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Sustainable plus energy neighbourhoods

Spain

FACTSHEET

Policy recommendations for sustainable plus energy neighbourhoods and buildings

April 2023

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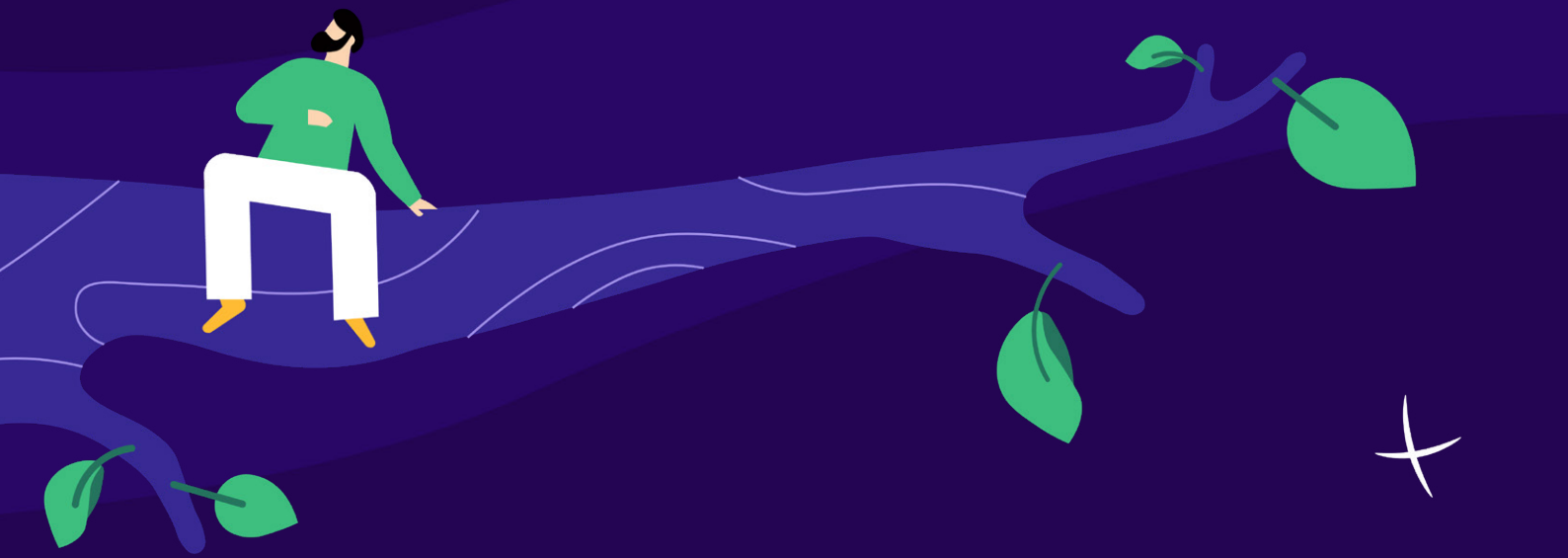
Glossary of Terms

CEC	Citizen energy community
CSC	Collective self-consumption
DH	District heating
DSF	Demand-side flexibility
EED	Energy Efficiency Directive
EMD	Electricity Market Design
EPBD	Energy Performance of Buildings Directive
REC	Renewable energy community
NZEB	Nearly zero-energy building
P2P	Peer-to-peer
PPA	Power purchase agreement
REDII	Renewable Energy Directive
SPEN	Sustainable plus energy neighbourhood
SRI	Smart readiness indicator



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Sustainable plus energy neighbourhoods

Sustainable plus energy neighbourhoods (SPENs) can contribute to decarbonising the building stock, while providing additional benefits for residents both at the building and neighbourhood level, enhancing wellbeing and a sense of community. SPENs can provide a range of shared spaces, services and facilities, such as shared heat pumps, PV panels, EV charging, EVs, bicycles, and common spaces with greenery, water and biodiversity. A neighbourhood approach provides additional benefits to demand-side flexibility (DSF) compared to single apartments or buildings. The optimisation of electricity and heat production and sharing renewable energy from various sources is managed by a system of twin modelling and automation.

