



Sustainable
Plus energy
neighbourhoods

Policy mapping and analysis of plus-energy buildings and neighbourhoods

BARRIERS AND OPPORTUNITIES OF PLUS-ENERGY
NEIGHBOURHOODS IN THE NATIONAL AND LOCAL
REGULATORY FRAMEWORK

Janne Rieke Boll, Vivian Dorizas,
Rutger Broer, Zsolt Toth (BPIE)

March 2021



This project has received funding from
the European Union's Horizon 2020
Research and Innovation Programme
under Grant Agreement N 869918.

PROJECT ACRONYM syn.ikia

PROJECT NUMBER 869918

PROJECT TITLE Sustainable Plus Energy Neighbourhoods

WEBSITEwww.synikia.eu

Technical References

Deliverable (number)	D5.1
Deliverable Name	BARRIERS AND OPPORTUNITIES OF PLUS ENERGY NEIGHBOURHOODS OF THE NATIONAL AND LOCAL REGULATORY FRAMEWORK
Work Package (number)	5
Task number and Title	T5.1
Dissemination Level	PU
Date of Delivery	March 31, 2021
Lead Beneficiary	Janne Rieke Boll, Vivian Dorizas, Rutger Broer, Zsolt Toth (BPIE)
Contributors	Jordi Pascual (IREC), Joan Estrada (INCASOL) Thijs van den Oord (Area Wonen), Mirjam Grooteschaarsberg (TNO) Klaudia Ecker, Magyari Ábel (ABUD), Ingeborg Straßl (SIR) Ann Kristin Kvellheim, Caroline Cheng, Lars Arne Bø (SINTEF), Stian Backe (NTNU) Clara Mafé Cortés and Julien Dijol (Housing Europe)
Reviewers	Mariangiola Fabbri, Hélène Sibileau, Jonathan Volt (BPIE) Niki Gaitani (NTNU) Barney Jeffries

Legal Notice. The sole responsibility for the content of this publication lies with the authors. It does not necessarily reflect the opinion of the European Union. Neither EASME nor the European Commission is responsible for any use that may be made of the information contained therein.

©syn.ikia, 2021. Reproduction is authorised provided the source is acknowledged. Published in July 2021 by syn.ikia.

Executive summary

The policy framework impacting sustainable positive energy neighbourhoods (SPENs) is an ongoing and dynamic process. This report provides a snapshot of the current state of the existing legislative landscape, relevant to the development of sustainable positive energy buildings and neighbourhoods. It summarises major development in national and EU regulatory frameworks, with a special focus on the policy landscape of the syn.ikia pilot countries: Austria, the Netherlands, Norway and Spain. The report attempts to identify gaps and weaknesses in the current regulatory framework, providing a robust basis for the ongoing efforts to redefine integrated strategies to the deep decarbonisation of buildings.

The report is a rich source of information for developers, urban planners, designers, researchers and policymakers at all levels. Policymakers and public authorities considering legislation on positive energy buildings and neighbourhoods will, hopefully, benefit from this comprehensive overview of the growing body of policy measures already in place and in the pipeline. Facilitating exchange and consistency across the broad range of thematic areas SPENs touch upon, as well as among the various public entities responsible for legislating in these fields, was one of the primary motivations behind the report.

EU policies on buildings' energy performance can be traced back to the 1970s. Regulations have slowly, but constantly evolved towards today's nearly zero energy building (NZEB) requirements. Building-related policies have traditionally centred around energy efficiency measures but over the last decade the focus has widened to include the enabling framework, including support for financing, capacity building, information availability and energy market integration. The regulatory trend of moving beyond individual buildings started with the Clean Energy Package and it is now being taken forward by the Renovation Wave. Policymakers are now looking at the synergies and potential of district and community approaches, including notions on how these could bring about healthier, greener and more affordable buildings.






The report comes at an opportune moment in EU policymaking, as the EU Commission is preparing to review key buildings-related legislation, including the European Performance of Buildings Directive (EPBD) and the Energy Efficiency Directive (EED) among others. The inventory and findings of this report can provide useful insights into the effectiveness of existing policy measures and help to identify gaps.

The development of SPENs meets the same challenges as energy performance improvements of conventional buildings (e.g. data accessibility, sectoral fragmentation, misalignment of incentives, lack of standardisation). Addressing these challenges will require a holistic approach and a comprehensive policy mix. SPENs involve a number of additional elements beyond energy performance to include cross-cutting policy areas, such as quality of life, sustainability and inclusiveness. For the purpose of the review, policy themes and issue areas relevant for SPENs are thus organised around five thematic areas: district approaches; energy efficiency; renewable energies; digital technologies; and affordability, health and wellbeing.

The challenge with developing the appropriate policy framework for SPENs is to seamlessly integrate the different fields it touches upon: building renovation, electricity networks, electric mobility, district heating and cooling, energy storage and flexibility, digitalisation, community engagement, urban development, etc. The analysis brings the spotlight on a number of issues holding back neighbourhood approaches, including the lack of synergies between sectors and the lack of common standards and definitions. One of the main policy barriers to the design and development of plus-energy districts and neighbourhoods is therefore the lack of synchronisation and consistency among policies.

However, this report also suggests that there is a strong political will to move towards SPENs. The Clean Energy Package including the Electricity Market Directive and the Renewable Energy Directive, the Renovation Wave including the European Bauhaus initiative and the European Green Deal play a crucial and supportive role in this. The ambitious decarbonisation targets set by the EU and adopted by Member States point in the same direction, although the implementation and delivery on these climate objectives are also under the

responsibility of cities or regional authorities, which are the main enablers of SPENs. The local-level decision and policymaking is exceedingly important to create the necessary synergies and partnerships for the implementation of SPENs that respond to local needs, utilise local renewable sources, disseminate benefits to energy community members and generate added value for the greater local communities.

	 District approach & integrated planning	 Energy performance of buildings	 Renewable energies & energy flexibility	 Digital technologies	 Affordability, health & wellbeing
Existing European policy framework	Initiatives for knowledge exchange, good practice sharing and awareness-raising (e.g. SET Plan, Smart Cities and communities platforms, city networks)	No mention of either positive energy buildings nor neighbourhoods in the EPBD; Renovation Wave promotes energy efficiency at district level and refers to the importance of positive energy districts	RED II, Electricity Regulation and Electricity Directive set EU targets for the uptake of renewable energies in electricity, transport, and heating and cooling	Requirements in the EPBD for smart metering, technical building systems and ducting of mobility charging infrastructure	Long-term renovation strategies require Member States to report on the wider benefits of renovations, including health, safety and air quality. Health and affordability are “key principles” of the Renovation Wave
Gaps	Lack of integrated planning to consider all aspects of SPENs; no regulation on the EU level requiring Member States to encourage, invest in or develop SPENs	The NZEB definition does not cover or support positive energy buildings; metrics and definitions need to be developed for system boundaries beyond individual buildings	Lack of integrated EU regulatory approach and ambitious implementation across Member States; ongoing barriers to the broad participation of buildings in demand flexibility to increase system efficiency	Lack of clear guidance and inconsistent application of GDPR in Member States risks hampering local energy trading and optimisation among neighbouring buildings	Requirements on achieving an adequate indoor environment are not mandatory in the majority of Member States; requirements applicable at the district level are missing.

There is no perfect answer to the question of what makes an appropriate regulatory framework for SPENs. In addition to the inherent complexity of SPENs and the novelty of the concept, the report highlights important variations amongst countries in terms of their legislative culture, building stock and available technology, public opinion and political leadership. SPENs will greatly benefit from long-term targets and common definitions, but these are not the only factors that determine an effective legislative framework.

Institutional arrangements and responsibilities, mobilisation of finance from private and public sources, knowledge sharing and awareness raising are important enabling factors which the report pays close attention to.

The report concludes that SPENs can have a strategic contribution to achieve climate and energy targets as they tackle larger-scale projects, simultaneously improving community facilities, health, wellbeing, safety and public spaces. The active role of buildings and prosumers in shaping the energy transition is gaining the interest of both policymakers and market players. District approaches, even though they are in their infancy, are an increasingly relevant complementary alternative to NZEBs, as they can exploit more of the available energy generation and energy storage potential of the community which needs to be fully recognised and embraced by legislation.

Contents

EXECUTIVE SUMMARY	2
1. INTRODUCTION	9
2. OBJECTIVES AND ANALYTICAL FRAMEWORK	10
3. OVERVIEW OF EU LEGISLATION DRIVING THE DEVELOPMENT OF PLUS-ENERGY BUILDINGS AND NEIGHBOURHOODS	13
3.1 District approaches and integrated planning	14
3.2 Energy efficiency	18
3.3 Renewable energy sources and energy flexibility	22
3.4 Digital technologies and data protection	26
3.5 Affordable living, health and wellbeing	31
4. SPAIN: NATIONAL POLICY FRAMEWORK, OPPORTUNITIES AND BARRIERS TO SPEN DEVELOPMENT	35
4.1 Overview of PED projects in Spain	35
4.2 Spain's energy mix related to the building sector	36
4.3 Governance structure in Spain	37
4.4 National policy review	38
4.5 Key takeaways	42
5. NORWAY: NATIONAL POLICY FRAMEWORK, OPPORTUNITIES AND BARRIERS FOR SPEN DEVELOPMENT	43
5.1 Overview of PED projects in Norway	43
5.2 Norway's energy mix related to the building sector	43
5.3 Relevant authorities and agencies	44
5.4 Local governance structure in Norway – the municipalities	45

5.5 National policy review	46
5.6 Key takeaways	50
6. THE NETHERLANDS: NATIONAL POLICY FRAMEWORK, OPPORTUNITIES AND BARRIERS FOR SPEN DEVELOPMENT	51
6.1 Overview of PED projects in the Netherlands	51
6.2 The Dutch energy mix related to the building sector	52
6.3 Governance structure in the Netherlands	54
6.4 National policy review	55
6.5 Key takeaways	58
7. AUSTRIA: NATIONAL POLICY FRAMEWORK, OPPORTUNITIES AND BARRIERS TO SPEN DEVELOPMENT	59
7.1 Overview of PED projects in Austria	59
7.2 Austria's energy mix related to the building sector	59
7.3 Governance structure in Austria	61
7.4 National policy review	62
7.5 Key takeaways	68
8. GAP ANALYSIS	69
9. CONCLUSIONS AND FINAL REMARKS	77
10. REFERENCES	78

LIST OF FIGURES

Figure 1: Assessment framework of the EU regulatory landscape in each policy area	10
Figure 2: Energy consumption in the Spanish residential sector, 2000-2018 ("Energy in Spain". Ministry for Ecological Transition and the Demographic Challenge, 2018)	36
Figure 3: Emission registration of the different sectors and – after 2020 – estimated emissions based on planned policy. Source: PBL, 2020.	52
Figure 4 Final electricity use (yellow) and electricity supply (blue) of households, including estimate from 2020-2030. Final gas use (green - corrected for temperature), including estimate from 2020-2030. Estimate is based on planned policy. Source: PBL, 2020	53
Figure 5: Changes in Austrian energy mix from 2002 to 2018 by household energy consumption. Source: Statistics Austria	60
Figure 6: Share of final energy consumption by energy sources and sectors. Source: Integrated National Energy and Climate Plan for Austria	61

LIST OF TABLES

Table 1: Existing policies and policy gaps in the relevant thematic areas	3
Table 2: Policy areas touching upon SPEN	11
Table 3: Inventory of SPEN related legislation in policy area 'District approach & integrated planning'	16
Table 4: Inventory of SPEN related legislation in policy area 'Energy efficiency'	19
Table 5: Inventory of SPEN related legislation in policy area 'Renewable energies & energy flexibility'	24
Table 6: Inventory of SPEN related legislation in policy area 'Digital technologies'	27
Table 7: Inventory of SPEN related legislation in policy area 'Affordability, health and wellbeing'	33
Table 8: Abbreviation of relevant Norwegian authorities and agencies	44
Table 9: Relevant Dutch authorities and agencies	54
Table 10: Assessment of policy area 'District approach & integrated planning'	70
Table 11: Assessment of policy area 'Energy efficiency'	71
Table 12: Assessment of policy area 'Renewable energies & energy flexibility'	73
Table 13: Assessment of policy area 'Digital technologies'	74
Table 14: Assessment of policy area 'Affordability, health and wellbeing'	75

Roles and responsibilities

Name	Role	Responsibility
BPIE	Task leader of D5.1, coordinator and main contributor to the report	EU policy review and gap analysis
NTNU	Contribution to the Norwegian country chapter and reviewer	National policy review Norway
SINTEF	Contribution to the Norwegian country chapter	National policy review Norway
INCASOL	Contribution to the Spanish country chapter	National policy review Spain
IREC	Contribution to the Spanish country chapter	National policy review Spain
Area Wonen	Contribution to the Dutch country chapter	National policy review the Netherlands
TNO	Contribution to the Dutch country chapter	National policy review the Netherlands
ABUD	Contribution to the Austrian country chapter	National policy review Austria
SIR	Contribution to the Austrian country chapter	National policy review Austria

Acknowledgements: BPIE would like to acknowledge the following experts for their valuable inputs provided for the gap analysis in chapter 8:

- Christopher Gollner (JPI Urban Europe)
- Reda Francesco (Smart Energy and Transport Solutions)
- Julien Dijol (Housing Europe)
- Ceciel Nieuwenhout (Groningen Centre of Energy Law and Sustainability, H2020 POCITYF project)
- Michael Villa (SmartEN)

1. Introduction

EU policies on buildings' energy performance can be traced back to the 1970s and the regulations have slowly moved towards today's nearly zero energy building (NZEB) requirements¹. Policies have traditionally centred around energy efficiency measures but over the last decade the focus has widened to include an enabling framework, including support for financing, capacity building, information availability and energy market integration. With the publication of the Renovation Wave strategy², the European Commission put the synergies and potential of district and community approaches upfront, including notions on how these could bring about healthier, greener and more affordable buildings.

The announcement of the Renovation Wave and the related revision of key EU directives is a policy window to enable district-led approaches. The Renovation Wave provides an opportunity to systematically address the regulatory and market barriers impeding the development of sustainable positive energy neighbourhoods (SPENs) across the EU. The strategy acknowledges the importance of an urgent transformation of the European building stock in light of the continent's carbon neutrality target. It sets out to double the renovation rate from the current 1% and introduces a range of actions to "make renovation a win-win for climate neutrality and economic recovery" after the Covid-19 pandemic. SPENs may serve as a strategic contribution to achieve climate and energy targets as they tackle larger-scale projects, simultaneously improving community facilities, health, wellbeing, safety and public spaces³.

The new strategy puts integrated renovation strategies and district approaches at the centre of European building policies, with the aim to fully realise system integration, aggregation of renovation activities, economies of scale and other cost savings that are attainable through a more holistic approach. The areas of intervention covered by the Renovation Wave include "comprehensive and integrated renovation interventions for smart buildings" by enabling digitally supported renovation solutions and increasing integration of renewable energies which support the development of EU-wide positive energy districts (PEDs) while providing comfort and wellbeing for the building users.

The strategy reiterates the potential of wider benefits that can be reaped by a participatory and neighbourhood-based approach. Smart buildings are integrated into the energy system combining energy storage and demand-side flexibility as well as on-site renewable energy generation, while promoting the active participation of users as prosumers. Prosumers can play an active role in the energy transition by generating, consuming, storing and selling locally produced energy, along with or as energy communities.

The regulatory trend of moving beyond individual buildings started with the Clean Energy Package and it is now being taken forward by the Renovation Wave. Feed-in tariffs, net metering for renewable energy generation, and energy communities consisting of multiple small-scale energy consumers and providers are gaining the interest of both policymakers and market players. District approaches, even though they are in their infancy, are an increasingly relevant complementary alternative to NZEBs, as they can exploit more of the available energy generation and energy storage potential of the community.

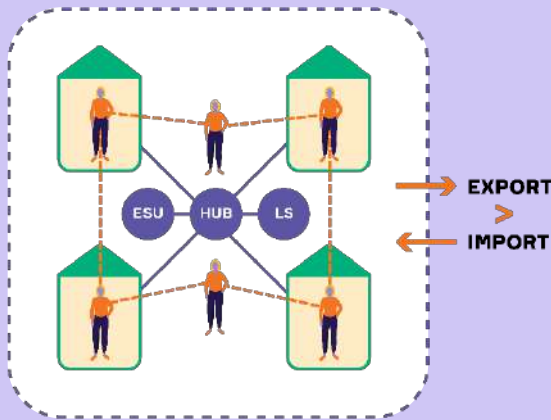
¹Economidou et al. (2020), *Review of 50 years of EU energy efficiency policies for buildings*, Energy and Buildings, Volume 225, 2020

²European Commission. *A Renovation Wave for Europe – Greening our buildings, creating jobs, improving lives* (COM(2020)662)

³See also JRC reports on the concept: Saheb, Y et al. (2019), *From nearly-zero energy buildings to net-zero energy district – Lessons learned from existing EU project and* Shnapp, S., Paci, D. and Bertoldi, P. (2020), *Enabling Positive Energy Districts across Europe: energy efficiency couples renewable energy.*

Definition of sustainable plus energy neighbourhoods

In the absence of an EU definition of a sustainable plus energy neighbourhood (SPEN), syn.ikia has adopted the following definition⁴. The concept builds on the description of plus-energy buildings⁵, but the system boundaries are enlarged to include the entire site of the neighbourhood development, including local storage (LS) and energy supply units (ESU).



Buildings, users and technical systems are digitally connected to fully exploit flexibility and self-consumption.

A SPEN takes a similar approach with several additional elements taken into account. Users, buildings, and technical systems are all connected via the neighbourhood digital cloud hub or common energy infrastructures.

The SPEN framework also includes a strong focus on cost efficiency, indoor environmental quality, occupant satisfaction, social factors (co-use, shared services and infrastructure), power performance (peak shaving, flexibility, self-consumption), and reduced greenhouse gas emissions.

2. Objectives and analytical framework

This report presents an overview of the current regulatory framework relevant for plus-energy districts and neighbourhoods, which are terms that largely cover the syn.ikia definition of SPENs. Given the lack of a generally accepted definition of positive energy neighbourhoods, as well as the relative novelty of this concept in the regulatory framework policy context, the terms plus/positive energy districts and neighbourhoods as well as SPENs are used interchangeably in this document.

The report reviews relevant policy provisions at local, regional and EU levels with the aim to inform policymakers and market actors about the existing policy landscape and remaining gaps hindering progress on SPEN developments.

As the definition suggests, SPENs involve a number of additional elements beyond energy performance to include several cross-cutting policy areas, such as quality of life, sustainability and inclusiveness. For the purpose of the review, policy themes and issue areas relevant for SPENs are thus organised around five thematic areas: district approaches, energy performance, renewable energies, digital technologies, and affordability, health and wellbeing; these are explained in Table 2.

⁴See syn.ikia - Methodology framework for plus energy buildings and neighbourhoods, <https://www.synikia.eu/library/>

⁵See Torcellini, Pless, Deru, and Crawley (2006). Zero Energy Buildings: A Critical Look at the Definition, National Renewable Energy Laboratory and Department of Energy, US, 2006

Policy framework for SPENs	
District approach & integrated planning	Well-planned and comprehensive renovations focusing on district or neighbourhood level can generate synergies with the energy system and be integrated into wider urban planning strategies. The district/neighbourhood approach can ensure the aggregation of systems and components for optimum performance and costeffectiveness.
Energy performance of buildings	Improving the performance of buildings reduces the overall energy need and enables a larger share of renewable energy. Ensuring a high energy efficiency level is a prerequisite for a SPEN.
Renewable energies & energy flexibility	A positive energy building produces more renewable energy than it consumes over a year while achieving an appropriate thermal comfort level. The locally produced renewable energy requests the building/district to maximise self-consumption and enable on-site flexibility. With a high penetration of locally, fluctuating renewable energy production, the flexibility (at demand level) is needed to ensure a real-time matching of energy demand and production.
Digital technologies	Digital technologies and automation offer both new opportunities for energy flexibility as well as unprecedented ways to engage citizens. Digitalisation is an important enabler of the smart energy system SPENs often rely upon.
Affordability, health & wellbeing	SPENs should create good indoor and outdoor environments to ensure health and wellbeing for building users, and solutions that empower users while ensuring affordability.

Table 2: Policy areas touching upon SPENs

The EU-level review (Chapter 3) is based on a thorough desk research of existing provisions and planned policies (e.g. as announced in the Renovation Wave). The policy overview includes both legislative acts and non-legislative measures; the latter especially does not claim to be exhaustive but rather a sample of relevant EU-wide initiatives in the respective policy area. The report draws on both the European Commission's own resources and publications as a primary resource, as well as analyses by key stakeholders and organisations as a secondary literature. The research has been enriched with insights gained from targeted interviews with experts and relevant market actors, in particular in regards to the identification of drivers, opportunities and bottlenecks in the current regulatory framework.

The EU-level overview is accompanied by in-depth reviews of the national policy landscape of positive energy districts and neighbourhoods in the four syn.ikia pilot countries: Spain, Norway, the Netherlands and Austria (Chapters 4 to 7). The national assessments are organised in a similar fashion, including the categorisation of measures across the five policy areas presented above, although many of the identified legislations cannot clearly be assigned to single policy areas which led to a more flexible structure. The country sections identify bottlenecks and opportunities on a national, regional and local level, taking the national circumstances and local market developments into account. Targeted surveys and interviews among key public and private sector stakeholders were carried out at national level too in order to acquire in-depth knowledge about the local context and validate findings.

The policy inventory is complemented by a gap analysis of the current EU regulatory framework (Chapter 8). It visualises the readiness of each policy area to support SPEN development in four categories (long-term framework, financial incentives, mandatory regulatory requirements, enabling factors) through a "traffic-light" rating. The gap analysis also includes the main outcomes of the country reviews.

Assessment of policy area			
Long-term target	●	●	●
Financial incentives	●	●	●
(Mandatory) regulatory requirements	●	●	●
Enabling factors (e.g. knowledge sharing, awareness raising)	●	●	●

Figure 1: Assessment framework of the EU regulatory landscape in each policy area

Finally, Chapter 9 wraps up the policy evaluation and provides the concluding remarks to be taken up in the follow-up policy recommendations report due later in the project.

The main objectives of this report are to:

- Present a concise overview of the current state of the existing legislation relevant to the development of plus-energy buildings and neighbourhoods.
- Explore and analyse regional, national and EU regulatory frameworks, with a special focus on the policy landscape of the syn.ikia pilot countries: Austria, the Netherlands, Norway and Spain.
- Identify gaps and weaknesses in the current regulatory framework based on the assessment of experts and market stakeholders, which will feed into the development of the forthcoming policy recommendations and tailored guidelines for EU and local policymakers.

3. Overview of EU legislation driving the development of plus-energy buildings and neighbourhoods

The recently launched Renovation Wave is expected to trigger a recast of several EU directives relevant for SPENs. The strategy emphasises, inter alia, the importance of innovative and sustainable renovation approaches, integration of smart solutions, an increase of renewable energy solutions at local levels as well as the promotion of clean mobility. Renovation solutions targeting districts, rather than individual buildings, offer the opportunity to deliver economies of scale and community engagement. Beyond the regulatory push, the recovery plan for Europe, especially the recovery instrument NextGenerationEU, mobilises unprecedented financial resources towards the building and clean energy sector that could support the uptake of SPENs across the EU.

This chapter provides an overview of the EU legislation impacting the development of SPENs. The most relevant EU directives related to SPENs are listed below. The forthcoming review of key legislation is an opportunity to shift focus from individual buildings to the district level, and for the legal framework to keep track with technological developments and climate mitigation and adaptation needs.

EPBD

The Energy Performance of Buildings Directive sets out to decarbonise the building stock and requires MS to develop comprehensive long-term renovation strategies, including initiatives to “promote smart technologies and well-connected buildings and communities”.
The nearly zero-energy building standard (NZEB) indirectly supports SPENs as well as the new obligation to install charging points for e-mobility promoting the integration of buildings into the energy system.

RED

The Renewable Energy Directive regulates renewable self-consumption and promotes the development and non-discriminatory treatment of renewable energy communities to facilitate local energy generation and peer-to-peer trading.

