PROSEU

Prosumers for the Energy Union: mainstreaming active participation of citizens in the energy transition

Policies for Prosumer Business Models in the EU

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Key policy recommendations

Prosumers – who both consume and produce renewable energy (RES) and actively modulate their demand – are now an significant feature of energy systems. Across the EU and in the UK, policymakers have sought to drive the adoption of RES, including significant volumes of rooftop photovoltaics (PV). Although this has driven down electricity CO_2 emissions it has also created new policy challenges. The intermittency of RES is creating significant volatility in wholesale markets, and decarbonization targets are making traditional fossil fuel sources of balancing/flexibility obsolete. Further, heat and transport systems will increasingly need to be decarbonised and electrified using RES.

In this report, we argue that one of the best ways to address these interrelated challenges is through emerging 'prosumer business models'. We cover eight 'families' of prosumer business models and highlight a range of relevant issues that inform our policy recommendations. By striving to enable these business models, policymakers can facilitate the continued deployment of RES whilst delivering system stability, enabling heat and transport decarbonisation, empowering communities and addressing energy poverty. To facilitate these new business models, we propose a series of key energy market reforms:

What should policymakers do?

Incentive Schemes: prosumers should receive guaranteed prices for exported power as well as tax incentives on renewable hardware. However, policymakers should move away from static incentives such as basic FITs or Net Metering, and towards Export Guarantees and incentives that reward prosumers on a dynamic basis – reflecting the value of exported power to the system. Incentives and grants should also be designed to benefit certain groups, e.g. the energy poor or energy communities.

Smart infrastructure: national policymakers should expedite their rollout of smart meters and EV chargers, with interoperability and product standards agreed at the EU level. Research suggests these efforts are best co-ordinated by government actors and DSOs, not energy suppliers and vehicle manufacturers.

Network charges: high volumetric and fixed network charges hinder business models which offer flexibility and disproportionally pass network costs onto non-prosumers. Adopting capacity based, locational and dynamic network charging can reward business models which enable flexibility, communal self-consumption and reduce the overall costs of integrating RES. In many cases, municipalities and communities should also operate local networks.

Taxes and Levies: the burden of energy taxation and renewable levies falls disproportionately on electricity bills, penalising low carbon heat electrification and disincentivising prosumer business models which valorise flexibility. Given the regressive nature of these charges for low income consumers, we suggest there is a strong case for shifting these levies into general taxation.

Supplier Codes & Licenses: licence exemptions for small or community-owned energy suppliers can be a key means of enabling local social value. Equally, relaxing mandatory 28 day switching legislation for long term energy service contracts can make prosumerism accessible to low income groups, helping to address the wider energy poverty and heat decarbonisation agenda. Further, relaxing the requirements for energy suppliers to coordinate transactions can enable P2P energy trading models to emerge.

Market Access: EU and national regulators should re-design wholesale, balancing and flexibility markets to be accessible to distributed flexibility and independent aggregators – likely to be the cheapest and lowest carbon source of system stability. DSOs should be encouraged to operate new local flexibility markets – balancing the system at the lowest voltage levels. This should also include allowing multiple energy suppliers and aggregators to power different systems in homes and businesses.

1. Introduction

PROSEU aims to mainstream the renewable energy 'prosumer' phenomenon in the European Energy Union. Prosumers both consume and produce energy from renewable sources (RES) and may actively modulate their energy use through demand side flexibility. The growth of RES prosumerism challenges current energy market structures, norms and institutions. PROSEU's research focuses on collectives of RES prosumers and will investigate new business models, market regulations, infrastructure, technology and energy policies across Europe.

The PROSEU project is therefore seeking to identify and analyse a range of prosumer business models and alternative finance mechanisms. These business models and finance mechanisms are of critical importance in developing a market for prosumerism to become mainstream. Business models in their broadest form describe the nature of the value delivered to customers, how organisations and networks create that value, and the means of capturing revenue from these activities [1]. In the context of prosumer led energy transitions, these business models must therefore deliver value to both prosumers and the energy system, valorise this across the energy value chain, and capture and monetise this in a way that is sustainable for all actors [2].

Previous work of the PROSEU project identified 15 'Prosumer Business Models in Europe' [3] using a 'business model archetype' approach [4]. These prosumer business models seek to overcome a series of related 'problems' including: a) the removal of subsidies in many EU nations; b) how to collectively self-consume more energy; c) how to achieve better export prices through local energy markets; d) how to earn revenue from prosumer flexibility; e) how to deliver multiple energy vectors through service payments; and, f) how to create value from electric vehicles. The report further provided some high level guidelines for policymakers looking to promote the uptake of prosumer business models across the EU.

