTRATION CASE OF SUSTAINABLE PLUS ENERGY NEIGHBOURHOODS IN MEDITERRANEAN CLIMATE

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### 3. Executive Summary

A key output of the syn.ikia project is to realize four real-life demonstration projects that will serve as co-creation hubs for developing and testing of novel systems, technologies, and processes for achieving sustainable plus energy houses at the neighbourhood scale in four climatic types in Europe. The demo cases represent four different ways of realizing sustainable plus energy neighbourhoods (SPENs) including both new construction and renovation of apartment buildings in different European contexts.

This short report provides a summary of the syn.ikia demo project in Mediterranean climate, as per March 2023. It gives an overview of the status of the demonstration project with a timeline for planning, design, construction and operation. It also includes photos from the construction site, construction drawings, floor plans, and a table with the Key Performance Indicators.

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## 4. Roles and Responsibilities

Name	Role	Responsibility
INCASÒL	Demo Developer	Main responsible for the development and implementation of the demo project
NTNU	WP 2 leader, Task 2.1 leader, Reviewer	Contributor to demo project design and documentation

## 5. Introduction

A key output of the syn.ikia project is to realize four real-life demonstration projects that will serve as co-creation hubs for developing and testing of novel systems, technologies, and processes for achieving sustainable plus energy houses at the neighbourhood scale in four climatic types in Europe. The demo cases represent four different ways of realizing plus energy neighbourhoods including both new construction and renovation of apartment buildings in different European contexts.

The Norwegian demo case is a new development in Fredrikstad, representing a cold climate. It includes the construction of two residential apartment blocks as part of a larger development of plus energy houses. The project and associated land areas are fully owned by the private developer Arca Nova Bolig AS. The area will be the first large development of plus energy houses in Norway, with approximately 1500-2000 units when it is finished.

The Dutch demo case is located in Uden, which is a typical mid-size town in the Netherlands, representing a marine climate. It includes the construction of a new residential building complex, and with syn.ikia's strategy; the neighbourhood will reach the plus energy standards. This can be replicated in similar neighbourhoods in the Netherlands and other comparable contexts in Europe.

The Catalan demo case is a new development in Santa Coloma de Gramenet (a city near Barcelona) in Catalonia (Spain), representing a typical Mediterranean climate. The development is a typical infill project in a dense urban area, with squares of multi-storey apartment blocks. This context is common in many European cities.

The Austrian demo case consists of 4 different projects all located in Salzburg, representing a continental climate: the transformation of the Gneis district into an energy community, and the construction of two renovation projects and one new construction project. This will become a model for sustainable plus energy neighbourhoods around Europe, and especially in Central Europe.

Together, the syn.ikia demonstration projects will serve as lighthouses for reaching the European energy efficiency and GHG goals.

This report provides a short description of the demonstration project in Catalonia (Spain), documenting the key technical and environmental aspects of the realized neighbourhood as a Demonstrator in syn.ikia. The other demonstration projects are documented separately in reports D2.3, D2.4, and D2.5.

## 6. Objectives

The overarching objective of the syn.ikia project is to deliver a blueprint masterplan, including technical, financial, legal, and social issues, for the development of sustainable plus energy neighbourhoods in different contexts,

climates, and markets in Europe. One of the key sub-goals of the project is therefore to demonstrate efficient ways to plan, design, and operate such neighbourhoods in different climates and context in Europe. This report shortly describes the overall status of the demonstration project as per March 2023, including illustrations, construction drawings, and photos from the site, as well as a summary of key performance indicators.

## 7. Description of the Deliverable

### Overall status of the demonstration project

The syn.ikia demonstration project for Mediterranean climate consists of one residential building block with a total of 38 apartments. It is located in Fondo neighbourhood in Santa Coloma de Gramenet, a city next to Barcelona with over 120.000 inhabitants and a rate of 17.000 hab/km<sup>2</sup> in a Mediterranean climate. This neighbourhood with high socio-cultural and commercial activity is characterized by narrow sloping streets with buildings over 50-60 years old with average heights of 3 and 4 floors (GF+3 or GF+4). in a Mediterranean climate. This neighbourhood with high socio-cultural and commercial activity is characterized by narrow sloping streets with buildings over 50-60 years old with average heights of 3 and 4 floors (GF+3 or GF+4).