EMD

The Electricity Market Directive sets rules for a just and competitive internal market for electricity with a new paradigm promoting “active consumers”.
The electricity regulation and directive set the framework for increased demand-side flexibility and promote an internal European market for electricity.

EED

The Energy Efficiency Directive requires, among other things, that MS assess the potential for high-efficiency cogeneration and district heating and cooling in their region and conduct a cost-benefits analysis based on technical feasibility, climate conditions and economic feasibility. It also requires national authorities to lead by example by renovating 3% of their public buildings “owned and occupied by its central government” each year.

3.1 District approaches and integrated planning

The notorious fragmentation of the building sector poses a serious challenge to its decarbonisation. This is due in particular to the difficulty of involving and aligning all stakeholders to ensure the successful design, development and uptake of climate-neutral and highly efficient solutions. Another significant challenge is to scale up and replicate deep renovations⁶ and high-performance new constructions.

SPENs can create synergies beyond individual buildings and increase the **efficiency and flexibility of the energy system**. District-level renovations, for example, can lead to significant **cost reductions, through economies of scale and streamlined logistics**. They can also improve the business case of investments due to project aggregation and distributed risk portfolios. Comprehensive planning regulations and urban development strategies incorporating a district approach can bridge the gap between energy efficiency, decarbonisation of heating and cooling and clean mobility objectives, which today are mostly addressed in silos.

The Renovation Wave refers to the need to “strengthen integrated and participatory approaches to sustainable urban development”, in order to achieve a holistic and balanced neighbourhood approach. Renovation-oriented policies and initiatives currently primarily address the single-building level even though the revision of the key energy directives, following the Renovation Wave in 2021, may introduce more comprehensive approaches.

The long-term renovation strategies (LTRS), mandated by article 2a of the amended [EPBD \(2018/844/EU\)](#), do not require Member States to design and outline district approaches. The EPBD does, however, demand “an overview of national initiatives to promote smart technologies and well-connected buildings and communities” (Art. 2a(1)) which could pave the way for more purposeful development of SPENs. Other comprehensive planning strategies are often initiated by local authorities (e.g. heat decarbonisation plans) or EU initiatives, such as the Covenant of Mayors’ sustainable energy and climate action plans ⁷ and do not necessarily address the district level.

The [Energy System Integration strategy \(European Commission COM \(2020\) 299\)](#), published by the European Commission in July 2020, set out the vision on how to accelerate **system integration**, an integrated planning and operating of the energy system across sectors including buildings. A first step towards system integration is established in article 8 of the EPBD which requires Member States to implement provisions for minimum requirements for electric vehicle charging infrastructures in buildings with car parks over a certain size and other minimum infrastructure (ducting) for smaller buildings. This provision is relevant in the context of linking the built environment with sustainable mobility through e-mobility charging and locally produced energy in support of an efficient system integration.

System integration is also encouraged through the participation of active customers (EU/2019/944, Art. 2) and aggregators in the market, as well as the exploitation of demand-side flexibility, which are regulated in the latest revision of the Electricity Directive (EU) 2019/944 (see Renewable energies and energy flexibility policy area).

Concerning the enabling provisions for the development of low-carbon districts, “Positive Energy Districts and Neighbourhoods for Sustainable Urban Development” are supported under the EU Strategic Energy Technology (SET)-Plan. Action 3.2 develops a framework for the planning, deployment and replication of innovative positive energy districts or neighbourhoods (PEDs/PENs). The EU programme aims to develop **100 positive energy districts across the EU until 2025** and to mainstream their implementation by increasing

⁶Deep renovation refers to renovation interventions which achieve energy savings of >60% (IPSOS & Navigant, 2019)

⁷Signatories to the Covenant of Mayors network are required to submit sustainable energy and climate ‘action’ plans (SECAPs) covering their local climate mitigation and adaptation activities every two years.

awareness through outreach and networking events, providing guidelines, and setting shared definitions and best practices across the Member States.

The new European Urban Initiative and the European Smart Cities Marketplace, as well as ongoing work of city and municipal networks such as ICLEI and Energy Cities, offer inspiration and guidance for integrated urban planning solutions.

District approach	Name of policy/regulation	Short description
EU legislation & strategic communication	<p>Renovation Wave strategy</p> <p>A Renovation Wave for Europe – greening our buildings, creating jobs, improving lives (COM (2020) 662)</p>	<ul style="list-style-type: none"> ● The Renovation Wave strategy identifies district approaches to decarbonise heating and cooling as one of the key interventions and announced an early revision of the EU RED (EU/2018/2001), the EED (EU/2012/27) and the EPBD (EU/2010/31) in 2021. ● The key areas of intervention also include the promotion of integrated, participatory and digital renovation solutions. ● The timeline for the European Commission's actions to materialise the Renovation Wave runs until 2024, with EPBD and EED proposals already presented in 2021.
	<p>Energy Performance of Buildings Directive (EU/2018/844)</p> <ul style="list-style-type: none"> ● Article 2a: Long-term renovation strategies ● Article 19: Review of integrated district or neighbourhood approaches ● Article 8. 2: Prerequisites for charging infrastructure of e-mobility 	<ul style="list-style-type: none"> ● LTRS shall include initiatives to “promote smart technologies and well-connected buildings and communities” (Art. 2a(1)). ● The European Commission shall, as part of the next review (2021), examine “in what manner Member States could apply integrated district or neighbourhood approaches in Union building and energy efficiency policy [...] for example by means of overall renovation schemes applying to a number of buildings in a spatial context instead of a single building.” (Art. 19). ● The amended EPBD includes a requirement for new non-residential buildings and non-residential buildings undergoing major renovation with more than 10 parking spaces to include at least one recharging point and ducting infrastructure for at least every five parking spaces to promote emobility; for residential buildings Member States shall ensure the same regarding ducting infrastructure for every parking space (Art. 8 (2)).
	<p>Renewable Energy Directive (EU/2018/2001)</p> <ul style="list-style-type: none"> ● Article 15: Renewable energies in urban planning: Administrative procedures, regulations and codes 	<p>Member States shall ensure that their competent authorities at national, regional and local level include provisions for the integration and deployment of renewable energy, [...] when planning, including early spatial planning, designing, building and renovating urban infrastructure, industrial, commercial or residential areas and energy infrastructure, [...]. Member States shall, in particular, encourage local and regional administrative bodies to include heating and cooling from renewable sources in the planning of city infrastructure [...] (Art. 15.3).</p>
	<p>Powering a climate-neutral economy: An EU Strategy for Energy System Integration (European Commission COM (2020) 299)</p> <p>Covenant of Mayors for Climate and Energy Energy Cities</p> <p>ICLEI – Local governments for sustainability</p> <p>Networks of local authorities, mayors and cities</p>	<p>The EU Commission's communication on an energy system integration strategy demonstrates the benefits of a sectoral integrated energy system “in which consumers play an active role in energy supply” (referring to energy communities).</p> <p>The different networks of European local governments, municipalities/cities and mayors promote the local planning of climate action and energy transition activities by enabling knowledge sharing and peer learning, and providing guidance and tools.</p>

District approach	Name of policy/regulation	Short description
Non-legislative enabling policies & initiatives		<ul style="list-style-type: none"> For example, the sustainable energy and climate action plans submitted by signatories to the Covenant of Mayors framework provide an integrated planning approach by covering climate mitigation actions in the field of buildings, facilities and urban transport as well as adaptation activities covering the scope of the municipality or region.
	<p>European Innovation Partnership on Smart Cities and Communities (EIP SCC, COM(2012) 4701 final)</p> <ul style="list-style-type: none"> Foundation for the Smart Cities and Communities Partnership 	<ul style="list-style-type: none"> In 2012, an EU Commission communication established a Smart Cities and Communities (SCC) innovation platform mainstreaming activities and research towards low-carbon and resource efficient urban development.
	<p>EU Strategic Energy Technology (SET)-Plan on Action 3.2 "Smart Cities and Communities"</p> <ul style="list-style-type: none"> "Positive Energy Districts and Neighbourhoods for Sustainable Urban Development" (PED programme) 	<ul style="list-style-type: none"> The PED programme aims to implement 100 PEDs in Europe by 2025 and conceptualises a reference framework to mainstream definitions and understanding of SPENs. The programme increases awareness and provides guidance for PED/SPEN development. Joint Programming Initiative JPI Urban Europe implements the PED programme including mainstreaming, monitoring and replication activities of PEDs across Europe (development of guidelines, tools and outreach and stakeholder engagement activities).
	<p>Smart Cities Information System (SCIS)</p> <ul style="list-style-type: none"> EU-funded knowledge platform 	<ul style="list-style-type: none"> The Smart Cities Information System (SCIS) is a knowledge platform to exchange data, experience and know-how and to collaborate on the creation of smart cities. SCIS brings together project developers, cities, research institutions, industry, experts and citizens from across Europe
	<p>EERA Joint Programme Smart Cities</p> <ul style="list-style-type: none"> Smart Cities and PED knowledge platform by the European Energy Research Alliance 	<ul style="list-style-type: none"> The EERA Smart Cities programme develops and disseminates a Technology Roadmap for PED in the European Union towards 2025 They also develop a systematic, robust, evidence-driven approach for PED Labs as open innovation playgrounds enabling results to be scaled up, transferred and mainstreamed across European cities as well as global society

Table 3: Inventory of SPEN-related legislation in policy area "District approach and integrated planning"

3.2 Energy efficiency

SPENs require an efficient use of energy in order to offset their energy consumption by the amount of energy produced on site. Legal provisions and other policies targeting energy efficiency improvements of buildings are therefore an essential starting point for SPENs.

Different provisions and initiatives aim to improve the energy efficiency of the EU building stock. The EPBD mandates Member States to define NZEBs and introduce **“cost-optimal minimum energy performance requirements for new buildings and for existing buildings undergoing major renovation”** (Art. 9) with a significant contribution of renewable energy sources covering the remaining energy demand. The EPBD also requires Member States to outline how they will improve and transform their national building stock to meet the vision of a highly energy-efficient and decarbonised building stock by 2050.

According to EPBD, Art. 2 and 9, all new buildings must be NZEB by 31 December 2020. The EPBD defines a NZEB as a building that has a very high energy performance. The nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby. **The reference to renewable energy produced “nearby” clearly opens the possibility to consider district approaches for the renewable energy production and distribution.** To further support this, the EPBD further encourages district or block heating and cooling systems.

Each Member State shall establish a national LTRS to support the renovation of the national stock, facilitating the cost-effective transformation of existing buildings into NZEBs. Three key new elements relevant for SPENs were introduced in the LTRS in 2018:

- **Wider benefits** – including environmental, social and economic benefits, which are relevant for making the business case for SPENs
- **Trigger points** – the right opportunities to carry out improvement works throughout the lifecycle of the property
- **Measures to tackle energy poverty** – actions to alleviate energy poverty should include energy efficiency measures alongside social policy measures.

The Energy Efficiency Directive (2012/27/EU) sets the overarching legal framework for energy efficiency policy in the EU, aiming to steer Member States towards meeting the 2030 energy efficiency targets. The 2018 revision of the directive set a 32.5% energy efficiency target by 2030, extending the lifespan of one of its main provisions, the “energy savings obligation”, beyond 2020. The EED requires Member States to assess the potential of high-efficiency cogeneration and district heating and cooling in their region and do a cost-benefit analysis based on technical and economic feasibility.

Following up on the Renovation Wave strategy, the European Commission will open several key directives for review during 2021, including the EPBD and EED. The European Commission will examine, inter alia, how Member States can **apply integrated district or neighbourhood approaches**, while introducing minimum energy performance standards for existing buildings, potentially mandating the worst-performing buildings to be improved. The Renovation Wave mentions concepts like the digital building logbook, building renovation passport and “standardised industrial solutions”, which are all relevant policy tools contributing to more integrated neighbourhood approaches.

The Energy Labelling regulation (2017/1369) contributes to the development and market uptake of smart products, which can interact with other systems such as the energy grid in order to reduce energy consumption, improve energy efficiency and increase the uptake of renewable energies. Additionally, the Ecodesign directive (2009/125/EC) also links with neighbourhood approaches by encouraging **energy efficient products, including household appliances, information and smart building technologies that can interact with the energy grid.** Finally, the European Climate Pact aims to engage citizens and communities in climate actions and inspire collaboration between individuals, regional authorities and civil societies.

Energy efficiency	Name of policy/regulation	Short description
EU legislation & strategic communication	<p>Energy Performance of Buildings Directive (EU/2010/31)</p> <ul style="list-style-type: none"> ● Article 2: definition of NZEB ● Article 9: requirement to establish NZEB standard for all new buildings from 2021 ● Annex I : Calculation framework for the energy performance of buildings ● EU/2018/844, Article 2a: Long term renovation strategies 	<ul style="list-style-type: none"> ● The NZEB defines a “building that has a very high energy performance [...] the nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby” (Art. 2). ● The Article 9 of the EPBD requires that: <ul style="list-style-type: none"> a) After 31 December 2020, all new buildings are nearly zero energy b) After 31 December 2018 all new public buildings have to comply with the NZEB standard. ● Annex I sets out a general calculation framework for the energy performance of buildings which the Member States shall use to adopt a national (or regional) calculation methodology and determine the NZEB definition accordingly. ● The amended EPBD (EU/2018/844) requires Member States to submit LTRS as roadmaps towards a decarbonised national building stock (Art. 2a), covering trigger points, wider benefits and measures to tackle energy poverty.
	<p>Energy Efficiency Directive (EU/2012/27)</p> <ul style="list-style-type: none"> ● Article 14: Promotion of efficiency in heating and cooling ● Annex VIII: Potential for efficiency in heating and cooling 	<ul style="list-style-type: none"> ● The Member States shall assess the potential for the application of high-efficiency cogeneration and efficient district heating and cooling (Art. 14). ● The comprehensive assessment of national heating and cooling potentials shall include amongst others a description of heating and cooling demand and infrastructures considering the following technologies: industrial waste heat and cold, waste incineration, high efficiency cogeneration, renewable energy sources (such as geothermal, solar thermal and biomass) other than those used for high efficiency cogeneration, heat pumps, and reducing heat and cold losses from existing district networks (Annex VIII).
	<p>Energy Efficiency First – Governance Regulation (Regulation (EU) 2018/1999)</p> <ul style="list-style-type: none"> ● Article 2(18) 	<ul style="list-style-type: none"> ● Introduces the definition of the “energy efficiency first” guiding principle which acknowledges that Europe’s biggest domestic energy source is energy efficiency and seeks to ensure that energy-saving solutions are not overlooked or undervalued. ● <i>Energy efficiency first means taking utmost account in energy planning, and in policy and investment decisions, of alternative energy efficiency measures to make energy demand and energy supply more efficient, in particular by means of cost-effective end-use energy savings, demand response initiatives and more efficient conversion, transmission and distribution of energy, whilst still achieving the objectives of those decisions.</i>

Energy efficiency	Name of policy/regulation	Short description
Non-legislative enabling policies & initiatives	Ecodesign Directive (2009/125/EC)	<ul style="list-style-type: none"> The Ecodesign Directive sets the mandatory technical and minimum energy efficiency requirements that energy-related products, including heating and cooling equipment, and information and communication technologies potentially used in smart buildings must fulfil before being placed on the market.
	Energy Labelling regulation (EU/2017/1369)	<ul style="list-style-type: none"> Energy labelling enables customers to make informed choices based on the energy consumption of “energy-related products which have a significant direct or indirect impact on the consumption of energy and, where relevant, on other essential resources during use”, excluding second-hand products and means of transport. The Energy Labelling regulation replaced the former energy labelling directive in 2017 and introduced a re-scaling of labelling (“A to G” labelling scale) applied to groups of products involving energy consuming home appliances as well as heaters and boilers.
	Building renovation passport <ul style="list-style-type: none"> Article 14: Promotion of efficiency in heating and cooling Annex VIII: Potential for efficiency in heating and cooling 	<ul style="list-style-type: none"> Building renovation passports provide tailored information for homeowners on how to achieve deep renovation avoiding technical and economic lock-ins. The Renovation Wave foresees that the building renovation passport will provide a clear roadmap for staged renovation over the lifetime of a building, helping owners and investors plan the best timing and scope for interventions.
	Energy Efficiency First – Governance Regulation (Regulation (EU) 2018/1999)	<ul style="list-style-type: none"> A joint agreement between the EU and the European Investment Bank (EIB) aiming to address the limited access to adequate and affordable commercial financing for energy efficiency investments. It offers a risk-sharing facility mitigating the credit risk of partner banks when financing energy efficiency projects, an expert support facility, and EIB loans for national partner banks
	One-stop-shops	<ul style="list-style-type: none"> One-stop-shops are easily accessible, integrated renovation services tailored for specific groups of homeowners which may include financing options to scale up residential renovation. As foreseen by the Renovation Wave, one-stop-shops can create a broad and inclusive engagement of inhabitants with a variety of useful advice, covering district approaches to transform neighbourhoods and create new business opportunities.

Energy efficiency	Name of policy/regulation	Short description
Non-legislative enabling policies & initiatives	European Climate Pact	<ul style="list-style-type: none"> In the frame of the European Climate Pact, the Commission will engage with relevant stakeholders to provide targeted support to specific areas, including buildings. This includes facilitating smart financing and assisting local authorities to support energy-efficient housing and regenerate European neighbourhoods through economic, social and cultural vitality.
	Smart Finance for Smart Buildings	<ul style="list-style-type: none"> The SFSB initiative analyses how to stimulate private and public investment concerning the energy efficiency of buildings and encourages investors to engage with energy efficiency through financial, technical and behavioural de-risking.
	Building Stock Observatory	<ul style="list-style-type: none"> A database established in 2016 as part of the Clean Energy Package that aims to provide an understanding of the European building stock and keep track of the characteristics and energy performance of buildings in the EU.

Table 4: Inventory of SPEN-related legislation in policy area “Energy efficiency”

3.3 Renewable energy sources and energy flexibility

An important aspect of SPENs is the amount of **locally generated renewable energy**, which needs to offset and even exceed the district's energy demand. Self-consumption, storage and the right to sell excess renewable electricity to the grid and neighbours are thus important features to be enabled by regulation in order for SPENs to succeed. The implementation of SPENs is supported by renewable energy communities, which are legal entities of neighbours entitled to produce, consume, store and sell locally generated renewable energy (e.g. through renewable power purchase agreements).

The 2018 recast of the EU Renewable Energy Directive (RED II, 2018/2001/EU) introduced an EU-wide binding target of 32% of gross final energy from renewable sources by 2030. To achieve this goal, the EU Commission committed financial support to successfully integrate renewable energy sources into the energy system, to increase flexibility and to maintain grid stability and manage grid congestion. In addition, the European Commission committed to working for the wider penetration of intelligent networks and storage facilities, which are key enablers of a flexible energy system. By June 2021, Member States must have transposed the RED II fully into national legislation.

The RED II provision requires all Member States to include **minimum levels of renewable energy deployment in their building regulations** and codes subject to cost-optimality, which leaves a flexibility and ambition level to the Member States. The RED II encourages measures to substantially increase renewables in the building sector by renewable self-consumption, local energy storage and increased energy efficiency relating to cogeneration and passive, low-energy and zero-energy buildings.

The directive also aims **at increasing the share of renewable energy in heating and cooling** by an indicative 1.3% per year between 2020 and 2030 and at least 1% yearly in district heating and cooling. These provisions can contribute to the development of SPENs; in particular, the increase of renewables-based district heating systems can be crucial to decarbonising supply at the neighbourhood level. Increasing electrification of decentralised heating systems by using heat pumps can also add to the decarbonisation of heating and cooling and be shared among buildings nearby. The **encouragement of district heating systems** is linked to syn.ikia's objectives as there is a potential for them to significantly contribute to a 100% renewable-based supply transition.

Regarding self-consumption of renewable energy, the RED II builds on the entitlement of individuals to consume and sell self-generated energy and introduces the rights of renewable energy communities, complementing the citizen energy communities regulated in the Electricity Directive ((EU) 2019/944)⁸ The RED II defines renewable energy communities as legal entities in which **households nearby can participate without administrative and regulatory barriers in consuming, storing and selling their excess energy** to maximise self-consumption and encourage on-site flexibility. Member States are encouraged to promote and facilitate the development of the communities by providing access to finance and information and enabling locally produced energy to be shared within the communities or be sold on all suitable markets. They must ensure that renewable energy communities are subject to fair and transparent regulations and nondiscriminatory treatment.

Renewable energy communities in Europe join forces under the federation of REScoop, which promotes the development of local energy communities⁹ and seeks to influence a supportive policy framework.

To achieve an integrated energy system powered by renewable energy sources, demand-side flexibility is an important prerequisite¹⁰. This is enabled by the directive on common rules for the internal market for

⁸ See Caramizaru & Uihlein (2020), *Energy communities: an overview of energy and social innovation*, JRC report, for a comparison between Renewable and Citizen Energy Communities

⁹ REScoop refers to "energy cooperatives", which is used as a synonym in this report.

¹⁰ See for example IEA (2019), *Characterization of Energy Flexibility in Buildings*, EBC Annex 67

electricity (2019/944/EU), and the new regulation on the internal market for electricity ((EU) 2019/943). The Electricity Market Directive regulates the **participation of active energy consumers and aggregators in the market**, and the establishment of a non-discriminatory framework for flexibility instruments and services, like **dynamic pricing and demand-response aggregation**.¹¹ The policy framework puts the consumer at the heart of the energy transition and enables their participation in energy generation, distribution and supply, consumption, aggregation and storage, including energy efficiency services and the generation of local renewable electricity. This increasing flexibility of energy shared locally is crucial for energy districts and neighbourhoods but requires the deployment of smart meters at scale to monitor real energy consumption.

With the Renovation Wave, the EU Commission also published the Commission Delegated Regulation C(2020) 6930 defining the optimal common scheme for rating the smart readiness of buildings and the technical modalities. The smart readiness indicator (SRI) will be based on an assessment of the capabilities of a building or building unit to adapt its operation to the needs of the occupant and the grid. The methodology will also **consider the flexibility of a building's overall electricity demand, including its ability to enable participation in active and passive as well as implicit and explicit demand response**, in relation to the grid, for example through flexibility and load shifting capacities. This policy instrument is relevant for SPENs, as the first step to ensuring demand response and flexibilities at the district level is to ensure that single buildings have these capabilities (*see policy area Digital technologies*).

The presented legislations **create an enabling framework for the production and consumption of renewables at the district level** and the local peer-to-peer trading of energy, which are prerequisites of a plus-energy neighbourhood. Their transposition into national law will be essential for the uptake and flexibility of renewables in positive energy districts and neighbourhoods and empowered citizens.

¹¹ See SmartEN (2020). *The implementation of the electricity market design to drive demand-side flexibility. Monitoring report. November 2020.*

Renewable Energy Directive II (EU/2018/2001)

- Article 15: Requirements to deploy minimum levels of renewable energies in new and renovated buildings
- Article 21: Renewables self consumers
- Article 22: Renewable energy communities

- Minimum levels of renewable energies have to be deployed in new buildings and buildings undergoing major renovations as required in building codes of the Member States (where technically, functionally and economically feasible based on cost-optimal calculation) (Art. 15).
- Member States shall enable self-consumption and ensure that individuals or aggregators are entitled to generate renewable energy for their own consumption, to store and sell their excess renewable electricity (including through power purchase agreements, energy suppliers and peer-to-peer energy trading platforms); enable residents in the same building or building block to join activities and share locally without network charges (Art. 21).
- Member States shall enable end users to participate in renewable energy communities which are entitled to produce, consume, store and sell renewable energy; Member States shall alleviate barriers and promote the development of renewable energy communities (Art. 22).