Shared assets, services and collective energy production installations interact differently with the urban infrastructure thus they often require new legislative frameworks. The Clean Energy Package of 2019 has important provisions to fill in these gaps and allow collective forms of producing, sharing and selling of energy, as well as to encourage prosumers to enter the market. This factsheet maps Spain's progress in implementing provisions of the 2018 Energy Performance of Buildings Directive (EPBD)[1], the Energy Efficiency Directive (EED)[2], the Renewable Energy Directive (REDII)[3], and Electricity Market Design (EMD)[4]. It reviews the latest developments in national, regional and municipal policies regarding the following aspects relevant to SPENs: i) energy performance, ii) renewable energy and energy communities, and iii) digital technologies and demand-side flexibility[5]. The factsheet provides an overview of existing gaps and barriers in the development and market uptake of SPENs, and provides policy recommendations.

The factsheet also lists the drivers, potential business models and policy support measures that enable investments and wider uptake of SPENs. The policy mapping and recommendations are based on desk research, ten interviews and two workshops with experts from the private and public sectors, including developers and local authorities involved in projects of SPEN and energy communities.

[1] Directive (EU) 2018/844
[2] Directive (EU) 2018/2002
[3] Directive (EU) 2018/2001
[4] Directive (EU) 2019/944
[5] A complete policy mapping is available in Boll et al. (2021)

1.
Energy performance

The positive energy balance of a SPEN can be achieved with three subsequent steps:

- Sufficiency measures at neighbourhood level
- Reducing energy demand with energy efficiency measures at the building level
- Collective production and sharing of renewable energy

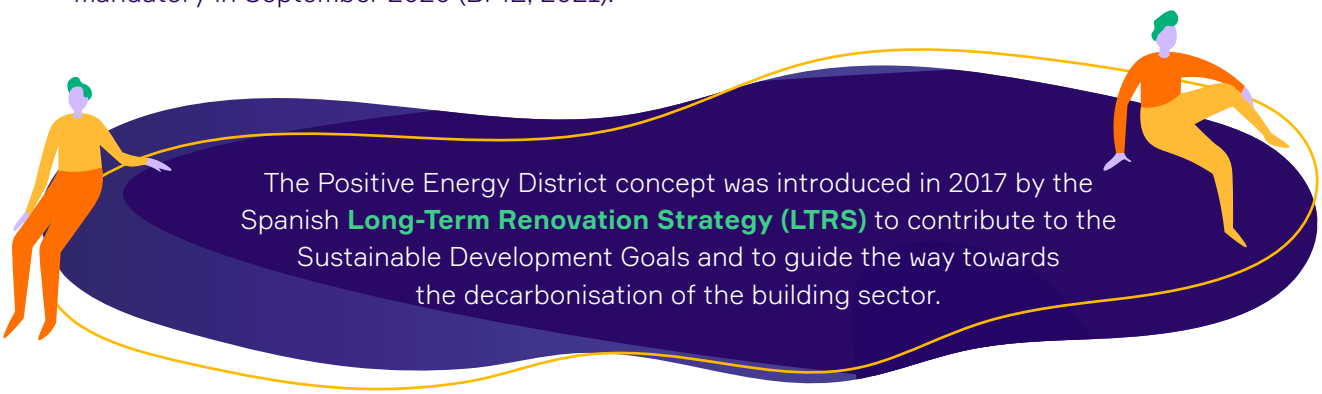
Energy sufficiency aims to reduce total energy consumption by analysing the need of services, spaces and the technology use in the design phase, by providing an adequate level of utility or services from energy. Sufficiency measures within SPENs, such as shared heating systems, EV charging stations, EVs, bicycles and common spaces, can reduce both operational and embodied emissions. The second type of measures that aim at reducing energy demand at the building level depend on building regulations for new constructions and renovations. Finally, after reducing the energy demand, the low amount of energy required should be covered by renewable energy produced and shared within SPENs.

The 2010 EPBD[6] mandated nearly-zero energy (NZEB) for new constructions by 2020 and minimum energy requirements for major renovations. This section will describe in detail the implementation of minimum energy performance requirements in Spain, considering that more ambitious requirements at the building level will also have an impact on the energy balance of SPENs. All the syn.ikia demo projects have implemented ambitious targets at the building level going beyond the statutory minimum requirements. Given the scope and ambition of SPENs to achieve energy-positive performance levels, a broader set of policy provisions and support measures are being reviewed, including policies that aim to reduce lifecycle climate impacts.

