European Commission

The impact of the EU's changing electricity market design on the development of smart and sustainable cities and energy communities

EU Smart Cities Information System

EMPOWERING SMART SOLUTIONS FOR BETTER CITIES www.smartcities-infosystem.eu

Energy

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1.1 INTRODUCTION

The implementation of the *EU's Clean Energy for all Europeans Package (CEP)* leads to important legislative updates, including recasts of the *Renewable Energy Directive*, the *Directive on common rules for the internal market for electricity* and the new *Regulation on the internal market for electricity.*

The impact of these regulatory changes on the development of smart and sustainable cities is considerable, as both domains are intrinsically tied to the EU's energy and climate goals and strongly interfere with each other. This is exemplified in ongoing pilot projects for the realisation of Positive Energy Districts (PEDs)[1]. Hereby it has become clear that PEDs are hard to develop while respecting the current – but soon obsolete - legislative frameworks.

What do the recast directives imply for enhanced smart and sustainable city development? Will observed barriers for the development of PEDs and innovative district energy systems be cleared? What is the role of the different stakeholders involved (e.g. prosumers), of flexibility (e.g. for providing grid services) and of new trading models (e.g. peer-to-peer trading)?

This policy paper aims to bring hands-on insights and experiences from (EU-funded) projects and initiatives on the ground, and to formulate policy recommendations based on these. The focus is on aspects that affect urban planning and governance for Smart Cities and Communities (SCC). The paper checks the assumptions that underpin the CEP, and identifies challenges and opportunities that come forward in the SCC domain. Like this, it connects the dots between the innovative edges of current practice and what one may expect from a fully implemented CEP for the future of climate neutral cities.

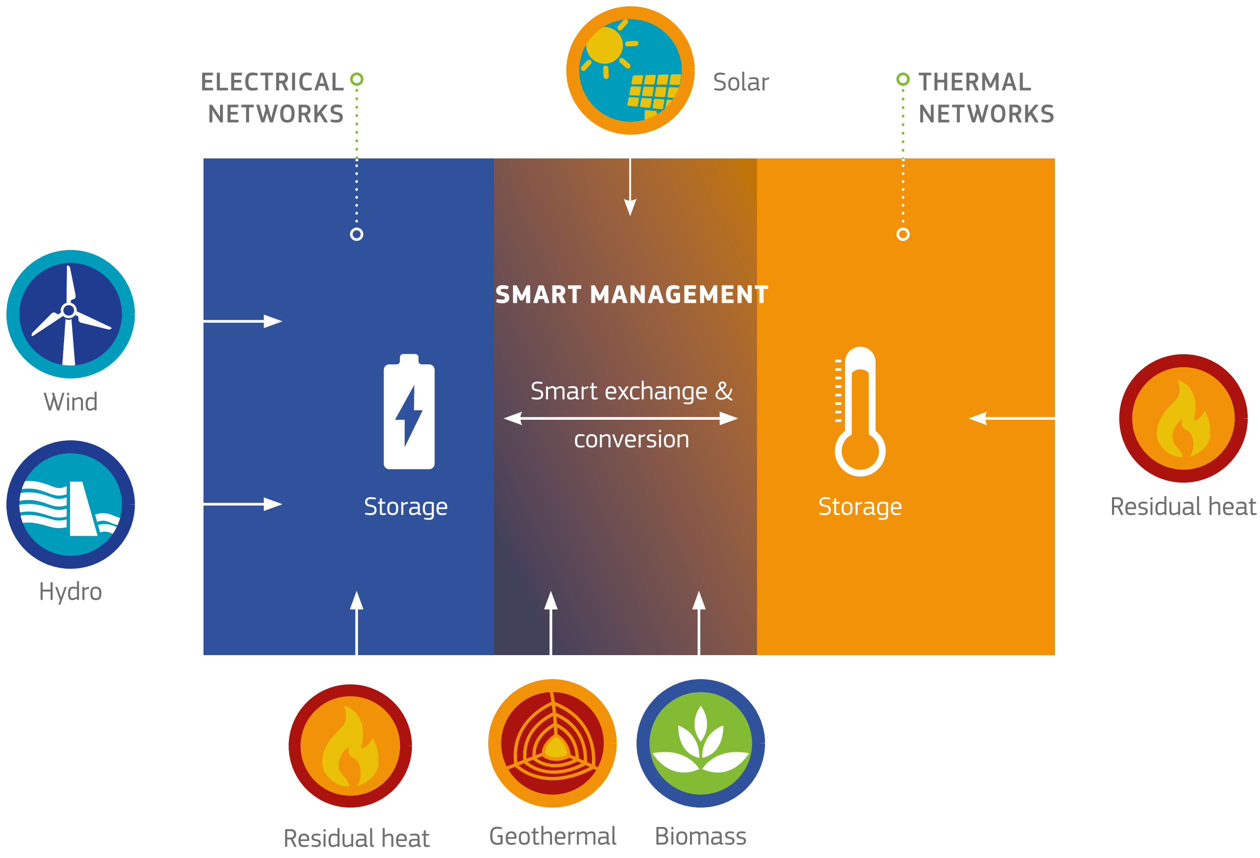
1 For a definition of PEDs, see *https://jpi-urbaneurope.eu/ped/*; for an overview of H2020 SCC Lighthouse Projects of which the most recent generations experiment with PED pilots, see *https://smartcities-infosystem.eu/scc-lighthouse-projects*.

1.2 CURRENT CONTEXT: THE ENERGY PARADIGM SHIFT

The transition towards climate neutral functioning, one of the European Union's major policy goals, implies a structural shift from the historically grown and centralised, fossil fuel based energy system towards a combined centralised-decentralised renewable sources (RES) based energy paradigm.

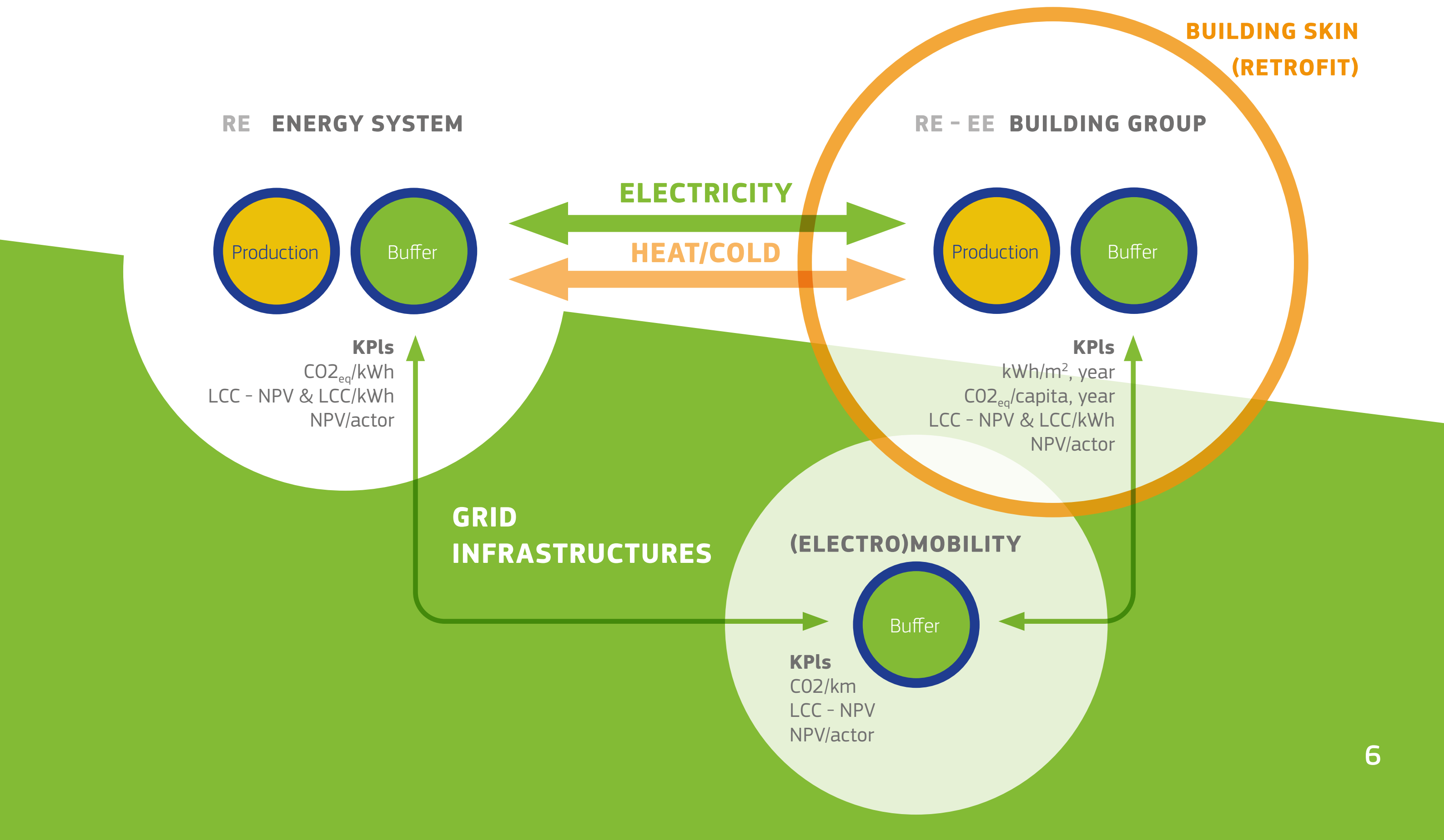
We may indeed speak of a paradigm shift as the entire energy system must be reconsidered in all of its aspects: technical-environmental, economic, social and legal.

At present, we are in the middle of this change process. Renewable and sustainable energy sources are taking up ever larger shares of the production volume, energy grids are becoming smart, markets diversified and legal frameworks updated. This mainly affects the electricity system, which is today more heavily regulated than the heat or combustible market – one reason being the need to keep the electricity grid in continuous momentary balance. However, through ongoing processes like electrification of heat demand and mobility, plus sector coupling, all vectors of the energy system come into play.



▲ *Figure 1: Conceptual scheme of an energy system with 100% renewable/sustainable energy sources where the electricity and heating/cooling pillars are functionally connected through sector coupling and where all flows are managed by smart grids.*

▼ *Figure 2: The role of buildings and transport, two main energy consumers of the urban environment, in the clean energy system. Quantifiable optimisations can be performed for key performance indicators (KPIs) like energy use, carbon emissions or total cost of ownership. These KPIs may have another optimum when considered at the district level, compared to optimisations at the single building level. From a perspective of total cost of ownership for society, it is therefore important to perform assessments above the level of single buildings when designing energy infrastructures.*



The current ‘in between’ position where the old and the new paradigm co-exist in a transitionary and continuously changing way, is uncomfortable for all involved actors. One relevant example under the scrutiny of the Smart Cities Information System (SCIS) are the Smart Cities and Communities Lighthouse Projects, where the development of PEDs and Energy Communities (ECs) is hindered by existing legal frameworks and the dominance of incumbent business models. It forces these projects to, respectively, require legal sand-boxes to be able to proceed, and to attempt at breaking open existing markets with experimental value propositions.

1.3 THE CEP AS A POLICY FRAMEWORK FOR THE NEW ENERGY SYSTEM

The CEP, adopted in 2019, is a major instrument to deliver on the EU’s commitments towards climate change mitigation under the Paris Agreement[2]. It serves as the EU-wide guiding framework for the implementation of the regulatory changes needed for delivering a future proofed energy system.

The CEP relies on eight legislative proposals for realising its goals. The *Directive on common rules for the internal market for electricity*, the new *Regulation on the internal market for electricity*, the recast *Renewables Directive* as well as the fully revised *Energy Efficiency* and *Energy Performance of Buildings Directives* directly affect the domain of SCC.

The other legislations concern the *Regulation on risk preparedness in the electricity sector*, a stronger role for the *EU Agency for the Cooperation of Energy Regulators,* and a new *Regulation on the Governance of the Energy Union and Climate Action*. These legislations specifically target national energy and climate plans, cross-border cooperation and risk management between Member States (MS) and thus regulate a higher operational scale level than the urban operational contexts and local energy communities considered in the present analysis.

Together, all these updates enable the energy transition that must underpin the EU’s climate neutral functioning by 2050.

These legal changes do not come too early. As stated in the Smart Cities Marketplace (SCM) and referring to ongoing innovative smart city projects, the *‘existing regulatory frameworks (…) were developed to serve the traditional energy industry, building sector and management of municipalities, and are hence often experienced as an obstacle for the energy transition and sustainable urban development’* [3].

While EU MSs are in the full process of transposing the new EU directives into national or regional legislation, projects on the ground struggle with the existing regulatory frameworks and market set-ups. This is exemplary of the uncomfortable ‘in between’ situation mentioned earlier.