[Internal Electricity Market Directive](#) (EU/2019/944)

- Article 2: Definitions
- Article 11: Entitlement to dynamic price contracts
- Article 13: Entitlement to aggregation contract
- Article 15: Definition of active consumers
- Article 16: Citizen energy communities
- Article 17: Demand response through aggregation
- Article 21: Entitlement to a smart meter

- Includes definitions of an "active customer", "citizen energy communities", "aggregation" and "demand response" (Art. 2)
- The directive covers consumer empowerment and protection, including the right to a dynamic price scheme (Art. 11), aggregation contracts (Art. 13), participating in the market and to a smart metering system (Art. 21). Consumers should be enabled to participate in all forms of demand response and should have the possibility to benefit from smart metering systems and dynamic electricity price contracts to be able to adjust their consumption according to price signals.
- Citizens energy communities should be enabled to engage in electricity generation, distribution and supply, consumption, aggregation, storage or energy efficiency services (Art. 16).
- Member States should implement transparent and fair rules to allow independent aggregators to fulfil their roles as intermediaries and to ensure that the final customer adequately benefits from their activities (Art. 17). Also, non-discriminatory and transparent rules and procedures for the exchange of data between market participants engaged in aggregation and other electricity undertakings are to be implemented to ensure easy access to data while fully protecting commercially sensitive information and customers' personal data (Art. 17.3).

Energy Performance of Buildings Directive (EU/2018/844)

- The European Commission is tasked with developing an optional common scheme for rating the smart readiness of buildings; the rating shall be based on an assessment of the capabilities of a building or building unit to adapt its

Renewable energies	Name of policy/regulation	Short description
Non-legislative enabling policies & initiatives	<ul style="list-style-type: none"> Article 8 (10): Development of an optimal common scheme for rating the smart readiness of buildings (SRI) 	<ul style="list-style-type: none"> operation to the needs of the occupant and the grid. The smart readiness indicator shall also consider the flexibility of a building's overall electricity demand, including its ability to enable participation in active and passive as well as implicit and explicit demand response, in relation to the grid, for example through flexibility and load shifting capacities (Art. 8 (10) and Annex IA)
	<p>IEA EBC Annex 67:</p> <ul style="list-style-type: none"> Characterization of Energy Flexibility in Buildings 	<ul style="list-style-type: none"> The flexible use of energy is essential for a widespread deployment of renewable energy sources. The aim of the Annex 67 is to increase knowledge and showcase the benefits energy flexibility in buildings can provide for energy grids, uptake of renewables and the users.
	<p>Renewable Grid Initiative</p> <ul style="list-style-type: none"> Collaboration of European NGOs and transmission system operators for a sustainable grid development 	<ul style="list-style-type: none"> The Renewable Grid Initiative (RGI) is a knowledge exchange and dialogue platform between NGOs and transmission system operators funded to develop the needed infrastructure to integrate large shares of renewable energy. The RGI engages in the public and policy debate by publishing factsheets and position papers on broad topics, covering grid development, energy storage and energy flexibility.
	<p>REScoop.eu</p> <ul style="list-style-type: none"> European federation of citizen energy cooperatives 	<ul style="list-style-type: none"> REScoop is a European federation of 1,500 energy cooperatives advocating for a supportive policy framework and supporting individuals and communities to set up energy communities.
	<p>BRIDGE Horizon 2020</p> <ul style="list-style-type: none"> Energy Communities in the EU Task Force under a European Commission/DG ENER initiative 	<ul style="list-style-type: none"> BRIDGE is a European Commission/DG ENER initiative to unite smart grid, energy storage, and digitalisation projects funded under the Horizon 2020 programme with energy system stakeholders, such as consumer representatives, grid operators, regulatory experts, local energy communities' representatives, power technology providers, energy suppliers, and research and innovation experts. In the frame of the Energy Communities in the EU Task Force, the initiative develops reports and formulates recommendations to the Commission for the uptake and replicability of energy communities.

Table 5: Inventory of SPEN-related legislation in policy area "Renewable energies and energy flexibility"

3.4 Digital technologies and data protection

Digitalisation of the building and energy sectors requires **access to data, connectivity and smart technologies**. Smart grids and digital tools for demand-side management such as smart meters, smart chargers, and building automation and control systems (BACS) can facilitate flexibility in the energy system, which can help align energy demand with supply¹². Supporting the digitalisation and smart integration of buildings should be a key objective to maximise flexibility and support the coupling of the built environment with local energy production, consumption and mobility. Enabling instruments like the SRI help inform and empower the consumer to optimise their energy use and to engage with the energy system as prosumer. Most of the ongoing challenges relate to data privacy, cyber resilience and interoperability of digital devices.

The recently published [Commission Delegated Regulation \(EU\) 2020/2155](#) on the optimal common scheme for rating the smart readiness of buildings defines the scope and the calculation methodology of the SRI. Annex IX of the regulation determines the aspects an SRI certificate should convey to the end-users, including information on connectivity, where available, meaning the ability to exchange data among digital systems, buildings and other entities. **The exchange of data on energy consumption and production is essential for the distribution of energy across neighbourhoods**. Also, information on the interoperability of data and the cybersecurity of systems and data protection is to be included where possible, to inform the end-users (users, building owners) about their buildings' smart readiness.

As data is becoming increasingly important in the design of plus-energy neighbourhoods and smart cities, and consumption and user data is often stored in cloud platforms or other online databases, the regulation of data rights and **data protection is crucial**. The EU adopted a new data protection package in 2016 with the [General Data Protection Regulation \(GDPR, \(EU\) 2016/679\)](#) in force since 2018, which needs to be carefully implemented in Member States and considered by utilities as well as housing developers dealing with consumer data.

Distributed ledger technology, such as blockchain, is an innovative technology which facilitates the exchange and trade of locally generated energy within the district or neighbourhood in a direct and secure way. Several projects in European Member States are testing **peer-to-peer trading with blockchain technology with cloud based solutions** to maximise flexibility and data security and thus support the efficient use of local energy systems and positive energy districts, e.g. [Peer2Peer im Quartier \(Austria\)](#) or [Pebbles](#) (Germany).

Also, the construction and renovation process is increasingly accompanied by **digital solutions in planning and implementation**, such as building information modelling (BIM), 3D printing, digital twins, Internet of Things or augmented reality. These help save costs and time but require suitable skills and the latest software to be most effective. The Renovation Wave identifies digitalisation as an important driver of zero-emission and smart buildings and intends to "support digitalisation in the construction sector through Horizon Europe, Digital Innovation Hub and Testing and Experimentation Facilities" (COM(2020) 662). The upskilling and **reskilling of the workforce** will be supported by a new pact for skills, as well as ongoing initiatives like the LIFE funded [BUILD UP Skills](#) programme of the 2020 Skills Agenda.

¹² See for example Lyons (2019), *Digitalisation: Opportunities for heating and cooling*, JRC report, Publications Office of the European Union, Luxembourg

Digital technologies	Name of policy/regulation	Short description
EU legislation & strategic communication	Renovation Wave (COM (2020) 662) <ul style="list-style-type: none"> ● Digitalisation in the construction sector ● Smart, integrated building renovation activities ● Digital building logbook ● Building information modelling (BIM) ● Pact for Skills 	<ul style="list-style-type: none"> ● The Renovation Wave stresses the importance of digitalisation and defines the “twin challenges of the green and digital transition” as a key principle. ● By 2023 the EU Commission will introduce a framework for introducing digital building logbooks integrating all building-related data. ● In 2021, the EU Commission will present a unified EU framework for digital permitting and recommending BIM in public procurement. ● The Pact for Skills will enable an up- and reskilling of the required workforce, including digital skills, by encouraging Member States to exploit Next Generation EU funds, the European Social Fund+ and the Just Transition Fund. The Commission’s Youth Employment Support package of July 2020 announced a renewed European Alliance for Apprenticeships adding to the Build Up Skills initiative ongoing under the LIFE programme.
	Energy Performance of Buildings Directive (EU/2018/844) <ul style="list-style-type: none"> ● Article 8 – Technical building systems, and smart readiness indicator ● Article 14(4), (5) – Building automation and control systems 	<ul style="list-style-type: none"> ● EPBD Art. 8(1) obligates Member States to set requirements on the energy performance, proper installation, and appropriate dimensioning, adjustment and control of new, replaced and upgraded technical building systems. ● The EC was required to adopt a delegated act by 31 December 2019, to establish an optimal common Union scheme for rating the smart readiness of buildings (Art. 8(10)) (see Commission Delegated Regulation (EU) 2020/2155 below). ● Member States shall require non-residential buildings to be equipped with building automation and control systems, where technically and economically feasible (Art. 14(4)). ● Art. 14 (5) requires residential buildings to deploy electronic monitoring systems to inform building users and effective control systems to ensure optimum generation, distribution, storage and use of energy.
	Internal Electricity Market Directive (EU/2019/944) <ul style="list-style-type: none"> ● Article 2(23) – Definition of a smart metering system ● Article 19, 20 – Smart metering systems ● Article 21 – Entitlement to a smart meter 	<ul style="list-style-type: none"> ● Art. 2(23) defines a smart meter as a system able to measure electricity fed into or consumed from the grid, to provide information and to transmit and receive data from other systems (interoperability). ● Strong recommendation to introduce smart metering systems, energy management systems, and innovative pricing formulas to optimise use of energy in line with data protection regulations (Art. 19) to inform consumers and active customers in the electricity market. ● Art. 20 and Annex II specify technical functionalities of smart meter systems with a focus on interoperability and compliance with data security rules. ● Final customers have the right to request a smart meter to be installed at their own cost where smart meters are not rolled out at large in their Member State based on cost benefit assessment (Art. 21)

[Commission Delegated Regulation \(EU\) 2020/2155](#) of 14.10.2020 supplementing Directive (EU) 2010/31/EU of the European Parliament and of the Council by establishing an optional common European Union scheme for rating the smart readiness of buildings

- Definition and specification of the SRI scheme (Article 2,3)
- Calculation methodology (Annex I)
- Smart readiness impact criteria (Annex II)

[Commission Implementing Regulation C\(2020\) 6929](#), detailing the technical modalities for the effective implementation of an optional common Union scheme for rating the smart readiness of buildings.

- The Commission Delegated Regulation (C(2020) 6930 final) establishes the SRI definition and its calculation methodology, as required under Art. 8(10) of the EPBD. Annex II defines the smart readiness impact criteria as energy efficiency, maintenance and fault predictions, comfort, convenience, health, wellbeing and accessibility, information to occupants and energy flexibility and storage.
- The technical modalities of the SRI set out in the Implementing Regulation (C(2020) 6930 final) ensure effective implementation of the SRI scheme, regulate the qualification of SRI experts (Art. 3) and the nature of the certifications (Art. 4) including the coupling with energy performance certification and inspection schemes (Art. 5). The regulation covers the monitoring and promotion of the SRI scheme within the Member States and towards the Commission (Art. 7) and allows for a testing phase of the SRI scheme (Art. 8).

[General Data Protection Regulation \(GDPR\) Regulation \(EU\) 2016/679](#) of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation)

- Article 4: Definition of 'personal data'
- Article 5: Principles relating to processing of personal data
- Article 12-15: Transparency, information and access to personal data
- Article 17-21: Right to erase personal data and right to object

- The 2016 GDPR regulation renewed the regulatory framework relating to the "protection of personal data and rules relating to the free movement of personal data" and limits the collection and storage of data to a minimum only "for specified, explicit and legitimate purposes" (Article 5); the GDPR defines the right under which processing of data is allowed, including the individual has given consent (Article 6,1)
- The amount and type of data collected by an organisation or company depends on the intended use and the reason for processing. Data processing must be transparent and lawful (Article 5 (a)), and specific purposes must be defined and communicated with those individuals of whom data is collected (Article 5 (b)). Only the data necessary to fulfil the purpose may be collected (Article 5 (c)), and the collecting organisation must assure data is up to date (Article 5 (d)). Data may not be stored longer than necessary to achieve the purpose (Article 5 (e)), while the collecting organisation must assure organisational and technical safeguards to secure the personal data (Article 5 (f)).
- The GDPR entitles individuals to access, acquire and delete their personal data

Digital technologies	Name of policy/regulation	Short description
Non-legislative enabling policies & initiatives	Building information modelling (BIM) standardisation and mainstreaming activities <ul style="list-style-type: none"> ● CEN TC442 BIM: Standardization in the field of structured semantic life-cycle information for the built environment ● ISO/TC59/SC13: Organization and digitization of information about buildings and civil engineering works, including building information modelling ● ISO 16739-1:2018 industry foundation classes for data sharing in the construction and facility management industries 	<ul style="list-style-type: none"> ● CEN TC442 BIM develops standards, specifications and reports which specify methodologies to define, describe, exchange, monitor, record and securely handle asset data taking technical ISO specifications into account; advises EU Commission on policy implementing BIM in Europe. ● The ISO Technical Committee 59/SC13 sets standards for the interoperability of information through the whole lifecycle of buildings and infrastructure across the built environment, e.g. setting industry foundation classes as standard for data sharing in BIM that is compatible across software applications.
	EU BIM Task Group	<ul style="list-style-type: none"> ● The EU Commission promotes the use of BIM in public procurement and building activities through the EU BIM Task Group (2017 Handbook for the introduction of Building Information Modelling by the European Public Sector). ● Objectives include supporting Member States in relation to long-term strategies and BIM, smart cities and district approach solutions.
	EU Blockchain Observatory & Forum	<ul style="list-style-type: none"> ● Set up in 2018, the Blockchain Observatory and Forum gathers information and existing initiatives on blockchain technology and monitors developments; one working group defines the policy, legal and regulatory conditions needed for large-scale deployment of blockchain services.
	BUILD UP Skills initiatives	<ul style="list-style-type: none"> ● Through its 2011 launched BUILD UP Skills initiative, the EU aims to equip the next generation of construction sector worker for the transformation towards an energy-efficient building stock, including NZEB requirements and BIM qualification.
	Horizon 2020 projects on BIM training <ul style="list-style-type: none"> ● BIMcert (2018-2020) ● BIMEET (2017-2020) ● BIMplement (2017-2020) 	<ul style="list-style-type: none"> ● Different Horizon 2020-funded projects¹³ develop qualification methodologies (standardised qualification framework, BIMEET) and certification schemes to upscale the implementation of ICT and BIM through upgrading skills and capacities of the EU construction workforce.

¹³ The Horizon 2020 projects referred to are only a sample and examples of BIM skills and education projects and do not aim to be exhaustive.

Digital technologies	Name of policy/regulation	Short description
	<p>DigiPLACE – Horizon 2020 project</p> <ul style="list-style-type: none"> • Towards a European Digital Platform for Construction 	<ul style="list-style-type: none"> • DigiPLACE aims at developing a framework to facilitate exchange of information and accelerate the uptake of innovative digital solutions in construction processes. • Mainstreaming of different languages, taxation and regulatory frameworks to develop common ecosystems of digital services that will support innovation in architecture and construction, laying the ground for SPENs.

Table 6: Inventory of SPEN-related legislation in policy area “Digital technologies”

3.5 Affordable living, health and wellbeing

As people spend about 90% of their time indoors, the indoor environment has a significant effect on their health and wellbeing. The transition to high performing buildings and SPENs will not be driven by energy savings alone. Instead, it must be approached through a more comprehensive perspective. Owners do not usually “buy” energy performance; rather, they tend to solve a problem, add value to their properties or seek an emotionally charged benefit like thermal comfort, safety, pleasure or privacy. Equally, they are not primarily looking for plus-energy homes, but they might want to improve health and quality of life. Measures simultaneously addressing energy performance and a healthy indoor environment (including aspects related to indoor air quality, thermal comfort, acoustics and lighting) are thus key to increase demand for SPENs.

A good energy strategy can also alleviate energy poverty by reducing the (fossil-fuel) energy consumption and related expenses. The success of SPENs will also depend on the affordability (rents + energy expenses) of these places. While the immediate benefits of SPENs (energy and cost savings, improvements in health, comfort, etc.) are most evident to residents, the wider and less tangible impacts can be felt in the surrounding neighbourhoods. These wider benefits may include a growth of local businesses and local job creation as a result of urban regeneration and improvement of community facilities, accessibility, safety and public spaces. Synergies with the social agenda become evident when scaled up to district and community approaches. SPEN initiatives underscore the importance of co-design, social support and community engagement to achieve maximum impact and ensure a socially inclusive transformation.

The EPBD addresses health and the indoor environment in several places (Art.2a, Art.7, Annex I, Annex IA). However, the references to health aspects are not directly connected to SPENs, even though the forthcoming EPBD review in 2021 is expected to require Member States to consider integrated district or neighbourhood approaches.

The demand for SPENs will also be determined by the ability of SPEN promoters to provide affordable housing solutions. Whether in a situation of homeownership, private rental or social housing, the ability of residents to pay for the increased costs of new construction and renovation will remain a stumbling block for the decarbonisation of the built environment. In theory, the increase of costs can be compensated by the decrease of energy consumption as well as by the income generated by local energy production. However, technical solutions need to be improved and manufactured at large scale so that they can help to achieve a sufficient level of comfort and affordability for residents and renewable energy self-consumption projects will need to be further supported so that residents can fully benefit from them.

Despite being mentioned in key building-related policies, health and wellbeing aspects are not systematically approached and recognised in existing policies and building regulations. Insufficient research and evidence means housing quality remains difficult to communicate, report, track and monetise. An example of this is the absence of costs related to health effects in the cost-optimality calculations of minimum energy performance for buildings and building elements (Cost-Optimality Commission Delegated Regulation 2010/31/EU).

A number of non-legislative initiatives are aiming to address this gap and to consider health, wellbeing and affordability aspects:

- The recently adopted (October 2020) Delegated Regulation establishing an optional common European Union scheme for rating the smart readiness of buildings includes health, wellbeing and accessibility in its calculation protocol. The SRI is essentially an assessment of the capacity of a building to adapt to the needs of the occupant and in reaction to signals from the grid (energy flexibility), which makes it particularly relevant for SPENs.
- [Level\(s\)](#), the common EU assessment and reporting framework, provides a common language for sustainability performance of buildings. It promotes lifecycle thinking and a core set of indicators including carbon, materials, water, health and comfort, climate change impacts and cost. Although Level(s) refers to the building level only, there is a potential to expand its scope at neighbourhood scale as well.

- Several initiatives, such as the Affordable Housing Initiative and the Energy Poverty Observatory, are aiming to combat energy poverty e.g. through national energy efficiency funding schemes targeting lower-income groups.
- The [Well Standard](#) as well as other green building rating tools are relevant market initiatives which have greatly contributed to awareness-raising, workforce training and change of investment models. As sustainability certifications are invariably close to the market, they can provide:
 - Useful avenue for policymakers to trial and test the introduction of new criteria, especially concerning health and wellbeing where policy/regulation is not yet well established
 - Feedback from real projects and on market readiness
 - Clarification as to what data should be collected and how to document multiple benefits.
- Relevant for SPENs, the WELL Community Standard pilot has broadened its scope to communities and public spaces. The WELL Community Standard aims to support the development of health-focused and supported communities, through 10 concepts: air, water, nourishment, light, movement, thermal comfort, sound, materials, mind and community.

While standards are voluntary codes and have no binding force by themselves, if they are part of a regulation or directive they essentially become a legal act. In other words, if a regulation or directive refers to a standard or ties certain requirements to a standard, compliance with the standard becomes a legal requirement. The EN 16798-1 standard along with several other EN standards (e.g. EN 7730, 12464-1 etc.) defines the requirements of indoor environmental parameters for thermal comfort, indoor air quality, lighting and acoustics and has raised awareness on health and wellbeing aspects of indoor environmental quality. The standards describe the comfort-related performance criteria that should be taken into account in the context of energy calculation and assessment based on the EPBD (EU/2018/844). The EN 16798-1 standard has been adopted by all Member States even though there is no legal obligation to apply it.

Finally, while not exclusively building-related, the Directive 2008/50/EC on ambient air quality and cleaner air for Europe, and the Directive 2015/1480/EC amending several of its annexes, set air quality objectives and limit values of specific contaminants of the outdoor air, which could be applicable to districts and neighbourhoods.

Affordability, health & wellbeing	Name of policy/regulation	Short description
EU legislation & strategic communication	<p>Energy Performance of Buildings Directive (EU/2018/844)</p> <ul style="list-style-type: none"> ● Article 2a: Long-term renovation strategy ● Article 7: Existing buildings ● Annex I: Common general framework for the calculation of energy performance of buildings ● Annex IA: Common general framework for rating the smart readiness of buildings 	<ul style="list-style-type: none"> ● Each LTRS shall encompass an evidence-based estimate of expected energy savings and wider benefits such as those related to health, safety and air quality (Art. 2a (1)). ● Each LTRS shall encompass an outline of relevant national actions that contribute to the alleviation of energy poverty (Art. 2a (1)). ● For buildings undergoing a major renovation, Member States shall address issues related to healthy indoor climate conditions (Art. 7). ● Energy needs for space heating, cooling, ventilation, lighting and other technical building systems shall be calculated in order to optimise health, indoor air quality and comfort levels defined by Member States at the national, regional or city/local level (Annex I). ● The methodology of the SRI shall rely on the ability to adapt its operation mode in response to the needs of the occupant while maintaining healthy indoor climate conditions (Annex IA).
	<p>Energy Efficiency Directive (EU/2012/27)</p> <ul style="list-style-type: none"> ● Cost-benefits analysis, Part 1: General principles of the Cost-benefits analysis, Part ● Article 7: Energy efficiency obligation schemes 	<ul style="list-style-type: none"> ● The prices used in the economic analysis shall reflect the true economic costs and benefits and should include external costs such as environmental and health effects to the extent possible. ● Article 7: Member States shall take into account the need to alleviate energy demand by requiring a share of energy efficiency measures under their national energy efficiency obligation schemes, alternative policy measures, or programmes or measures financed under an energy efficiency national fund, to be implemented as a priority among vulnerable households, including those affected by energy poverty and, where appropriate, in social housing.
	<p>Commission Delegated Regulation (EU) 2020/2155 of 14.10.2020 supplementing Directive (EU) 2010/31/EU of the European Parliament and of the Council by establishing an optional common European Union scheme for rating the smart readiness of buildings Commission Recommendation 2019/786 on building renovation</p>	<ul style="list-style-type: none"> ● One of the impact criteria considered in the calculation protocol of the SRI is health, wellbeing and accessibility. ● For the “response to user needs” key functionality, the relevant impact criteria are comfort, convenience, information to occupants, health, wellbeing and accessibility. ● Guidance on recently revised provisions of the EPBD including Art. 2a on LTRS. The guidance elaborates indicators and milestones including quantitative and qualitative data related to potential wider benefits.
Non-legislative enabling policies & initiatives	<p>EU Level(s): A common EU framework of core sustainability indicators for office and residential buildings</p>	<ul style="list-style-type: none"> ● Macro-objective 4: Health and comfortable spaces refers to important aspects of the indoor environment such as air quality, thermal comfort, lighting and acoustics. ● Macro-objective 5: Adaptation and resilience to climate change refers to the protection of occupier health and thermal comfort.

Affordability, health & wellbeing	Name of policy/regulation	Short description
Non-legislative enabling policies & initiatives	Energy Efficiency Financial Institutions Group (EEFIG) – Multiple Benefits Working Group	<ul style="list-style-type: none"> EEFIG addresses barriers to energy efficiency financing through both policy design and market-based solutions to increase the scale of energy efficiency investments. The focus of the working group is on better capturing and articulating the multiple benefits of energy efficiency investments for decision-makers and in reporting.
	Affordable Housing Initiative	<ul style="list-style-type: none"> The Commission will launch this initiative for 100 lighthouse projects to examine if and how EU budget resources can be used to fund national energy efficiency and savings schemes targeting lower-income populations.
	Energy Poverty Observatory <ul style="list-style-type: none"> Initiative by the European Commission 	<ul style="list-style-type: none"> Aims to help Member States in their efforts to combat energy poverty, to improve the measuring, monitoring and sharing of knowledge and best practice of energy poverty.
	Zero Pollution Action Plan	<ul style="list-style-type: none"> To secure clean air, water and soil, healthy ecosystems and a healthy living environment for Europeans, the EU needs to better prevent, remedy, monitor and report on pollution, mainstream the zero pollution ambition into all its policy developments and decouple economic growth from the increase of pollution, in line with UN-driven efforts.
	All policies for a Healthy Europe (AP4AHE)	<ul style="list-style-type: none"> An intersectoral initiative that brings together a diverse group of NGOs, think-tanks, associations, companies and individuals aiming to put citizens' health and wellbeing at the heart of EU policymaking.
	EN 16798-2: 2019 Energy performance of buildings: Ventilation for buildings – Part 1: Indoor environmental inputs parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics	<ul style="list-style-type: none"> This EN standard specifies the requirements of indoor environmental parameters for thermal comfort, indoor air quality, lighting and acoustics and mentions how to establish these parameters for designing the building system and calculating the energy performance.
	WELL Building Standard WELL Community Standard pilot	<ul style="list-style-type: none"> WELL Building Standard is a performance-based system for monitoring, measuring and certifying features of the built environment that impact human health and wellbeing through air, nourishment, water, light, fitness, control and mind. The WELL Community Standard pilot builds on the WELL Building Standard and is aiming at protecting health and wellbeing across all aspects of community life.
	Green building certification tools (such as BREEAM , DGNB , LEED , HQE , etc.)	<ul style="list-style-type: none"> Rating tools are used to assess and award buildings that meet certain green requirements or standards. In effect, they drive the market towards more sustainable practices. All rating tools include modules on a range of environmental and social criteria including energy and water use, health and wellbeing, pollution, transport, materials, waste, ecology and management processes.