[6] Directive 2010/31/EU

Minimum energy performance requirements

The energy performance requirements for new buildings in Spain are regulated through the **Technical Building Code (CTE)**. This document, along with **complementary guidelines**, drives the application of the regulatory requirements and supports professionals in understanding them. Spain has had a new NZEB building code in place since December 2019, which became mandatory in September 2020 (BPIE, 2021).



However, no significant advances in developing and promoting the concept have been made since then. The Technical Building Code increased ambition for the energy performance of buildings and for renewable energy generation. Building regulations support positive energy buildings, but in practice they cannot drive the real-world implementation of SPENs, as this requires more than just building codes.

A new or existing building that meets the regulatory requirements set out in the Basic Document (**DB HE Energy Saving**) is defined as a NZEB.

The total primary energy consumption ($C_{ep,tot}$) of the spaces contained within the building's thermal envelope must not exceed the following limit values (Table 1):

Table 1: EC NZEB benchmarks and energy performance and renewable energy requirements. Source: BPIE (2021)

	EC NZEB benchmarks for the Mediterranean region		Energy performance and renewable energy requirements	
Building type	**Primary energy threshold (kWh/m² per year)**	**Renewable as % of total primary energy**	**Maximum primary energy demand (kWh/m² per year)**	**Renewable as % of total primary energy**
Residential buildings	50-65	71-87%	40-86 (avg. 63)	Not applicable[7]
Non-residential buildings	80-90		120-165 (avg. 143)	

[7] Renewable energy requirements in Spanish NZEB standards cover DHW and in some cases electricity from RES.

The total primary energy consumption limit values per winter climate zone are given below (Table 2).

Table 2: Total primary energy consumption for residences (in kWh/m²/year).
Source: DB HE Energy Saving.

Winter climate zone	α	A	B	C	D	E
New buildings and extensions	40	50	56	64	76	86
Changes to use to private residential	55	75	80	90	105	115

Energy performance requirements for the renovation of existing buildings are also regulated in the **Technical Building Code (CTE)**. According to the regulation, deep renovations must comply with the energy performance requirements established for the construction of new buildings. For partial renovations, the requirements vary according to the parts of the building that are being renovated.

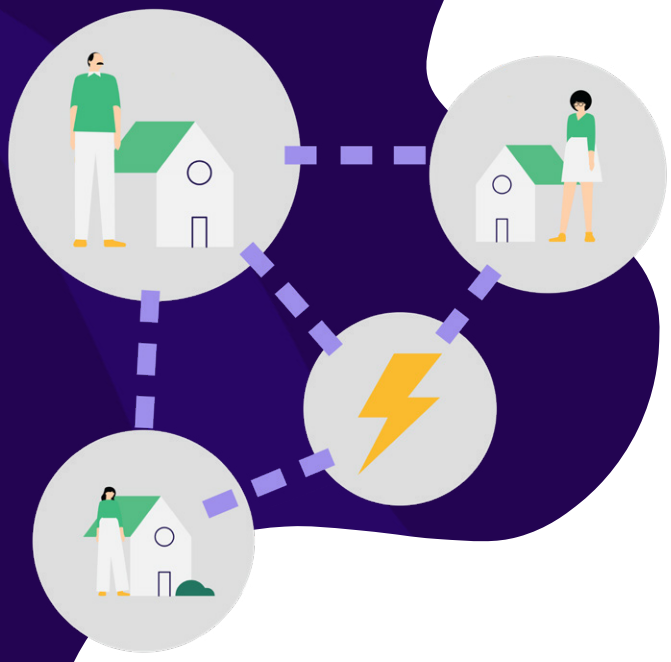
Policies to encourage positive energy buildings

The **Law 10/2022** on urgent measures to promote building renovation in the context of the Recovery, Transformation and Resilience Plan, strengthens the ability of homeowner associations to access credit, thus enhancing their financing capacity. This law also articulates measures to facilitate access to bank financing for owners, usufructuaries and neighbourhood communities through a new line of **ICO guarantees** which will be developed through an agreement with the Ministry. The risks of loans granted by private financial institutions for home energy efficiency renovations will be partially covered. With regards to tax incentives, renovation benefits from tax deductions through different aid programmes (including the programmes just mentioned). This policy encourages energy communities by simplifying the administrative procedures. It undoubtedly brings citizens closer to cooperative systems related to energy production and empowers them towards the 'prosumer'[8] concept, which can also encourage the development of SPENs.