Will the revised frameworks thus solve the problems these projects encounter? In order to better understand the possibilities hereof, we investigate the different aspectual layers of the question. These regard the environmental-technical boundary conditions of the future clean energy system, the identification of market barriers and opportunities, and social aspects like involving citizens more in the energy transition, or fighting energy poverty.

2 *https://ec.europa.eu/energy/topics/energy-strategy/clean-energy-all-europeans_en*

3 Myrstad, M., Livit, K., Wyckmans, A. (2020), A new EIP SCC initiative on regulatory frameworks within the Integrated Planning, Policy and Regulation Action Cluster, p.4, *https://cityxchange.eu/wp-content/uploads/2020/10/EIP-SCC-Initiative-Regulation-Framework-finished1.pdf*

1.4.1 SCALE INTEGRATION

In this section we refer to 'scale integration' as a combined spatial and technical planning problem: what type of infrastructure should be laid out where in order to arrive at an optimal overall energy system design? This is not a sole matter of electrical or thermal engineering. It also regards spatial planning and actor constellations. RES installations often require substantial space and will enter in competition with other spatial claims. Like this, scale integration is an important challenge we identify for the future multi-commodity, multi-actor and multi-governance energy system when considering its relation to spatial and urban planning.

The emerging energy system will not be entirely decentralised. It will continue to rely on large-, medium- and small-scale energy installations with their necessary grid integration. Large scale wind-, hydro-, biomass- and concentrated solar power plants represent the first category. They remain centralised in the established meaning of the word, whereas the two other categories are to be labelled as decentralised. Typical instances of meso-scale installations are (collective) energy production and distribution facilities like solar farms and district heating and cooling networks. They operate at a supra-building scale level. Small-scale installations pertain to the individual building domain and have become mainstream in the form of PV panels, solar boilers, individual biomass installations[4] and hybrid systems like heat pumps sourcing different types of ambient heat. Scale integration between macro-, meso- and micro scale equipment will be a primary functional parameter to take into account for smart and sustainable city planning. Scale integration implies that the technical, spatial, economic, social and regulatory boundary conditions for the good functioning of the energy system are fully addressed at the different scale levels, and that the resultant design choices are mutually integrated to provide for the most effective combination of production installations in a given context.

Figure 3: Macro-, meso- and micro-scale RES installations (composite image by the author).

4 Individual biomass installations come with a series of sustainability and contamination concerns that must be addressed, and that imply that they should often not be promoted for use on a large scale. The discussion of their sustainable application potential is however beyond the scope of this paper.

Scale integration is of particular importance where a city or a region is striving towards climate neutrality. In this case, an energy potential mapping[5] exercise will identify supply and demand figures for the concerned area, after which combined strategies for increased energy-efficiency (EE) and renewable/sustainable energy input (RES) can be developed. A trade-off between betting on EE on the one hand, and on RES input for filling in the residual demand on the other hand, will always be required as part of the climate action plan. Hereby, the remaining RES demand will have to be filled in with production facilities and installations at the aforementioned different scale levels. Different scenarios for realising climate neutrality can then be quantitatively assessed from both an environmental-technical and a financial-economic point of view. These scenarios and results can be fed into the stakeholder process for further discussion and decision-making.

In this context, one must consider that cities cannot be considered as (energy) islands, but remain functionally embedded in a regional (electricity, heat and cold) as well as a supra-regional (electricity) hinterland with which they are in continuous exchange.

Sector coupling between electricity and heat and cold adds to the complexity of interplays, see also further.

As renewable energy production typically has much higher space demands than fossil fuel extraction, i.e. the renewable energy's density is substantially 'thinner' than the one of fossil fuels, claims for production space may come to conflict with the needs of other users of space. The archetypal example of such conflict is the opposition of inhabitants to the erection of wind turbines in the proximity of their homes. Another such spatial dilemma is food-energy: do we allow using agricultural grounds for energy production, e.g. through solar fields or biomass plantations? With increasing shares of renewables, the number of such potential conflicts may dramatically rise. Reversely, well-thought urban and spatial planning can try to solve this problem by smart integration of renewable energy production in the landscape, while aiming at maximum symbiosis with other uses of space. As an example, agrivoltaics[6] may formulate an answer to the food-energy dilemma. A whole discipline of 'energy landscape planning' is therefore emerging. The main challenge to address here is to obtain a coherent integration of spatial planning and energy system design. This needs a fully inter- and transdisciplinary[7] approach by the concerned design and engineering teams[8], but also sufficient awareness and competence with other involved actors like local authorities and public administrations that must set up planning instruments and issue environmental or building permits. At the same time, opening up the effort and involving citizens and other urban stakeholders in a consultation or co-creation process from the outset is strongly recommended.

5 For a definition and discussion of energy potential mapping, see Broersma, S., Fremouw, M., van den Dobbelsteen, A. (2013), Energy Potential Mapping: Visualising Energy Characteristics for the Exergetic Optimisation of the Built Environment, in: Entropy, Vol. 15, p. 490-506; see also Vandevyvere, H., Stremke, S. (2012), Urban planning for a renewable energy future: methodological challenges and opportunities from a design perspective, in: Sustainability, Vol. 4, No. 6, p. 1309-1328.

6 In 2020 the subject was for the first time addressed in a dedicated international conference, see *https://www.agrivoltaics-conference.org/home.html*

7 In this context transdisciplinary stands for the involvement of (future) users and stakeholders.

8 See e.g. Vandevyvere, H., Stremke, S. (2012), op. cit.

At present, such scale integration is not yet commonly expressed as a design parameter for the (local, national or EU-wide) energy system but it may be expected that, with increasing levels of clean energy input, its importance will increase. It allows to fine-tune the interplay between centralised (macro-) and decentralised (meso-, micro-) components of the energy system.

Energy landscape design may thus be considered as the meaningful translation of integrated energy system design into coherent spatial and urban land use planning.

Appropriate governance of the corresponding transition trajectory, involving all stakeholders from the programming phase on, becomes equally important.

▲ *Figure 4: Energy landscape design explorations by H+N+S Landscape Architects for Rotterdam (l) and Overijssel (r) (copyright H+N+S Landscape Architects)..*

▼ *Figure 5: Energy landscape planning for the 'Flemish Metropolitan Dream' by Posad Spatial Strategies (https://www.youtube.com/watch?v=mZXzuP75Dec – copyright PosadMaxwan).*

ENERGY POTENTIAL MAPPING UNDERPINNING THE CLIMATE ACTION PLAN FOR THE CITY OF BRUGES (BE)

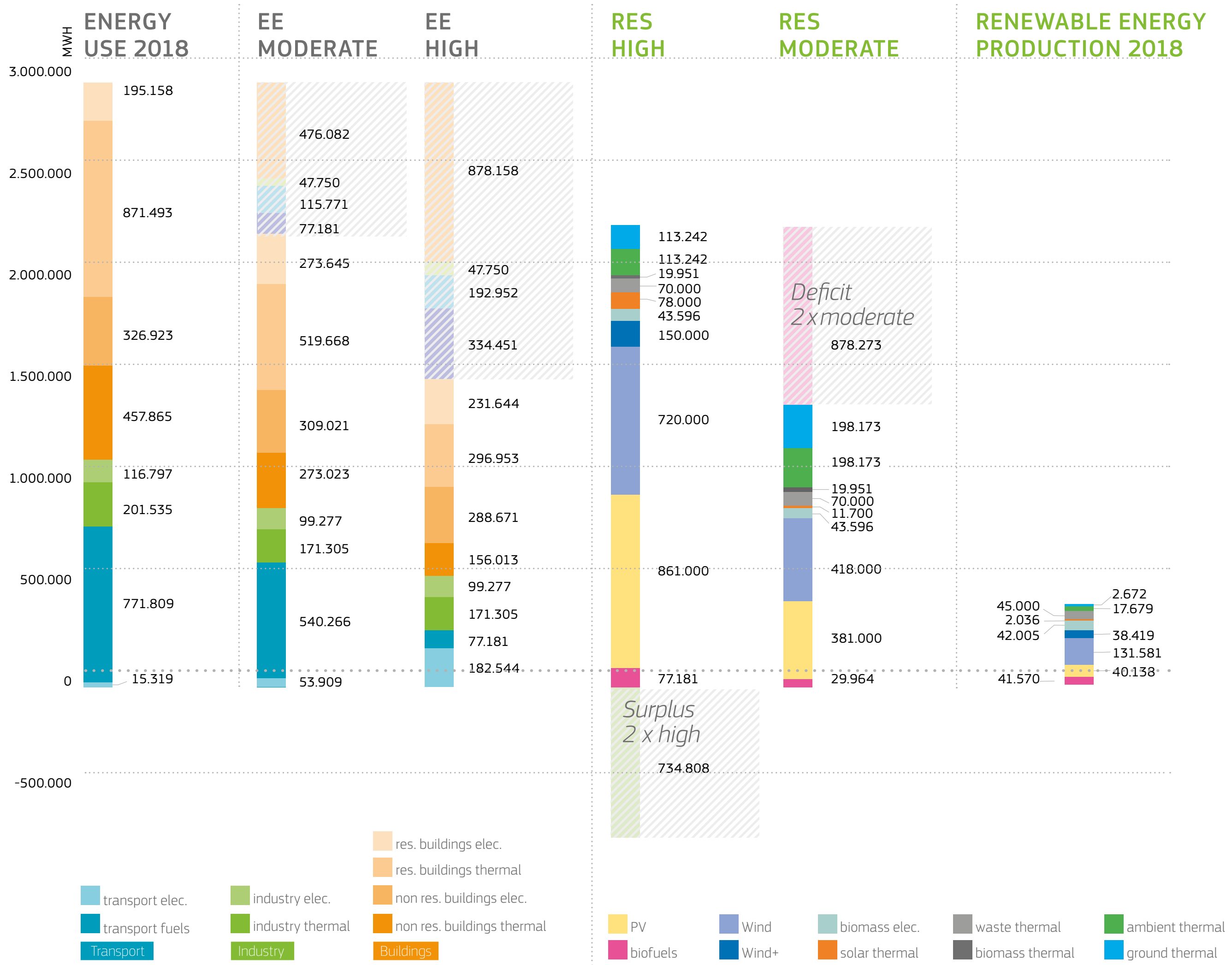


Figure 6: Energy potential mapping to support the update of the climate action plan for the city of Bruges (BE).

CASE

In **Bruges**, a city-wide energy potential modelling exercise is performed to support the update of the city's climate action plan. It considers both local EE and RES potentials. The analysis represented in the scheme is static (energy totals over a year, no dynamic modelling for grid balance). Column 1 represents current energy demand according to the different sectors, column 6 shows the present clean energy production. Columns 2 and 3 show moderate and high increases in energy efficiency (EE), while columns 4 and 5 represent high and moderate increases in clean energy production (RES). Combining high ambitions for EE and RES fosters a surplus while moderate ambitions for both result in a gap. High EE and moderate RES or moderate EE and high RES combined can realise net climate neutrality over the year. All scenarios have a substantial impact on the mix of RES production facilities, and require scale integration in order to arrive at the optimum feasibility. In a subsequent phase, energy landscape design can help to accommodate the required infrastructures within the city's territory.

1.4.2 VARIABILITY OF RES

Generation technologies are defined by the maximum power they can produce, the generation capacity. In this context, a distinction is made between firm and non-firm or variable capacity. The former refers to generators which can produce electricity when necessary and can be switched on or off on demand. Non-firm generation technologies are not always able to generate electricity since they depend on external factors like the presence of wind and sunshine.

RES can be considered a non-firm generation technology since their power generation is characterised by their intermittency, unpredictability and uneven geographical distribution. A high dependency on RES in the total generation capacity, can lead to situations where the peak load is exceeding the firm capacity which entails that generation cannot not be guaranteed at all times, impacting security of supply. Demand response and flexibility in general could therefore be a valuable resource to compensate for the lack of secure capacity.

1.4.3 GRID IMPACT OF ELECTRIFICATION

For optimised electricity transactions, the most efficient allocation of assets must be sought within the constraints imposed by the physical system. The introduction of high levels of RES together with increased electrification of mobility and heat or cold demand will considerably affect the distribution and national transmission networks. In areas with low demand in particular, where electricity generation from RES may easily exceed consumption, distribution systems have to be reinforced and extended. In a similar fashion, demand may increase significantly due to heat pumps, electrical vehicles and new energy intensive appliances. This could require considerable investment from distribution system operators (DSOs) and hence increase the need for flexibility as a possible alternative to grid reinforcement.