Table 7: Inventory of SPEN-related legislation in policy area "Affordability, health and wellbeing"

4. Spain: national policy framework, opportunities and barriers to SPEN development

The Spanish LTRS¹⁴ introduced the PED concept in 2017 as a key structure to reach the Sustainable Development Goals and to smooth the path for the decarbonisation of the building sector. Since then, however, there have been no notable advances in defining or promoting the concept, from either a political or regulatory point of view. Only the regulation related to shared energy self-consumption stands out,¹⁵ as a preliminary step to fully transposing the concept of energy communities into law, which is still pending. Overall, there is a lack of policy coherence for PEDs and developers of district approaches must navigate a maze of unfavourable regulations. This review of the Spanish policy landscape puts a special focus on Catalanian legislation as the syn.ikia pilot case is situated here.



4.1 Overview of PED projects in Spain

The first compilation of European PED projects undertaken by JPI Urban Europe¹⁶ in February 2020 indicated that Spanish PED activities, beyond syn.ikia, fall mainly under the umbrella of one research project (smartcity-Atelier¹⁷) and one private initiative (Barrio La Pinada¹⁸), resulting in two demo cases located in Bilbao (in implementation stage) and Paterna (in planning stage). Smartcity-Atelier started in 2019 and considers both new and existing buildings, including residential, office, industrial and educational uses. La Pinada, which began earlier in 2016 but has a longer implementation scope (until 2027), focuses mainly on new construction and residential uses, with a remarkable participatory vision. A JPI analysis highlights two other Spanish projects which, although they have no declared PED ambition, present interesting features for the PED programme. These are the already implemented Pozo Barredo district heating project in Mieres¹⁹ (of particular interest for the size of the ambition and the different affected uses), and Móstoles Ecoenergía,²⁰ Spain's largest and most ambitious biomass-based district heating plant.

From a broader perspective, multiple initiatives of the recent past can be considered as precursors of the current PED initiatives, mainly promoted through European funds (such as the Seventh Framework Programme). Out of a total of nine pioneer projects, four (R2Cities, EU-GUGLE, ZenN and CITYFIED) were led by Spanish entities, and 22% of the participants were national bodies. Those projects mainly focused on the rehabilitation of districts (composed mostly of residential buildings), the deployment or modernisation of heat networks and the deployment of renewable energy sources, in addition to the control of buildings and energy systems. Spain is also heavily involved within the Horizon 2020 Smart Cities and Communities lighthouse project initiative, being the Member State with the most projects (7.41% of the total). Spain has 7 of the 46 lighthouse cities, and a further 5 (out of a total of 70) cities replicating these projects.²¹

¹⁴ LTRS Spain (ES): <https://www.mitma.gob.es/el-ministerio/planes-estrategicos/estrategia-a-largo-plazo-para-la-rehabilitacion-energetica-en-el-sector-de-la-edificacion-en-espana>

¹⁵ Royal Decree 244/2019, which regulates the conditions administrative, technical and economic self-consumption of electrical energy. <https://www.boe.es/boe/dias/2019/04/06/pdfs/BOE-A-2019-5089.pdf>

¹⁶ JPI Urban Europe (2020), EUROPE TOWARDS POSITIVE ENERGY DISTRICTS, A compilation of projects towards sustainable urbanization and the energy transition https://jpi-urbaneurope.eu/wp-content/uploads/2020/06/PED-Booklet-Update-Feb-2020_2.pdf

¹⁷ Smart City Atelier project website: <https://smartcity-atelier.eu>

¹⁸ Barrio La Pinada project website: <https://www.barriolapinada.es/en>

¹⁹ Pozo Barredo district heating project: <http://www.aulahunosa.es/red-de-calor-mieres>

²⁰ Renewable Heating & Cooling, 2050 vision for 100% renewable heating and cooling in europe, 2019, <https://www.rhc-plgt-form.org/content/uploads/2019/10/RHC-VISION-2050-WEB.pdf>

²¹ EU Smart Cities information system: <https://smartcities-infosystem.eu/scc-lighthouse-projects>

4.2 Spain's energy mix related to the building sector

The generation of electrical energy in the Spanish system 2019 was based on 39% renewable production (hydropower, wind, solar photovoltaic (PV), solar thermal, renewable waste and other renewables) and 61% non-renewable (nuclear, coal, gas, combined cycle, cogeneration, pumping and non-renewable waste).²² Renewable power installations are growing faster than non-renewable sources (50.1% of new installed renewable capacity in 2019 vs. 49.9% of non-renewable sources). Traditionally hydropower was the dominant source of renewable electricity, but has been overtaken by wind power. In recent years, solar PV has also begun to stand out.

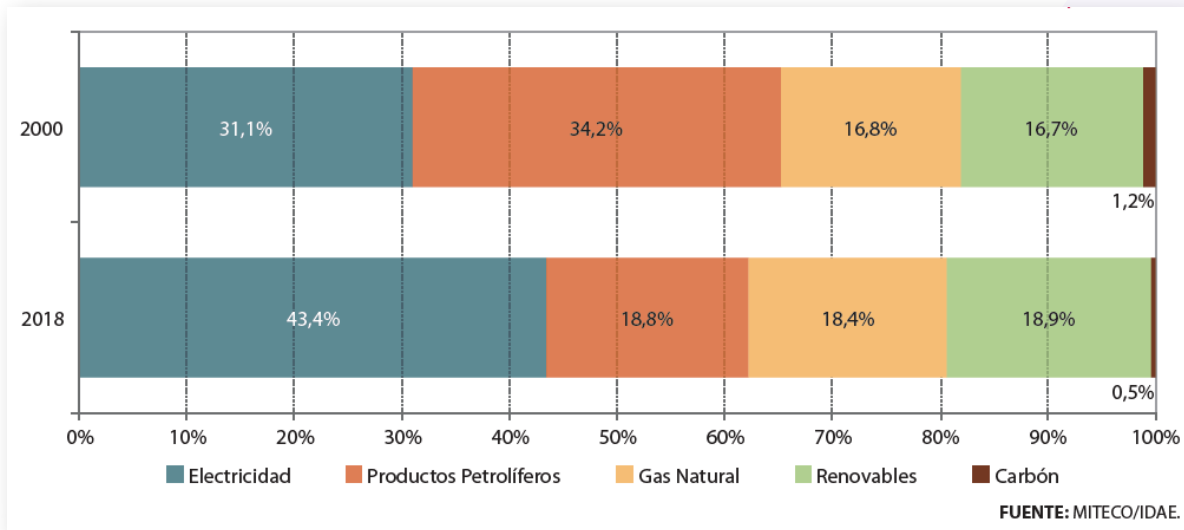


Figure 2: Energy consumption in the Spanish residential sector, 2000-2018 ("Energy in Spain". Ministry for Ecological Transition and the Demographic Challenge, 2018)

It is not easy to assess the exact energy consumption in all buildings as the sector is allocated to the "diverse uses" category in the statistical data. However, for the residential sector, 43.4% of the consumption is electricity, 18.9% comes directly from renewable sources, while the remaining 37.7% comes from fossil fuels.²³ This represents a clear upward trend in the electrification of the sector compared to previous baseline data.

End users in Spain are free to choose their power supplier and choose between different electricity contracts to find one that suits their needs. Currently, Spanish end users are free to choose from more than 500 suppliers. There are two main modalities in the contracting of electricity: on the one hand, the so-called regulated market, which offers an electricity tariff at a supervised price, and on the other hand, the free market. In the first case, there is the option of an hourly rate to the small consumer, based on a price per kW for each hour of the day, or the option of rates with a fixed price. The various free-market tariffs are more common among large consumers; they do not allow access to social bonds (for mitigating cases of energy poverty). From the transposition of the Energy Efficiency Directive 2012/27/EU, over 99% of the Spanish households have smart meters installed.²⁴

²² Electricity system report (Informe del sistema eléctrico), Red Eléctrica de España 2019: https://www.ree.es/sites/default/files/11_PUBLICATIONES/Documentos/InformesSistemaElectrico/2019/inf_sis_elec_ree_2019_v2.pdf

²³ Energy statistics Spain 2018 (La energía en España 2018): <https://energia.gob.es/balances/Balances/LibrosEnergia/Libro-Energia-2018.pdf>

²⁴ European Commission, Benchmarking smart metering deployment in the EU-28, 2020 <https://op.europa.eu/en/publication-detail/-/publication/b397ef73-698f-11ea-b735-01aa75ed71a1/language-en>

Spain is on course to reduce the energy consumption of the building stock through several initiatives drafted in the national energy and climate plan (NECP) 2021-2030²⁵, aligned with the recently introduced recovery funds plan called España Puede.²⁶

4.3 Governance structure in Spain

Spain features a three-tier governance system comprising the national government, elected county councils at the regional level, and municipalities with elected councils at the local level. The policy framework is formed on these three levels. Although Spain is a decentralised country, with relevant competences transferred to the 17 regions, regulations for the building and energy markets are quite dispersed. Some key regulations, such as those referring to the ownership of the building, are national level, while others, such as those concerning urban planning, are implemented on the regional and local level. Despite this, there is currently a clear trend on the part of the national government to redefine or introduce new regulations that allow a transition towards decarbonisation of the economy and compliance with Paris Agreement goals, and to allow local authorities to design and implement support actions.

²⁵ Spanish National energy and climate plan (NECP): <https://www.idae.es/informacion-y-publicaciones/plan-nacional-integrado-de-energia-y-clima-pniec-2021-2030>

²⁶ Spanish Economic Recovery and Resilience Plan, "España Puede", 2020: <https://www.lamoncloa.gob.es/presidente/actividades/Paginas/2020/espana-puede.aspx>

4.4 National policy review

Key issues CATALONIA	Name of the policy/ initiative/ measures	Key facts	Implementing organisation and governance level	Strength/ weakness
Self consumption costs	Act 24/2013 of 26 December on the Electric Sector	The law aims to ensure an orderly development of self consumption of electricity, compatible with the need to ensure the technical and economic sustainability of the electricity system as a whole.	Ministry of Energy, Tourism and Digital Agenda (national level)	WEAKNESS What in principle should be a great help for development in fact becomes a weakness, as it significantly limits the network development and penalises its implementation and normalisation. In this respect, the articles of the law establish the obligation of self-consumption facilities to contribute to the financing of system costs and services to the same extent as other consumers.
Electric supply policy	Royal Decree 1955/2000 of 1 December	Regulates transport activities, distribution, supply and procedures for the authorisation of electric energy facilities.	Ministry of Energy, Tourism and Digital Agenda (national level)	WEAKNESS The supply contract is personal, and its owner must be the actual user of the energy, who may not use it in a different place from which it was contracted, or transfer or sell it to third parties. This clearly impairs the development of shared networks and the optimisation of resources.
Landscape and heritage protection	Local ordinances	Criteria for urban landscape or protection of architectural heritage	City councils (municipal level)	WEAKNESS The ordinances may have elements limiting the correct development of both positive energy buildings and district renewable energy production networks. Provisions on urban landscapes or protection of architectural heritage are in many cases barriers to the deployment of both larger and smaller-scale renewable energy installations. Protected roofs, view protection and complex structures can be significant limitations that make it impossible to achieve positive energy buildings and therefore districts. In historic neighbourhoods, this problem is widespread, limiting the degree of positive energy that many cities could achieve.
Budget limitations on public housing	Decree 75/2014 of 27 May, of the Plan for the Right to Housing	The Plan for the Right to Housing brings in the social housing programme, the retrofitting promotion programme, the social housing programme and other related and complementary measures.	Regional Ministry of Territory and Sustainability Catalonia (regional level)	WEAKNESS The decree sets the maximum rents/sale price for social housing, as well as the maximum sale in second and later transfers. This significantly limits the investment possibilities of the promoters of social housing, as the budget is clearly affected. The modules set by decree (€/m ² of usable area) do not allow major improvements to be made above the mandatory regulations, which can clearly affect the promotion of positive energy housing.

Key issues CATALONIA	Name of the policy/ initiative/ measures	Key facts	Implementing organisation and governance level	Strength/ weakness
Public sector procurement	Act 9/2017 of 8 November, on Public Sector Contracts, implementing into the Spanish legal system the Directives of the European Parliament and of the Board 2014/23/EU and 2014/24/EU, of 26 February 2017 (Official State Gazette 9/11/2017)	The purpose of the act is to regulate public procurement, in order to comply with the principles of freedom of access to tendering, publicity and transparency of procedures, and non-discrimination and equal treatment between tenderers; and to ensure, in relation to the objective of budgetary stability and control of expenditure, and the principle of integrity, an efficient use of funds for the execution of works, the acquisition of goods and the contracting of services requiring the prior definition of the needs to be met, the safeguarding of free competition and the selection of the most economically advantageous tender.	Ministry of Finance (national level)	<p>WEAKNESS</p> <p>The main concern with this law is the timing and award criteria. The bidding process is long and complex. The guarantees required often limit the competition. The award criteria is not flexible enough to take into account the uniqueness of the proposals. The evaluation must be based not only on objective, measurable criteria, but include contractual solutions that assess criteria that could be considered more subjective.</p> <p>For projects that include innovation, the administrative clauses governing the association of innovative teams or companies should include not only the estimated cost of the research phase, but also anticipate the amount of any contracts arising from the association. This will depend, in the first place, on the success of the research, and secondly on the viability in terms of effectiveness, efficiency and cost-benefit of the solution achieved.</p>
Energy aspects not sufficiently considered in the assessment of architectural projects	Law 12/2017 of 6 July, on Architecture	This law regulates that in selecting tenders for public contracts, priority is given to quality, environmental and social considerations, the energy transition, and aspects that affect self-production and new energy management.	Catalonian Regional Ministry of the Presidency (regional level)	<p>WEAKNESS</p> <p>The law runs the risk of overestimating architectural criteria to the detriment of technical criteria in the field of energy, rather than finding architectural solutions that facilitate the production and distribution of energy for both buildings and urban sectors.</p> <p>In addition, bidding is long and complex and the addition of the Act on Architecture in Catalonia further slows the procurement of public projects, which need to be selected through a specialised jury in order to improve the architectural quality.</p>
Promotion of renewable energy production	Ordinances	Promotion of renewables in urban areas	City councils (municipal level)	<p>STRENGTH</p> <p>There are new local ordinances which encourage the generation of renewable energy both for self-consumption and to share with other buildings or even with other energy communities. The Catalan Energy Institute has drafted a template for ordinances for municipalities concerned with the promotion of photovoltaic energy.</p>

Key issues CATALONIA	Name of the policy/ initiative/ measures	Key facts	Implementing organisation and governance level	Strength/ weakness
<p>Technical building code: positive but insufficient requirements</p>	<p>Technical Building Code (Amendment 2019)</p>	<p>This regulation sets all aspects and requirements in the field of construction at state level. The latest updates aim to reduce energy demand for buildings, introduce requirements for energy efficiency and especially encourage the use of renewables.</p>	<p>Ministry of Transport, Mobility and Urban Agenda (national level)</p>	<p>STRENGTH The Technical Building Code is a good help to reach positive energy buildings, as the requirements of the latest revision are more demanding in terms of energy efficiency and energy generation from renewable energy sources.</p>

Key issues CATALONIA	Name of the policy/ initiative/ measures	Key facts	Scope and implementing organisation	Strength/ weakness
Self consumption possibilities	Royal Decree 244/2019 of 5 April, regulating the administrative, technical and economic conditions of the self consumption of electric energy	Most relevant regulation in the production and management of renewable energy – has led to a major change in both individual buildings and local networks.	Ministry of Transport, Mobility and Urban Agenda (national level)	STRENGTH This regulation has clearly expanded the possibilities of sharing electricity generated from solar PV; however, the spread of SPENs is not easy as flexibility is still quite limited. For example, the distance between the generation and consumption points cannot exceed 500 metres. In addition, although smart meters are put in place, regulations don't allow a flexible energy share because the electricity generated must be distributed according to yearly fixed coefficients in a fixed consumer community independently of individual consumption.
Energy transition	National agreement for the energy transition of Catalonia	This document of intentions sets the energy challenges of Catalonia up to 2030, identifying the main challenges that Catalonia faces in the energy field and those fundamentally linked to positive energy districts.	Regional level (government of Catalonia)	STRENGTH The objectives of this agreement focus on making Catalonia an energy efficient and competitive region. Main points are: <ul style="list-style-type: none"> • Promote a low-carbon, resource-efficient and competitive economy • Promote demand management and the transformation of social perception towards energy • Generalise the application of energy saving and efficiency measures • Ensure the energy supply of the future • Improve energy governance.
Energy transition	Draft Climate Change and Energy Transition Act (29 May 2020)	Willingness to make important changes in laws limiting the development of positive energy districts.	Ministry for the Ecological Transition and the Demographic Challenge (national level)	STRENGTH This law, which has not yet been approved, will considerably revise the regulatory framework that currently limits the development of SPENs. Improvements will affect, for instance, the management of electricity demand through independent brokers or aggregators of demand and a new remuneration framework for the production of electricity from renewable energy sources, based on the long-term recognition of a fixed price for energy.

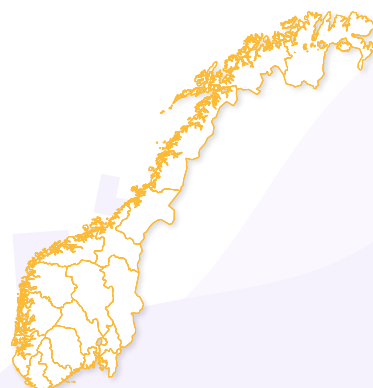
4.5 Key takeaways

- Although recent regulations have expanded the possibilities of sharing electricity generated from solar P V, the spread of SPENs is not easy as flexibility is still quite limited. For example, regarding local energy communities as a key element of SPENs, the distance between the generation and consumption points may not exceed 500 metres, and the overall installed power must be lower than 100 kWp. In addition, although smart meters are put in place, regulations do not allow a flexible energy share because the electricity generated must be distributed according to yearly fixed coefficients linked to a specific consumer community with no regard to the variability of individual consumption.
- The latest revision of the Spanish technical building code increased the ambition of buildings' energy performance and renewable energy generation. In theory, this building regulation supports positive energy buildings but the framework does not reflect the actual conditions of PED implementation (i.e. regarding the types of energy consumption considered or the energy user profiles implemented), so it cannot drive real implementation of SPENs.
- Several local regulations do not allow certain energy installations in heritage neighbourhoods/buildings or in zones with landscape protection when they can affect the urban landscape or the aesthetics of those buildings and zones. On the other hand, local ordinances increasingly encourage the generation of renewable energy, including both self-consumption and sharing of locally produced energy with other buildings or even with other energy communities. Also, regional government institutions, such as the Catalan Energy Institute, are promoting such activities, particularly to increase the number of prosumers.
- At national level in Spain, there are no significant actions to promote SPEN development at the cut-off date of this report. However, the acceleration of the different decarbonisation plans, linked to the recovery funds, may bring specific subsidy and financing schemes which, combined with legislative changes underway, will allow for a more conducive frame of reference.
- The recent introduction of collective self-consumption in Spanish regulations should be accompanied by capacity building and communication measures so that citizens can easily adapt to the change from traditional individual consumption to collective energy management.
- Regarding social housing, regulations limit the maximum rents of the dwellings destined for rental and the maximum price of the dwellings destined for sale, as well as the maximum price of sale in the second and later transfers. This significantly limits the budget of social housing developments as well as the introduction of technical solutions for energy efficiency and generation, although they would be cost-effective in a lifecycle cost balance. This clearly influences the promotion of positive energy buildings for social housing.

5. Norway: national policy framework, opportunities and barriers for SPEN development

SPEN is a relatively novel policy concept that requires innovations in many different areas. In Norway, no specific regulations addressing positive energy neighbourhoods/districts are implemented yet. The policy framework in Norway consists of different laws and regulations, guiding principles and standards which SPEN developers and researchers have to navigate through. This section outlines some important aspects of Norway's national policy context.

NORWAY



5.1 Overview of PED projects in Norway

The first compilation of European PED projects undertaken by JPI Urban Europe²⁷ in February 2020 indicated that Norwegian PED activities fall mainly under the umbrella of three research projects, both national and international: [+CityxChange](https://cityxchange.eu),²⁸ [ZEN](https://fmezen.no)²⁹ and Syn.ikia. Both +CityxChange and Syn.ikia are projects under EU calls specifically targeting positive energy blocks and districts, while ZEN is funded by the Research Council of Norway which supports FMEs (Research Centres for Environmentally Friendly Energy) on a range of topics, of which the ZEN centre is one. Chronologically by project kick-off, FME ZEN is the first, having been initiated in 2017, followed by +CityxChange in 2018 and syn.ikia in 2020. Together, these three projects are developing 12 pilot sites in Norway into positive energy neighbourhoods/districts.

5.2 Norway's energy mix related to the building sector

Norway's power system is based on renewable energy with electricity production sourced mainly from hydropower.³⁰ Norway is also one of Europe's leading producers of hydropower.

More than 80% of energy use in Norwegian buildings is electric.³¹ End users in Norway are free to choose their power supplier between different electricity contracts and find one that suits their needs. As of December 2020, Norwegian end users are free to choose from more than 50 suppliers.

The three types of contracts are fixed-price, standard variable price, and spot price (based on market prices with a mark-up). All Norwegian households have smart meters installed as part of the rollout of advanced metering systems³² and a central database for the Norwegian power market (known as Elhub). These smart meters can measure electricity consumption hour by hour. The advanced metering system is paving the way for new types of electricity contracts to be developed based on hourly prices, but new pricing models and grid tariffs still need to be introduced to realise the potential of the smart grid.

²⁷ JPI Urban Europe (2020), *EUROPE TOWARDS POSITIVE ENERGY DISTRICTS, A compilation of projects towards sustainable urbanization and the energy transition*, https://jpi-urbaneurope.eu/wp-content/uploads/2020/06/PED-Booklet-Update-Feb-2020_2.pdf

²⁸ CityxChange project website: <https://cityxchange.eu>

²⁹ ZEN project website: <https://fmezen.no>

³⁰ Energy facts Norway, *The Power Market*: <https://energifaktanorge.no/en/norsk-energiforsyning/kraftmarkedet>

³¹ Statistics Norway, *Energy consumption in residential buildings*: <https://www.ssb.no/energi-og-industri/statistikker/husenergi>

³² ELHUB website: <https://elhub.no/en/about-elhub/elhubs-impact-on-the-norwegian-energy-system>

The Norwegian government has also been focusing on reducing consumption in the building sector as a whole with the state enterprise for energy efficiency, Enova, instituting a number of appliance and product labelling measures to influence household purchasing decisions considering energy consumption.

However, there is a general consensus that the relatively cheap end-user electricity price (compared to most countries in Europe) and the emission-free status of electricity in Norway can actually be a hindrance to energy-efficient end-user behaviour.

5.3 Relevant authorities and agencies

A number of authorities and agencies are responsible for legislations and guidelines. In addition, there are other actors providing incentives and investment support directed at both private and public actors to pave the way to a low-carbon society in Norway. Two such actors are ENOVA SF and Innovation Norway.

