OPENING THE DOOR TO SMART BUILDINGS

DRIVING THE TRANSITION WITH EU DIRECTIVES

BPIE

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INTRODUCTION

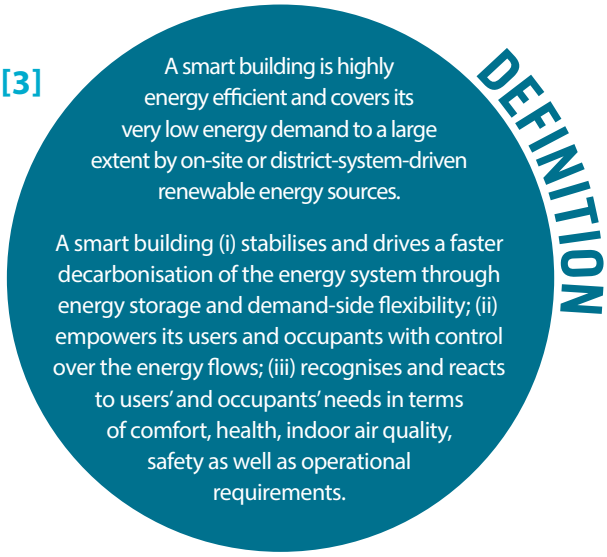
A more efficient and smarter building stock is a cornerstone of a decarbonised energy system. Increased integration of distributed energy (re)sources, renewables and storage and the growing peak demand for electricity will drive the need for increased flexibility, demand-response capabilities and consumer empowerment to further develop an affordable, reliable and decarbonised energy system. Buildings have the potential to be at the forefront of providing flexibility to the energy system, through energy production, control, storage, and demand response, as well as, through an interconnection with electric vehicles.

Market frameworks and regulation need to allow buildings to connect to and interact with the energy system. To date, this is not always the case across the European Union (EU). For example, many EU Member States do not allow residential buildings to participate in demand-response activities [1]; thus, innovation and development within this field are delayed. Without a forward-looking legislative framework, the EU risks losing out, in terms of competitiveness and innovation, compared to the markets in North America and Asia.

As important, smart buildings enable and ensure a healthy and comfortable living and working environment for the occupants. To be considered smart, a building should encompass functions that include automation and user-friendly controls.

The smartness of a building depends on the capacity of its functions and the interoperability of the different components. BPIE has, in previous reports [2] [1] [3], explored the concept of smart buildings.

DEFINITION OF A SMART BUILDING [3]



One of the biggest barriers to a revolution and a widespread penetration of smart buildings across the European Union is the legislative framework. Existing legislation should be revised and future-proofed, in order to support the features of smartness and envisage a future smart building stock in Europe. This means highly energy efficient buildings that drive a faster decarbonisation of the energy system, empower its users and react to their needs in terms of comfort, health, indoor air quality and safety.

While the proposed Clean Energy for All Europeans policy package [4] makes some incremental steps in the right direction, several of the proposed measures must be clarified and others should be added for the package to fulfil its purpose. This paper links the support needed with the relevant legislation that either currently exists or has been recently proposed by the European Commission and assesses whether this is sufficient.

SMART BUILDINGS AND THE SMARTNESS INDICATOR

As part of the tabled revisions to the Energy Performance of Building Directive (EPBD), the European Commission proposed the introduction of a smartness indicator [4]. To give value to smart buildings, the indicator must pull the market in the direction of smarter buildings, while also providing meaningful information on the potential of the building to prospective new tenants or buyers.

The characteristics set out in BPIE's definition of a smart building [3] provide a vision of what smart buildings should entail. The smartness indicator should reflect this by assessing those features required in a smart building.

Features of the smartness indicator, recommended by BPIE

HIGH BUILDING PERFORMANCE

through reduction of energy demand and greater use of locally-produced renewable energy, to ensure a healthy and comfortable indoor environment for users and occupants;

DYNAMIC OPERABILITY

to empower users and occupants with control over the energy flows and enhance the ability to optimise comfort, indoor air quality, well-being and operational requirements;

ENERGY-SYSTEM RESPONSIVENESS

to contribute to the optimum, smooth and safe operation of the energy system and district infrastructures to which the building is connected.