In most cases the more novel business models such as Micro-grids or Peer-to-Peer Trading are operating in isolated examples, heavily subsidised through grant funding or regulatory sandboxes in one-off trials. In many member states, these business models were not present and in some cases unviable due to a range of regulatory, institutional or political barriers. Often these business models, while technically possible, were not widespread due to the dominant logic of large centralised energy suppliers effectively 'crowding out' new business models and alternative governance approaches.

In this policy brief, we build on these high level policy discussions through an analysis of the regulatory and broader institutional challenges facing these emerging business models for the nine member states in scope[1]. We therefore seek to address the following questions:

- In which member states can these business models exist and why?
- What are the key policy constraints and enablers for their replication in other contexts?
- How can policymakers enable their diffusion to disrupt or consolidate existing markets, institutions and stakeholders?

By addressing these questions, we aim to provide policymakers with a set of concrete recommendations for how to mainstream the prosumer phenomenon through new business models which can deliver value to both prosumers and the energy system.

[1] Belgium, Croatia, France, Germany, Italy, Netherlands, Portugal, Spain, United Kingdom

2. Prosumer business models in the EU

In this section, we briefly outline the prosumer business models operating in the nine case study countries of the PROSEU project. In doing so, we have aggregated the 15 identified business models into eight 'families' of models, which share similar characteristics. The families are described as; Basic Prosumers; Micro-grids; Communal Self Consumption; Local Energy tariffs; Peer-to-Peer (P2P) Trading; Energy Service Contracts; Flexibility Aggregator & Vehicle To (V2G). These eight families of business and their relationship to a generic European energy system are shown in Figure 1 with each business model denoted by a numbered green box. For a detailed exposition of these models, including which models are included in each family please refer to the Appendix and companion document [3].