If the charging of electric vehicles is allowed to happen in an uncoordinated way, the electrification of transport may well affect the electricity grid in a negative way, resulting in both voltage issues and power congestion which are detrimental to the reliability and security of the distribution grid[9, 10]. Furthermore, if the residential evening power peak coincides with the start of the charging process for uncoordinated charging, insufficient generation capacity will be available at higher penetration levels of EVs[11]. Like this, the additional demand from EVs could raise the peak demand by 21% by 2035[12]. In these situations, measures like peak shaving through coordinated charging provide a solution.

Similar observations hold for the increased use of heat pumps, but also the additional electricity demand stemming from increased cooling needs and more electric appliances in households.

9 Sundstrom, O., Binding, C. (2012), Flexible charging optimization for electric vehicles considering distribution grid constraints, in: IEEE Transactions on Smart Grid, Vol. 3(1), p. 26-37.

10 Deilami, S., Masoum, A.S., Moses, P.S., Masoum, M.A.S. (2011), Realtime coordination of plug-in electric vehicle charging in smart grids to minimize power losses and improve voltage profile, in: IEEE Transactions on Smart Grid, Vol. 2(3), p. 456-467.

11 Clement-Nyns, K. (2010), Impact of Plug-in Hybrid Electric Vehicles on the Electricity System, PhD thesis, KU Leuven.

12 Eurelectric (2015), Smart charging: steering the change, driving the change, Eurelectric Paper, *https://www.eurelectric.org/media/1925/20032015_paper_on_smart_charging_of_electric_vehicles_finalpsf-2015-2301-0001-01-e.pdf*

1.4.4 CHARACTERISATION OF FLEXIBILITY

1.4.4.1 SIZE MATTERS (1).

It is becoming clear that providing a service at the level of a single household, for example **flexibility** in the form of demand side responsiveness or storage, may not be financially rewarding for the single household while this may well be the case if a large number of such small flexibility assets are combined into one offer. This has important consequences for the type of party that will be interested to take up the flexibility need in the market – in this case, an aggregator may do so. But even so, the business model for the relation between the aggregator and the household may still be jeopardised by the excessively low profit that can be shared with the household. **Examples from practice indicate that the expectations on the profitability of flexibility services have been set too high. This will have landslide consequences for the type of market that will be viable, and other incentives will be needed to render such services attractive to step in.**

Nevertheless, stacking of services could also lead to multiple benefits. Also in the future, at larger penetration levels of electrical vehicles (EVs), heat pumps (HPs) and batteries, portfolios can become significant, containing similar or one technology. This makes the communication and control more feasible. Although the assets are dispersed, the technological characteristics are similar (e.g. portfolio of home batteries) and the portfolio of flexibility is valued in the market, especially in the context of non-location specific services (reserves).

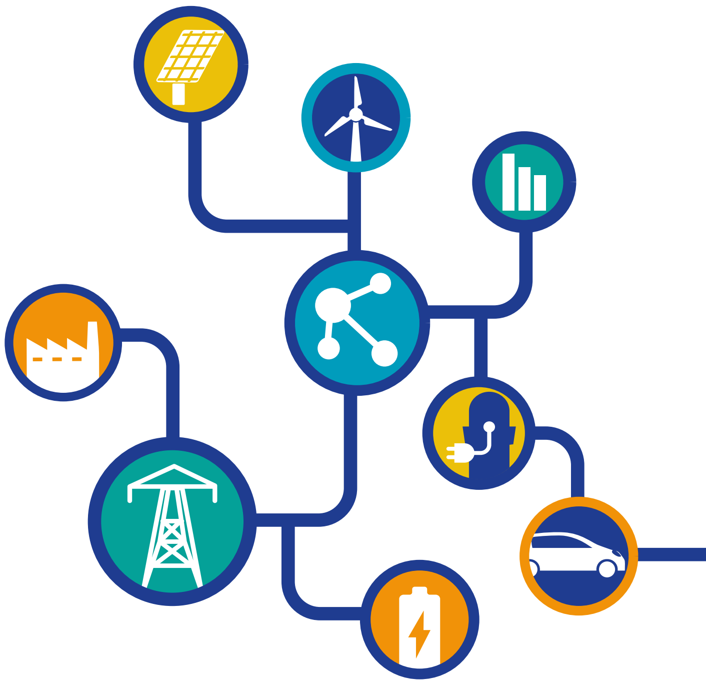
CASE

TIKO Switzerland provides flexibility services using the flexibility of several thousands of heat pumps. It does however not refund the end consumers, due to the fact that the administrative processing of the transaction would cost more than the amount earned by the delivered flexibility service. Even if blockchain payments were used, the numbers would remain low. Instead, TIKO provides alternative value to its customers: comparison with peers, automated assessment of energy consumption, suggestion for a better contract or calculation of the return on investment (ROI) for RES investments. *https://tiko.energy/*

ThermoVault aggregates the flexibility of electric boilers, which are widely used for preparing domestic hot water (DHW). They generally have a simple control ensuring that the tank is always filled with warm water. However, this implies unnecessary losses. ThermoVault therefore helps consumers and utilities to save money while allowing for the integration of more renewables. It developed a simple add-on control that applies a self-learning algorithm to ensure enough hot water is produced for the moment you need it while not having the excess losses. Aside from the typical 15% to 20% energy savings, the retrofit solution makes the boiler ready for grid-responsive energy services. Over 1 GW of flexible loads is currently connected to the platform. In this way, the aggregated boilers support the further integration of intermittent renewable energy in the energy market. *http://www.thermovault.com/*

1.4.4.2 SIZE MATTERS (2).

The newly defined energy communities are intended at empowering citizens to take up an active role in the energy market, but from a logistic point of view, this comes with challenges. Large players on the market have competitive advantages in terms of resources, for example regarding available work force or regarding technical, financial and legal knowledge about the electricity system. It is not evident for a group of citizens wanting to set up an EC to handle all these technical, economic, regulatory, administrative, privacy-related (GDPR) and ethical aspects while not being experts in the matter or having staff readily available to manage the roll-out of the EC.



1.5. MARKET CHALLENGES AND OPPORTUNITIES

The increase of distributed renewable energy resources, changes in the consumption pattern of end-consumers and technological developments, pose new challenges to all stakeholders involved in the energy market.

Buildings and urban districts will play an important enabling role in this energy paradigm shift, moving from being unresponsive and highly-energy-demanding entities to becoming efficient, micro- or meso-scale energy-hubs embedded in the wider energy system: consuming, producing, storing and exchanging energy in a smart way, and thus making the system more flexible and efficient.

Identifying suitable markets and business models for the new energy paradigm is a major challenge. This is due to the complexity of the energy system, and the sometimes **conflicting boundary conditions** that must be fulfilled.

Despite those many uses, with widely varying timing and technical requirements, the need for flexibility always boils down to efficiently **maintaining the energy balance** while **guarding the grid capacity constraints** to prevent and/or **mitigate emergency situations**. Besides these system objectives, also **consumer-oriented objectives** can be pursued.

1.5.1 CONSUMER ORIENTED OBJECTIVES

1.5.1.1 ENABLING CONSUMERS TO SAVE ON THE ENERGY BILL

End-consumers experience various incentives and triggers which influence the final energy bill. The interplay between these incentives makes up the reaction of the end-consumer and defines the potential savings within reach. The consumers' energy bill covers the energy commodity price, the grid tariff and levies and taxes.

Through the energy component, the own production can be valorised, individually or within a collective activity. At the moment, the impact of the energy component on the total energy bill of consumers is limited, given its small share within the whole. Here, the implementation of dynamic energy prices, varying over time according to the momentary situation in the electricity grid, can offer additional benefits. It is up to the commercial market players to draw up and offer the right price programs and commercial products in function of the developments around collective activities.

Another component of the energy bill is the network tariff. Via the network tariffs, the different grid costs are invoiced to the final consumer. These tariffs have been worked out in the past with certain objectives in mind. Cost reflectivity and non-discrimination are ways to ensure that every end-consumer contributes to the grid costs in a proportionate manner.

Currently, a distinct shift towards capacity-based tariff designs is identified across different European countries as a manner to increase cost-reflectivity. In this context, the total grid costs for the consumer depend on the (15 minute averaged) peak loads of the connected property or the contracted power. If one can lower the peak electricity demand or the contracted power, that consumer's grid costs can be decreased. This is considering an individual perspective.

Given the significant share of the grid tariff on the energy bill, the potentially limited use of the public grid by certain local collective activities and the resulting potential benefits from a grid operation perspective, a reduction or adaptation of grid tariffs for energy communities is a topic of discussion. Tailored grid tariffs could be worked out for energy communities to reflect the benefits achieved. There are, however, certain attention points which should be taken into consideration.

- It should be noted that not all energy communities can achieve (to the same degree) network and/or system benefits. The existing grid capacity, the occurrence of grid congestions and the orientation of the EC towards a specific grid asset (e.g. feeder or transformer) determine the extent to which energy communities can generate benefits.
- All consumers must contribute appropriately to the overall system and the financial stability of the electricity grid must be guaranteed. If tariff reductions for energy communities are implemented, the tariff-base, i.e. the number of consumers or the financial basis from which the total grid costs can be recuperated, decreases. Subsequently, this leads to increases in tariff for consumers which are not part of an energy community. This phenomenon is often referred to as the erosion of the financing base of grid operators. There should be no socialisation of costs on end consumers that are not part of the collective activity. In this perspective, special attention should be paid to economically or socially weaker groups, for example people in energy poverty. Without incentives, consumers with less resources (including knowledge) will, more than others, remain out of the new schemes but, at the same time, risk to be confronted with the increasing grid tariffs – thus losing two times. From a just transition point of view, it is therefore also recommended to implement measures that incentivise the participation of energy poor and vulnerable households, whether in decision-making or activity associated benefits of ECs, see also further.
- It is important to note that the European directives do not entail a reduced tariff for energy communities compared to other actors. The directives clearly emphasise the level-playing-field.
- Furthermore, it is important that the general grid design principles are taken into account.
- The relationship between existing market concepts (e.g. an industry or an aggregator acting as a Flexibility Service Provider) and ECs should be considered. Additional incentives for collective activities by ECs should be non-discriminating towards the other market players.
- Developing business models for energy communities based solely on cost avoidance of grid tariffs may therefore include increased risks as mentioned above.

CASE

Amsterdam pilot scheme for V2G: In the FP7 SCC project City-zen, a V2G experiment indicated the risk that well-off participants of the scheme, disposing of electric cars, will profit from the financial incentives set up to attract them, while the costs of these rewards are also paid by non-participants in the scheme through the common grid fees.

Source: Gerritse, E. et al. (2019), City-zen, a balanced approach to the city of the future, City-zen D5.7–5.10–5.11–5.12–7.4, p. 109, *http://www.cityzen-smartcity.eu/wp-content/uploads/2019/12/city-zen_d5-7_d5-10_d5-11_d5-12_d7-4_cityzen_smart_grid.pdf*

1.5.1.2 MAXIMISING THE (COLLECTIVE) SELF-CONSUMPTION OF LOCALLY GENERATED ENERGY

Maximising self-consumption can serve the triple goal of being more energy-independent, unburdening the grid (and thus potentially avoiding costly grid upgrades) and realising savings on the energy bill (see previous section). The incentive for self-consumption must be seen in the context of changing regulations and support mechanisms, for example feed-in tariffs for renewable energy production may become less attractive in the future. Important assets for maximising self-consumption are flexible technologies like Demand Response (DR) or storage, in most cases implemented as electrical battery storage. Hybrid electric-thermal technologies are possible as well, for example where heat pumps warm up or cool down a buffer or building when abundant electricity is available or when heating during a demand peak should be avoided. By using an indoor thermal comfort zone stretching over a few °C temperature, an interesting time lag deriving from the thermal inertia of the building mass can be exploited.

From an energy system point of view, the maximisation of self-consumption might negatively interfere with a future-proof energy system. In particular, a tension may arise between the need for flexibility from a system level perspective on the one hand and the (individual) optimisation towards self-consumption on the other hand. The latter might move consumers in the direction of investments that are not desired. For example, in the case where the maximised flexible consumption during own production hours could better be shifted to a later moment in time to answer to a system need (e.g. to maintain a balanced portfolio of demand and supply).

1.5.1.3 TRADING ON THE ENERGY MARKET

Prosumers can venture with smartly trading energy and reaping the financial benefits from it. Similarly, an aggregator can utilise all of the energy production and storage systems in its pool to trade energy on the wholesale markets. For example, the use of a home battery allows for energy storage when electricity prices are low and to discharge the battery when these are high. A single battery system is however not large enough (neither allowed) to trade on the wholesale market, which is where the aggregator or Flexibility Service Provider (FSP) comes in by managing a larger set of (home, vehicle, neighbourhood, …) batteries[13]. As mentioned before, such trading may be financially interesting for an EC but in certain conditions it may at the same time have a negative impact on the stability of the wider grid. Therefore, **the pricing mechanisms adopted within the EC as well as those necessarily imposed on it to safeguard the wider system stability make up for an important set of steering principles.**

1.5.2 MAINTAINING THE ENERGY BALANCE

The electricity grid requires a perfect balance between supply and demand of electricity at any point in time. Every high-voltage Transmission System Operator (TSO) is responsible for maintaining the balance in its control area. The relevant TSO is supported in this task by Balancing Responsible Parties (BRPs), which are responsible for taking all the measures available to them to maintain the balance in their own balancing perimeters.