*Illustration of building at the demo site in Santa Coloma de Gramenet.*

The plot is the result of an urban renovation plan that started at the beginning of the present century, and the result is the creation of a big square which will become a new reference for the area. It will be a meeting and a concentration point. The target of this transformation was to lighten the area and to reduce the density. The square will be consisted of two new buildings, and one of them is the syn.ikia demo building, and the other one is already finished on the opposite side.

The building has 38 social rental homes, all of them are of two bedrooms and are thought for programs for families for 3 or 4 people.

The building was designed by applying an integrated energy design procedure. This procedure implies analysing the building with detailed and subsequent modelling patterns to test its energy tendencies. We were able to carry it out thanks to the support of IREC (Institut de Recerca de l'Energia de Catalunya) and the implication of the designing team. This brought us to modelling and improving the different design options to obtain the optimal energy results. For example, we adapted openings on the façade, wall isolation thickness, shading systems to avoid overheating, ventilation systems. At the same time, the building will generate energy from photovoltaic panels that feed a centralized system of sanitation and heating water. The final design is a Plus Energy Building that will require integrated energy management supported on the monitoring and digitalization of the system. Performance simulations show that the project meets the ambitions of the syn.ikia project.

One of the aims of SYN.IKIA is fostering Sustainable Plus Energy Neighbourhoods. We are working together with health centre in Santa Coloma de Gramenet to set up a consumption community in order to share energy between the two public buildings.

The design of the building is completed, and the construction of the block has started.

### Timeline for the planning, design, construction/operation of the demo project

TASK	2018				2019				2020				2021				2022				2023				2024							
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4				
Architect tender																																
Project development																																
Construction licence																																
Works contract																																
Construction works																																
Keys hand over																																

EU Project

### Construction drawings/plans



Figure 1. Typical floor plan with 9 different apartment layouts.