The availability of subsidies through the Royal Decree 853/2021 is an effective incentive for driving energy renovation. While it is more aimed at individual building renovations, it may also be applied to public housing and urban regenerations (neighbourhood refurbishments) that could promote SPEN development.

[8] Producer and consumer

Policy	Implementation level	Main provisions
Royal Decree 853/2021: regulates assistance programmes in residential rehabilitation and social housing for the Recovery, Transformation and Resilience Plan	National	Financing the joint implementation of renovations, requiring reduction of non-renewable primary energy consumption by at least 30 %, referring to energy certification and the reduction of the overall annual energy demand for heating and cooling. Targeted mainly at residential buildings, including single-family dwellings, and the urbanisation or redevelopment of public spaces within the scope of the so-called Residential Environments of Scheduled Rehabilitation (ERRP).
Law 10/2022: urgent measures to promote the activity of building rehabilitation in the context of the Recovery, Transformation and Resilience Plan	National	Strengthens the capacity of homeowner associations to carry out works and actions that improve energy efficiency, meaning they require less support to get rehabilitation actions approved by homeowner associations, and to request financing and public aid.



2.
Renewable energy and energy communities

REDII (Directive (EU) 2018/2001) and EMD (Directive (EU) 2019/944) contain important provisions and definitions for a legal framework enabling the production, storage, sharing and selling of energy. The implementation of these Directives can enable smaller players such as SPENs to play an increasing role in the energy market – and thus in the energy transition. However, Member States have opted for different strategies and are at different stages in implementing the definitions of collective self-consumption (CSC), renewable energy community (REC) and citizen energy community (CEC). The transposition of these frameworks into national legislation is a key enabler for SPENs.

Overview of existing policies

CSC was first introduced in 2018 and then modified by Royal Decree 244/2019 at the national level. In REDII (Directive (EU) 2018/2001) CSC ('jointly acting renewables self-consumers') was limited to a single multi-apartment building. In Spain, as in most Member States, CSC was extended beyond a single building, being allowed for several buildings located in proximity. The distance permitted between the production and consumption was initially limited to a range of 500m, then later extended to 1km and eventually 2km, as is the case in France. CSC projects also have to be connected to a low-voltage distribution grid. Alternatively to being restricted to the 2km range and a low-voltage distribution grid, CSC can be located within the same cadastral reference.

Additionally, CSC is limited to electricity – this is a limitation for SPENs, which also need to be able to share renewable heat and all types of renewable energy, such as geothermal, biomass etc.

CSC is also encouraged at the municipal level. The Working Group of Local Authorities, promoted by the Catalan Institute of Energy, has approved a model of municipal ordinance for the promotion of self-consumption facilities with photovoltaic solar energy. The legal framework for CSC allows energy sharing between the residential building and medical centre in the syn.ikia demo project in Barcelona. The existing range of 2km allows a mix of building uses within a SPEN, and facilitates larger projects.

Table 3: Transposition of collective self-consumption and energy communities in national legislation in Spain. Adapted from Frieden et al. (2020) and Murley & Mazzaferro (2022)

Collective self-consumption (CSC)	Renewable energy community (REC)	Citizen energy community (CEC)
Royal Decree 244/19 (including use of public grid) – national level Decree Law 24/2021 – regional level	Definition first introduced in the Royal Decree-Law 23/2020	First mentioned in the Royal Decree-Law 23/2020 No CEC framework available

Even though in the legislation there is a distinction between CSC and REC (Table 3), in practice, both private and public stakeholders often use these two concepts interchangeably under the term collective self-consumption (***autoconsumo compartido*** in Spanish). The definition of REC introduced by the Royal Decree-Law 23/2020 is a literal transposition from REDII (Directive (EU) 2018/2001), without further elaboration on the terms or legal entities that can be part of it.