13 It should also be noted that batteries have own losses and should permanently be available for charging and discharging, implying an average state of charge of around 50%, if one wants to perform market operations with these batteries.

In the past, flexibility services in the context of balancing the control area were solely reserved for grid users connected to the transmission grid, typically provided by centralised, flexible power plants and large industrial consumers. Certain market participation rules prevented distribution grid connected grid users to participate in the balancing market. As electricity generation is increasingly based on renewable, intermittent energy sources, the complexity to maintain the balance of the energy system becomes more and more challenging. It has become clear that solely relying upon transmission grid connected resources is insufficient. Decentralising the energy production increases the need to source flexibility at distribution level. This balancing context provokes the need to develop smart electric grids, capable of continuously handling the complex, dynamic balancing operations within the system.

Different sources of flexibility provide main contributions to the balancing need of the energy system. Both BRPs and TSOs are searching for flexibility in the context of their respective tasks in energy balancing, being portfolio management and frequency response. Flexibility can be provided by different assets, connected to different voltage levels and in a variety of scales.

In addition, new actors such as FSPs appear on the market. The latter combine different flexibility technologies of a larger group of active consumers into one common pool in order to offer services in an aggregated manner.

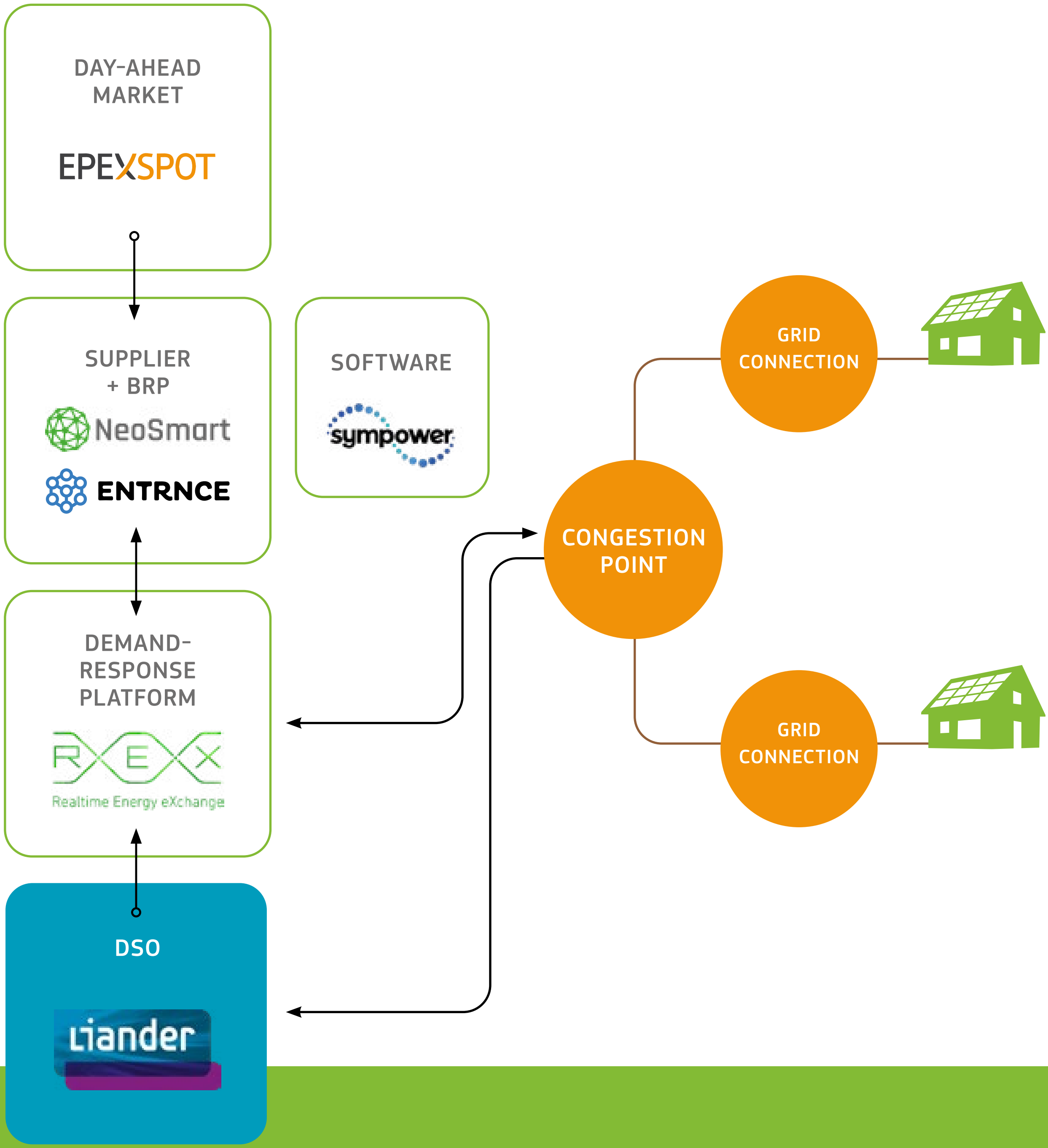
1.5.3 EFFICIENTLY GUARDING THE GRID CAPACITY CONSTRAINTS

Congestion management used to be primarily focused on dealing with transmission grid constraints with limited consideration of the distribution grid. Due to the vast increase in RES in the generation mix, investments in transmission grid infrastructure could not keep the pace in some EU countries, which lead to re-dispatching the actions traditionally taken by TSOs.

From the perspective of the distribution grid, a ‘fit and forget’ approach has been pursued where over-dimensioned distribution grids were deployed by default. Hence, the need for active management of the distribution grid was not getting traction. Spurred by the paradigm shift from central to more decentralised generation, DSOs have received continuously increasing connection requests. In the occurrence of grid connection issues, the conventional approach would be to limit the connections either by creating a connection queue or by exerting non-firm access. In the context of electrification of heat and the ever more integration of electric vehicles, efficiently guarding the grid capacity constraints increases in importance.

Flexible assets can be used to support the local grid during local peak moments. If a flexible asset (individually or within an EC) can be operated in this way, it may prevent the need for (additional) grid investments. For the procurement of these services, in response to the system operator’s needs, different methods can be implemented to obtain sufficient flexible volume to resolve certain challenges and issues. In general, these methods can be divided into three categories, with a growing level of incentivisation of flexibility providers, being rule-based methods, tariff solutions and market-based mechanisms[14].

14 CEER Distribution Systems Working Group (2018), Flexibility Use at Distribution Level - A CEER Conclusions Paper (C18-DS-42-04), CEER asbl, *https://www.ceer.eu/documents/104400/-/-/e5186abe-67eb-4bb5-1eb2-2237e1997bbc*.



CASE

Figure 7: The schematic overview shows the information flow between all parties involved in the ***Virtual Power Plant (VPP) of the FP7-project City-zen*** *(Amsterdam demonstrator site, grid support use case). 'The sustainable energy supplier (NeoSmart) gathers information from the European day-ahead energy market (EPEXSPOT) prognosis, and makes an energy profile for the next day based on this information using the Sympower software, to optimise profits. The balance responsible party or BRP (ENTRNCE) sends this profile to the demand-response platform (REX) which sends instructions to the VPP in order to match the profile designed by the aggregator and the PV output as closely as possible. In the meantime, the DSO (Liander) gathers dynamic information about the smart grid from congestion points, and combines this with static grid information. They can then send a signal to the demand-response platform in case of emergency, so that the VPP can respond to alleviate peak loads.'*

Citation and adapted illustration from: Gerritse, E. et al. (2019), City-zen, a balanced approach to the city of the future, City-zen D5.7–5.10–5.11–5.12–7.4, p. 38-39, http://www.cityzen-smartcity.eu/wp-content/uploads/2019/12/city-zen_d5-7_d5-10_d5-11_d5-12_d7-4_cityzen_smart_grid.pdf

CASE

Flexibility products for the +CityxChange PED pilot projects

The SCC Lighthouse Project +CityxChange defines three types of flexibility products to be applied in its PED pilots:

- **P1: Energy product** with a time resolution of 1 hour or more. It will provide incentives to invest in, and operate energy flexibility resources, in particular between electricity and heat (sector coupling). It will also give incentives to more active use of energy storage resources and focus on the key issue of reaching a net yearly positive energy balance for the district;
- **P2: Capacity product** with a time resolution between 15 minutes and 1 hour. It will reduce peak demand and in addition will efficiently serve active usage of energy storage, which could also be used as capacity reserve;
- **P3: System service product** with a time resolution of less than 15 minutes. Demanded for the purpose of secure local system stability and quality of supply.

Source: Bertelsen, S., Livik, K., & Myrstad, M. (2019). D2.1 Report on Enabling Regulatory Mechanism to Trial Innovation in Cities. Retrieved from +CityXchange, p. 20, *https://cityxchange.eu/wp-content/uploads/2019/08/D2.1-Report-on-Enabling-Regulatory-Mechanism-to-Trial-Innovation-in-Cities.pdf*

USEF framework: a market model for rewarding interactions that prevent congestion

'USEF helps the DSO to mitigate risk and play a smarter role in the system. It delivers easier access to prosumers' flexible supply and demand by making their active participation in the grid possible. This can be used to alleviate grid stress and defer or avoid grid upgrades. It also encourages prosumer reliance on the grid by providing them with the opportunity to benefit financially. This reduces the likelihood of their defection as storage technologies become more readily-available, making self-balancing achievable.

USEF's DSO Workstream has also assessed a range of existing EU DSO congestion management models that utilise flexibility. These can be found in the workstream's final report.' (cited from https://www.usef.energy/general-benefits/dso/)

1.5.4 MITIGATING EMERGENCY SITUATIONS

Aside from balancing and congestion management, System Operators are faced with other challenges to allow a safe operation of the grid. Voltage stability, from this perspective, is essential to ensure safe operation of the grid. TSOs are responsible for controlling the voltage within their control area and traditionally rely on centralised connected producers to absorb or feed sufficient reactive power to achieve this. As generation is becoming more decentralised, there are less online centralised production units which are providing the bulk of reactive power today. Furthermore, reversed power flows in distribution grids amplify voltage issues. Assets (also within distribution grids) can contribute to voltage control for the TSO.

There are also some challenges on how to deal with planned and unplanned issues which could lead to power system failure. In the event of a power failure, a large energy storage or production facility can act as an emergency power supply. Given the technical characteristics of the service, only limited technologies and assets are able to answer the service request. Current restoration strategies very often depend on the use of centralised, synchronous generation. With the integration of more (distributed) RES, fewer of these plants will be available as already mentioned. System failure issues could happen at lower grid levels needing additional measures and the participation of other assets. The basis for islanding and black start is not standard but rather depends upon the location and the nature of the grid under consideration, which makes it difficult to create markets to procure these services.

1.5.5 MARKET RULES VERSUS TECHNICAL-ENVIRONMENTAL AND FINANCIAL OPTIMISATION

A stress factor may be that certain established or upcoming market and consumer protection rules (unbundling, free choice of energy supplier) do not fit well with the environmental, technical or financial viability requirements for the optimal functioning of local (renewable) energy communities, in particular when one relies on district energy systems rather than on individual building installations to realise them. For example, a district heating system's viability depends on a sufficient density and proximity of its consumers. If most nearby potential consumers opt out of the district heating option, it may become unfeasible altogether.

Hybrid setups are possible, for example combining enforced flexibility with a market approach. This could be realised through a guaranteed capacity band and a flexible capacity on top. In this flexible capacity range, actions in function of grid congestion can be implemented by the DSO. An assessment of enforced flex versus market flexibility from the perspective of different services is always required. For example, reducing power demand of a charger could intervene with offering reserve services. There should be clear rules on how often this could occur (in relation to obligatory grid reinforcements).

A similar concern is that one should ensure that investments are wisely made from an energy and resource efficiency perspective, taking into account a whole systems perspective rather than a single use case. The drivers therefore may lack at the level of single prosumers or communities of prosumers (in case, energy communities).

1.6 SOCIAL ASPECTS: CITIZEN ENERGY

The CEP has been envisaged with a clear ambition of promoting locally and sustainably produced and consumed 'citizen energy', with a view on better anchoring and expanding its role in the transforming energy actor's landscape. Moreover, from a perspective of integrated sustainable development, this effort should not only be viewed from the environmental-technical and economic point of view, but also from a social and governance point of view. Energy is indeed so deeply permeating all societal functions that the social and governance pillar must be fully addressed in order to guarantee a successful energy transition.