	Most relevant authorities and agencies	Norwegian name and links	Abbreviation	Brief description
1.	Norwegian Water Resources and Energy Directorate	Norges vassdrags- og energidirektorat	NVE	A directorate under the Ministry of Petroleum and Energy responsible for the management of Norway's water and energy resources.
2.	Norwegian Energy Regulatory Authority	Reguleringsmyndigheten for energi	NVE-RME	The national regulatory authority for the electricity and natural gas market in Norway.
3.	Ministry of Local Government and Modernisation	Kommunal- og moderniseringsdepartementet	KMD	The national regulatory authority for the electricity and natural gas market in Norway.
4.	Ministry of Climate and Environment	Klima og miljø departementet	KLD	The ministry responsible for carrying out the environmental policies of the Norwegian government.
5.	Ministry of Petroleum and Energy	Olje og energi departementet	OED	The ministry responsible for a coordinated and comprehensive energy policy.
6.	Norwegian Building Authority	Direktoratet for byggkvalitet	DIBK	The ministry responsible for carrying out the environmental policies of the Norwegian government.
7.	ENOVA	ENOVA	-	A state enterprise under the Ministry of Climate and Environment tasked with Norway's transition to a low emission society; also manages the Energy Fund which provides subsidies for energy efficiency and renewable energy solutions.
8.	Innovation Norway	Innovasjon Norge	IN	The Norwegian government's official trade representative abroad; also provides grants and loans linked to environmental technology or commercialisation of new solutions.
9.	Statnett (system operator)	Statnett	-	The sole system operator of the Norwegian power system, owning and operating the transmission grid and maintaining the balance between consumption and production; also the developer of Elhub.
10.	Standards Norway	Standard Norge	SN	Responsible for all standardisation areas except electro technology and telecommunication.

Table 8: Relevant Norwegian authorities and agencies

5.4 Local governance structure in Norway – the municipalities

Norway is organised across three levels of policymaking, with a governance system that includes the national government, elected county councils at the regional level, and municipalities with elected councils at the local level. The policy framework is formed on these three levels.

Municipalities are the primary level of local government and administration in Norway. As of December 2020, there are 356 municipalities and 11 counties in Norway. Municipalities are responsible for local area planning and environmental issues, in addition to primary health care, primary and lower secondary education, social services, water and sewage. Municipalities are also engaged in what can be called voluntary tasks such as reducing greenhouse gas emissions and measures to decrease energy consumption in municipal buildings. Municipalities are also responsible for municipal masterplans and zoning plans³³ as part of the Planning and Building Act (PBA), and these two planning instruments need to be considered in the development of SPENs.

³³Norwegian government, Planning and Building Act: <https://www.regjeringen.no/en/topics/plan-bygg-og-eiendom/plan-og-bygningsloven/planning/id1317>

5.5 National policy review

District approach

Key issues	Name of the policy/initiative/ measures	Key facts (objectives, status, impact)	Implementing organisation	Strength/ weakness
Not possible to demand higher standard than minimum requirements in the building code	<p>Planning and Building Act (PBA) §11-7 Alterations to and revocation of the land-use element of the municipal masterplan</p> <p>§12-5 Land-use objectives in a zoning plan</p> <p>Building code (TEK17)</p>	<p>The law limits the possibility for the municipality to demand higher standards from the developer than the requirements in the building code.</p> <p>Note: Building code is ambitious with respect to requirements for new buildings but does not encompass neighbourhoods.</p>	<p>Ministry of Local Government and Modernisation (Kommunal- og moderniserings departementet, KLM)</p> <p>Ministry of Climate and Environment (Klima og miljø departementet, KLD)</p>	<p>STRENGTH: Public projects (municipality and state) can demand high ambitions within their own projects.</p> <p>WEAKNESS: The power of the municipality is limited in the development of SPENs (size and land use) when external private developers take part in the project.</p>
Not possible to demand that energy budget (which shows total greenhouse gas (GHG) emissions) be followed up	<p>Planning and Building Act § 11-9 no.8 (can also have provisions at municipal masterplan level)</p> <p>GHG assessment</p> <p>Norwegian Standard -NS 3720</p>	<p>GHG assessment per area.</p> <p>It is necessary to have an energy budget to get a building approved, but it is not obligatory to follow up (improve % better than the assessment).</p>	<p>State level (Ministry and Directorate)</p> <p>KMD</p> <p>KLD</p>	<p>Weakness: If the municipality is not the developer itself, it cannot set requirements for the developer (e.g. "GHG emissions must be reduced by at least 40% compared to a reference building/area.")</p>
Cannot demand emission-free building site	<p>Planning and Building Act § 12-7 nr. 12.</p>	<p>If the intention of the law is to provide the best possible conditions for fulfilling the goal of sustainable development, it will be appropriate to be able to set requirements for the construction phase/building site as well. It is uncertain whether one can demand it by law.</p>	<p>State level (Ministry and Directorate)</p> <p>KMD</p> <p>KLD</p>	<p>Weakness: The municipality cannot set the emissions requirements for the developer for the construction phase/building phase. This is a weakness for the further developers of SPENs which consider a lifecycle approach.</p>
There are different interpretations of stakeholder involvement. Some are mandated by law such as "public hearing" ("offentlig høring") and "neighbourly notice" ("nabovarsel"), while some are voluntary, like workshops or public meetings.	<p>Planning and Building Act (PBA) §5-1</p> <p>+ Municipal masterplan</p>	<p>Under this first paragraph of the PBA, anyone who submits a plan proposal must facilitate participation. The developer is obliged to ensure stakeholder involvement and to develop a comprehensive urban strategy. However, this is a very complex and difficult process. For example, neighbours can delay a project by complaining. This is already a challenge for building any buildings in any area, and in particular it is made more difficult in the development of SPENs.</p>	<p>State level and local level (Ministry and municipalities)</p> <p>KMD</p> <p>KLD</p> <p>Municipalities</p>	<p>Weakness: It can be a challenge to the party responsible for stakeholder involvement to plan sufficient time and extent of stakeholder involvement. The government has its own guide for how the participation should be done: https://www.regjeringen.no/globalassets/upload/km-d/plan/med-virkningsveileder/h2302b_veileder_medvirkning.pdf</p>

Energy efficiency (efficient utilisation of the distribution grid)

Key issues	Name of the policy/ initiative/ measures	Key facts (objectives, status, impact)	Scope and Implementing organisation	Strength/ weakness
Current grid tariffs do not incentivise smart balancing of energy use on a neighbourhood scale	<p>Forskrift (directions) om kontroll av nettvirksomhet §13-1.</p> <p>Possible exemptions through §14-3: When unreasonably expensive, the grid company can offer metering and billing per common inlet pipe.</p>	<p>The primary objective of the Energy Act is to ensure economic efficiency in the power system by promoting competition between parties.</p> <p>Huge investments are planned by the Norwegian government to strengthen the distribution grid. To postpone/avoid this, energy systems can be smartly coordinated within SPENs.</p> <p>Economic incentives provided by grid companies are more to single households.</p>	<p>Government level (Ministry of Petroleum and Energy)</p> <p>OED</p> <p>NVE-RME</p>	<p>Weakness: SPENs' proposition of providing a flexibility buffer cannot be exploited as an incentive for end users.</p> <p>Balancing at a neighbourhood scale is not incentivised in the current billing practice.</p> <p>SUGGESTION FOR ALTERNATIVE TO CURRENT PRACTICE: By looking at several electricity users as an integrated system, rather than setting the system boundary around each individual user, it is possible to achieve efficiency gains by coordinating the load of all users in the neighbourhood. Note that this is not just relevant for several buildings, but also for single buildings housing several users, e.g. an apartment building.</p>
The separation of stakeholders within a SPEN makes it difficult for housing cooperatives to achieve profitability from their local energy production	<p>Energy Act § 4-1</p> <p>Forskrift (directions) om kontroll av nettvirksomhet §15-2 "Plus-customer agreement"</p> <p>Directives §13-1</p> <p>Control of network operations (kontroll av nettvirksomhet). Possible exemptions through §14-3 (fair competition): When the main rule is unreasonably expensive, the grid company can offer metering and billing per common inlet pipe.</p>	<p>When electricity is produced and consumed by the same stakeholder, the production is reduced consumption, and the stakeholder avoids payments linked to electricity production, taxes and grid.</p> <p>If electricity production is not produced and consumed by the same stakeholder, the surplus production can only be sold via a power company with concessions to sell electricity to other end users. The seller of surplus electricity must pay a small tariff when selling a lot of surplus electricity.</p> <p>When mounting PV panels on a housing cooperative's rooftops, most of the power must be sold to the grid because of the principle of choosing your own electricity provider. The value of local electricity production for housing cooperatives is therefore reduced by 60-70% compared to single households.</p> <p>The income for the seller of surplus electricity is about one third of the enduser electricity spending, because the owner of surplus electricity does not receive tax and grid payments as income.</p>	<p>Government level (Ministry of Petroleum and Energy)</p> <p>OED</p> <p>NVE-RME</p> <p>SSB (electricity price data)</p>	<p>With the cost of local electricity production being almost three times that of Norwegian hydropower,³⁴ the business case for surplus local electricity is currently poor in Norway.</p> <p><u>Status:</u> Since January 2020, the Norwegian regulators have been conducting hearings to contemplate a regulatory framework that will allow locally produced electricity by housing cooperatives to be allocated as electricity savings by its inhabitants. As of March 2021, the matter is being evaluated by the Norwegian Ministry of Finance in cooperation with the Ministry of Petroleum and Energy.³⁵</p>

³⁴ LCOE rooftop PV: 1.16 NOK/kWh; LCOE hydro power: 0.37 NOK/kWh. From <https://www.nve.no/energiforsyning/energiforsynings-data/kostnader-i-energisektoren>

³⁵ Norwegian Energy Regulatory Authority, Division of surplus power into apartment blocks «Plusskundeordning for boligselskap», see <https://www.nve.no/reguleringsmyndigheten/nettjenester/nettleie/tariffer-for-produksjon/plusskunder>

Renewable energy

Key issues	Name of the policy/ initiative/ measures	Key facts (objectives, status, impact)	Scope and Implementing organisation	Strength/ weakness
<p><i>Pricing of surplus electricity production</i></p> <p>Local electricity production consumed by several neighbouring buildings (on an individual household level)</p>	<p>Energy Act § 4-1</p> <p>Forskrift (directions) om "kontroll av nettvirksomhet" (this is an extension from paying feed-in tariff as formulated in §15-2 Plus-customer agreement)</p>	<p>Background of Energy Act: Competition is meant to ensure the rights of the consumer (energy-security and competitive price). The structure of the current billing practice ensures funding of further grid developments and maintenance, as well as tax income to the state.</p> <p>A single household can produce and consume as much as it wants. However, the price for selling to the grid is often equal to the spot price (see below).</p> <p>Surplus electricity production is unlikely to be profitable. Self-consumption (when legal) is more profitable because tariffs are avoided. With a net surplus of annual electricity production, a SPEN will feed significant amounts of electricity into the grid. Surplus electricity must be sold via an energy company, and the selling price is commonly equal to the wholesale electricity price in Norway. The revenue from selling electricity is 60-70% lower than the savings from not using electricity. With the cost of local electricity production being almost three times that of Norwegian hydropower, the business case for surplus local electricity is currently poor in Norway.</p> <p>Self-consumption is most favourable from an economic perspective.</p>	<p>Government level (Ministry and directorate)</p> <p>OED</p> <p>NVE</p> <p>NVE-RME</p>	<p>Weakness:</p> <p>Insufficient incentives for households, but in particular housing cooperatives, to produce energy on-site.</p> <p>Insufficient incentives to produce energy on-site for single households.</p> <p>The economic incentive for SPENs will increase if either Norwegian electricity prices increase significantly, or support schemes lower the cost of local electricity production.</p> <p>(+See point above regarding flexibility buffer of SPENs that can balance behind a common meter) apartment building.</p>
<p>Concessions when installing and connecting electricity production</p>	<p>Energy act, §3-1</p> <p>§ 4-2 Directive on grid regulation and energy market Forskrift om nettregulering og energimarkedet (NEM) since November 2019.</p>	<p>To install and connect electricity production in Norway usually needs concessions. There is one concession to build the facility (anleggskonsesjon) and another concession to sell electricity from the facility (omsetningskonsesjon).</p> <p>Facilities in SPENs will normally be small enough to be exempt from both concessions. Recent exemption for gaining concessions applied for building integrated facilities producing <1 GWh/year, which normally includes SPENs, in the period 2021-2024.³⁶</p>	<p>Government level (Ministry of Petroleum and Energy)</p> <p>OED</p> <p>NVE-RME</p>	<p>Strength:</p> <p>A SPEN will not require concessions from national regulators for installing, connecting and selling energy production.</p> <p>Note: Very large production facilities (>1000 V of any component) need to apply for concessions. Concessions can be granted to any project with a good cost-benefit ratio from a societal perspective. This is so that solar panels and wind farms won't be built anywhere without any official regulation.</p>

³⁶ Norwegian Energy Regulatory Authority, Commercial license obligation for power producers:

<https://www.nve.no/reguleringsmyndigheten/omsetningskonsesjon/omsetningskonsesjonsplikt-for-kraftprodusenter>

<p>District heating and obligation for developers and construction companies to connect</p>	<p>Plan and building act §12-7 no 8</p>	<p>In Norway, developers have an obligation to connect, but it is not obligatory to use district heating in areas where district heating infrastructure is already in place and where a new building is to be built.</p> <p>The municipality decides who will be associated with the licence for district heating in the land-use section of the municipality masterplan (KPA), PBL§ 12-7 no. 8.</p> <p>The obligation to connect to a district heating grid (which often comes into force, especially in cities) can displace heat pumps or other more environmentally friendly energy carriers.</p> <p>The licensing scheme for district heating is anchored in the "Law of production, transformation, conversion, turnover, processing and use of energy": a district heating licence is required when establishing a waterborne heat supply with installed power greater than 10 MW and delivery to at least one external customer.</p>	<p>Government level (Ministry of Petroleum and Energy)</p> <p>KMD</p> <p>KLD</p>	<p>Weakness: Being obliged to connect to a district heating system (and sometimes also forced to utilise this energy not just as "top load") makes it more difficult to comply with the requirements of a SPEN.</p> <p>Developers are faced with high connecting costs.</p> <p>Note: There is an exception in the Energy Act that, if the developer can prove that an alternative solution is more cost efficient and environmentally friendly, the obligation to connect can be avoided. However, in practice, it is difficult to get exemptions from the obligation to connect.</p> <p>If successful, a concession is granted for a period of 30 years. For example, in Trondheim (Norway), Statkraft varme has been granted a concession for a plant at Heimdal (south of Trondheim) extracting waste heat from garbage combustion among several other energy sources.</p>
---	--	--	--	--

Other issues

Key issues	Name of the policy/ initiative/ measures	Key facts (objectives, status, impact)	Scope and Implementing organisation	Strength/ weakness
<p>Regulatory sandboxes, dispensations and pilots are too short term</p> <p>If the project includes activities that are not in accordance with current regulations, NVE may in special cases grant dispensation during the pilot or demonstration project's testing period.</p>	<p>Temporary exemptions from current laws and regulations</p>	<p>Innovations related to SPENs often challenge existing regulations and laws. This can be a hindrance to the necessary testing of innovative solutions. One possibility is to apply for a dispensation from the relevant directions (forskrift) to set up a regulatory sandbox. A regulatory sandbox is a general exemption from specific paragraphs in the regulations. However, government bodies seem to be more interested in targeted dispensations and piloting linked to projects.</p>	<p>Government level (Ministry and directorate)</p> <p>OED</p> <p>NVE-RME</p>	<p>Weakness: Difficult to establish general exemptions (regulatory sandboxes). Exceptions are given from the regulations for a limited period of time, from one to five years. Renewable energy resources are special in that they have high investment costs and operating costs down to zero. A longer payback period than five years is required.</p> <p>Strength: Some pilot projects have received exemptions: e.g. "Energy hub Powerhouse Brattøra" in Trondheim has got a dispensation to distribute electricity to neighbouring buildings, electrical buses and vehicles, electrical boats, in a local microgrid.</p>

5.6 Key takeaways

Most legislation and directives have not caught up with the neighbourhood level of building technology and solutions. The regulations in Norway are aimed at individual customers. A gap remains to establish a “neighbourhood entity” that can be treated as a single stakeholder from a regulatory perspective. In the development of SPENs, it is useful to discern the role of the municipality – whether it assumes the role of the client or landowner, or whether as the planning authority. As a landowner, the municipality can request conditions on how the building/area is to be constructed. In a private law context, for example, it is possible to stipulate energy ambitions through ownership. In the latter case, in its role as the planning authority, the municipality cannot control energy solutions since it does not own the land. In the capacity of a planning authority, the municipality cannot make demands beyond the Norwegian building code (TEK17). Another point to note is that the primary party responsible is also obligated to facilitate stakeholder participation. How user engagement should be carried out (when solutions extend to the neighbourhood level) remains challenging (for example, how to communicate the requirements of SPENs to neighbouring entities). The heart of the Norwegian Energy Act is to ensure consumer rights in terms of energy security and competitive pricing, while also supporting the efficient development and utilisation of power system assets. A key issue for SPEN developers to consider is that current grid tariffs do not incentivise smart balancing of energy use on a neighbourhood scale.

The balance between individual consumer rights and system coordination is challenged with the growing electrification of society, and regulatory guidelines ought to be revised to ensure efficient infrastructure development, e.g., revision of grid tariff signals. Incentivising consumers to coordinate within a SPEN is technically feasible with advanced metering systems, and coordinated load shifting by SPENs could defer unnecessary infrastructure investments.

The current regulation does not allow several customers to consume electricity directly from local production. The low price of electricity in Norway can also dilute the attractiveness of electricity production within SPENs in that the owners of local electricity production have an insufficient incentive to sell back to the grid. However, consuming locally produced electricity within a SPEN as a single electricity customer can be economically profitable. Regulatory frameworks allowing several customers to consume electricity directly from local production will increase the attractiveness of SPENs.

6. The Netherlands: national policy framework, opportunities and barriers for SPEN development

Awareness of PEDs is slowly growing among policymakers and project developers in the Netherlands, as illustrated by the knowledge dialogue organized by the Verdus Network in January 2021.³⁷ Representative project leaders and researchers from municipalities, universities of applied sciences and research universities gathered to discuss knowledge gaps and existing expertise in the field. This illustrates a growing awareness about the concept of PEDs, and potential of SPENs, among policymakers and researchers; however, upscaling of implementation still has a long way to go.

THE NETHERLANDS



6.1 Overview of PED projects in the Netherlands

Activities related to developing PEDs in the Netherlands are still in their infancy. Although the government of the Netherlands aims to renovate the Dutch building stock through its district approach and natural-gas-free districts programme in the context of the national Climate Agreement³⁸, the central aim is to disconnect existing buildings from the gas network, rather than develop positive energy buildings or districts. Even though renovation efforts by local authorities in the context of the natural-gas-free districts programme are facing many technical, legislative and financial setbacks, the programme has potential for the development of PEDs. On the website of the programme, participating local authorities are informed about financing and collaborative research opportunities and invited to participate in the EU PED programme.³⁹ Another promising avenue for PEDs could be the further development of net-zero renovations (Nul op de meter – NOM – in Dutch) at district level, which is currently being developed (also known as Energiesprong).⁴⁰ In the context of these solutions, opportunities to further reduce whole-life emissions are being evaluated in the field of circular economy.⁴¹ These examples indicate potential, but simultaneously show that attention is focused on reaching net-zero carbon districts, rather than energy-positive districts.

On a practical level the Netherlands has seen a few pioneering projects in the field of PED. Exemplary projects are the EU-funded Atelier project in Amsterdam⁴² and the EU-funded MakingCity (Horizon 2020) project in Groningen.⁴³ In Amsterdam, the former industrial area Buiksloterham is being transformed into a mixed-use, low-carbon, smart and positive energy district. This is facilitated through a derogation from Dutch energy laws, allowing for local smart grids, energy sharing and renewable energy generation. In Groningen, residential and other buildings are being renovated with a focus on energy efficiency, solar energy generation and geothermal district heating systems.

³⁷ VerDus (2020). Knowledge dialogue positive energy districts. Accessible at:

<https://www.verdus.nl/evenementen/kennisdialoog-positive-energie-districts-positive-energy-neighbourhoods>

³⁸ National Climate Agreement (2019). Klimaatakkoord hoofdstuk Gebouwde Omgeving. Available at:

<https://www.klimaatakkoord.nl/gebouwde-omgeving/documenten/publicaties/2019/06/28/klimaatakkoord-hoofdstuk-gebouwde-omgeving>

³⁹ Program natural-gas free districts (PAW) website. Wordt jouw wijk een Positive Energy District? Available at:

<https://aardgasvrijewijken.nl/nieuws/1440059.aspx>

⁴⁰ Stroomversnelling website (n.d. – accessed 2021). Wijken met nieuwe energie – Wijkkompas en Kwaliteitskaders voor de wijk.

Available at: <https://stroomversnelling.nl/thema/wijken-met-nieuwe-energie>

⁴¹ Abma, K.y. (2020). The potential of coupling the circular economy and energy transition in the built environment: A mixed methods study to the potential environmental impact reduction of applying different circular economy strategies within Net-Zero Energy Building refurbishment solutions. Master Thesis University Utrecht. Available at:

<https://energielinq.stroomversnelling.nl/nul-op-de-meter/circulaire-kansen-bij-nul-op-de-meter>

⁴² Atelier project website. Available at: <https://smartcity-atelier.eu>

⁴³ Making City project website. Available at: <http://akingcity.eu/groningen>

6.2 The Dutch energy mix related to the building sector

The recent Dutch Climate and Energy Outlook (PBL, 2020)⁴⁴ shows that the built environment – dark orange in Figure 3 – is responsible for circa 8% of total CO₂ emissions. It also shows that based on planned policy (concrete enough to be modelled in the outlook) the Netherlands will not meet its 2030 climate targets (49% reduction with 1990 as base year).

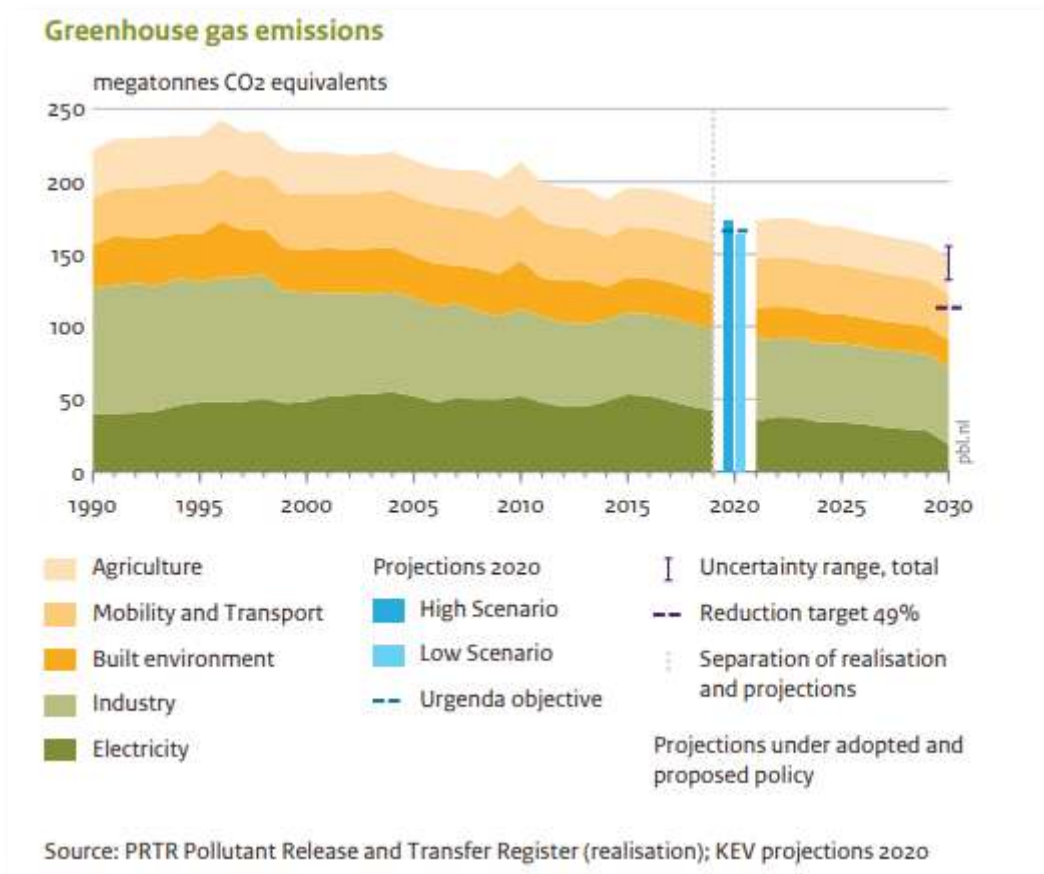


Figure 3: Emission registration of the different sectors and – after 2020 – estimated emissions based on planned policy. Source: PBL, 2020.