These features should result from embedded and interconnected technical building equipment, components, storage and appliances steered and optimised through dynamic and self-learning control systems. They need to be included in the revised EPBD.

Capturing and promoting the benefits of smart buildings for building users and occupants (e.g. cost savings, an optimal environmental comfort), the energy system (e.g. reduced pressure on the energy markets, security of supply reduced need for investment in new capacity), the economy (e.g. creation of local jobs) and society as a whole (e.g. tackling climate change, reducing air pollution) must be the underlying purpose of introducing a smartness indicator.

THE WIDER SMART BUILDINGS LANDSCAPE

The features encompassed by the smartness indicator need further support from many of the other parts of the Clean Energy for All policy package to ensure and encourage high building performance, dynamic operability to empower users and occupants, and responsiveness to the energy system. As with components in a smart building, the directives are interrelated.

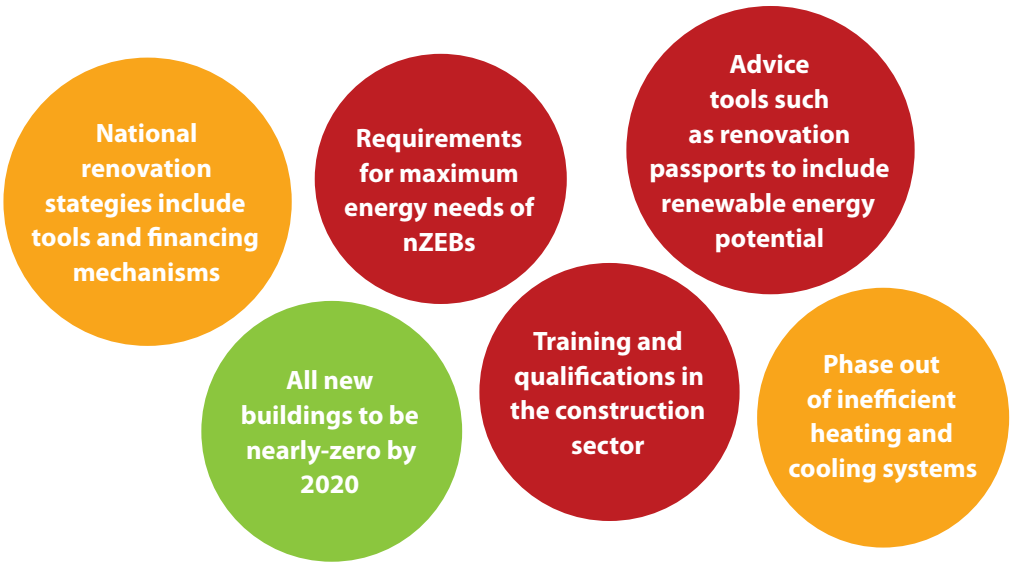
This chapter considers what is necessary to achieve this reciprocal relation and whether the proposals contained in the European Commission's Clean Energy for All Europeans policy package are sufficient. The package covers the proposals for revising the Energy Performance of Buildings Directive, the Energy Efficiency Directive, the Renewable Energy Directive and the Electricity Directive.

ENERGY PERFORMANCE OF BUILDINGS DIRECTIVE (EPBD)
ENERGY EFFICIENCY DIRECTIVE (EED)
RENEWABLE ENERGY DIRECTIVE (RED)
ELECTRICITY DIRECTIVE

ENSURING ENERGY EFFICIENT AND HEALTHY BUILDINGS

Buildings that waste energy are simply not smart, nor can they deliver benefits for occupants in terms of comfort, health or lower energy bills. A smooth transition to an energy efficient and healthy building stock requires looking at several areas of legislation. Delivering greater energy efficiency and penetration of on-site renewable energy requires supportive policies in the Energy Performance of Buildings Directive, and the Renewable Energy Directive.