This implies addressing social aspects like public support for the energy transition, quality of life aspects and future-proofness, energy democracy, inclusivity, education and behavioural changes, fostering social cohesion and trust. Connecting with the economic pillar, this further involves fighting energy poverty, increasing energy independency, and enhancing local value chains and local employment in both low- and high-skilled activities[15].

Apart from the need to inform citizens duly on what the energy transition implies and brings as new opportunities (as e.g. recommended in the Renewable Energy Directive art. 18(6)), engaging citizens, especially on the longer term, requires a specific address. Given the importance of this aspect, SCIS has produced a Solution Booklet on Citizen Engagement[16].

A number of social and governance aspects are analysed in more detail in section 1.8.2.3 on the social roles of energy communities.

15 Delnooz, A., Vanschoenwinkel, J., Mou, Y., Höschle, H. (2020), Onderzoek naar de mogelijkheden van collectieve activiteiten in Vlaanderen (final report), EnergyVille, p. 20-26

16 Jaubin, J. et al / SCIS (2020), Citizen Engagement Solution Booklet, *https://smartcities-infosystem.eu/content/citizen-engagement*

1.7 INSIGHTS AND RECOMMENDATIONS FROM PED DEVELOPMENTS: THE IMPORTANCE OF THE NEXUS OF ENERGY PLANNING – URBAN PLANNING – COMMUNITY BUILDING

A PED can rely on an EC for its realisation, but PEDs and ECs are not necessarily equivalent. They may, however, intersect at many points. At present, they can both be considered as spearheading the (r)evolutions in the urban energy transition. Developing PEDs therefore provides many insights that are relevant for ECs and vice versa.

1.7.1 THE SCM INITIATIVE ON REGULATORY FRAMEWORKS: FEEDBACK AND RECOMMENDATIONS FROM H2020 SCC LIGHTHOUSE PROJECTS DEVELOPING PEDS

The H2020 SCC Lighthouse Projects developing PED pilots[17] are pre-eminent living labs for the urban energy transition. They are strongly affected by the uncomfortable 'in between' position regarding the old versus the new energy paradigm identified before, and therefore often need to revert to legal sandboxes in order to be able to proceed with the implementation of their demonstrators. They report that *'existing regulatory and legal frameworks are acting as obstacles, rather than enablers, in the transition towards positive energy districts and climate neutral cities.'* Hereby *'many pilot projects are ongoing, but typically the regulations do not make it logical and profitable to scale up to enable the energy transition'* [18].

The Lighthouse Projects are strategically situated in the nexus of energy and urban planning, and thus confronted with the *'multi-level, multi-sectoral, multi-functional, and multi-type nature of energy system planning and operation'* in a context of sustainable urban development. About all of the challenges discussed before come together in these projects, from energy landscape design to the technical and administrative burdens of intervening in the local electricity grid.

The related SCM initiative proposes eleven multi-sector actions and required changes in current regulatory frameworks. While it is to be expected that the implementation of the CEP and the revised EU energy directives will substantially contribute to overcoming the stated barriers and supporting the required solutions, practice will have to point out if the MS's transpositions of the directives will accommodate for all of the stated needs.

Within the framework of this policy paper, the recommendations from the initiative can be reinterpreted in two main groups, as follows:

17 These are the most recent generations of H2020 SCC projects; see https://smartcities-infosystem.eu/scc-lighthouse-projects

18 Myrstad, M., Livik, K., Wyckmans, A. (2020), A new EIP-SCC Initiative on Regulatory Frameworks within the Integrated Planning, Policy and Regulation Action Cluster, *https://cityxchange.eu/wp-content/uploads/2020/10/EIP-SCC-Initiative-Regulation-Framework-finished1.pdf*

1.7.1.1 FACILITATING THE ENTRY OF NEW ACTORS INTO THE LOCAL CLEAN ENERGY MARKET

The initiative reiterates the needs of, in terms of the CEP, a **real level playing field**.

Not only energy regulations need to be made fit in this way, the same holds for urban planning regulations.

'The energy industry is well regulated, with a split between natural monopolies, such as distribution networks or low voltage grids, and open markets for trade of a range of electricity products and services. This model fits well to serve the existing structure of the energy and power market, but is not appropriate for managing the future energy system.'

'At the same time energy consumers such as citizens and local businesses that want to contribute to sustainability are looking for opportunities to become more active prosumers. Focus on sustainability, technology shifts and digitalisation challenge current regulations for both urban development and energy. This is not only relevant for the traditional energy actors within electricity generation, transport and supply. Several additional parties have been observed to take an interest, like housing associations, new businesses and even start-ups. Investments in local renewable energy production, increased energy-efficiency, local batteries and flexibility, e-mobility, home automation, and smart meters are consequences of the ongoing transition. In parallel it is obvious that innovative business models and sustainable city development will evolve in similar directions. In order to safeguard optimal socio-economic outcomes, regulatory frameworks must in turn adapt to the new reality.'

Hereby *'tensions arise between the technical requirements of keeping the electricity grid in balance at every moment, the actual situation of increasing decentralised and multi-actor production and the guaranteed principles of a free market. Rules regarding the easy switching of energy suppliers hamper the development of long-term engagements in local energy systems and thus also the investments in the latter'* [19].

Facilitating the entry and long-term engagement of new actors therefore entails that:

- (There is a need to) *define and specify needs for new/changed mandates and responsibilities that will be necessary for the climate-neutral and smart cities of the near-future, towards a climate-neutral Europe by 2050*;
- *Energy system operators are allowed to buy system services to avoid grid disturbances and reduced quality of supply locally to a locally set price;*
- *Producers are allowed to sell locally without a supply licence;*
- *If possible digitally, the consumer shall be free to sell flexibility and buy supply locally;*
- *Digitalisation* (creates) *new possibilities for small producers/consumers to act as individual actors in the local market;*
- (There are) *invoicing and metering procedures that allow consumers to be part of both the local and global power market;*
- (There are) *licences that invite and give commercial actors incentives to new entrants to operate local energy market roles,* (...) *and opportunities for new actors to generate new business models'*[20].

19 Myrstad, M., Livik, K., Wyckmans, A. (2020), op. cit.

20 Slightly reworded from Myrstad, M., Livik, K., Wyckmans, A. (2020), op. cit.

Planning application procedures should in a similar way allow for smaller actors or smaller projects (i.e. meso- and micro-scale energy infrastructures) to obtain building and exploitation permits with a proportionate effort. Where lengthy and complex administrative procedures have only been conceived with large infrastructures in mind, they should be re-tailored to reduce the administrative burden and processing time for smaller projects[21]. The revised Renewable Energy Directive effectively mandates such administrative simplification.

From a market perspective, it is to be noted that the revised Renewable Energy Directive and the Electricity Regulation allow to provide for specific support to small-scale installations in order to accelerate their uptake, for example by exempting them from balancing responsibilities or being strictly market-responsive. Regional diversification in support schemes is also allowed[22].

1.7.1.2 CONTEXT SENSITIVITY: REGULATIONS, TARIFFS, TAXES AND BUSINESS MODELS THAT ANSWER TO THE SPECIFIC CONDITIONS OF THE LOCAL CONTEXT

There is a clear demand to have regulations, tariffs, taxes and business models responsive to the specific conditions of the local context. This should however not be interpreted as demanding a safe conduct towards avoiding the (socialised) grid costs.

In addition, sector coupling obviously depends much on the local conditions of both electricity and heat and cold potentials, therefore, one should take into account that linking these two pillars of the local energy system must be facilitated as well: *'… the current regulation neglects the connections and exchanges between the different energy carriers typical of a (local) multi-energy system. Such 'sector coupling' is becoming particularly important between electrical and thermal infrastructures. Putting scalable flexibility to work remains difficult or impossible.'*

Responsiveness to the local context therefore entails that:

1. *The grid tariff and price structure must be set dependent on local grid costs.*
2. *Metering requirements are in line with local market preferences when it comes to system operation and billing of supply, including the grid fee.*
3. (It is investigated) *How* (…) *tax regulations* (can) *be used to strengthen incentives to implement local, sustainable energy systems and roles. This would imply, for example, that what is desirable in the system is not or only slightly taxed, and what is not desirable is heavily taxed (de facto coming down to a 'green tax shift'). Another example is whether we can avoid double taxation of storage (feed in, feed out)[23].*
4. (It is) *Possible to operate a local energy system independently of the responsibility of the local distribution system operator (DSO) – or in cooperation with the DSO.*
5. (There are) *funding instruments to support local energy system start-ups[24]*.

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21 The procedural burden is echoed in an analysis by the Öko-Institut and cited by Nouicer, A., Kehoe, A.-M., Nysten, J., Fouquet, D., Hancher, L., Meeus, L. (2020), The EU Clean Energy Package (2020 ed.), Florence School of Regulation, p. 48, *https://cadmus.eui.eu/bitstream/handle/1814/68899/QM-01-20-700-EN-N.pdf?sequence=1&isAllowed=y*.

22 Nouicer, A. et al. (2020), op. cit., p. 49-50.

23 Here the revised Directive on common rules for the internal market for electricity (EU) 2019/944 states that active customers (i.e. prosumers) owning energy storage facilities must indeed not be double charged for the electricity stored and remaining on their premises, or when they provide flexibility services.

24 Slightly reworded from Myrstad, M., Livik, K., Wyckmans, A. (2020), op. cit.

1.7.2 ADDITIONAL RECOMMENDATIONS REGARDING URBAN ENERGY TRANSITION PROJECTS: THE CENTRAL FACILITATING ROLE OF LOCAL AUTHORITIES

Cities and local authorities are in a privileged position to provide incentives for new, locally operating energy actors. Such incentives can be financial, administrative/logistic or process-related, for example by setting up local governance structures that support and further legitimise the clean energy projects. More precisely,

- The city could be initiator or support the set-up of a PED/EC. ECs may be initiated by a single person or a small group of citizens, as the history of energy cooperative proves. In a similar vein, a group of neighbourhood residents may come up with the idea of realising a climate neutral or positive energy district. Such bottom-up initiatives could strongly benefit from help with administrative matters, permitting procedures and support in reaching out to relevant stakeholders. Cities can help in setting up the right governance structure and, by their explicit support, augment the legitimacy of the initiative;
- Linked to this, ECs can be set up in a socially fair way and thus reduce local opposition to clean energy projects, and even have such opposition disappearing altogether (see box with examples);
- PEDs/ECs have to be fair and inclusive, cities have a decisively important role in safeguarding these principles for the PEDs/ECs being set up with or within the city. Municipalities should cherish the opportunities of community building and fostering social cohesion that can come with the setup of PEDs/ECs;
- Attention is also to be paid to an inclusive approach with regard to those citizens that cannot co-invest in PEDs/ECs. This is linked to the risk of socialising the costs of PEDs/ECs to the whole of society while reserving the profits to the project participants, as discussed elsewhere in this paper. But reversely, PEDs/ECs could precisely be conceived in an integrative way and, for example, attack energy poverty. Municipalities are well placed to keep an eye on this while permitting or supporting local projects;
- Local energy projects, as much regarding increased EE as for rolling out RES, lead to substantial local employment opportunities. This also helps to keep money streams local, instead of having financial leakage to distant fossil fuel providers;
- Cities should assess compatibility with their long-term climate and energy strategy when providing financial support or tailored favourable conditions to emerging initiatives, thus making sure that the proper initiatives are being supported;
- Cities can help in gradually and interactively broadening the services and actions the PED/EC includes, enabling an effective and valuable contribution of the PED/EC to the energy ambitions of the city, but also to its wider sustainability goals. Typical examples are to include sustainable mobility or local (organic) food production and consumption.