Dutch households are responsible for about 70% of total built environment emissions. Household energy use is mostly electricity and gas (for heating and cooking). Only a small proportion of households are connected to district heating networks. In Figure 4 the outlook shows that households only recently (2017-2018) started to produce significant amounts of electricity themselves; this is expected to increase in the next decade. The figure also shows a current and expected decrease of gas use. Main reasons for this are better energy performance of homes and buildings, smaller households and relatively warm winters.

⁴⁴The English summary of this report is available here:

<https://www.pbl.nl/en/publications/netherlands-climate-and-energy-outlook-2020-summary>

Finaal aardgas- en elektriciteitsverbruik en elektriciteitslevering aan huishoudens

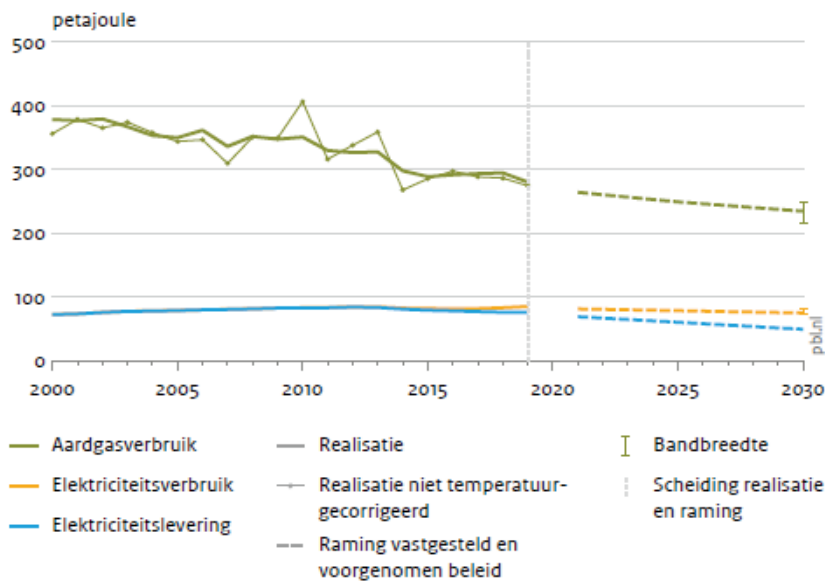


Figure 4 Final electricity use (yellow) and electricity supply (blue) of households, including estimate from 2020-2030. Final gas use (green - corrected for temperature), including estimate from 2020-2030. Estimate is based on planned policy. Source: PBL, 2020

Recent policy initiatives are based on looking for more integrated concepts for buildings, e.g. the Energy Performance Coefficient Standards and NZEBs (Dutch: BENG). These concepts mostly apply to new buildings, but some also target the existing building stock. Current performance standards and measures are mostly focused on the building level, and not on apartment complex level or district level. Chapter 6.4 presents an overview of Dutch policy measures and initiatives relevant for syn.ikia.

There are, however, multiple policy initiatives and newly implemented legislation that consider district approaches. The policy overview also covers new relevant policy topics that have already passed and are being implemented, such as the Environment and Planning Act, which is replacing over 20 existing regulations on environmental planning. The Dutch Climate Agreement (implementation of the 2015 Paris Agreement) has resulted in, amongst others, two programmes that go beyond residential and building approaches: the gas free district programme (original: Programma Aardgasvrije Wijken, PAW) with the aim of making circa 12,800 districts in 390 municipalities natural gas free (including new building), and the regional energy strategies programme. For the latter, the Netherlands has been divided into 33 energy regions. Each of these regions is developing its own regional energy strategy that states how to reach 2030 and 2050 climate targets, based on regional characteristics and capabilities (e.g. PV, wind, geothermal renewable systems).

Two other relevant policy characteristics of the Netherlands are the separation of energy distribution (regulated/public) and energy supply (open market/private). The policymaking process for many climate or energy transition-related initiatives is based on the involvement of several stakeholders in roundtable sessions or national debates. The climate agreement, for example, was a result of five sectoral roundtables, where all relevant stakeholders were asked to participate, e.g. industry associations, municipalities, provinces, environmental associations, sector associations, homeowner associations.

6.3 Governance structure in the Netherlands

Organisation	Original name (Dutch)	Abbreviation	Description
Ministry of Economic Affairs and Climate	Ministerie van Economische Zaken en Klimaat	EZK	Ministry responsible for climate and environmental regulations
Ministry of Interior	Ministerie van Binnenlandse Zaken en Koninkrijksrelaties	BZK	Ministry in charge of the implementation of the natural-gas-free districts programme
Ministry of Infrastructure and Water Management	Ministerie van Infrastructuur en Waterstaat	I&W	Ministry responsible for climate adaptation, among others in the built environment
Inter-provincial platform	Interprovinciaal Overleg	IPO	Association of the Dutch provincial policymakers, which are involved in spatial planning, environmental policy and infrastructure development
Association of Dutch Municipalities	Vereniging Nederlandse Gemeentes	VNG	Association of Dutch municipalities, responsible for the implementation of the Dutch district approach and development of local construction and renovation projects
The Netherlands Enterprise Agency	Rijksdienst voor ondernemend Nederland	RVO	Agency responsible for the approval and provision of subsidies for, among others, renovation and construction
Netherlands Environmental Assessment Agency	Planbureau voor de Leefomgeving	PBL	Agency responsible for policy assessment and evaluation, tracking progress towards climate targets and implementing research related to environmental and climate affairs, including those related to the built environment
TenneT	TenneT		Electricity transmission operator
Gridmaintenance Netherlands	Netbeheer Nederland		Association of Dutch distribution system operators (electricity, gas)

Table 9: Relevant Dutch authorities and agencies

6.4 National policy review

Key issues	Name of the policy/ initiative/ measures	Key facts (objectives, status, impact)	Scope and implementing organisation	Strength/ weakness
Integrated approaches maximising the synergies between energy efficiency and renewable energy at the district level.	Klimaatakkoord: District approach (Wijkgerichte aanpak) Climate agreement (2019)	Municipalities draft specific plans to decarbonise each district in their jurisdiction. Plans need to be handed in end 2021. Each municipality develops a transition vision for their complete jurisdiction and district-specific transition implementation plans.	The municipalities are supported by the national government and expertise centre heating (ECW).	Strength: decentralised approach allows policy tailored to local circumstances; decisions are taken closer to building owners; approach allows participation of local stakeholders Weaknesses: lacking capacity; insufficient data availability
	Environment and Planning Act (EPA) Website Omgevingswet (topics covered) Website Omgevingswet (laws integrated in EPA)	The new Environment and Planning Act aims to integrate aspects of 26 laws completely or partially into one law. The envisioned benefits are that this will create more overview and bring decision-making closer to the local level. The law concerns all topics related to physical planning, including amongst others waste, soil, energy efficiency, renewable energy, climate adaptation, air, mobility, public participation, spatial planning, urban planning and water.	After 2022 the new EPA will provide significant responsibility to municipalities, water boards and provinces in urban planning. The environmental vision contains a strategy document with an integral strategic plan for the physical environment. The law will provide clear procedures for complex decision-making processes on local or regional levels related to project development.	Strength: Simplicity of one law versus 26 laws; one digital platform and central location bundling information and indicating possibilities to a variety of public, private and civic stakeholders Weakness: Complex law trajectory; implementation has been postponed numerous times; high responsibility for local authorities might result in capacity issues; uncertain if success will be achieved
Develop a comprehensive urban strategy, including urban regeneration	Heating Law 2 (Warmtewet 2/Wet collectieve warmtevoorziening) Update law trajectory Dec 2019 Update on tariff regulation 2020	The Heating Law is being revised in 2020 in light of the decarbonisation of the built environment. The existing heating law is not suited to facilitate the development of collective heating infrastructure, particularly in dense urban areas, which are considered essential in decarbonising the built environment and which feature in the National Climate Agreement. The updated Heating Law concerns the development of collective heating systems, market ordering for heating, transparency of tariffs, requirements related to supply adequacy and assurance of decarbonisation.	In the latest proposal, which was under consultation from June-August 2020, municipalities get significant influence to determine heating parcels – demarcated areas or districts within the municipal boundaries – to which they would be able to appoint one responsible heating company. The law is being updated by the ministry of economic affairs. Ministry of Economic Affairs and Climate Policy – Consultation	Strength: Experienced heating companies will be stimulated to develop district heating and decarbonise complete districts; fair prices will be guaranteed; focus on districts rather than individual buildings Weaknesses: Lack of capacity amongst municipalities to define heating parcels; insufficient involvement of distribution system operators – see Warmtemanifest
Streamline and aggregate energy efficiency solutions and processes at the neighbourhood level	Programme Natural-Gas Free Neighbourhoods (PAW) PAW website	National programme to facilitate learning about and development and upscaling of decarbonisation techniques on a district level. It consists of pilot district and a knowledge and learning programme, and aids municipalities on specific issues related to drafting transition vision documents.	Interdepartmental collaboration between the Ministry of Interior, Ministry of Economic Affairs and Climate, Association of Municipalities, Inter-Provincial Dialogue and the Platform of Water Boards	Strength: Learnings based on pilot districts; collaboration between multiple layers of government Weaknesses: critical review of the audit chamber – too high expectations, few buildings actually detached from gas

	<p>Startmotor /Renovation Accelerator Housing Associations</p> <p>RVO website Climate Agreement p31</p>	<p>The startmotor is an agreement between the government and housing associations to decarbonise 100,000 dwellings in 2022. This ambition is supported by the Renovation Accelerator. The subsidy programme Renovation Accelerator aims to stimulate demand aggregation, standardisation and industrialisation of building renovation for collaboratives of owners and providers of renovation solutions.</p>	<p>Ministry of Interior, RVO, Aedes, VNG, IVBN, Bouwend NL, Techniek Nederland, Energie Nederland, OnderhoudNL en warmtebedrijven</p>	<p>Strength: provides significant funding to projects; stimulates aggregation and industrialisation of construction products</p>
--	---	---	---	---

Energy efficiency

Key issues	Name of the policy/ initiative/ measures	Key facts (objectives, status, impact)	Scope and implementing organisation	Strength/ weakness
Trigger acceptance and behavioural change of owners and occupants around energy performance	<p>Public participation with the regional energy strategy and the district approach</p> <p>Website Climate Agreement Website PAW</p>	<p>The Climate Agreement provides guidelines for public participation to municipalities, who can integrate the concerns and views of local stakeholders in their decarbonisation plans.</p>	<p>Ministry of Economic Affairs and Climate Policy</p>	<p>Strength: public participation can improve the quality of decisions taken; if organized well participation can foster public acceptance and legitimacy</p> <p>Weaknesses: participation is complex to facilitate; lack of capacity amongst municipalities; might slow down the transition</p>
	<p>EPV introduction</p> <p>Website Government</p>	<p>The energy savings allowance (EPV) allows housing associations to charge inhabitants financial compensation in exchange for lower energy bills after NOM or BENG renovations</p>	<p>Ministry of Interior</p>	<p>Strength: stimulates housing associations to renovate buildings; energy performance guarantees assure building owners costs will not rise</p>
Accelerate the market penetration of innovative solutions	<p>Financial instruments for building renovation:</p> <ul style="list-style-type: none"> - National Heating Fund - Easier access for credit for renovation loans - Changes energy tax (gas electricity) - Energy Investment Deduction (EIA – for companies) - ISDE subsidy - Subsidy energy savings private households (SEEH) - Lower VAT for implementing insulation (21 to 6%) <p>Chapter 8 LTRS-NL (p58-65)</p>	<p>Variety of financial measures and regulations aimed to stimulate individual building owners to invest in energy renovation of their properties.</p>	<p>Various ministries, including the Ministry of Interior, Ministry of Economic Affairs and Climate Policy, Netherlands Enterprise Agency (RVO)</p>	<p>Strength: stimulates the capacity of building owners to invest and access financial means required to renovate their buildings and invest in renewable energy generation</p> <p>Weaknesses: focused on individual building owners, or single buildings, rather than focusing on districts</p>

Renewable energy

Key issues	Name of the policy/ initiative/ measures	Key facts (objectives, status, impact)	Scope and implementing organisation	Strength/ weakness
Create an enabling framework for positive energy buildings through supporting renewable energy penetration in buildings (and consequently districts)	National Programme Regional Energy Strategy (RES) Website Nationaal Programma RES	Following the Climate Agreement in 2019, the Netherlands was divided in 30 "energy regions" as part of the national programme RES. These energy regions are responsible for assessing how and where sufficient renewable electricity can be generated to comply with the targets set in the Paris Agreement from 2015, and how existing renewable heating sources can be used to decarbonise the building stock and decouple buildings from gas. The deadline before which all regions must present their definitive Regional Energy Strategies is 1 July 2021 .	Each energy region has a platform where representatives from the national government, provinces, water boards and municipalities collaborate with other stakeholders. These stakeholders include amongst others energy companies, knowledge institutes, distribution system operators, civil society, environmental groups and other companies.	Strength: Decentralisation allows local authorities to take local concerns and issues into account for planning the construction of new heat and electricity infrastructure and the division of available heat sources The regional energy strategy plans will highly influence the available renewable heat, and thereby the heating installations and insulation levels of positive energy districts.
	VAT return and net metering (solar)	Individuals and companies can apply to reclaim the VAT for the installation and purchase of solar panels from the Dutch tax authorities.	NL tax authorities National government	Strength: Stimulates the generation of renewable solar energy among private residential building owners through reduced investment costs.
	Tax exemption for selfgenerated energy for energy cooperatives		National government	

Affordable living, health and wellbeing

Key issues	Name of the policy/ initiative/ measures	Key facts (objectives, status, impact)	Scope and implementing organisation	Strength/ weakness
Integration of health, wellbeing and comfort aspects in legislation and policy instruments associated with positive energy buildings/green buildings	Environment and Planning Act (Omgevingswet)	The Environment and Planning Act includes tools and rules to ensure appropriate sound, smell, light and general health levels in the built environment. Expected to be in force in 2022.	Besluit Bouwwerken Leefomgeving Algemene Maatregelen Bestuur (including BBL) Site Environment and Planning Act sound (Geluid/geluidsbelasting) Site omgevingswet smell (Geur) Site omgevingswet light (Lichtinval) Site omgevingswet general health (Gezondheid algemeen) .	Strength: The aim of the law is to ensure integrated planning that considers health and wellbeing aspects related to sound, smell and general health while using and developing the physical environment. Local authorities will be able to make balanced considerations between various health-related aspects when giving permits for the development of new projects, such as PEDs. Weaknesses: Not yet been implemented – currently this is planned for 2022.

6.5 Key takeaways

In the Netherlands several initiatives have the “district” as focus, although few are aiming to create new PEDs; instead, initiatives such as the district approach and the natural-gas-free districts programme address decarbonisation of existing buildings. The district approach, pursued in accordance with the Dutch Climate Agreement, incentivises municipalities to take the district level as a starting point in planning decarbonisation efforts. The natural-gas-free districts programme has provided grants for municipalities with well-developed plans for decarbonisation of complete districts, besides functioning as a platform to share practical lessons learned. These policy initiatives represent a very ambitious policy framework to drive PED development. However, municipalities have been faced with serious setbacks of legislative, financial, technical and social nature. Even though the focus is on a district level, the solutions provided have been mostly tailored to individual dwellings and homeowners. In the current form, the programme cannot be scaled up to achieve the envisioned renovation of complete districts. Lessons learned from these initiatives could be relevant when developing plans for PEDs that focus on renovating existing buildings rather than constructing new residential buildings.

Additional financial support for the local authorities implementing the decarbonisation is required, while sometimes the technical know-how required to renovate complete districts is lacking among local policymakers. Moreover, crucial legislation to reform the heating market and planning procedures in the physical environment is currently being revised. The Heating Law and the Environment and Planning Act are relevant in this regard. The enactment of these revised laws is expected in 2022 or later. This will provide local authorities with the tools and legal basis required to upscale the efforts in building renovation and the creation of PEDs.

Dedicated subsidy programmes, like the Renovation Accelerator for social housing associations and the energy allowance regulation, have incentivised the renovation of apartment blocks or buildings at the district scale but most financial support instruments are still tailored to individual buildings or building owners. The district approach and the Environment and Planning Act both have a structural focus on public participation in the planning of the decarbonisation of the building stock. Public participation will therefore also be essential for the development of PEDs.

7. Austria: national policy framework, opportunities and barriers to SPEN development

Austria has a wide range of PED-related policies on different levels, covering energy efficiency, renewable energy generation and neighbourhood involvement. However, there is no specific legislative framework for an integrated PED approach available yet. Legislative processes to cover a coherent framework on all levels (EU compliance, Bund, Bundesländer, Gemeinden) are under constant development. A significant revision (expected in 2021) will regulate the interchange of energy between at least two owner units, which will be a milestone concerning the development of SPENs (renewable expansion law).



Literature and regulations in Austria mention PEDs instead of SPENs, but the goals and definitions used are similar. Our analysis therefore refers to SPEN as a synonym for PED. Further, the Austrian policy review puts a special focus on local regulations in the City of Salzburg where the syn.ikia pilot case is situated.

7.1 Overview of PED projects in Austria

The development of positive energy districts and neighbourhoods is the focus area of ongoing research programmes and projects. The JPI Urban Europe programme involves Austrian PED projects and the “City of the Future” research projects “Zukunftsquartiere Wien” and “Urban Area Parameters” contribute to setting up an integrated approach and a practice-oriented system change.

Different levels of government have a high interest in the development of sustainability masterplans. Besides the [national commitment](#) of the federal government, there is a climate and energy strategy for the province of Salzburg ([Klima- und Energiestrategie Salzburg 2050](#)) which is currently under revision and on the communal level there is the [Smart City Masterplan](#) for the city of Salzburg.

7.2 Austria's energy mix related to the building sector

According to the Austrian official statistics office (Statistics Austria) the energy mix of the Austrian residential sector is split into the energy sources presented in figure 5 as of 2018.

The largest share of residential energy consumption is attributed to natural gas (22.5%), electricity (22.2%), wood (19.1%), heating oil (14.1%) and district heating (12.3%).

In 2019, the total electricity supply mix consisted of 44.4% hydropower, 21.0% thermal electricity production (HCP), 8.4% wind, PV and geothermal and 26.2% physical imports.

Energy carriers	2003/2004	2005/2006	2007/2008	2009/2010	2011/2012	2013/2014	2015/2016	2017/2018
Hard coal	0.5%	0.4%	0.4%	0.2%	0.2%	0.1%	0.1%	0.1%
Lignite	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Lignite briquettes	0.3%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%
Coke	1.1%	0.6%	0.6%	0.5%	0.3%	0.2%	0.1%	0.1%
Wood	21.7%	20.5%	20.5%	21.0%	21.7%	21.2%	19.8%	19.1%
Wood pellets	0.5%	1.6%	1.6%	1.8%	2.2%	2.7%	2.6%	2.5%
Pellets	0.4%	1.0%	1.0%	1.2%	1.5%	2.0%	2.1%	2.2%
Wood briquettes	0.1%	0.6%	0.6%	0.6%	0.7%	0.7%	0.5%	0.4%
Wood chips	1.2%	1.5%	1.5%	1.5%	1.7%	2.2%	2.3%	2.4%
Heating oil	21.0%	19.1%	19.1%	17.7%	17.1%	14.4%	14.4%	14.1%
Liquid gas (LNG)	0.8%	0.8%	0.8%	0.5%	0.4%	0.5%	0.4%	0.4%
Natural gas	23.2%	24.5%	24.5%	24.0%	22.6%	22.6%	23.2%	22.5%
District heating	6.8%	7.7%	7.7%	8.1%	8.8%	10.5%	10.9%	12.3%
Electricity	21.5%	21.2%	21.2%	21.8%	21.9%	22.0%	22.0%	22.2%
Solar thermal	0.7%	1.1%	1.1%	1.6%	1.6%	1.8%	1.9%	1.6%
Heat pump	0.6%	0.8%	0.8%	1.2%	0.4%	1.7%	2.1%	2.5%
Total	100%	100%	100%	100%	100%	100%	100%	100%

Figure 5: Changes in Austrian energy mix from 2002 to 2018 by household energy consumption. Source: Statistics Austria

In Austria, the renewable share of gross final energy consumption was around 33.5%⁴⁵ according to the latest national energy and climate plan (NECP). This also includes the share of renewable energy in transport. When looking at heating and air conditioning use, the renewable share was around 33.3% in 2016. The renewable share of the gross electricity consumption was around 72.6%. Renewable share by final energy consumption of the residential sector in 2016 was 29% according to the NECP (Figure 6: Share of final energy consumption by energy sources and sectors. Source: Integrated National Energy and Climate Plan for Austria).

⁴⁵ National energy and climate plan Austria, 2019:

https://ec.europa.eu/energy/sites/ener/files/documents/at_final_necp_main_en.pdf

Energy carriers	Fossil	Renewable	Electricity	District Heating
Industry	50%	18%	28%	3%
Transport	91%	6%	3%	0%
Residential	35%	29%	24%	12%
Services	23%	8%	45%	24%
Agriculture	45%	33%	19%	2%

Figure 6: Share of final energy consumption by energy sources and sectors. Source: Integrated National Energy and Climate Plan for Austria

It also needs to be stated that in district heating there are local differences between renewable share; in Salzburg, for example, the renewable share of district heating is much higher (around 65%). The energy price index shows that after a brief period of depreciating gas and electricity prices between 2016 and 2018, prices started to increase again from 2019⁴⁶.

The Austrian government aims to phase out fossil fuel-powered heating systems in the residential sector. It has started an initiative to provide incentives for this, called the “oil phase-out premium”. Overall, clear trends can be identified in the direction of a strong growth of the renewable share in the residential sector and subsequently a decreasing share of fossil fuel-powered energy generation.

7.3 Governance structure in Austria

The federal government and the individual provinces set very high energy standards for housing subsidies (far above legal requirements for social housing), which go beyond the standards laid down in construction law. The provinces have direct representation in the institutions at federal level through the “Bundesrat”. The Association of Municipalities (Gemeindebund) and the Austrian Association of Cities and Towns (Städtebund) both offer representation on a communal level (Article 115(3) Austrian Federal Constitution).

The provinces, the Gemeindebund and the Städtebund have to be informed of government proposals. The provinces also have to inform the Gemeindebund and the Städtebund of their legislative proposals.

In relevance to SPENs, each province has its own subsystem of authorities, institutions and agencies responsible for the enabling of energy efficiency and the take-up of SPENs. While this multi-level approach results in a very complex setting of regulations and institutional relations, the system has an advantage on the practical level due to the deep insight into the local specifics.