The CEC is mentioned in the Royal Decree-Law 23/2020, but it hasn't yet been transposed.

CSC and REC pilot projects are encouraged by several programmes and policies which aim to simplify the administrative procedures and provide access to public funding: see Table 4.

Table 4: Main policy updates (for a complete list of policies relevant for SPENs and renewable energy deployment, see Boll et al. (2021))

Policy	Implementation level	Main provisions
Royal Decree 24/2021	Regional	Simplifies administration for the self-consumption of energy through measures such as excluding certain photovoltaic installations for self-consumption electricity generation from the administrative, construction and operation authorisation system.
Law 10/2022	National	Strengthens and simplifies provisions related to energy communities. Encourages prosumers to enter the market and play an active role.
CE IMPLEMENTA 2022	National	First Call and Second Call for Incentives for unique energy community projects provides funding for 29 pilot schemes and is part of the Recovery, Transformation and Resilience Plan.

Existing drivers and barriers

Drivers	• Well-defined framework for CSC for sharing electricity. Since it does not require a legal entity, it allows collective production and sharing of energy within a SPEN. It is limited to 2km and low-voltage distribution grids. • Administrative simplification for CSC such as the exclusion from the administrative, construction and operation authorisation system. • The public sector is an important driver for RECs, funding 29 pilot projects. Social housing and local administrations are drivers for SPENs and REC pilot projects.
Barriers	• Not a clear regulatory framework, fragmentation over many layers of national, regional and municipal regulations which are changing. For example, the initial 500m boundary for CSC was extended to 1km and eventually 2km. This does not create a predictable context for SPEN investments. • Confusion on the market and in the public sector between CSC and REC with the generic term of 'collective self-consumption'. • Partial implementation of RECs, not defined in detail which legal entities are allowed to participate in a REC, which brings the risk of corporate abuse. • Lack of transposition of CEC framework. • SPENs, like other prosumers that request connection and power to the distribution network, will have to pay for access rights and the costs of a new network extension (this is usually necessary given its limited capacity). • Technical regulations require oversized electrical installations for the connection of apartments with the local grid. These are outdated since the energy demand and peak loads are lower with the new minimum energy performance requirements for new constructions. • Information about grid capacity is not publicly available. There's a lack of monetary incentives for distribution system operators to allow new players such as SPENs to enter the market.

3.
Digital technologies and demand-side flexibility

An adequate policy framework is a prerequisite for a successful implementation of demand-side flexibility (DSF). DSF refers to a mechanism that allows consumers to change their electricity consumption or generation (reduce, increase or shift) for a certain duration based on external signals, such as market price. In this way, they could reduce their exposure to high energy prices, hedge against potential power outages, and monetise their flexible energy use.

Electricity markets need to improve the accuracy of demand-supply forecasts. Thus, the so-called 'imbalance settlement period'[9] should be set at 15 minutes. This would drive market price balance, and the system would be closer to becoming a real-time electricity market. All smart meters can deliver 15-minute measurements. Previously, yearly net metering[10] was being used as an incentive to encourage investments in renewable energy; however, it does not encourage DSF as the alternative of 15-minute imbalance settlement. DSF is important to reduce peak demands and avoid additional investments in grid upgrades.

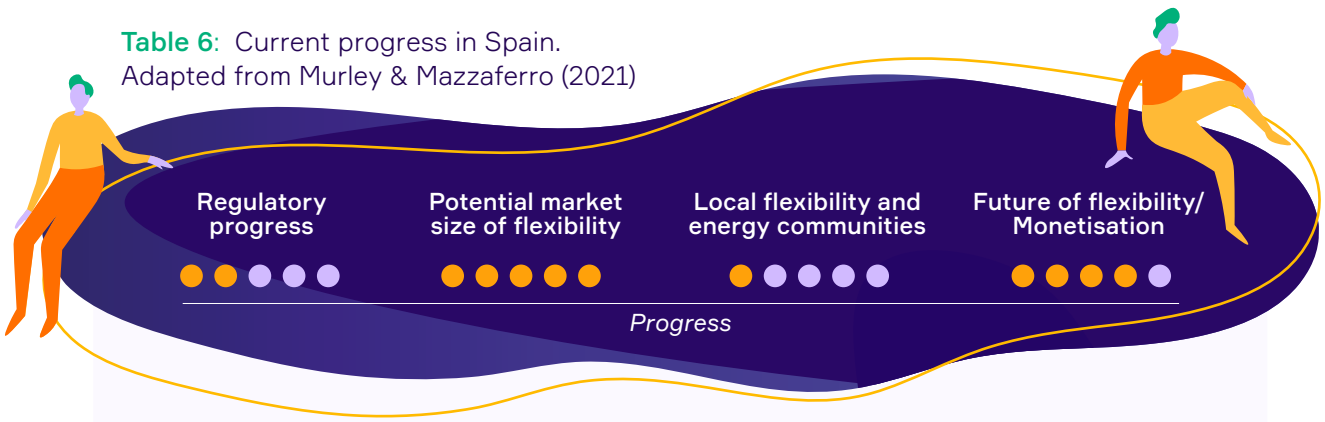
Overview of existing policies: existing drivers and barriers