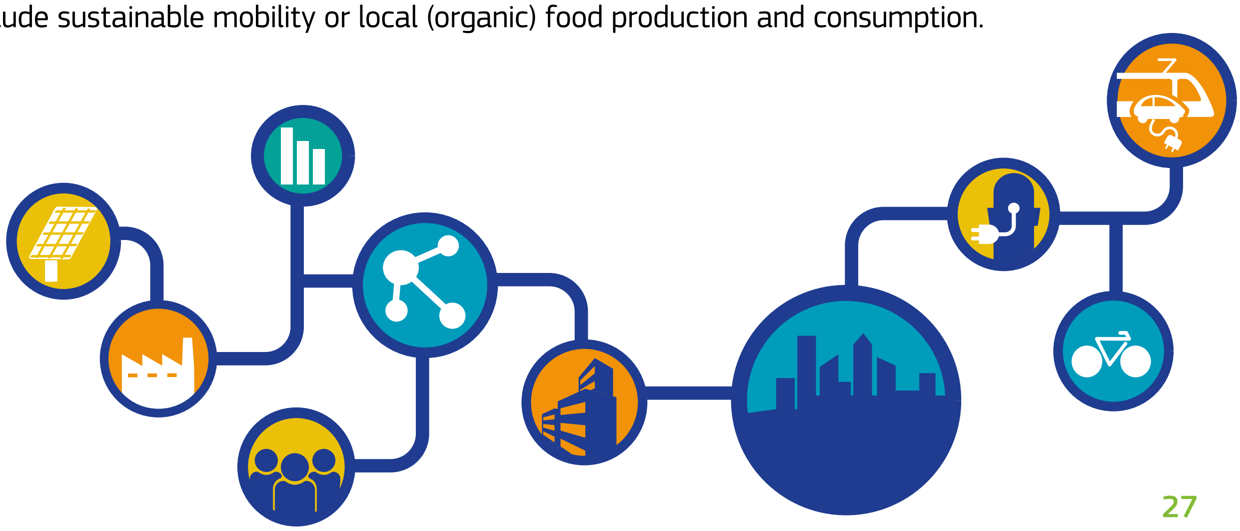


Figure 8: solar boiler field and district heating plant at Nordby, Samsø (copyright Sven Stremke).

CASE

Samsø, a rural island in Denmark with about 3.700 inhabitants, succeeded to become net energy positive over a span of eight years. The renewable energy sources put to work were wind, sun and biomass. The swift transition could be realised thanks to a kickstarting government subsidy, local pioneering leadership and extensive involvement and shareholdership by the local community. The island proceeds its efforts and hopes to ban all fossil fuels by 2030 (and thus not only compensating the use of these fossil fuels, still present in e.g. transport and boilers, by an excess in renewable energy production).

http://www.pioneerguide.com/

http://reregions.blogspot.com/2010/03/samsoe-denmark.html

https://local-social-innovation.eu/news/?c=search&uid=GWdyEdhN

Eeklo, a town with 20.000 inhabitants in Belgium, built a reputation of being able to install wind turbines without local protest and lawsuits. The secret is in its approach to the wind projects, where priority is given to involvement and shareholdership by local inhabitants through a cooperative society. In 2020, Eeklo will have produced more renewable electricity than the city's electricity demand – 130% to be precise. The municipality now starts to develop a city-wide district heating network, fired by the local waste incinerator and based on the same principles of citizen involvement and shareholdership.

https://www.gemeentevoordetoekomst.be/artikel/eeklo-en-ecopower-een-succesverhaal-met-massa-s-windmolens-en-nul-bezwaarschriften

https://www.ecopower.be/nieuws/warmtenet-eeklo-gaat-definitief-van-start

https://www.vrt.be/vrtnws/nl/2020/12/08/eeklo-produceerde-afgelopen-jaar-30-meer-groene-energie-dan-nod/

1.7.3 CONCLUSION

It is most desirable to swiftly move from a situation of exemptions and legal sandboxes to a situation where the CEP is in full-fledged application, making the former (temporary and/or experimental) mechanisms obsolete and easing the widely reported pains of first movers in the field of RECs, CECs and PEDs.

When transposing the revised energy directives into national or regional law, the legislator should fully account of the local leverage factors that are typically present in municipalities. They should also embed in the rules a type of flexibility that allows to tailor solutions to the specific needs and opportunities of a given local context, as comes forward from current experiments with setting up PEDs and ECs on the ground.

Much of the needed changes are effectively foreseen in the recast energy directives. One question remains what the situation will be for meso-scale installations, as many exemptions in the directives are stated for small-scale installations and the definition of 'small-scale' is moreover set to evolve over time.

1.8 DEEP DIVE: ENERGY COMMUNITIES

This section analyses how ECs can provide an answer to the challenges discussed above: the activities they may perform and the objectives that fit ECs, including the social functions they can fulfil.

1.8.1 CONCEPT ANALYSIS

ECs come forward as a powerful organisational concept for supporting the clean energy transition while involving local communities in its realisation.

ECs are not a new phenomenon. Notably in Germany, Austria, Sweden, Belgium, the Netherlands and Denmark, these types of initiatives are well-represented and have a history that dates back to the 1970s and 80s[25].

A common and well-known form are energy cooperatives, cooperative societies for the production and consumption of energy, in practice mostly based on RES[26].

Another relevant example are the German municipal utilities or Stadtwerke, local distribution companies which are partly or wholly owned by municipalities. In 2012, it was estimated that individual citizens and communities accounted for 34% of the total installed capacity of renewable energy in Germany, with nearly 50% of the total installed PV capacity and 25% of the total installed onshore wind capacity in the hands of individual citizens or communities[27]. By 2017, private individuals owned 49% of solar capacity and 41% of onshore wind capacity in Germany[28].

25 Bauwens, T., Gotchev, B., Holstenkamp, L. (2016), What drives the development of community energy in Europe? The case of wind power cooperatives, in: Energy Research & Social Science, Volume 13, p. 136-147.

26 REScoop defines these sustainable energy cooperatives as 'a business model where citizens jointly own and democratically control an enterprise that works on renewable energy or energy efficiency projects.' (*https://www.rescoop.eu/the-rescoop-model*)

27 See in this regard Amecke, H. et al. (2012), German Landscape of Climate Finance, Climate Policy Initiative, p. 1-23, *https://www.climatepolicyinitiative.org/publication/german-landscape-of-climate-finance/*

28 Nouicer, A. et al. (2020), op. cit., p. 55.

In Denmark, wind cooperatives or *guilds* are most common[29]. In addition, there are also entire island communities, such as the Danish Samsø[30], that aspire to be energy-independent through (partial) community ownership.

In other MSs however, ECs are either absent or only represent a small segment of the market[31].

These initiatives are often confronted with a range of institutional barriers due to a regulated energy market that is traditionally dominated by large, vertically integrated companies with affluent financial, technical resources and, related, institutional advantages. This situation prevents energy communities from entering and/or competing on the EU energy markets on equal footing with the traditional energy companies[32].

For this reason, the CEP reintroduces energy communities as a cooperation concept in the energy market with the intention to level the playing field for ECs vis-à-vis the more traditional energy market players.

The recast EU directives foresee two related concepts: 'citizen energy communities' (CEC) in the revised Internal Electricity Market Directive and 'renewable energy communities' (REC) in the revised Renewable Energy Directive. Their setup is also intended to help mobilise private capital, enhance the flexibility in the market and lower public resistance against the energy transition[33].

As observed in the Energy Community Definitions report of the EU funded *Compile* project, both are based on open and voluntary participation and their primary purpose is to provide environmental, economic or social community benefits for its shareholders or members or for the local areas where they operate, rather than financial profits[34].

29 A recent study shows that there are approximately 100 wind cooperatives. See in this regard, Oteman, M., Wiering, M., Helderman, J.K. (2014), The institutional space of community initiatives for renewable energy: a comparative study of the Netherlands, Germany and Denmark', in: Energy, sustainability and society, Vol.4, Article 11, *https://energsustainsoc.biomedcentral.com/articles/10.1186/2192-0567-4-11*.

30 See in this regard, Jørgensen, P.J. (2007), Samsø. A renewable energy island - 10 years of development and evaluation, PlanEnergi and Samsø Energiakademi.

31 Recently, a renewed interest in energy cooperatives has emerged in the UK, Sweden, the Netherlands and Belgium. See in this regard e.g. Saintier, S. (2017), Community energy companies in the UK: A Potential Model for Sustainable Development in "Local" Energy?, in: Sustainability, Vol. 9, p. 1325-1343.

32 Examples of institutional barriers are unfavourable legislation, support mechanisms, administrative barriers, grid access, high investment costs, and the existence of oligopolies (due to large economies of scale). See in this regard, Huybrechts, B., Mertens, S. (2014), The relevance of the cooperative model in the field of renewable energy, in: Annals of Public and Cooperative Economics, Vol. 85, p. 193-212. See also Koirala, B., Koliou, E., Friege, J., Hakvoort, R., Herder, P. (2016), Energetic communities for community energy: A review of key issues and trends shaping integrated community energy systems, in: Renewable & Sustainable Energy Reviews, Vol. 56, p. 722-744. We can further differentiate between hard and soft institutions. In this regard, hard institutions refer *inter alia* to legislations, capital markets, whereas soft institutions consider cultural and social norms. Other barriers are socio-economic, technological and environmental. For a comprehensive oversight of potential social barriers see e.g. Heaslip, E., Costello, G.J., Lohan, J. (2016), Assessing good-practice frameworks for the development of sustainable energy communities in Europe: lessons from Denmark and Ireland, in: Journal of Sustainable Development of Energy, Water and Environment Systems, Vol. 4, p. 307-319.

33 Vision expressed by Mikolaj Jasiak (DG ENER) in a presentation on 29/4/2020 in Ghent.

34 Roberts, J., Frieden, D., d'Herbemont, S. (2019), Energy Community Definitions. Retrieved from *https://www.compile-project.eu/wp-content/uploads/Explanatory-note-on-energy-community-definitions.pdf*.

The following table describes the main characteristics of the CEC and REC concept.

	CEC	REC
MEMBERSHIP	Open to all types of entities	Natural persons, small and medium sized enterprises, local authorities
GOVERNANCE	Controlled by shareholders or members of the project, but shareholders engaged in medium and large-scale companies and stakeholders for which energy constitutes a primary area of activity are excluded from control	Controlled by shareholders or members that are located in the proximity of the REC project
GEOGRAPHIC LIMITATION	None	Shareholders or members must be located in the proximity of the renewable energy project they are investing in, though MSs can define the scope of proximity.
TYPE OF ENERGY	Electricity	Only renewable energy
PURPOSE	Provide environmental, economic or social community benefits for its members or the local areas where it operates rather than financial profits	Provide environmental, economic or social community benefits for its shareholders/members or the local areas where it operates rather than financial profits

The concept principally fits very well with long term decarbonisation and sustainability goals. In this context, main drivers may be more (i) sustainable energy provision, (ii) local generation and hence (iii) local job creation, (iv) active engagement of citizens (energy by and for citizens, increased energy consciousness) as well as (v) a way to deliver energy at lower cost to the residents and hence to contribute to alleviating energy poverty. Participation is open to a wide group of stakeholders, i.e. citizens, local authorities, public entities and companies, while decision-making must be organised in a way to avoid that established entities active in the sector monopolise the initiative[35].

ECs, whether CECs or RECs, are interesting concepts to increase active end-consumer participation in the energy market, to increase the investment in renewable energy and to ensure the energy transition is open to all and inclusive.

All MSs have to ensure a level-playing field for citizen initiatives, no excessive administrative burden, and clear and consistent regulation. In the context of citizen participation, the renewable energy community also emphasises the importance of proximity. This is freely definable by MSs and strongly depends on population density, socio-economic conditions, technical and geographical parameters, etc.

Depending on the EC, there is a distinction in terms of energy carriers and activities. The citizens energy community only focuses on electricity, while the renewable energy community solely focuses on renewable energy sources regardless of the energy carrier (gas, heat and electricity). ECs have the right (for the respective energy carriers within consideration) to assume certain roles and activities (including consumption, energy sharing, production, supply, grid management, aggregation, storage…).

35 Caramizaru, A., Uihlein, A. (2020), Energy communities: an overview of energy and social innovation, JRC Science for Policy Report, https://publications.jrc.ec.europa.eu/repository/bitstream/JRC119433/energy_communities_report_final.pdf - see also further for the difference between CEC and REC.

The Internal Electricity Market Directive even leaves the MSs the opportunity to allow citizen energy communities to operate their own grid. Many MSs and stakeholders involved are hesitant to foresee a supporting framework and national regulation of these MSs is unlikely to advance in that direction. There are several reasons for that:

- Grid management entails complex obligations and responsibilities in order to guarantee a safe grid operation. It is questioned to what extent all responsibilities and tasks should be considered when an EC operates the own grid as this can be a significant burden for the EC. However, these responsibilities are put in place to safeguard the grid operation within technical preconditions. Hence, only an objectifiable and justifiable difference can lead to a different approach of the EC and the public grid operator.
- The lifespan of an EC can be shorter than the lifespan of the jointly operated grid within the EC. Processes and regulations should be in place to cover the handover of the EC-grid to the public grid operator.
- The current model is based on socialising the system costs. If own grid operation is facilitated, there is a risk of erosion of the financing base of the public grid operators. In particular, ECs that operate their own grid potentially contribute less to the total grid costs of the public grid operator as energy flows can be optimised behind the point of common coupling and thus pay less grid tariffs. As more and more ECs take up grid operation activities, the number of remaining consumers directly connected to the public grid decreases, lowering the financing base.
- Fragmentation of the grid operator landscape and de-standardisation.