⁴⁶E-Control, Energy Statistics Austria 2020:

https://www.e-control.at/documents/1785851/1811582/Statistik-brosch%C3%BCredeutsch_FINAL.pdf?76a285c4-10f4-1a8e-b618-03265b2d6a15?t=1601286846708

7.4 National policy review

District approach

Key issues	Name of the policy/ initiative/ measures	Key facts (objectives, status, impact)	Scope and implementing organisation	Strength/ weakness
Integrated approaches maximising the synergies between energy efficiency and renewable energy at the district level	Electricity Industry and Organisation Act 2010 (EiWOG 2010, rev. 2018) Rechtsvorschrift für Elektrizitätswirtschaftsund organisationsgesetz - EiWOG 2010, rev. 2018	Legal framework that allows joint facilities to produce renewable energy and distribute it among tenants in multi-family housing.	Federal State of Austria [In reference to RED II (2018/2001/EU) art. 21] Scope: national	Strength: + The act was a strong driver for the field of renewable energy (especially PV)
	Federal Energy Efficiency Act (Bundes Energieeffizienzgesetz)	Currently in appraisal. It introduces renewable energy communities (Erneuerbare Energie-Gemeinschaften – EEG) as legal entities. The act makes it possible to trade energy at a regional level, especially within neighbourhoods.	Federal State of Austria (in reference to RED (EU/2018/2001) art. 2). Scope: national	Strength: Necessary step to make SPENs even possible Weakness: Difficult issue with different interests of stakeholders (especially electricity industry)
	Climate active - settlements and districts (Klimaaktiv – Siedlungen und Quartiere)	Certification programme for whole settlements and districts that are fulfilling the climate-friendly sustainability criteria. -> new programme since 2019	Federal Ministry Republic of Austria – Climate Action, Environment, Energy, Mobility, Innovation and Technology Scope: national	Strength: Holistic programme that focuses on the bigger picture (interconnection between buildings concerning sustainability and energy efficiency)
Streamline and aggregate energy efficiency solutions and processes at the neighbourhood level	Spatial Energy Planning for Heat Transition (GELSEP/Wärmeatlas)	The research project is developing the necessary basics for spatial energy planning. The aim is to implement a heat map of the whole region, which can be the basis for future energy decisions.	Joint Research Project Scope: regional (different demo regions)	Strength: Important basis for quick decision making in terms of energy planning (also for SPENs) Weakness: Very complex matter with different interests of specific stakeholders (energy sector)
Develop a comprehensive urban strategy, including urban regeneration	Smart City Salzburg	Initiative of the City of Salzburg to support the holistic sustainable development of the city involving • Smart energy • Smart mobility • Smart buildings • Best practices • People and lifestyle Period: 2014 - 2023	The City of Salzburg Scope: City	Strength: Integrated approach for different energy fields Connection and exchange of know how with other Austrian smart cities Weakness: Very soft goals that partly cannot be controlled

Energy efficiency

Key issues	Name of the policy/ initiative/ measures	Key facts (objectives, status, impact)	Scope and implementing organisation	Strength/ weakness
Minimum performance requirements	<p>OIB-Guidelines (OIB_Richtlinie 2015)</p>	<p>OIB - national technical guidelines for different construction fields, e.g. OIB RL 3: Hygiene, health and the environment, and OIB RL 6: Energy efficiency and heat protection. Revisited every four years. In Salzburg the OIB 2015 is the base of the current Building Technology Act (below) with some special clauses regarding KPIs.</p>	<p>Development: Austrian Institute for Building Technology (Österreichisches Institut für Bautechnik - OIB)</p> <p>(In reference to EPBD (EU/2018/844) art. 9).</p> <p>Scope: national</p> <p>Implementation: governments of the federal provinces</p>	<p>Strength: National framework for harmonisation of the building sector Very high relevance Constant revision</p> <p>Weakness: Each federal state implements it at a different time and with several adaptations Implementation takes a very long time (in Salzburg the guidelines from 2019 are still not implemented)</p>
	<p>Building technology act of the federal province of Salzburg (Salzburger Bautechnik-Gesetz, Nr. 55/2016 unter Berücksichtigung von Sonderregelungen)</p>	<p>Legal framework for the implementation of technical building guidelines. Mostly based on the OIB Richtlinie, but the federal provinces have the possibility of individual adaptations. It defines the requirements of the following aspects:</p> <ol style="list-style-type: none"> 1. mechanical strength and stability 2. fire protection 3. hygiene, health and environmental protection 4. safety in usage, accessibility 5. noise protection, 6. energy saving and thermal protection 7. sustainable use of natural resources. 	<p>Government of the federal province of Salzburg</p> <p>Scope: regional</p>	<p>Strength: - Adaptations allow the consideration of regional specifics</p> <p>Weakness: - High dependency on administrative staff (individual influence) - Regional adaptations create national variations</p>
Trigger acceptance and behavioural change of owners and occupants around energy performance	<p>Energy consultancy in the federal province of Salzburg</p> <p>(Energieberatung Salzburg und Umweltservice Salzburg)</p>	<p>In the federal province of Salzburg there are more than 100 energy consultants who work for the "Energieberatung Salzburg" and the "Umwelt Service Salzburg". They offer consultancy to private and commercial building owners in questions of energy efficiency, renovation and renewable energy sources. The service is free and product-neutral.</p>	<p>Federal province of Salzburg in cooperation with the energy supplier Salzburg AG</p> <p>Scope: regional</p>	<p>Strength: - Subliminal influence on the neighbourhood scale - In the actual project: potential in consultancy for private neighbours to join the SPEN</p>
	<p>Climate active – Buildings and Renovations</p> <p>(klimaaktiv – Bauen und Sanieren)</p>	<p>National incentive programme for sustainable buildings with a focus on energy efficiency. The standards of bronze, silver and gold go far beyond the legal requirements for buildings. There are three steps of declaration: planning, implementation and usage of the building.</p>	<p>Federal Ministry of the Republic of Austria – Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK)</p> <p>Different regional partners</p> <p>Scope: national</p>	<p>Strength: + Voluntary programme since 2005 – 1,000 buildings have a declaration, so therefore high reputation and recognition + Constant development of the criteria with standards well above the legal requirements + Some big players and communities have voluntarily committed themselves to the standard (e.g. BIG - Bundesimmobiliengesellschaft)</p>

	<p>Climate active – renewable heat (klimaaktiv – erneuerbare Wärme)</p>	<p>National programme for the decarbonisation of the heating sector. Focus lies in consulting and education of decision-makers and planners.</p>	<p>Federal Ministry of the Republic of Austria – Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK)</p> <p>Different regional partners</p> <p>Scope: national</p>	<p>Strength: National programme providing independent consulting</p>
	<p><u>e5-Programme</u> energy efficient communities</p>	<p>Incentive programme to support communities in energy-efficient policies and measurements. A certification and quality management system that supports participants to improve their communal energy efficiency and to increase the utilisation of renewable energy. Established since 1998.</p>	<p>Programme execution by syn.ikia project partner SIR</p> <p>Scope: regional, spreading across Austria</p>	<p>Strength: - Voluntary and motivational programme - in Salzburg 36 out of 118 communities are participating with numbers rising - Raises awareness within communities and makes them comparable, even competitive about energy issues</p>

Renewable energies

Key issues	Name of the policy/ initiative/ measures	Key facts (objectives, status, impact)	Scope and implementing organisation	Strength/ weakness
Create an enabling framework for positive energy buildings though supporting renewable energy penetration in buildings (and consequently districts)	The national Energy Efficiency Act (2014) (Bundesenergieeffizienzgesetz EeffG)	National law that ensures energy efficiency, security of supply, increase of renewable energy, reduction of GWG emissions. Under revision due to expiration by the end of 2020.	The federal government of Austria In reference to EED II- Directive on energy efficiency (EU/2018/2002) Scope: national	Strength: National law that enforces the use of renewable energies and therefore strengthens the SPEN approach Weakness: So far the leverage is not very high as the regulations are too vague and there are no enforceable penalties for noncompliance
	Government Programme 2020-2024 (Agreement of the national government coalition)	Austria is to become climate neutral by 2040 – 10 years before the EU target. The government agreed on measures such as an Austria-wide public transport ticket, the exit from oil and coal in space heating and a climate check for laws. In the energy sector there will be a phase-out of oil and coal in space heating and the enforcement of electricity from renewables	National parliament via regulations and laws Scope: national	Strength: Clear signal to citizens of the need for change Weakness: - Dependent on the stability of the government - Timeframe is linked to the legislative period
	Planning law for the federal country of Salzburg (Salzburger Baumordnungsgesetz, 2009, amendment of 2017)	Legal framework for spatial planning goals and principles, e.g.: - Economical and sustainable use of land, in particular the economical use of building land - Priority for inward settlement development and avoidance of urban sprawl - Greater consideration of environmental concerns - Orientation of settlement development to public transport and other infrastructure facilities, taking into account the greatest possible economic efficiency of these facilities. - Active land policy of the municipalities for affordable residential and industrial building land - Economical use of energy and priority use of domestic renewable energy sources	Federal province of Salzburg Authority is the local mayor of a city or community Scope: regional	Strength: Overall regulations for the economical use of land
	Spatial development concept BEK Stadt Salzburg (REK – Räumliches Entwicklungskonzept 2007)	Each communal entity in Austria develops a spatial development concept (valid for approximately 10-15 years). It must follow the principles of the planning law (ROG) and defines the development of land usage, energy supply, mobility, etc. Currently under revision.	City of Salzburg Controlled by the federal province of Salzburg Scope: city/community	Strength: Long-term vision of municipal development

Create an enabling framework for positive energy buildings though supporting renewable energy penetration in buildings (and consequently districts)	Land-use plan (Flächenwidmungsplan Stadt Salzburg)	Defines the classification and thereby specific use of land on the parcel level. Categories are: - building land - grassland - special areas.	City of Salzburg Controlled by the federal province of Salzburg Scope: city/community	The land-use plan has enormous influence on the development of a city Strength: Decisions about reclassifications have a great influence on building new SPENs including the existing neighbourhood
	Building plan (Bebauungsplan Stadt Salzburg)	Defines the specific rules of a building site concerning building heights, density, but also energy sources.	City of Salzburg Controlled by the federal province of Salzburg Scope: City/Community	Strength: Can be a tool to regulate the density and energy sources for building sites Weakness: The plan is being individually adapted there are no basic rules for energy supply now
	Currently in appraisal: Heating Cost Accounting Act (Heizkostenabrechnungsgesetz)	Regulates the accounting of heating costs based on actual consumption instead of usable floor space. A 15-20% reduction of heating consumption is expected from this measure.	Federal government of Austria (In reference to EED II - Directive on energy efficiency (EU/2018/2002) Scope: national	Strength: Raises awareness of tenants concerning their energy consumption Weakness: Not implemented yet
Maximise flexibility of locally produced energy by demand response, storage and sector coupling	Rollout of Smart Meters (Salzburg AG – Smart Meter)	The energy supplier Salzburg AG is rolling out the necessary equipment for energy management systems. The rollout is supposed to cover 95% of all households in the province of Salzburg by 2022.	Salzburg AG Scope: regional	Strength: Rollout of the necessary equipment for making SPAN even possible

Digital technology

Key issues	Name of the policy/initiative/ measures	Key facts (objectives, status, impact)	Scope and implementing organisation	Strength/ weakness
Optimise energy use through automation and self-regulation	Zeus-Datenbank	The ZEUS database collects energy data by registration of all energy certificates (Energieausweise) of new and refurbished buildings. Public buildings can connect their monitoring systems to the database and use it for analysing the energy demand.	Federal province of Salzburg Scope: regional (including the provinces Carinthia, Styria and Burgenland)	Strength: Region-wide data collection of the building status Weakness: Monitoring system is still in development technical improvement is necessary
	Smart readiness indicator for buildings (SRI Austria)	The research project SRI Austria has delivered some recommendations for SRI to be implemented in energy certificates for buildings. Still in progress.	AEE - Institute for Sustainable Technologies (AEE INTEC) Calculation and implementation (in reference to EPBD (EU/2018/844)) Scope: national/EU	Strength: Project is in progress implementation not sure yet

Affordable living, health and wellbeing

Key issues	Name of the policy/initiative/ measures	Key facts (objectives, status, impact)	Scope and implementing organisation	Strength/ weakness
Integration of health, wellbeing and comfort aspects in legislation and policy instruments associated with positive energy buildings/green buildings maintain affordable living	Climate active – Buildings and Renovations (Klimaaktiv – Bauen und Sanieren)	National incentive programme for sustainable buildings with focus on energy efficiency. The standards of bronze, silver and gold go far beyond the legal requirements for buildings. There are three steps of declaration: planning, implementation and usage of the building.	Federal Ministry of the Republic of Austria – Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK) Different regional partners Scope: national	Strength: - Integration of comfort aspects such as air quality, overheating in summer, volatile organic compounds, etc. - Some big players and communities have voluntarily committed themselves to the standard (e.g. BIG - Bundesimmobiliengesellschaft)
	Housing Subsidy Salzburg (Wohnbauförderung Salzburg)	Subsidy especially for residential buildings. The subsidy is linked to specific energy-related parameters and requires a price limit for the accommodation units.	Federal Province of Salzburg – Office for housing subsidy Scope: regional	Strength: The subsidy ensures there can still be affordable living Weakness: Different systems in each province make it difficult to compare within Austria
	Federal subsidy programmes (Bundesförderprogramme, Umweltförderung) (KPC)	The federal state of Austria creates programmes for funding of social housing in their federal provinces, for the erection of new-build apartments for rent and for refurbishment of housing projects.	Federal State of Austria Implemented by Kommunal Kredit Public Consulting (KPC) Scope: national	Strength: High flexibility concerning the actual focus Weakness: Many different constantly changing subsidies make it difficult for applicants and even advisors to keep an overview

7.5 Key takeaways

Austria has only recently started to implement directives and legislations regarding energy communities and other neighbourhood level solutions in 2021 which makes a thorough analysis of the SPEN policy landscape rather difficult.

The recently introduced regulations tackle important barriers, subject to energy sharing and feed-in tariffs. This is a big step forward, since current legislations do not tackle these questions which made, for example energy sharing between buildings an ambiguous topic for stakeholders and professionals. One example is the Federal Energy Efficiency Act (Bundesenergieeffizienzgesetz) which is currently in appraisal and regulates energy communities as legal entities. This will allow groups of people in nearby buildings to act as a legal entity and share the energy produced between within the energy community and also to sell it to the market.

Generally the Austrian legislative landscape is missing consistency due to different implementation of regulations on municipal, regional and national level – one of the side-effects of multi-level governance in a federation of nine states. Coherence is currently missing between different levels of government, which makes it harder and longer to implement new legislation/policies. On the other hand, since the national level only sets a general legislative basis for the nine state, individuals and entities are able to effectively express their needs and opinions in terms of regulatory changes and thus directly influence the legislative works. This creates a positive feedback loop at the lower levels, and participation rates remain high both at city and province levels.

Affordable living is subsidised both on federal state level and also by different province and city programmes. At country level funding and other programmes are available subsidising the creation of new multifamily buildings, and refurbishment of old rental buildings. On province and city levels there are special subsidies directly linked to specific energy use and emission values, incentivizing more conscious and environmental friendly planning and building.

Research projects and urban-scale initiatives both successfully promote energy transition in Austria due to their direct outreach to local communities. The course of the Austrian energy landscape development is significantly connected to smart city programmes and the application of digital technology.

8. Gap analysis

This section presents an assessment of gaps in the existing policy framework and evaluates how well the various provisions support the development of SPENs. The analysis focuses on EU policy and its implementation at Member State level. It doesn't look at additional gaps on national and local levels that are not directly linked to legislation originating from the EU.

The assessment is visualised through a “traffic light” rating across five evaluation categories as described in Chapter 2 above. The scoring reflects the level of development and comprehensiveness of the policies in support of SPEN development as regards the existence of a long-term framework, financial incentives, regulatory requirements and non-legislative enabling factors, such as capacity building, knowledge sharing initiatives or research programmes.

District approach and integrated planning

The focus of existing EU legislation is still predominantly on individual buildings, while aggregated and integrated renovation approaches are currently being tested and demonstrated in research and pilot projects, such as the Dutch *Energiesprong*⁴⁷ approach. The national legislations also predominantly focus on individual buildings, hampering the development of integrated district approaches.

Comprehensive renovation strategies and district approaches are featured in the EU's Renovation Wave strategy. The concept of districts/neighbourhoods as micro-energy hubs is still rather new on the political agenda, and therefore no long-term regulatory targets or requirements exist at the EU or national level. The planned EPBD revision offers the opportunity to bring clarity to the debate and introduce clear definitions and provisions on neighbourhood approaches. In addition, a range of research and pilot projects currently underway and supported through the Horizon 2020 programme is contributing to the academic and public debate on smart cities and positive/ plus-energy districts and neighbourhoods.⁴⁸ Results of these projects will provide useful resources to strengthen implementation in Member States.

The urban planning dimension is an important aspect to consider for the optimisation of energy efficiency interventions and the integrating of renewable energy sources. Most municipal heat plans and sustainable development schemes emerge from local ambitions. These often lack a comprehensive approach to systematically and simultaneously address buildings and decarbonisation of heating and cooling as well as transport and infrastructure. EU-wide strategic planning instruments, like the NECPs and LTRS, mostly cover single-building renovations. The European Commission could support comprehensive municipal planning by encouraging LTRS at the local level. Municipal renovation strategies enabling energy efficiency and renewable energy interventions at the district level could act as a driver for SPENs and push an efficient energy system.

Finally, a clear EU-wide definition of a neighbourhood or district approach would help to facilitate its implementation in national legislation. In addition, the requirement of local renovation strategies to support the national LTRS would push municipalities to consider how they will decarbonise their built environment and how to increase the uptake of SPENs.

⁴⁷ See energiesprong.org

⁴⁸ See for example, *MakingCities*, *Sharing Cities*, *PoCITYf* and *CityxChange*

DISTRICT APPROACH & INTEGRATED PLANNING STATUS OF POLICY FRAMEWORK

 Overall	The policy frameworks rarely address the neighbourhood and district levels directly. Overall, there is a lack of integrated planning to consider all aspects of SPENs. Currently, no regulation at the EU level requires Member States to encourage, invest in or build SPENs. The investments in research projects and pilot projects do lower the associated risk while increasing interest in integrated neighbourhood approaches.
 Long-term target	No long-term framework for the implementation of integrated and district approaches exists at the EU level or in the Member States. The Renovation Wave strategy does, however, promote comprehensive and integrated renovation interventions and it might be featured in the upcoming EPBD revision.
 Financial incentives	District approaches can offer significant cost savings, such as lower administrative and planning costs and distribution of risks through large scale, synergies between technologies and solutions, and aggregation of renovation projects. No financial incentives, though, are aimed directly at district solutions at the EU level. Equally, most financing mechanisms at the national and local level only target performance improvements of individual buildings rather than neighborhoods. The Dutch Renovation Accelerator represents a good example of a more comprehensive subsidy (project aggregation, synergies between building renovation and renewable energy installation) for social housing associations.
 (Mandatory) regulatory requirements	No regulatory requirements for district solutions exist at EU or Member State levels. The Dutch approach towards natural-gas-free districts encourages municipalities to develop integrated decarbonisation plans but on a voluntary basis.
 Enabling factors	Many EU-level initiatives for knowledge exchange, good practice sharing and awareness-raising exist (e.g. SET Plan, Smart Cities and communities platforms, city networks). Pilot projects of industrial and district renovation solutions are currently being implemented across Europe (see Energiesprong).

Table 10: Assessment of policy area "District approach and integrated planning"

Energy efficiency

Recent policy developments seem to increase the focus on energy efficiency and SPENs, yet the importance of district approaches will need to be more consistently embraced. The EPBD requires all new buildings to be NZEBs from January 2021 and highlights the possibility to consider district approaches for renewable energy production and distribution. The NZEB definitions, including minimum requirements for renewable energy,⁴⁹ applied in the Member States ought to be further strengthened to support the ambitious energy performance level required by PEBs. Neighborhood approaches and energy efficiency policy are also touching upon comprehensive renovation schemes applied to multiple buildings instead of a single building; existing provisions will be reviewed in 2021.

⁴⁹ While most countries cover renewable energy requirements in their NZEB definition, some Member States cover the obligation only indirectly in their requirements to meeting minimum energy performance standards (CA EPBD (2018), Factsheet)

The current EPBD provides no further references to neighbourhoods or districts. The Renovation Wave strategy, however, clearly promotes energy efficiency at the neighbourhood level. In particular, one-stop shops are promoted to create business opportunities and transform the performance of neighbourhoods, while energy supply options and better information about the building stock will be conducive to improve the energy performance of buildings and decarbonise heating and cooling at the neighbourhood level.

To make sure that the existing gaps are addressed, building codes and standards that support the development of PEDs should be further explored and the readiness of local authorities to enable and support a district model should also further analysed. Better collaboration among stakeholders including local authorities, municipalities and citizens is critical to creating enabling frameworks for PED approaches.






ENERGY EFFICIENCY: STATUS OF POLICY FRAMEWORK	
 Overall	The EU regulatory framework on energy efficiency is well established but to enable the development of SPENs the framework of NZEBs should be further strengthened towards PEBs. Metrics and definitions need to be developed for system boundaries beyond the individual buildings.
 Long-term target	The EU directives (EPBD and EED) promote measures to achieve a highly efficient and decarbonised building stock by 2050. This is mainly supported by the LTRS, which requires all Member States to set up long-term renovation plans with milestones. It is also very promising that the Renovation Wave promotes energy efficiency at the district level and also refers to the importance of PEDs. A long-term strategy for how to increase SPENs across Europe is, however, missing.
 Financial incentives	Private Finance for Energy Efficiency (PF4EE) is a financial incentive at the EU level offering the potential to be used for district approaches. Smart Finance for Smart Buildings (SFSB) is aimed at making energy efficiency investments in the buildings sector, but does not offer the opportunity to expand this on a district or neighbourhood scale. The financing schemes for energy efficiency improvements of buildings at national level focus mainly on individual building solutions.
 (Mandatory) regulatory requirements	The EPBD requires that by 31 December 2020, all new buildings are NZEBs; however, these standards are less ambitious than what SPENs would require. The consideration in the Renovation Wave to introduce a “deep renovation standard” could steer investments towards highly efficient buildings and thus support SPENs.
 Enabling factors	Several initiatives exist at EU level to introduce enabling factors of energy efficiency, supporting SPEN development, including the European Climate Pact and various H2020 projects.

Table 11: Assessment of policy area “Energy efficiency”

Renewable energies and district energy flexibility

The RED II, the Electricity Regulation and the Electricity Directive set EU targets for the uptake of renewable energies in electricity, the transport sector, and the heating and cooling sector (32% overall). The legislation puts the consumer at the heart of the energy transition and aims to alleviate regulatory barriers to demand-side flexibility to support the concept of smart buildings and the use of locally produced energy. Increased demand-side flexibility provided by SPENs will be crucial for the overall management of the electricity system, to keep costs down and limit costly grid expansions.

The RED II has brought some legal clarity and enforcement for citizen energy projects which are involved in producing, storing or consuming renewable energy. Member States need to ensure that citizens, through renewable energy communities, can participate in support schemes and that they enjoy a level playing field with other energy actors. The RED II and the Electricity Directive promote the implementation of renewable and citizen energy communities⁵⁰ respectively, demanding Member States ensure that energy communities are subject to a non-discriminatory regulatory framework. SPENs are key energy infrastructures themselves and an active part of the wider energy system, so district energy flexibility should be further encouraged.

Demand response (as regulated under the Electricity Directive) can mitigate demand peaks and thus avoid grid imbalance. Concerns related to imbalances in the grid are increased by a large share of distributed renewable energy generation (like solar and wind). Demand response is one solution to this problem as it can shift and mitigate the peak, e.g. through dynamic pricing contracts or energy storage solutions (including vehicle-to-grid solutions). A prerequisite to shift end-user demand is the transparency of real consumption data, which can be made available through smart meters. The ongoing smart meter roll-out in Member States should cover the latest available technologies to prevent lock-in of end-user services. Demand-side flexibility is currently only acknowledged in the Electricity Directive but should be encouraged consistently in the RED II, the EED and the EPBD to enable the participation of (residential) buildings in demand response. Demand-side flexibility capacity targets could be another viable policy option to support SPEN residents to become active in the market and ensure efficient system operation on a regional level.

Overall, the current main gap is an ambitious implementation at a national level that translates the comprehensive regulatory framework in the Member States. Regulatory barriers, such as charges or fees that reduce the benefits of self-consumption and demand-response measures at the local or regional level, should be alleviated as a matter of priority.

⁵⁰ Two similar concepts with some minor differences regarding membership and governance structure regulated under the Renewable Energy and Electricity Market directives respectively.