Figure 1 - Progress on key indicators (Source: BPIE)



Directive/ Article

Ramp up deep renovation of the existing building stock

Up to 90% of the existing European building stock will still be standing and in use in 2050. The majority of these buildings are inefficient, making deep renovation of the building stock a necessity to meet the EU's climate and energy goals.

EPBD Article 2a [Proposal]

The Commission's proposal for revising the EPBD is not sufficient to stimulate faster and deeper renovation. Fostering renovation activities requires striking a balance between creating tools that stimulate the financial market for energy renovations and defining mandatory requirements for better energy performance of public and commercial buildings. This means developing more comprehensive and user-friendly tools such as building renovation passports [5], to better guide building owners and investors on how and when to invest in their buildings, and expanding existing legislation to require not only the renovation of central government buildings but of all public and commercial buildings.

National renovation strategies encourage the development of such tools and facilitate financing, tailored to national circumstances. The development and implementation of strategies has been insufficient so far, but there is a need for better guidance on suggested measures and monitoring of progress. A stronger link between the national renovation strategies and how Member States allocate the European Structural and Investment Funds would be beneficial, in terms of both ensuring an optimal use of funds but also to set out how these funds can be better used to leverage more private investments in energy renovations.

Boost the market uptake of nearly Zero-Energy Buildings

By 2020, all new buildings must be nearly Zero-Energy Buildings (nZEBs), a level defined by national governments. Until now, only approximately 60% of Member States have legally specified their nZEB definition [6].

EPBD Article 9 [Existing provision]

Specific requirements setting maximum energy consumption needs of nZEBs are called for, to specify the final energy demand, the renewable share and nearby-produced energy. This should encourage buildings to have the lowest possible energy demand with any remaining met with renewable energy. To support the achievement of these low levels of energy demand, adequate enforcement of implementation, compliance and control mechanisms must be in place to ensure they are adhered to.

Directive/ Article

Upskill the construction sector

Strategic initiatives, [e.g. BUILD UP Skills]

The transformation of the construction sector through enhanced training and qualifications for the property developers, architects, and workforce is needed to build competence and awareness of innovative combined solutions; this way, ensuring that a higher level of energy performance in buildings can be achieved, as well as avoiding inadequacies caused by poor practices.

Consumers should be able to rely on the skills of building professionals and be confident that they will get what they pay for. This requires a skilled workforce, since highly energy-efficient products and construction techniques require the installer to have a proper understanding and training. To ensure reliable and qualitative construction and installation of highly energy efficient buildings and the interoperability of components, quality frameworks should be put in place and all professionals involved in the process should receive proper training.

RED Article 18 [Previously existing Article 14]

The Renewable Energy Directive includes requirements for certification or qualification schemes for installers of several types of renewable energy technologies.

Phase out inefficient technologies

Heating systems are responsible for about 80% of the energy consumption of buildings [7]. Phasing out old and inefficient heating systems while guiding building owners towards renewable choices would increase the market for smart and low-carbon technologies.

RED Article 18 [Previously existing Article 14]

Ecodesign has an important role to play alongside access to information. Clear and reliable information on the benefits of installing such technologies needs to be provided to end-users. The Renewable Energy Directive requires information on the benefits, costs and energy efficiency of equipment and systems used for heating and cooling, as well as information on the share of electricity from renewable energy sources to be available, in order to inform consumers, builders, installers, planners and architects. This requirement recognises the importance of professionals and consumers being able to properly consider the optimal combination of renewable energy sources, high-efficiency technologies, and district heating and cooling when building or renovating buildings.

EPBD Article 10 Article 20 [Proposal]

Advice tools such as building renovation passports and Energy Performance Certificates (EPCs), provided to building owners and occupants, should contain information on the building's capacity to consume self-produced or nearby-produced renewable energy. This would increase the visibility of its potential and thereby encourage the uptake of smart buildings, for example through placing an additional value on buildings with greater ability to produce/consume renewable energy.