The success of the DSF development will largely depend on i) having demand-side regulation in place, ii) potential market size, iii) the presence of local flexibility mechanisms, and iv) monetisation and the possibility of having markets in the future.

[9] Imbalance settlement determines the electricity deliveries between the parties operating in the electricity market.
[10] Net metering an electricity billing mechanism that allows consumers who generate electricity to account for it in the billing as electricity used anytime within a certain time period, instead of when it is actually used.

The progress of the existing regulatory framework, as well as future regulatory targets and flexibility market maturity, is presented in Table 6.

Table 6: Current progress in Spain.
Adapted from Murley & Mazzaferro (2021)



Regulatory progress

To enable DSF, the regulatory framework must allow aggregators or other companies offering DSF or ancillary services[11] to enter the market. Aggregator is an energy service provider which can increase or moderate the electricity consumption of a group of consumers according to total electricity demand on the grid and can also operate on behalf of a group of consumers producing their own electricity by selling the excess electricity they produce. DSF and potential savings on the bill for residential consumers allow for new types of services on the electricity market, provided by aggregators. Thus, the new electricity market regulations must allow new companies to enter the market, including in the REC context, at the same time protecting consumers who must ultimately benefit from savings from DSF (BEUC, 2018).

The Spanish market has very high entry requirements in terms of minimum capacity or energy volume, which limits DSF participation, even though the market is technically open to it. For example, for one of the markets, a minimum portfolio size of 200MW is required with the possibility to aggregate generation or demand assets. Furthermore, various ancillary services have technical requirements that are not adjusted to having a DSF mechanism.

The same challenges apply to the resource adequacy mechanism[12]. Spain changed the regulations in 2021, since when variable pricing, which is beneficial for DSF, is being adjusted across three fixed time periods for residential customers, and three to six for commercial and industrial customers.

Smart readiness indicator (SRI)[13] is a policy to encourage smartness and ICT in the building sector at the European level. It was first introduced as a voluntary scheme by the 2018 EPBD recast.

[11] Ancillary services are additional services provided by the distribution system operator required for a proper operation of the grid such as keeping the frequency, voltage, and power load within certain limits.

[12] Resource Adequacy means the provision of adequate generating resources to meet projected load and generating reserve requirements in each region.

[13] Smart readiness indicator measures the capacity of buildings to use information and communication technologies and electronic systems to better suit the needs of occupants and the grid, as well as improve energy efficiency and overall building performance.

SRI may be a useful certification for buildings that have implemented smart building automation, since developers usually want to attest to the additional investments. However, as it has not yet been implemented in Spain, SRI is not widely known on the market and may not be useful for final consumers.

Potential market size of flexibility

Electricity markets encompass many ancillary services, which can create revenue opportunities. These ancillary services need to exist in the local market; the regulation needs to enable a dynamic and flexible market, with no double network charges, and to enable aggregation of resources.

Spain allows market players to invest in EV recharging infrastructure deployment in a competitive way by the prohibition of ownership, development, management, and operation of energy storage facilities by distribution system operators. Another anticorporate regulation is to ensure that all eligible parties have non-discriminatory access to data managed by distribution system operators, an important condition for the development of innovative services (Murley & Mazzaferro, 2021). However, this regulation is currently not being implemented and SPEN developers have limited access to information regarding grid capacity.