RENEWABLE ENERGIES AND ENERGY FLEXIBILITY: STATUS OF POLICY FRAMEWORK






 Overall	The EU policy framework for the uptake of renewable energies for power and heat is quite advanced, as is the framework for the use of demand-side flexibility regulated in the Electricity Directive. However, the dynamic dimension of the energy system is not incentivised consistently over the EU energy policy framework (e.g. RED, EED, EPBD) causing barriers to the broad participation of buildings in demand flexibility which would increase system efficiency.
 Long-term target	Annual renewable energy increase of 1.3% for heating and cooling established under RED II but no fixed renewable energy target in buildings. Member States have the flexibility to calculate technically, functionally and economically feasible minimum levels of renewables in new and existing buildings subject to major renovation. No consistent demand-flexibility regulatory framework exists.
 Financial incentives	Requirements to implement legislation regarding the entitlement to renewable self-consumption (including renewable energy communities) and demand flexibility (e.g. entitlement to dynamic pricing, aggregators and smart meters) at national level.
 (Mandatory) regulatory requirements	Locally produced and flexible shared energy might offer cost savings for building users depending on the national regulatory framework. No CO2 price at EU level in the building sector, which would incentivise renewable energy systems.
 Enabling factors	Support of energy communities through REScoop federation and EU projects (e.g. Horizon 2020 Renaissance or Compile project). Awareness-raising for demand-side flexibility for private end-users is rather limited.

Table 12: Assessment of policy area "Renewable energies and energy flexibility"

Digital technologies

The application of digital technologies in construction and renovation processes offers opportunities for significant cost and time savings allowing for faster and high-quality design, planning and implementation of projects. The digitalisation and innovation speed in the construction sector generally falls behind other sectors, yet many digital tools, such as 3D printing or augmented reality, are tested and slowly gaining more attention from market actors. Building information modelling (BIM) is one solution that has gained a lot of traction and is broadly applied for new buildings. Digital twins are becoming the go-to tool for creating robust data models about all aspects of a building, neighbourhood or city at the various stages of their lifecycle. BIM and digital twins can be used/integrated with larger urban planning strategies and are therefore very relevant for SPEN development.

Digitalisation enables the uptake of smart energy services for building users, allowing the development of demand-side management strategies to integrate flexible and decentralised renewable energy systems into the energy system. The Renovation Wave recognises digital and innovative technologies supporting the development of smart buildings and the centralised handling and storing of building-related data as crucial aspects to be supported and regulated. By 2023, the EU Commission will introduce digital building logbooks, while a unified EU framework for digital permitting and recommendations to use BIM in public procurement is expected in 2021.

With the increasing use of personal data in energy services and monitoring, the EU GDPR is an important regulatory framework to protect user data. However, without clear and consistent guidance on application in Member States, there is a risk that it will hamper local energy trading and optimisation among neighbouring buildings.






DIGITAL TECHNOLOGIES: STATUS OF POLICY FRAMEWORK	
 Overall	An EU policy framework enabling the uptake of digital technologies in smart buildings and neighbourhoods is underdeveloped. Though innovative digital renovation solutions and smart technologies are gaining attention in the market, their broad application is still missing. The SRI, an instrument to inform end-users about the optimisation capability of a building to adapt to grid signals and users' needs, might incentivise the use of smart appliances.
 Long-term target	Long-term framework needed to prepare the workforce on the required skills is still missing but different upskilling projects exist across EU countries. The Renovation Wave sets out courses of action for the increasing use of digital tools and shows mid-to long-term vision
 (Mandatory) regulatory requirements	Requirements for smart metering, technical building systems and ducting of e-mobility charging infrastructure supportive; no mandatory use of digital tools, such as BIM in EU regulations. BIM is mandatory for certain projects in some European countries (such as the UK and Denmark). Data protection requirements might hamper the development of SPENs. Regulation for smart readiness indicator established but not mandatory.
 Financial incentives	Smart metering and related dynamic pricing leading to the flexible use of energy and reduced costs for the building users. Digital construction/ renovation solutions using BIM lead to decreased costs due to saved time and resources.
 Enabling factors	Monitoring of real energy consumption through smart meters supports building occupants in tracking their energy use and motivates energy savings. Upskilling of workforce regarding BIM and other innovative technologies in EU projects and initiatives.

Table 13: Assessment of policy area "Digital technologies"

Affordability, health and wellbeing

The ongoing transition towards more human-centric buildings has highlighted the importance of health and wellbeing in the built environment. Even though the EPBD encourages Member States to address issues of healthy indoor climate conditions in buildings undergoing a major renovation, neither prescribes requirements in this sense nor refers to district approaches. The Renovation Wave does, however, reiterate the importance of healthy, accessible and affordable buildings.

Several private building certification schemes (such as the WELL Building Standard or the Home Performance Index) support health and wellbeing. However, only a few consider the neighbourhood level (including the WELL Community Standard). EN and ISO standards providing requirements for indoor environmental quality parameters are adopted at the national level; however, for the majority of Member States they are not mandatory and are mainly focused on the indoor environment, not at the district or neighbourhood level.

The affordability of SPENs is crucial to deliver energy-efficient, healthy housing for all households, including the vulnerable ones. The Affordable Housing Initiative as announced in the Renovation Wave offers the chance to implement 100 lighthouse projects showing how limited budget and EU resources can be used to fund district energy efficiency and healthy housing schemes.

AFFORDABILITY, HEALTH AND WELLBEING: STATUS OF POLICY FRAMEWORK






 Overall	Although the EU policy framework includes aspects of health and wellbeing at the building level, a broader application at the district level is missing. Certification schemes show the right direction, yet there are limited financial incentives and mandatory requirements in support of health and wellbeing in buildings, and especially at district levels.
 Long-term target	Member States are required to report on the alleviation of energy poverty and the multiple benefits of health, safety and air quality stemming from renovations in their LTRS. The national LTRS rarely cover these aspects in detail. Detailed long-term targets for the built environment are generally missing at the local level.
 (Mandatory) regulatory requirements	Requirements on achieving an adequate indoor environment that can also be expanded at the district level are not mandatory in the majority of Member States. Most health and wellbeing aspects are only indirectly covered in the national/regional building regulations.
 Financial incentives	EU funds can be used for national energy efficiency and savings schemes targeting populations of lower income, while both lighthouse projects (Affordable Housing Initiative) and mature financing schemes (Irish Warmer Homes grant) exist.
 Enabling factors	Several building certification schemes are being implemented at EU level, e.g. WELL Community Standard, WELL Building Standard. Green building certification tools help raise awareness and complement harmonising EU frameworks (e.g. LEVEL(s)). The Energy Poverty Observatory as an EU-wide information platform shares good practices on (financial) building renovation schemes alleviating energy poverty.

Table 14: Assessment of policy area "Affordability, health and wellbeing"

Country-specific analysis and additional insights

At EU level, the Electricity Market Regulation and Directive provides the necessary regulatory framework to encourage demand-side flexibility. The legislation aims to remove existing regulatory barriers to demand-side flexibility, enable active participation of all energy consumers in the transition to clean energy and increase system efficiency. Although transposition of the Electricity Market Directive to the national level was meant to be done by December 2020, innovative demand response and flexibility services are still in their infancy in most Member States. In Norway, the Norwegian Energy Act regulates consumer rights, competitive pricing and efficient utilisation of supply-side resources. However, smart balancing of end-user energy consumption on a district scale is currently not incentivised by the grid tariffs and the current regulation does not allow locally produced energy to be sold to neighbouring customers.

In Spain, where the syn.ikia demo project is implemented as a public building project, several barriers related to a long and complex public procurement process are identified. Procurement criteria are rather static and complex, posing administrative barriers to research and innovation projects. Also, the architecture law is not supportive to the development of public SPEN projects, not giving priority to highly energy-efficient, innovative plus energy buildings in its selection criteria. In Norway, municipalities could drive the development of PEDs in their role as building owners by strengthening energy requirements and requiring integrated district plans. Currently, municipal authorities cannot demand any requirements that go beyond the Norwegian building code, partly hindering ambitious public PEDs.

Almost all households have smart meters installed in Spain and Norway to monitor end-use energy consumption. The Spanish self-consumption law theoretically enables the sharing of locally generated electricity, but in reality it hinders full flexibility through fixed consumption coefficients and strict regulations regarding the distance between generation and consumption, which limits the application in SPENs. At the time of writing this report, a public consultation has been launched by the Ministry for the Ecological Transition and the Demographic Challenge on the revision of the static to dynamic coefficients of distribution of energy consumption in shared facilities⁵¹. Although the final text of the legislation is unknown, the revision could facilitate the creation of energy communities and more flexible shared consumption as required by SPENs.

The district approaches promoted by the Dutch policies, especially the gas-free districts programme, offer huge opportunities to drive SPEN development in the Netherlands. However, decarbonisation solutions still mainly focus on the supply side and are tailored to single buildings and homeowners. At the same time, municipalities are faced with legislative, financial, technical and social barriers that have to be addressed to enable larger-scale development of PEDs.

In Austria, key legislation that would assist PED development, such as the Federal Energy Efficiency Act setting out the establishment of energy communities, is partly still in the implementation phase and partly still under review. However, different soft measures, such as the certification programme for climate active settlements and districts and the e5 municipal energy efficiency scheme, are useful tools to create awareness about comprehensive district approaches.

⁵¹ <https://energia.gob.es/es-es/Participacion/Paginas/DetalleParticipacionPublica.aspx?k=404>

9. Conclusions and final remarks

The challenges related to energy efficiency improvement of individual buildings (e.g. data accessibility, sectoral fragmentation, misalignment of incentives, lack of standardisation) are likewise relevant for SPENs. Addressing these challenges will require comprehensive policy packages. SPENs are a relatively novel concept, existing projects are few and most of these are still in a pilot phase.

Reflecting the innovative nature of the concept, the policy areas SPENs are touching upon are equally dynamic and highly diverse. The supportive regulatory framework is still very much a work in progress and will only be fully developed over the coming years. The challenge with developing the appropriate policy framework for SPENs is the need to seamlessly integrate the different fields it touches upon: building renovation, electricity networks, electric mobility, district heating and cooling, energy storage and flexibility, digitalisation, community engagement, urban development, etc. A consequence of this broad range of different policy areas relevant for district approaches is that the success of SPENs is highly dependent on legislative changes.

As policymaking and public administration have been traditionally organised in silos, extending energy efficiency and distributed generation from buildings to entire neighbourhoods is no doubt a daunting task. This analysis has brought the spotlight on a number of policy gaps holding back district/neighbourhood approaches, including the lack of synergies between sectors and the lack of common standards and definitions. One of the main policy barriers to the design and development of SPENs is the lack of synchronisation and consistency among policies.

However, this report also suggests that there is a strong political will to move towards SPENs. The Clean Energy Package, including the Electricity Market Directive and the Renewable Energy Directive, the Bauhaus initiative and the European Green Deal play a crucial and supportive role in this. The ambitious decarbonisation targets set by the EU and adopted by Member States point in the same direction, even though the implementation and delivery of these climate objectives are also under the responsibility of cities or regional authorities, which are also the main enablers of SPENs.

A large proportion of national legislation affecting the built environment is derived from EU-level policymaking. Whereas many laws are shaped to one degree or another by the EU, the local level decision- and policymaking is exceedingly important to create the necessary synergies and partnerships for the implementation of SPENs that respond to local needs, utilise local renewable sources, disseminate benefits to energy community members and generate added value for the greater local communities.

Energy market regulation has seen an unbundling of the energy market, resulting in increased competition and more rights for the end-user over the past decade. However, to achieve a highly efficient, decarbonised energy system, residential buildings should be enabled to participate in demand response and provide local flexibility services to ensure the large-scale consumption of distributed renewable generation and avoid grid reinforcements. Demand-side flexibility is currently only regulated under the Electricity Market Directive, while efficiency is still seen as a rather static concept in the RED, EED and EPBD.

Affordable living, health and wellbeing are important drivers which cannot be neglected for creating demand for SPENs. The role of the building users, their active participation and empowerment are critical for creating energy communities and prosumers across Europe. Sharing not only locally produced energy but infrastructure, facilities and common spaces offers opportunities for a strong involvement of building users, which is crucial for the development of vibrant districts. Residents will need to be involved in the design and implementation of SPEN plans early on to make sure user interfaces are easily accessible and smart appliances fit their needs, which is why thorough stakeholder engagement activities are part of most demonstration projects.

Finally, the European Commission's target of developing 100 PEDs by 2025 under the umbrella of the JPI Urban Europe Programme "Positive Energy Districts and Neighbourhoods for Sustainable Urban Development" (SET Plan, Action 3.2) could be a driver for the spread of SPENs as significant support will be available for research and innovation. This is an important step which paves the way to mainstreaming demo projects and developing much-needed dedicated funding, capacity building and training.

10. References

BPIE, "A Guidebook To European Building Policy. Key legislation and initiatives," 2020.

Caramizaru, A. and Uihlein, A., "Energy communities: an overview of energy and social innovation", Publications Office of the European Union, Luxembourg, 2020.

Economidou, M., T odeschi, V., Bertoldi, P ., D 'Agostino, D ., Zangheri, P., Castellazzi, L ., "Review of 50 years of EU energy efficiency policies for buildings". Energy and Buildings, Volume 225, 2020.

Erhorn-Kluttig, H., Erhorn, H., "National applications of the NZEB definition – The complete overview Status February 2018", Concerted Action EPBD, Germany 2018

European Commission, IPSOS, and Navigant, "Comprehensive study of building energy renovation activities and the uptake of nearly zero-energy buildings in the EU." p. 87, 2019.

Level(s), The European framework for sustainable buildings, European Commission, 2020.

Lyons, L., " Digitalisation: Opportunities for heating and cooling", Publications Office of the European Union, Luxembourg, 2019.

Knotzer, A., Roberta, P. and Ostergaard Jensen, S., "Characterization of Energy Flexibility in Buildings", Energy in Building and Communities Programme, Annex 67 Energy flexible buildings, IEA 2019

Saheb, Y., Shnapp, S. and Paci, D., "From nearly-zero energy buildings to net-zero energy districts - Lessons learned from existing EU projects", EUR 29734 EN, Publications Office of the European Union, Luxembourg, 2019.

SmartEN, "The implementation of the electricity market design to drive demand-side flexibility. Monitoring report", November 2020.

SmartEN, "Empowering end-users to achieve climate neutrality in the most cost efficient way - Recommendations for the Fit for 55 package", Position paper, March 2021.

Shnapp, S., Paci, D. and Bertoldi, P., "Enabling Positive Energy Districts across Europe: energy efficiency couples renewable energy", EUR 30280 EN, Publications Office of the European Union, Luxembourg, 2020.

Torcellini, Pless, Deru, and Crawley, "Zero Energy Buildings: A Critical Look at the Definition, National Renewable Energy Laboratory and Department of Energy", US, 2006.

EU level policies and legislative acts

European Commission. *A Renovation Wave for Europe – Greening our buildings, creating jobs, improving lives*" (COM(2020)662)

European Commission, "*Powering a climate-neutral economy: An EU Strategy for Energy System Integration*", COM/2020/299 final, 2020.

Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings

Directive (EU) 2018/844 of the European Parliament and of the Council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency

Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC

Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable source

Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC

Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU

Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products

Regulation (EU) 2017/1369 of the European Parliament and of the Council of 4 July 2017 setting a framework for energy labelling and repealing Directive 2010/30/EU

EU Strategic Energy Technology (SET)-Plan on Action 3.2 "Smart Cities and Communities"

Commission Delegated Regulation (EU) 2020/2155 of 14 October 2020 supplementing Directive (EU) 2010/31/EU of the European Parliament and of the Council by establishing an optional common European Union scheme for rating the smart readiness of buildings

Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation)

Country level policies and regulations

Spain

Andreu, A. et al., "2050 vision for 100% renewable heating and cooling in Europe", European Technology and Innovation Platform Renewable Heating & Cooling, Brussels 2019, Available at: <https://www.rhc-platform.org/content/uploads/2019/10/RHC-VISION-2050-WEB.pdf>

JPI Urban Europe (2020), EUROPE TOWARDS POSITIVE ENERGY DISTRICTS, A compilation of projects towards sustainable urbanization and the energy transition https://jpi-urbaneurope.eu/wp-content/uploads/2020/06/PED-Booklet-Update-Feb-2020_2.pdf

Ministry of Transport, Mobility and Urban Agenda, Long-term renovation strategy, Available at: <https://www.mitma.gob.es/el-ministerio/planes-estrateg-cos/estrategia-a-largo-plazo-para-la-rehabilitacion-energetica-en-el-sector-de-la-edificacion-en-espana>

Ministry for the Ecological Transition and the Demographic Challenge, "Energy in Spain 2018" (La energía en España 2018), Available at: <https://energia.gob.es/balances/Balances/LibrosEnergia/Libro-Energia-2018.pdf>

Ministry for the Ecological Transition and the Demographic Challenge, Spanish National Energy and Climate Plan 2021-2030 (Plan Nacional Integrado de Energía y Clima (PNIEC) 2021-2030), Available at: <https://www.idae.es/informacion-y-publicaciones/plan-nacional-integrado-de-energia-y-clima-pniec-2021-2030>

Royal Decree 244/2019, which regulates the conditions administrative, technical and economic self-consumption of electrical energy. <https://www.boe.es/boe/dias/2019/04/06/pdfs/BOE-A-2019-5089.pdf>

Spanish government, Spanish Recovery and Resilience Plan, "España Puede", October 2020, Available at: <https://www.lamoncloa.gob.es/presidente/actividades/Paginas/2020/espana-puede.aspx>

Tounquet, F. and Alaton, C., "Benchmarking smart metering deployment in the EU-28", Final report for the European Commission, Luxembourg: Publications Office of the European Union, 2020, Available at: <https://op.europa.eu/en/publication-detail/-/publication/b397ef73-698f-11ea-b735-01aa75ed71a1/language-en>

Norway

C. Gollner, R. Hinterberger, S. Bossi, S. Theierling, M. Noll, S. Meyer, H.G. Schwarz, „EUROPE TOWARDS POSITIVE ENERGY DISTRICTS, A compilation of projects towards sustainable urbanization and the energy transition", Urban Europe, First update, February 2020.

Elhub AS c/o Statnett SF, "Elhubs impact on the Norwegian energy system", website Elhub, Available at: <https://elhub.no/en/about-elhub/elhubs-impact-on-the-norwegian-energy-system/>

Energy consumption in residential buildings, Statistics Norway (Statistisk sentralbyrå), Available at: <https://www.ssb.no/energi-og-industri/statistikker/husenergi>

Norwegian Energy Regulatory Authority, Norwegian Energy Act (Lov om produksjon, omforming, overføring, omsetning, fordeling og bruk av energi m.m. (energiloven)), Available at: <https://energifaktanorge.no/en/norsk-energiforsyning/kraftmarkedet>

Norwegian Directorate for Building Quality, Building technical regulations (TEK17), Available at: <https://dibk.no/regelverk/byggteknisk-forskrift-tek17/>

Norwegian government, Ministry of Local Government and Modernisation, Planning and Building Act, Available at: <https://www.regjeringen.no/en/topics/plan-bygg-og-eiendom/plan--og-bygningsloven/planning/id1317/>

Norwegian Energy Regulatory Authority, Public consultation for energy plus consumers, Available at: <https://www.nve.no/reguleringsmyndigheten/nettjenester/nettleie/tariffer-for-produksjon/pluskunder/>

The Netherlands

Abma, K.Y., "The potential of coupling the circular economy and energy transition in the built environment: A mixed methods study to the potential environmental impact reduction of applying different circular economy strategies within Net-Zero Energy Building refurbishment solutions" Master Thesis University Utrecht 2020, Available at: <https://energielinq.stroomversnelling.nl/nul-op-de-meter/circulaire-kansen-bij-nul-op-de-meter>

Dutch government, National Climate Agreement, "Klimaatakkoord hoofdstuk Gebouwde Omgeving", 2019 Available at: <https://www.klimaatakkoord.nl/gebouwde-omgeving/documenten/-publicaties/2019/06/28/klimaatakkoord-hoofdstuk-gebouwde-omgeving>

LTRS The Netherlands, "Lange Termijn Renovatiestrategie: Op weg naar een CO2-arme Gebouwde Omgeving", 2020, Available at: <https://www.rijksoverheid.nl/documenten/rapporten/2020/03/06/lange-termijn-renovatiestrategie-op-weg-naar-een-co2-arme-gebouwde-omgeving>

Ministry of Economic Affairs and Climate, Environment and Planning Act, "Kamerbrieven – overzicht van Kamerbrieven over de voortgang van de Omgevingswet en de aanvullingssporen vanaf mei 2019. Website omgevingswet" 2021 Available at <https://aandeslagmetdeomgevingswet.nl/actueel/kamerbrieven/>

Ministry of Economic Affairs and Climate, Heating Law 2, "Kamerbrief over de voortgang wetstraject Warmtewet 2", 2021. Available at: <https://www.rijksoverheid.nl/documenten/kamerstukken/2019/12/20/kamerbrief-over-de-voortgang-wetstraject-warmtewet-2>

PBL Netherlands Environmental Assessment Agency, "Climate and Energy Outlook 2020" (Klimaat- en Energieverkenning 2020). Available at: <https://www.pbl.nl/en/publications/netherlands-climate-and-energy-outlook-2020-summary>

Programme natural-gas free districts (PAW) website. Wordt jouw wijk een Positive Energy District? Available at: <https://aardgasvrijewijken.nl/nieuws/1440059.aspx>

Stroomversnelling website, "Wijken met nieuwe energie – Wijkkompas en Kwaliteitskaders voor de wijk", 2021, Available at: <https://stroomversnelling.nl/thema/wijken-met-nieuwe-energie>

VerDus, « Knowledge dialogue positive energy districts » Accessible at: <https://www.verdus.nl/evenementen/kennisdialoog-positive-energy-districts-positive-energy-neighbourhoods>

Austria

Austrian government, "Electricity Industry and Organisation Act (Elektrizitätswirtschafts- und -organisationsgesetz) 2010" (EIWOG 2010, rev. 2018), Available at: <https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=20007045>

Austrian government, Federal Energy Efficiency Act (Bundes-Energieeffizienzgesetz), Available at: <https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=20008914>

Austrian government, Heating Cost Accounting Act (Heizkostenabrechnungsgesetz), Available at: <https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=10007277>

City of Salzburg, Smart City Masterplan 2025, Available at: <https://www.stadt-salzburg.at/smartcity/masterplan-2025/>

Federal Ministry Republic of Austria for Climate Action, Environment, Energy Mobility, Innovation and Technology, Federal subsidy programmes (Bundesförderprogramme, Umweltförderung), "Raus aus Öl" (Exit oil), Available at: <https://www.umweltfoerderung.at/>

Federal Ministry Republic of Austria for Climate Action, Environment, Energy Mobility, Innovation and Technology, Climate initiative "Klimaaktiv" (climate active) providing advice, quality standards and trainings, Available at: <https://www.klimaaktiv.at/ueber-uns.html>

Federal Ministry Republic of Austria for Climate Action, Environment, Energy Mobility, Innovation and Technology, "e5-Programme for energy efficient communities", Landesprogramm Salzburg, Available at: <https://e5-salzburg.at/index.php>

Federal Ministry Republic of Austria, Sustainability and Tourism, National Energy and Climate Plan Austria (2019), Available at: https://ec.europa.eu/energy/sites/ener/files/documents/at_final_necp_main_en.pdf

E-Control, Energy Statistics Austria 2020, Available at: https://www.e-control.at/documents/1785851/1811582/Statistikbrosch%C3%BCre_deutsch_FINAL.pdf/76a285c4-10f4-1a8e-b618-03265b2d6a15?t=1601286846708

State of Salzburg, Building technology act (Salzburger Bautechnik-Gesetz, LGBl Nr. 55/2016 unter Berücksichtigung von Sonderregelungen), Available at: <https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=LrSbg&Gesetzesnummer=20001000>

State of Salzburg, 2009 Planning law for the federal country of Salzburg (Salzburger Raumordnungsgesetz 2009, amendment of 2017), Available at:

<https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=LrSbg&Gesetzesnummer=20000615>

State of Salzburg, Climate and Energy Strategy Salzburg 2050, Programme on climate protection, energy transition and climate change adaptation, Available at:

<https://www.salzburg.gv.at/themen/umwelt/salzburg2050>

State of Salzburg, Climate + Energy 2030 Master Plan, Available at:

https://www.salzburg.gv.at/umweltnaturwasser_/Documents/MasterplanKlimaEnergie2030.pdf

State of Salzburg, Housing Subsidy Salzburg (Wohnbauförderung Salzburg), Available at:

<https://www.salzburg.gv.at/themen/bauen-wohnen/wohnen>



This report is part of a project that has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 869918.