The rights and obligations of energy communities have been conceptually described in the European directives. The transposition to national legislation can lead to different local regulations. In addition, Europe allows to define other national concepts next to the concepts defined in the directives, as long as this does not in any way hinder the effective implementation of the citizen and renewable energy communities.

While several pilot projects have been launched, the profitability of ECs is still questionable. Lowered tariffs for in-community exchange and supporting business models were developed to obtain an economic profit. However, economic triggers are a topic of debate and the reduction in grid tariffs is not always justifiable (see discussion section 1.5.1.1).

1.8.2 DETAILED OUTLOOK

1.8.2.1 ACTIVITIES OF ECS

ECs are entitled to take up a wide range of activities. Those with regards to energy are set out in the directives.

1.8.2.1.1 (SELF-)CONSUMPTION

Self-consumption implies the instantaneous or near-instantaneous (within a 15 minutes timeframe) matching of production and consumption within a geographically confined area, where the consumers and producers are located behind a single connection point.

Note: ECs are to be distinguished from collective self-consumption schemes *sensu stricto*. The latter share renewable energy, generated at the building-level, between the users of that single building – a typical example being a multi-apartment block. Collective self-consumption does not require the set-up of an EC.

1.8.2.1.2 SHARING OF ENERGY

The new directives enable energy sharing between the members of an EC. That implies that excess energy produced by one member or energy produced by a common asset can be used to supply the other members.

Via the exchange of energy flows between multiple consumers and producers of the EC collective self-consumption can be achieved.

The conditions under which energy sharing will be allowed are dependent on the transposition by the MS and by the rules agreed upon in the specific EC.

For example, the definition of the geographical location is dependent on the MS's transposition of the EU directives. Hence the manner in which energy sharing or collective self-consumption is linked to the electricity grid infrastructure can differ. Both physical and virtual interpretations can (co-)exist.

Simple sharing rules could be applied or more intelligent hardware, such as smart meters, micro-controllers, batteries and on-line trading platforms (cf. smart micro-grid) could be implemented to facilitate energy sharing. Application of blockchain technology and crypto-currencies are also possible. A trade-off between the investment in these technological innovations and the potential gain is needed, before deciding the best way forward.

MSs could, but are not obliged to, decide to support and encourage energy sharing or collective self-consumption by applying a (grid tariff) cost reduction or financial incentive.

1.8.2.1.3 PRODUCTION

Production is often the primary activity of ECs. This activity either stands alone or is combined with other activities, such as supply. In a REC, any production should be from renewable sources. In a CEC this is limited to electricity but also non-renewable technologies apply.

1.8.2.1.4 SUPPLY

In order to facilitate the supply-activity for ECs, the CEP foresees the concept of multiple suppliers on a single metering point. This enables the supply of locally produced energy within the EC while simultaneously allowing the consumer to select a conventional supplier for the energy that cannot be supplied by the community.

If sufficient production is available, the EC can act as the single supplier.

1.8.2.1.5 DISTRIBUTION

The Internal Electricity Market Directive leaves open the option for MSs to allow CECs to take over the distribution activities for electricity. Whether this should be allowed or not is still a topic of debate and up to the national policymakers to decide.

In Germany, there is a re-municipalisation trend where local municipalities take over the grid, but also energy communities such as EWS Schönau eG (see box under 1.8.2.2.1) have shown to be capable of operating the local distribution grid in a safe and efficient way.

1.8.2.1.6 AGGREGATION

Energy communities can aggregate the electricity produced by the production units owned by the community, the consumption of their participants and/or external customers as well as the flexibility of its assets, and offer these aggregated loads collectively in any electricity market. The EC can do so themselves or could use an intermediary that is specialised in this service. Aggregators could limit the aggregated portfolio to specific assets (e.g. widely used in the community or within the existing portfolio of the aggregator) or could consider a collective approach, combining the available flexibility assets and valorising the collective behaviour.

1.8.2.1.7 ENERGY SERVICES

ECs can serve different purposes within the energy market. Amongst others, an EC can provide flexibility in function of energy balancing or it can help maintain an efficient grid operation.

From the **energy balancing** perspective, the EC can become a balancing service provider, meaning that its aim is not to be in balance at EC-level, but to assist in the system balance. The proliferation of this type of flexibility will have a positive effect on the balancing market but creates additional challenges and complexities. It has to be scrutinised to what extend the DSO-grid is impacted by the activation of flexibility for balancing purposes. In particular, the activation of flexibility can lead to peak consumption or injection in the electricity grid which might even become larger than before, requiring an increased grid capacity and additional grid investments. For an EC to act as a flexibility service provider, the right conditions need to be met and the impact on third parties needs to be identified as the flexibility provider set-up might not be beneficial in every case.

It should furthermore be noted that the provision of balancing services is not tied to a specific location and that no (technical) proximity is required. The balancing exercise is performed within the control area of a TSO and assets within an EC participating in the balancing service can be dispersed.

CASE

One location where balancing the grid will become increasingly important in the following years is **Amersfoort**, the Netherlands, where the aim is to become independent of gas. Electrification has therefore gained momentum, with more and more households switching to heat pumps as a way to address the heat demand. Concretely, in Amersfoort there will be an increase in the electricity demand and in local PV production, which will cause peaks in the grid. Within the Interreg ACCESS project, an EC is installed in the city. Apart from balancing this EC on its own, this might open up opportunities for Amersfoort to act as a flexibility service provider for the rest of the country.

https://northsearegion.eu/access

Energy services provided by ECs can also serve the grid. An EC can make additional investments in the capacity of the grid redundant by avoiding congestion. A distinction can be made between **'congestion management'** and **'grid capacity management'**. The first aims to prevent congestion in the present where congestion is a condition where one or more constraints (thermal limits, voltage limits, stability limits) restrict the physical power flow through the network. The second considers a more long-term perspective and aims to decrease the chance of congestion in the future.

In contrast to the balancing service, ECs aiming to contribute to congestion management services require a proximity of the participating assets. More in detail, the EC should be composed of members with a technical proximity in order to take into account future product requirements (e.g. technical or geographic parameters). **It should be noted that an EC can only provide certain grid services if the grid at a certain location really needs them. If congestion is not an issue, neither currently nor to be expected in the future, there might be little added value to implement an EC**[36].

The distribution grid operator should therefore ideally indicate where network problems are expected so that location-specific solutions can be sought. By providing insight into the need for congestion services, ECs can prepare themselves in organisational and technical terms. An important balancing exercise in this context is the trade-off between providing insight into the network status and the need for congestion services on the one hand and the limitation of market power and the **possibilities of gaming of flexibility providers** (which respond to the requested service) on the other hand.

For offering location-specific services (e.g. congestion management) via technical flexibility, there are no products available yet. The introduction of congestion services must be weighed against other control mechanisms which can obtain the same or a similar effect (e.g. distribution grid tariff).

1.8.2.1.8 OTHER ENERGY-RELATED SERVICES

Other energy-related services can also be provided to the members of an EC, including services of EV charging, a shopping guide for energy-efficient appliances, a mobile application to save energy, rental of power meters, subsidies for insulation and replacement or installation of heat pumps, consultancy services, energy auditing, consumption monitoring, energy monitoring and managements for network operations, etc.

36 Hackett, S. B. et al. (2019), +CityxChange D2.3: Report on the Flexibility Market, *https://cityxchange.eu/wp-content/uploads/2020/02/D2.3-Report-on-the-Flexibility-Market-v06-final.pdf*

1.8.2.2 ECONOMIC OBJECTIVES OF ECS

An assessment must be made as to whether ECs receive sufficient financial incentives to support a profitable business case or whether additional financial incentives are necessary.

The investment in supporting structures like sharing platforms or crypto-currencies, with the needed metering and communication, needs to be seen in relation to the potential gain. A realistic view avoids a lock-in where the main advantage is for the intermediary parties instead of directed towards the community.

Facilitating measures must be taken with a concrete objective in mind. These extra stimuli can reward ECs for the added value they (potentially) create. It should be noted here that one should not only look at the added value for the grid and energy system, but also take into account ecological and social added value.

From the definitions, it becomes clear that the main incentive for stakeholders to participate in an EC should not be financial in the first place. Therefore, an EC does not have to be (financially) advantageous for everyone. Moreover, other (non-financial) services have already proven to add value to participants. Energy savings and tailored advice are a few of such offers that have proven to be successful.

Finding the most suitable electricity pricing scheme within an EC is a major challenge that has yet to be solved. A good example that clarifies this issue can be found within the +CityxChange project[37].

In order to frame the discussion on the added value appropriately, an insight into the different economic objectives is necessary.

1.8.2.2.1 FOSTER LOCAL ECONOMIC GROWTH/CREATE LOCAL VALUE

Energy is the key driver of any industrialised economy. The decentralisation of technology unlocks the potential for local governments to take control, in collaboration with citizens and industries, over energy technology and generate additional income through flexibility services or sales of energy. Income that can subsequently be used to invest in other community projects that foster local economic growth and contribute to its prosperity.

Increased energy independence comes here as a secondary benefit.

CASE

In Germany, **EWS Schönau eG** owns the local distribution network and outsources the maintenance works to local companies, which allows the taxpayer's money of the local residents to be kept inside of the community.

https://www.ews-schoenau.de/

1.8.2.2.2 MOBILISE PRIVATE CAPITAL

Individual citizens have the opportunity to contribute and co-invest in resources and consequently benefit from the economies of scale to spread the risk of investment in energy-related activities.

1.8.2.2.3 FINANCIAL PROFIT VERSUS WHOLE VALUE

Related to this issue is the danger that lies in personal gain for participants in ECs. Depending on the used price scheme within the EC, prosumers or automated systems might be incentivised to unbalance the grid. This could be the case when activation pricing is used: suppose a prosumer who lowers his electricity production in case of high demand because electricity prices will then increase so he can sell at a higher price. This way he can play the market in an undesired manner, which is a consequence of the chosen pricing scheme[38].

37 Hackett, S. B. et al. (2019), op. cit.

38 Hackett, S. B. et al. (2019), op. cit.

1.8.2.3 SOCIAL ROLES FOR ECS

ECs aim to deliver important social and societal advantages. However, there is **no one size fits all**. Socio-economic differences, urban planning, climatic conditions, culture and habits influence the EC model and the impact it can have.

Another point of attention of which the importance can hardly be underestimated is clear communication. Actors on the ground must be sufficiently aware of the possibilities that the revised energy directives provide, a provision which is moreover explicitly stated in the recast Renewables Directive, Article 18(6). Understandable information on ECs will have an impact on the success thereof. When implementing new technologies and concepts, which are essential in the current energy transition, **there should be a broad framework for actors like citizens and local community project initiators to get on board.** People are moreover intrinsically averse to the unknown, as it embodies taking risks. Creating a fertile soil for ECs also includes informing and actively involving the larger public.

1.8.2.3.1 SOCIAL COHESION AND TRUST

ECs have the potential to foster community cohesion across ideological boundaries, and could further contribute to increasing trust in local representatives and municipal governments. Good examples are widespread, e.g. the earlier mentioned Leuven2030 initiative. But the city-wide approach is not the only way this can be realised.

1.8.2.3.2 INCLUSIVITY AND FIGHTING ENERGY POVERTY

Energy communities can be an important way to meet the increasing demand for electricity and alleviate energy vulnerable or poor households by matching local production and demand, resulting in reduced electricity prices. In Greece, municipalities are planning to use income generated by ECs to build rooftop solar panels and boilers to stimulate energy saving for energy vulnerable or poor households[39]. In Belgium, a new cooperative society created by 64 social housing associations serves as a vehicle to invest in solar energy production over its complete social housing stock, granting the benefits to the inhabitants[40].

1.8.2.3.3 COMMUNITY COHESION

It is important that some form of prior social cohesion exists amongst the community members. Indeed, a priori social cohesion is a key ingredient in mobilising a large share of the citizens to participate in an EC.

1.8.2.3.4 EMPLOYMENT OPPORTUNITIES

Creating local employment opportunities can help municipalities to counteract the drain of local talent to big cities. In Germany, for example, the EC of Schönau employs about 110 people, most of whom are young people raised in and around the village of Schönau. Also in Hindelang, the EC is a decisive local employer. In Denmark, on the island of Samsø, the initiator of the energy transition project took the concept further and started organising courses and visits, turning the energy transition of the island into a long-lasting business.

1.8.2.3.5 INCREASE SOCIAL ACCEPTANCE

ECs have the potential to establish a dialogue between specialists and non- specialists in order to achieve a wider and long-lasting consensus on complex multi-level investment and policy decisions related to energy strategies for a low-carbon future. Research has shown that when citizens share in the benefits and decision-making process, they will feel more fairly treated, which increases the level of support for the outcome[41]. Hence, ECs are a way to overcome the NIMBY (Not In MY BackYard) problem. The Belgian Wasewind is a good example of such local cooperative project.