Local flexibility and energy communities

The regulatory framework should also enable energy production and the sharing and selling of excess energy by transposing the CSC, REC and CEC into national legislation. The regulatory framework for CSC is well established and allows energy sharing within a range of 2km, the REC framework is partially transposed, while there is no framework available for CEC (Table 3).

Future of flexibility

The progress of policies in terms of future targets for renewables or target dates to join European market coupling is assessed in Table 6, as well as the current monetisation of flexibility. Within the CSC framework, SPENs can choose between two options: either feed the excess energy into the grid, or net metering. If the project is bigger than 100kW, it can only feed into the grid. An hourly imbalance settlement period and dynamic tariffs are additional incentives for DSF.

Table 5: Implementation of smartness and DSF in electricity regulation. Adapted from Murley & Mazzaferro (2022)

Residential dynamic tariffs	15-minute imbalance settlement period	Storage in ancillary service	Distribution system operator flexibility – commercial/trial
Available	Not implemented (Hourly imbalance settlement implemented)	No	Trial

Managing the exchange of heat and electricity within a SPEN and shifting demand and response at the neighbourhood level is more complex than DSF in the case of single apartments. It includes heating, electricity and mobility at apartment and neighbourhood level. It requires modelling, smart systems and automation, as well as knowledge regarding the legal and contractual aspects with other market players. With outputs from energy monitoring, the contracts can be adjusted to maximise the local consumption of energy and to allow consumers to reap the maximum benefits from billing. The need for an energy administrator within SPENs opens up new opportunities for business models. In the electricity sector, new market players such as aggregators offer services for DSF; however, in the context of SPENs, these services should go beyond electricity and also manage heat from all sources of renewable energy.

Drivers	• CSC is limited to 2km or within the area of the same distribution transformer: this allows collective production and self-consumption of electricity within a SPEN without the need for a legal entity. • There is additional potential for DSF within a SPEN compared to single apartments because of a mix of building uses and shared assets such as shared heat pumps, PV panels, EV charging, EVs and bicycles. • The optimisation of electricity and heat production requires a SPEN energy manager. This allows for business models similar to aggregators, but managing both electricity and heating. • Hourly imbalance settlement period and dynamic tariffs.
Barriers	• The optimisation of electricity and heat production requires complex and costly modelling and automation. • Monopolies in the electricity sector, administrative barriers, and limited access to data managed by distribution system operators. • SRI is at an early stage of implementation.

4.
Financing, business models and enabling conditions

The low energy demand and the surplus of energy of a SPEN offers new business model opportunities for energy sharing within SPENs, as well as selling the excess energy within a REC. The business models (Table 7) were analysed in a workshop with experts and developers, to assess their applicability to existing SPENs and their alignment with the existing regulatory framework (Table 8).