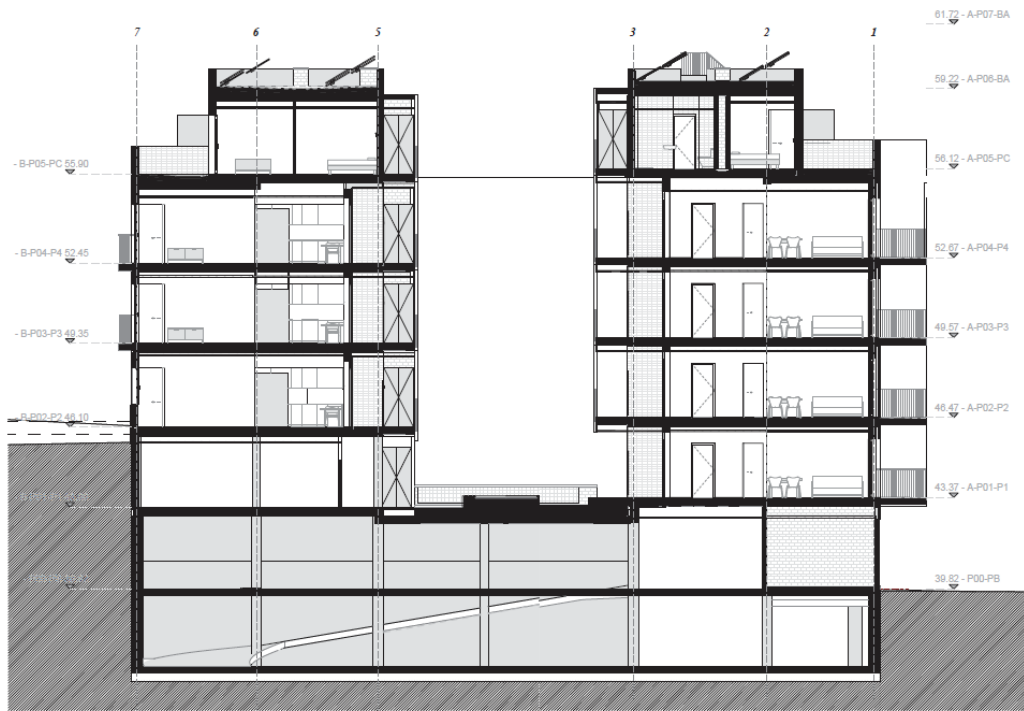


Figure 2. Elevation for building

Photos from the construction of the demo project

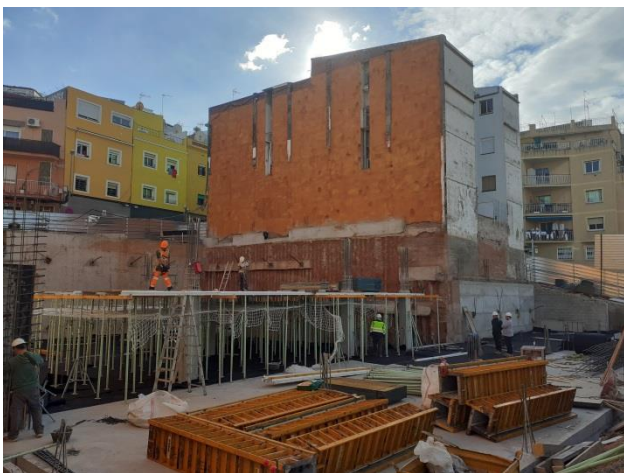


Figure 3. The construction site (November 2022)



Figure 4. The construction site (March 2023)





Figure 5. The construction site (March 2023)

### Key Performance Indicators

Category	Sub-category	KPI <sup>1</sup>	Performance [P]: Predicted/Simulated [M]: Measured [A]: Assessed	Status and plans for follow-up
Energy and Environmental performance	Overall energy performance	Non-renewable primary energy balance	-15.56 kWh/(m <sup>2</sup> y) [P]	Number is based on simulations/predictions. Final value will be based on measurements.
		Renewable energy ratio	0.83 [P]	Number is based on simulations/predictions. Final value will be based on measurements.
	Matching factors	Grid purchase factor	0.86 [P]	Number is based on simulations/predictions. Final value will be based on measurements.
		Load cover factor	0.14 [P]	Number is based on simulations/predictions. Final value will be based on measurements.
		Supply cover factor	0.09 [P]	Number is based on simulations/predictions. Final value will be based on measurements.
		Net energy	-1.74 kWh/(m <sup>2</sup> y) [P]	Number is based on simulations/predictions. Final

<sup>1</sup> Core KPIs as defined in D3.1 'Methodology Framework for Plus Energy Buildings and Neighbourhoods'

	Grid interaction factors			value will be based on measurements.
		Peak delivered/exported energy	182.9 kW [P]/ 34.3 kW [P]	Number is based on simulations/predictions. Final value will be based on measurements.
		Connection capacity credit	0.36 [P]	Number is based on simulations/predictions. Final value will be based on measurements.
	Environmental balance	Total greenhouse gas emissions	-2.84 kg CO <sub>2</sub> eq/(m <sup>2</sup> y) [P]	Number is based on simulations/predictions. Final value will be based on measurements.
Economic Performance	Capital costs	Investment costs	1.232 €/m <sup>2</sup> [A]	Preliminary number. Will be updated once the construction is finished.
	Operational costs	Operational costs	6.54€/m <sup>2</sup> y [A]	Preliminary number. Will be updated once the construction is finished.
	Overall performance	Net present value	262,000€y [A]	Preliminary number. Will be updated once the construction is finished.
Indoor Environmental Quality	Indoor air quality	Carbon dioxide level	Xx ppm [M]	Will be measured during building operation
	Thermal comfort	Predicted Mean Vote	[M]	Will be based on measurements from building operation
		Predicted Percentage Dissatisfied (PPD)	[M]	Will be based on measurements from building operation
	Lighting and visual comfort	Illuminance	Xx lux [M]	Will be based on measurements once the building is constructed
		Daylight Factor	Xx % [M]	Will be based on measurements once the building is constructed.
	Acoustic comfort	Sound Pressure Level	[A]	Will be based on specialized laboratory tests once the building is constructed.
Social performance	Equity	Access to services	[A]	Will be based on occupant survey during building operation
		Affordability of energy	[A]	Will be based on occupant survey during building operation
		Affordability of housing	[A]	Will be based on occupant survey during building operation
		Democratic legitimacy	[A]	Will be based on occupant survey during building operation

		Living conditions	[A]	Will be based on occupant survey during building operation
	Community	Social cohesion	[A]	Will be based on occupant survey during building operation
	People	Personal safety	[A]	Will be based on occupant survey during building operation
		Energy consciousness	[A]	Will be based on occupant survey during building operation
Smartness and Flexibility	Flexibility	Flexibility Index	[A]	Will be based on assessment once the building is constructed
	Smartness	Smartness Readiness Index	[A]	Will be based on assessment once the building is constructed

## 8. Acknowledging EU funding



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