RED Article 23 [Proposal]

Energy labelling of existing heating systems by professionals could also increase the level of information provided to consumers and the awareness on the potential for energy savings and use of renewable energy. The consumers can be guided to make planned replacements rather than taking decisions only when the existing system fails, which often leads to a replacement with the same technology. This system is already in place in Germany.

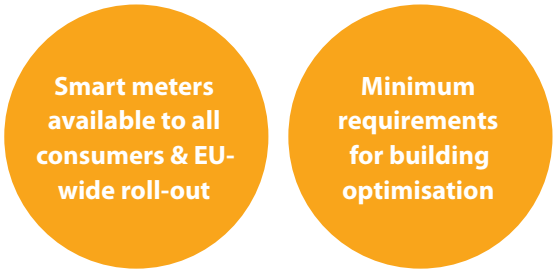
The Commission's proposal for revising the Renewable Energy Directive includes requirements to encourage the increase in the share of renewable energy supplied for heating and cooling by 1% every year. Member States can decide how to implement this share, with the aim of increasing the market for renewable heating and cooling.

INCREASE DYNAMIC OPERABILITY

Smart buildings need to go beyond being energy efficient and healthy, and also recognise and react to users' and occupants' needs to optimise comfort, indoor air quality, well-being and operational requirements. Ensuring these needs requires looking at several areas of legislation, including the Energy Performance of Buildings Directive, the Electricity Directive and the Energy Efficiency Directive.

Dynamic operability inside a building is intrinsically linked to the interaction of a building with the wider energy system. Therefore, the elements in this and the next section are essential to ensure both features.

Figure 2 - Progress on key indicators (Source: BPIE)



Directive/ Article

Empower all consumers with smart meters

Smart meters allow consumers and aggregators to have (near-) real time data on their energy use, adapt their energy consumption according to the price of energy at any time, offer this ability to reduce demand as a flexibility service to network and energy service companies, and achieve savings on the consumer's energy bills. All consumers should be able to have a smart meter, at a reasonable price, dynamic pricing contracts for their energy supply as well as access to the grid (see next section). The Commission's proposals for an Electricity Directive include the right for all consumers to request a smart meter.

Electricity Directive Article 21 [Proposal]

It is important that smart meters can be easily used by all consumers, and have an universal communication protocol allowing interoperability between appliances and systems. Standardisation, for example, building on the Smart Appliances Reference Ontology, should ensure compatibility and enable consumers to easily choose and swap technologies without impacting their interoperability. The proposed Electricity Directive includes a series of principles to be followed where smart meters are rolled out.

Electricity Directive Article 19 Article 20 Annex III [Proposal]

For commercial and tertiary buildings, requirements should encourage the installation of smart meters. The Energy Efficiency Directive and Electricity Directive encourage the use of smart meters, subject to a cost-benefit assessment. To date, only four countries – Sweden, Finland, Italy and Estonia – have completed their roll-out of smart meters [1].

EED Article 9 &10 [Existing provision]

It is important that citizens are aware of both their electricity and heating consumption, taking into consideration that usually heating accounts for about 65-70% of people's energy bills.

Article 9a &10a [Proposal]

Gaining consumers' trust in these meters is essential. Data protection should be carefully considered and addressed within the relevant legislation.

Directive/ Article

EPBD Article 8 [Existing provision]

EPBD Article 14 Article 15 [Proposal]

EED Article 9 &10 [Existing provision] Article 9a &10a [Proposal

Optimise buildings with automation and controls

Building automation and controls complement smart metering. Buildings should react to the occupants' needs, and the energy use of the building should be continuously optimised, by ensuring that the energy is used only when and where necessary and that all technical building systems are properly integrated.

The performance of a building and its technical building systems should be controlled and monitored in a way that is easy-to-use, informative and empowers the owner or occupant. This means that the right and informed decision on the long-term operation and performance of the building can be taken based on real data. It also opens the possibility for consumption patterns to be collected and used for the management of the building and for informing future maintenance and renovation strategies at building level.