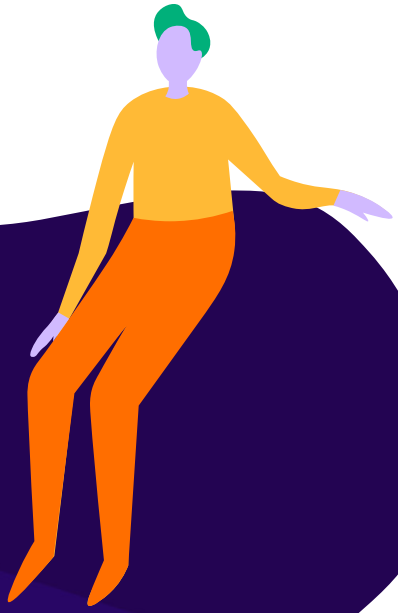


Table 7: Overview of potential business models relevant for SPENs

Business model	Description	Relevance for SPENs
P2P or local electricity market	Promote collective self-consumption by creating a marketplace among prosumers and consumers.	Energy sharing system among positive energy buildings in a SPEN. It incentivises and rewards plus-energy buildings. It encourages the community as a whole to share electricity and achieve a potential net gain.
Joint Shared Assets	Shared energy assets and investments such as batteries, PV panels etc.	Assesses the added value of SPEN projects compared to business as usual. Determines the optimal investments and the source of revenues to pay these (individual, collective, or both).
SPEN as an Energy Retailer	The SPEN becomes a retailer that buys power directly from wholesale markets, hence reducing costs by avoiding an intermediary (currently retailers).	Assuming that an advanced energy management system is available in the SPEN, automatises the hourly energy balance and predicts demand commitments in the power market. It brings advantages including more choices of energy suppliers and independence from retailers. This challenges the status quo and has the potential to channel more revenues to consumers, by avoiding the transaction costs of a retailer.
PPA	Power purchase agreements. Green or zero-carbon-emission energy might be of interest for industry or public buildings to certify guarantees of origin.	PPAs offer the possibility of a long-term commitment to sell surplus energy from SPENs to external players interested in acquiring certified renewable energy.
Inter-SPEN	The surplus energy of a SPEN can be traded or offered to an open marketplace, for example within a REC.	Trading surplus energy outside SPENs may incentivise additional investments in energy efficiency and renewable energy. Surplus energy could be bought by aggregators, other neighbourhoods or SPENs, industry, retailers etc. RECs and CECs may enable small actors such as SPENs to enter the electricity market.
SPEN flexibility services	Business models based on DSF: shifting demand according to energy availability to reduce peak loads and reduce grid congestion. The DSF avoids additional investments in grid upgrades.	SPENs provide energy flexibility to external actors: distribution system operators, aggregators, local grid, EV smart charging etc. The SPEN, through the energy management system, engages in DSF that has to be monetised and brings financial benefits to the consumers.

Table 8: Overview of possible business models for SPENs in Spain

Business model	P2P or local electricity market	Joint shared assets	SPEN as retailer	PPA	Inter-SPEN	SPEN flexibility services
Applicability of business models for SPENs in Spain	No	Yes	Limited	Yes	Limited	No
Regulatory framework requirements	CEC and CSC	REC and CSC	CEC	REC	CEC and REC	CEC and REC

SPENs have a strong focus on social cohesion and community building, as well as the comfort and wellbeing of the tenants. The SPEN concept foresees shared spaces and services, and often requires additional investments in green space, water infrastructure and mobility. Certification schemes can attest to the added values of SPEN developments compared to business as usual and become a source of verified documentation that can support compliance with sustainable finance claims (taxonomy) or the articulation of the business case for SPENs.

5. Policy recommendations for Spain

Reducing energy demand at the building level for new constructions and renovations plays an important role in the total energy balance of a SPEN. Implementing the 2018 EPBD set minimum requirements to NZEB levels for new constructions. However, the implementation of NZEB levels in Spain is less ambitious than the recommended benchmarks from the EC for the Mediterranean region. Besides, no minimum share of renewable energy produced on-site or nearby has been set, as in other Member States. The next steps towards defining and implementing the zero-emission building will be set out in the upcoming recast EPBD of 2023, and Spain should seize this opportunity to tighten the requirements for new constructions and renovations.

Spain has implemented a solid CSC framework that allows collective production and sharing of energy within 2km. However, the existing REC framework should be further defined and improved, while CEC remains to be defined. Several recommendations are provided below to enable new actors such as SPENs, aggregators or energy managers to enter the electricity market.

Energy performance	• The upcoming implementation of zero-emission building standards of the revised 2023 EPBD should increase the ambition for new constructions and renovations, also considering the embodied carbon. • Support schemes are necessary to encourage additional investments in positive energy buildings, beyond minimum requirements.
Renewable energy and energy communities	• A coherent and stable framework for energy sharing has to be set to allow predictability for SPEN investments. • REC should be further defined, detailing which legal entities are allowed; a supervising authority should be assigned for consumer protection purposes. • CSC should not be limited to electricity, it should include renewable heating and cooling. • Regulatory sandboxes are necessary to experiment with ways of sharing renewable energy through a local grid. • Update the technical regulation on the low-voltage electrical installation with less conservative simultaneity coefficients to avoid costs due to oversizing.
Digital technologies and demand-side flexibility	• Further elaborate frameworks for REC and CEC for regulating the role of new market players such as aggregators or SPENs with energy communities. • Remove the administrative and financial barriers, create new business models to encourage distribution system operators to collaborate with SPENs, and allow smaller actors on the market.

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