1.8.2.3.6 FOSTER ENERGY DEMOCRACY

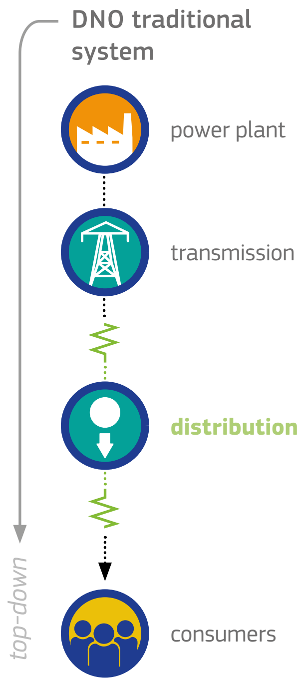
ECs can help increase local legitimacy of municipalities by extending principles of democracy to the socio-economic sphere by collaborating with or giving citizens and SMEs more control over energy, either indirectly through representative bodies (e.g. municipalities) or directly through participation in an EC.

39 *https://www.rescoop.eu/news-and-events/news/energy-communities-talk-about-energy-communities-highlights-from-the-first-national-virtual-gathering-of-energy-communities-in-greece*

40 *https://aster.vlaanderen/nl*

41 Bauwens, T., Devine-Wright, P. (2018), Positive energies? An empirical study of community energy participation and attitudes to renewable energy, in: Energy policy, Vol. 118, p. 612-625.

1.8.2.4 ADDITIONAL ROLES ANTICIPATED: THE COMMUNITY SYSTEM OPERATOR



1.8.2.4.1 ACTIVATING THE DSO OR REVERTING TO A CSO?

Ongoing experiences with setting up PEDs[42] reveal that a party is needed to act as the operator, also called the community system operator (CSO). The function of the CSO can be taken up by a new party or by the existing distribution system operator. One of the advantages of having the DSO as CSO, is that the DSO already has the needed dispensations. This means that fewer adjustments to the regulation are needed[43]. This however implies that the DSO acts on a progressive basis and wants to experiment with EC setups.

DSOs may thus have a decisive role in the success of ECs. Hancher and Winters (2017) summarise well the transition DSOs will have to undergo in this respect, stating that '*The traditional monopoly roles of DSOs are being increasingly contested with the emergence of private and micro-grids. At the same time the current role of DSOs in the energy value chain is very divergent across the 28 Member States. This is in part due to national variations in the degree of consolidation as well as the extent of unbundling (there are an estimated 2400 DSOs active in the 28 Member States). Although the traditional or so-called "passive network" duties of the DSOs are adequately defined in the current legal framework, the scope for DSOs to engage in what is termed "active network operation" is far from clear'*[44]. The question then arises if DSOs will take up these additional functions, or if these will rather be performed by new entities such as the CSO.

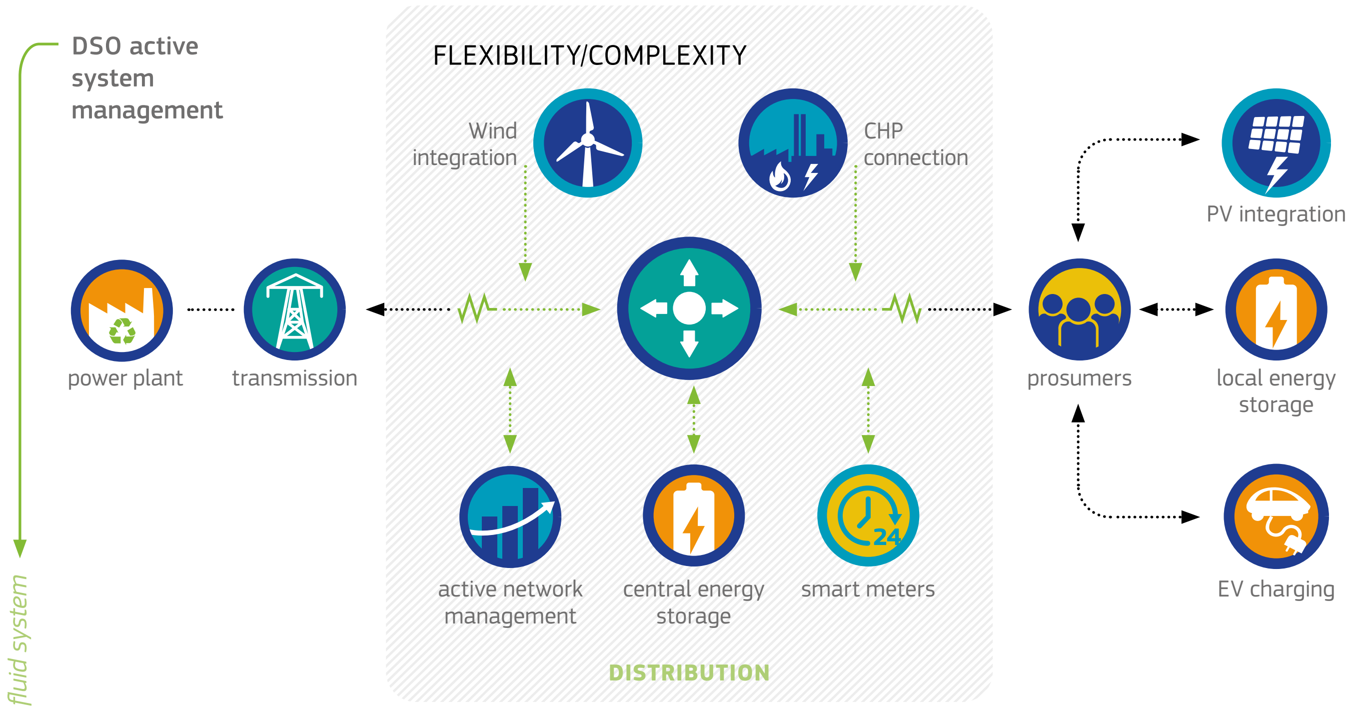


Figure 9: Changing roles for the DSO. Illustration adapted from +CityxChange D2.1 (copyright +CityxChange).

42 Positive Energy Districts come with a definition of their own, but will in practice need or come very close to setting up a LEC.

43 Bertelsen, S., Livik, K., Myrstad, M. (2019), +CityxChange D2.1 Report on Enabling Regulatory Mechanism to Trial Innovation in Cities, *https://cityxchange.eu/wp-content/uploads/2019/08/D2.1-Report-on-Enabling-Regulatory-Mechanism-to-Trial-Innovation-in-Cities.pdf*

44 Citation from Hancher, L., Winters, B.M. (2017), The EU Winter Package - Briefing paper, p.12, *https://fsr.eui.eu/wp-content/uploads/The-EU-Winter-Package.pdf*

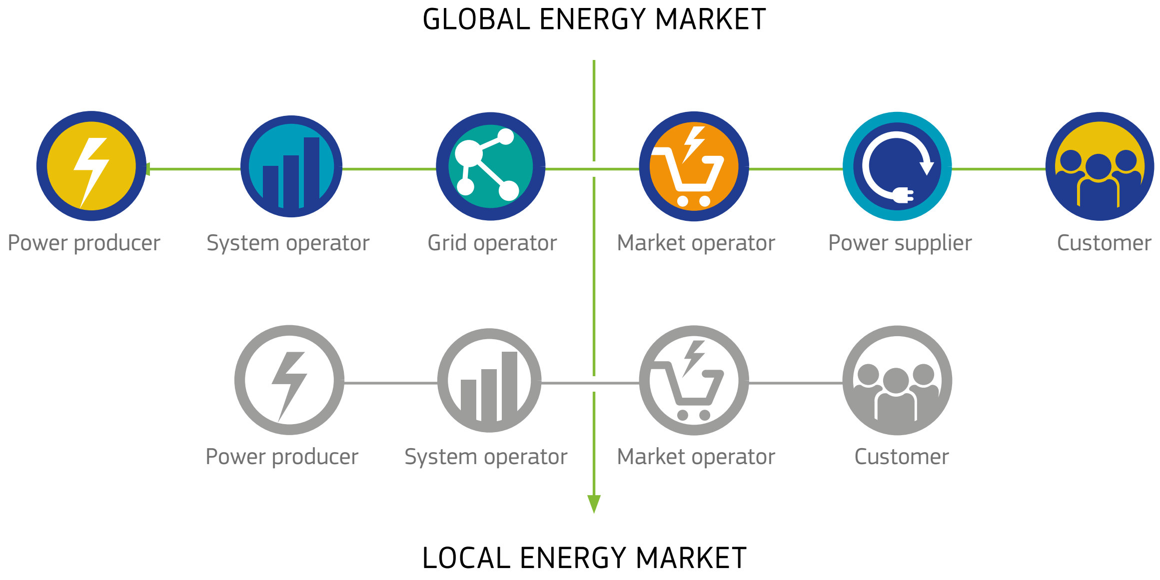


Figure 10: Two market level system. Illustration adapted from +CityxChange D2.1 (copyright +CityxChange).

1.8.2.4.2 FITTING USE CASES TO THE SYSTEM: THE ROLE OF DSOS VERSUS CSOS AND THE 'LAYERED MARKET' CONCEPT

The corresponding new P2P-markets can be represented visually as a layer under the global (EU among other) energy market as shown in figure 10.

For the +CityxChange pilot projects in Lighthouse City Trondheim, a model was developed in which two electricity markets are superposed. These being the global electricity market and the local electricity market, linked to a community. In this case, the DSO was chosen as the operator of the PED. In Trondheim, regulatory bottlenecks were observed.

In Limerick, another +CityxChange Lighthouse City, the CSO is a new entrant under the supervision of the DSO. Therefore, the CSO needs to be granted new dispensations. One of the issues that can arise in this kind of structure is that the role of the CSO will legally conflict with the one of the DSO. DSOs have the aim to provide best value to all consumers, while CSOs have to "*deal with the enabled or ever-increasing levels of new Renewable & Recycling Energy Electricity Generators connected under Disturbance Neutral Prosumer Group*"[45].

A similar conceptual framework for such layered market set-up, the 'Layered Energy System', has been proposed by the Dutch grid operator Stedin[46].

45 Bertelsen, S., Livik, K., & Myrstad, M. (2019), op. cit.,p.8

46 Stedin & Energy21 (2018), White Paper Layered Energy System, *https://www.stedin.net/-/media/project/online/files/duurzaamheid-en-innovaties/layered-energy-system-white-paper.pdf*

1.8.2.5 SOME GENERAL LESSONS LEARNED – FEEDBACK FROM THE BRIDGE WORKING GROUPS[47]

How ECs are to be defined and rolled out in MSs is a subject of debate on many platforms. Bridge is a H2020 cooperation initiative between H2020 smart grid, energy storage, islands and digitalisation projects dealing with cross-cutting issues encountered in the demonstration projects and which may constitute an obstacle for innovation. Bridge has working groups on data management, customer engagement, business models and regulations. Some of the initiative's insights regarding ECs can be summarised as follows:

- There are various ways in which ECs can lead to private capital being used for renewable energy projects.
- Expectations should remain realistic regarding the potentially limited or even non-existing reduced tariffs for peer-to-peer exchange between EC members. Furthermore, a baseline comparison and a cost benefit analysis considering all costs (metering, digital infrastructure, local assets and operational management) versus all benefits are needed. Overinvesting in technologies should be avoided.
- The possibility of playing on deferred grid investments is only valid for specific locations with certain characteristics of the grid. Potential ECs should therefore engage early in the process with the local DSO and check the possible value proposition to be created.
- The approach to flexibility services remains unclear as the EC concept's transposition is too often considered and developed independent of Article 32 of the Internal Electricity Market Directive regarding flexibility in distribution grids. There is a lack of regulatory clarity about flexibility services: regarding local flexibility markets and regarding barriers for participation of ECs in TSO markets.

47 *https://www.h2020-bridge.eu/*

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GLOSSARY / LIST OF ACRONYMS

BRP	balance responsible party
CEC	citizen energy community
CEP	Clean Energy (for all Europeans) Package
CSO	community system operator
DG	Directorate-General
DHW	domestic hot water
DSO	distribution system operator
D(S)R	demand (side) response
EC	energy community
EE	energy efficiency
EU	European Union
EV	electric vehicle
FSP	flexibility service provider
GDPR	General Data Protection Regulation
HP	heat pump
H2020	Horizon 2020
KPI	key performance indicator
MS	Member State
P2P	peer-to-peer
PED	Positive Energy District
PV	photovoltaic
REC	renewable energy community
RES	renewable energy source(s)
ROI	return on investment
SCC	Smart Cities and Communities
SCIS	Smart Cities Information System
SCM	Smart Cities Marketplace
TSO	Transmission System Operator
VPP	virtual power plant
V2G	vehicle-to-grid

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