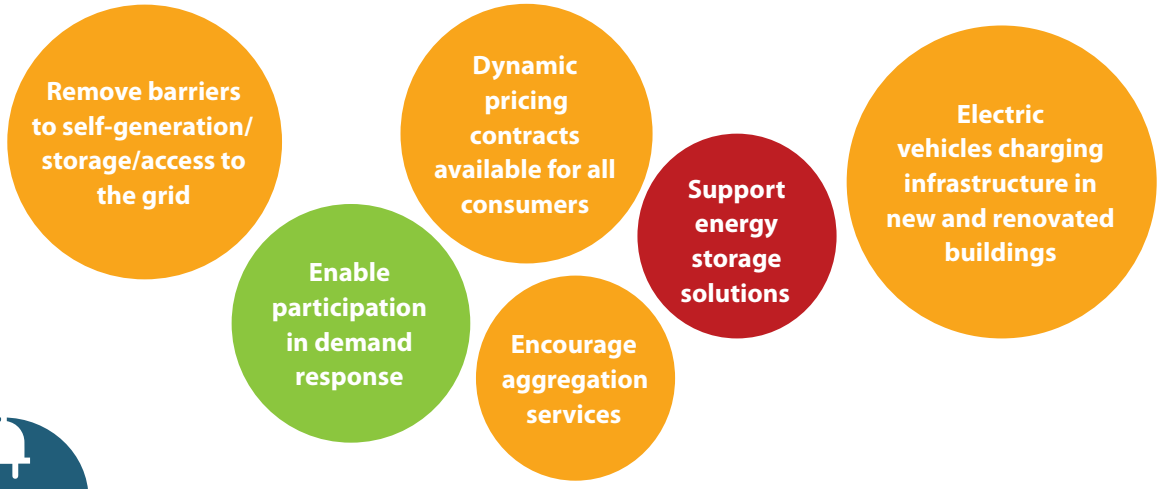
The EPBD obliges Member States to set minimum requirements for building optimisation, but implementation has been slow due to a lack of guidance. Minimum performance requirements for technical building systems should be more explicit and linked to functionalities such as control of energy generation, distribution and emission of heating and cooling. Large buildings should be equipped with functionalities that continuously monitor and adapt energy use in order to optimise their energy consumption. Some simple options, such as controls for room temperature for residential buildings, could be made mandatory, since they enable consumers to act on the feedback from consumption-based billing for space heat, which is required by the Energy Efficiency Directive.

Directive/ Article

ESTABLISHING ENERGY-SYSTEM RESPONSIVENESS

Beyond operability, a smart building should also interact with the wider energy system. In this way, a smart building can provide various energy services, including demand management, energy storage and integration of renewable energy. The proposal to revise the Electricity Directive (Article 3) requires Member States to ensure that national legislation does not hamper consumer participation (including demand response), flexible energy generation, energy storage or electromobility. This needs to be embedded with specific provisions in all legislation, including in the Electricity Directive, the Energy Performance of Buildings Directive and the Renewable Energy Directive.

Figure 3 - Progress on key indicators (Source: BPIE)



Allow and encourage occupants to generate and self-consume renewable energy

Electricity Directive Article 3 Article 15 [Proposal

Consumers should be able to generate, consume and store their own energy, as well as to sell it to the grid and heat networks. This could open the door to millions of people to become active in the market. Self-consumption of renewables is currently hampered in several Member States, due to frequent changes to support schemes, unnecessary administrative burden and policies that hinder self-consumption [8]. Regulations and measures obstructing self-consumption and on-site or nearby renewable energy production such as high network tariffs, additional taxes or levies for connecting to the grid, should be lifted and administrative procedures simplified to be more user-friendly. A stable regulatory and financial framework for renewable self-consumption in buildings must be encouraged in every Member State.

Renewable Energy Directive Article 21 Article 24 [Proposal]

For heat, the proposal to revise the Renewable Directive allows producers of heating and cooling from renewable sources or waste heat or cold to feed this into local heating and cooling systems. For electricity, the revised Renewable Directive requires Member States to ensure that consumers can self-consume renewable electricity without undue restrictions and be remunerated for the electricity they feed into the grid, with particular attention to consumers in multi-apartment blocks or multi-occupant commercial buildings. It is important that innovative solutions such as leasing of solar panels or collective self-consumption are also encouraged.

Directive/ Article

Electricity Directive Article 3 Article 13 Article 17 [Proposal]

Enable the participation of demand response

All consumers should be allowed to feed into the grid the electricity they generate, but do not use, and/or to participate in demand-response activities. This means that hurdles to participation, such as exclusion of smaller players or high prices for grid connections, should be prevented. Significant barriers to demand response continue to exist in most European countries [1].

Building on the provision in the Electricity Directive to remove the barriers to consumer participation in the electricity market, the Commission's proposals include requirements for national regulatory authorities to encourage final consumers to participate in demand response. There are also provisions to establish the right of consumers to sell flexibility, independent of their contract to procure energy. This is useful to prevent current suppliers from suppressing demand-side flexibility and aggregation where it could be seen as a competition with the supply side.

Participation of customers to demand response should be encouraged by Member States as it could deliver many benefits, not least by providing flexibility and additional capacity. The cost of balancing this resource is often cited as a reason for limiting this capacity. However, the European Commission estimates that increased demand-side flexibility could lead to savings of €5.6bn/year from reduced back-up capacity, network and fuel costs [9]. Requirements to assess the benefit against the costs would also help to encourage the uptake.

Electricity Directive Article 11 [Proposal]

Make dynamic pricing contracts available for all consumers

All consumers should be able to have dynamic pricing contracts for their energy supply and network tariffs. This, alongside smart meters and controls, would allow them to benefit from adapting their energy consumption according to the price of energy at a particular time. Different types of approaches should be considered: automatic, semi-automatic or customer response-driven adaption to make best use of price signals. The Commission's proposals for the revised Electricity Directive include the right for all consumers to request a dynamic electricity price contract.

Dynamic pricing would also encourage energy to be stored when the price is low, and this stored energy to be used when the price is higher. This could apply to different types of storage, such as vehicle batteries and hot water tanks. A reduction in demand during high-priced hours could reduce wholesale market prices in those hours, which would be a benefit not only to those providing demand-response services, but to all energy consumers.

Network charges and national taxes should not hamper dynamic prices as consumers should be able to feel the full benefits of their flexibility. Today, the penetration of dynamic pricing for households is very limited, due to a combination of regulatory barriers and a lack of enabling technology [10]. Also linking controls and smart appliances with dynamic tariffs can facilitate demand management by automating responses to these tariffs. Studies show that peak demand reduction is 60% to 200% greater for smart tariffs with automation compared to those without [11].

Directive/ Article

Electricity Directive Article 13 Article 17 [Proposal

Enable aggregation services

Market operators must open the energy market to aggregators. Aggregators should, on behalf of consumers (including commercial, residential and industrial users), be able to combine the flexibility from multiple customers for sale, purchase or auction in energy and (where relevant) capacity markets.

Aggregators can play an important role as intermediaries between customer groups and the market, and can take charge of managing the process, with the consent of customers. However, the relationship between different market actors and aggregators must be defined in a regulatory framework to enable the participation of independent aggregation service-providers in smooth functioning markets and ensure consumer protection (e.g. standardised processes for information exchange, transfer of energy and financial settlement between these parties).

The revised Electricity Directive encourages aggregators to participate in the market to enable greater involvement of customers in demand-response activities. It is important that aggregators can compete on a level playing field in all markets and that regulatory and market barriers to participation (such as minimum bid requirements) are removed. Ensuring customers have the freedom to contract the aggregator of their choice, without requiring the supplier's permission, as proposed in the Electricity Directive, is important to gain consumers' trust in aggregation.

Legislation missing

Encourage immediate use or storage

The share of energy being stored or used immediately or locally needs to be maximised. This means encouraging energy storage possibilities in buildings. Where possible, for example in urban areas, clustering buildings within local districts could encourage energy generated, but not needed, by one building to be used by another nearby.

The market update of energy storage has so far been limited due to high price (especially for electrical storage). However, economies of scale are leading to significantly reduced costs for home-battery systems, as demonstrated by the World Energy Council forecasts that the cost of batteries for large-scale energy storage could drop by 70% over the next 15 years [12]. On the other hand, thermal energy storage using, for example, the structure of the building or solar thermal water storage tanks, tends to be cheaper.

Policies are needed to support storage, and existing policies should be checked to ensure they do not create barriers to its use, such as requirements on the positioning of batteries in residential buildings.

Directive/ Article

Enable synergies between smart buildings and electric vehicles

Most normal daily charging of passenger electric vehicles takes place at workplaces or homes since it is most convenient. This means that most charging needs are provided by or through buildings. Therefore, ensuring synergies between smart buildings and electric vehicles is key to fostering the transition to electromobility across Europe. This is not just about buildings getting smarter, but cars and their charging stations too. Smart charging avoids costly spikes in power demand and can operate as storage to deliver valuable services to the electricity system.

EPBD Article 8 [Proposal]

Proposals within the Commission's package for revising the Energy Performance of Buildings Directive require installation of charging infrastructure, and the proposal for revising the Electricity Directive encourages Member States to facilitate installation of public and private charging points. However, given that the technology related to electric vehicles and charging is developing rapidly, any lock-in to existing known technologies must be avoided, since others, not yet widely known or even envisaged, could enter the market in the coming years. Therefore, pre-equipping buildings (with conduits for pre-cabling, for example) and access to a sufficient power supply, to enable the installation of recharging points later, is more appropriate than a specification of charging infrastructure that may be outdated, unnecessary, insufficient or oversized once the building is used. In addition, the cost of equipping buildings with conduits is expected to be considerably cheaper, so this could be easily put in place in all new or renovated buildings.

Electricity Directive Article 33 [Proposal]

Increasing the visibility of charging points, such as in workplaces and shopping centres, stimulate their uptake by making consumers more aware of the potential to charge electric vehicles.

Burdensome permitting and approval procedures are also a barrier to installing charging points in existing shared buildings today. This means that those wanting to install charging points currently face long and uncertain procedures. These procedures need to be simplified, through a revision of national building, property and tenancy laws for example, and residents should be granted the right to install charging points. Such procedures have already been successfully implemented in France [13], Spain [14] and Portugal [15].

CONCLUSION

The proposed Clean Energy for All Europeans policy package is a unique opportunity to shape what the European building stock will look like in 2030. Missing the chance to set out a framework that enables and encourages efficient and smart buildings will come to a high cost for the European Union, in terms of global competitiveness, restrained investments and grid congestion. Legislations should avoid locking-in technological pathways by instead setting out a dynamic framework that supports increased interoperability within and between buildings, districts, vehicles and the energy system.

Buildings are an integral and elementary part of Europe's energy system and should play a pivotal role in the clean energy transformation. For buildings to be able to wield this responsibility as micro energy-hubs - empowering occupants to control their own renewable energy production and consumption; cutting energy bills and facilitating the surge of large-scale renewable energy; support the uptake of electrical vehicles; as well as facilitating better living and workplaces – they must first and foremost be energy efficient. Energy efficiency is the key cornerstone of a smarter building stock and a smarter energy use.

The Clean Energy for All Europeans policy package should lead the way, in terms of how to incorporate buildings as micro energy-hubs in the European energy system. Europe's innovation and technology leadership could gain a much-needed support through this transformation of the building stock, benefitting both the economy and European citizens, by providing healthier places to live and work, as well as innovation and jobs in the construction sector. Innovation within the ICT and clean energy sector is progressing rapidly. If we are unsuccessful in adapting and upgrading the current legislative framework, there is a risk of not just hampering the development, but also causing lock-in to soon outdated technologies.

The Clean Energy for All Europeans policy package should build the legislative foundation for the transition to a decarbonised and smart building stock. The European building stock is the cornerstone of the European society. It is time to be smart about it.

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