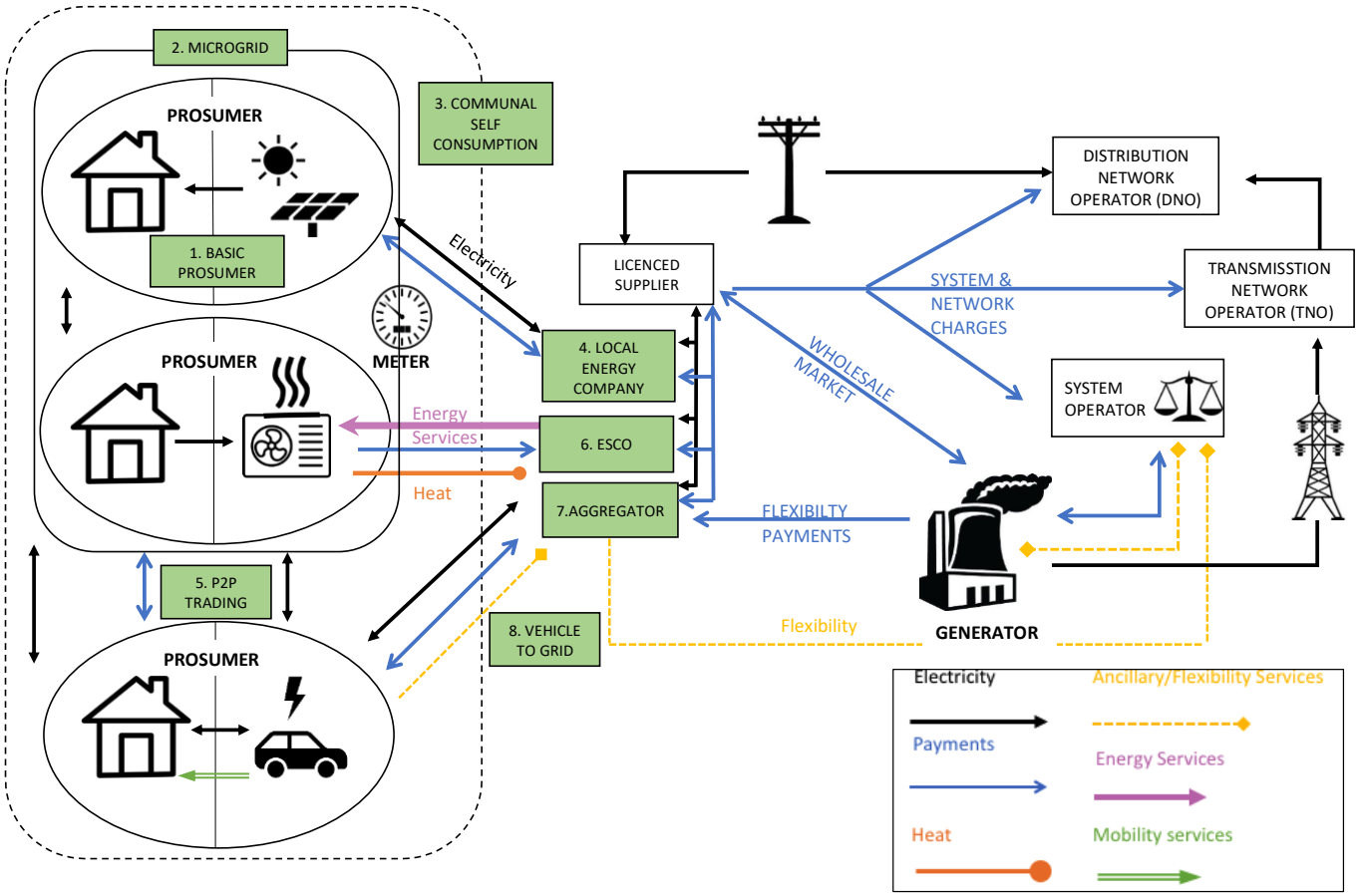

Figure 1 Eight families of prosumer business model

1. Basic Prosumer

The basic prosumer (box 1 Figure 1) has been the dominant business model for prosumerism in the EU to date. Typically, rooftop solar PV installations are installed 'behind the electricity meter' and prosumers self-consume energy when its generated with any excess generation spilling onto the grid. Historically, these models were supported by Feed in Tariff (FiT) or Net Metering incentives (see Section 3.1), although these incentives are being withdrawn in some member states. Without FiTs or Net Metering, these models may only be economically viable in locations with high levels of solar irradiance (or micro wind potential), high retail electricity prices and high self-consumption rates, e.g. when supplemented with behind the meter batteries or EV charging. However, in many cases new business models are needed.

2. Micro-grid/private wire/internal grid

In a micro-grid, multiple individual prosumers are located on a private network or 'behind the electricity meter', e.g. within a building or compound. As denoted by the solid line on box 2 in Figure 1, this increases the potential for self-consumption of renewable electricity, with multiple prosumers using a private distribution network. Some models may involve a 'virtual energy company', which bills different prosumers in the micro-grid whereas the German Mieterstrom model allows multi-occupancy landlords to sell discounted solar energy to their tenants. Although many early micro-grids were 'islanded', these models usually have a grid connection but seek to minimise import and export as much as possible.

3. Communal Self Consumption

Communal self-consumption models are similar to micro-grids in that they promote 'self-consumption', although they use the public distribution network. Here, regulators have provided special dispensation, for instance for Spanish residents to share communally owned solar within 500m, or Dutch cooperative members in adjacent postcodes to self-consume – as in the Post-Code-Rose model. In each case, regulators and network operators have created special metering arrangements to create 'virtual private networks' as shown by the dotted line in box 3, Figure 1 – shielding prosumers from some or all use of system charges.

4. Local Energy Tariff

Local energy tariffs sell locally-generated electricity to both prosumers and non-prosumers through special tariffs in specific geographies. Exporting prosumers can sell electricity into a local pool – where they typically receive improved prices – and importing prosumers/consumers theoretically pay less for locally-generated electricity. These models are optimised when smart meters are paired with time of use tariffs – incentivising consumption when local generators/prosumers are exporting. These models use the local public grid, although are not usually rewarded for avoiding use of the wider network. UK examples below a 2.5MW derogation level have received exemptions from full supplier licence requirements – allowing small community run companies to emerge.

5. Peer-to-Peer (P2P) Trading

P2P business models remove the licensed supplier as an intermediary when trading prosumer generation over the public grid. Using third-party digital platforms, prosumers can securely trade energy with minimal involvement from suppliers (box 5, Figure 1). In principle, prices can be negotiated directly with other prosumers, allowing them to select the provenance of their electricity. These models potentially facilitate dynamic and cost reflective prices, rather than forcing prosumers to accept whatever price a supplier is prepared to offer. However, in all EU examples of P2P trading, customers must still have a contract with a licenced supplier who provides balancing and settlement services upstream of the P2P trades.

6. Energy Service Contract

Traditional energy supply models involve the retail of energy commodities (oil, gas, electricity) and conversion hardware (PV panels, boilers, batteries) to consumers. Under energy service contracts, consumers are instead guaranteed certain levels of energy service that involve converting these raw commodities into their useful derivatives of reliable electricity supply, hot water, cooling, lighting or motive power (box 6, Figure 1). In the context of prosumer systems, these models include solar-as-a-service models where energy service companies (ESCOs) provide a reliable electricity supply at no upfront cost to the prosumer, and heat or comfort-as-a service models where ESCOs may also improve the efficiency of the building fabric and optimise operation of heating systems alongside an on-site or local renewable electricity supply.

7. Flexibility Aggregator

Variations in electricity demand and system stability are maintained through wholesale markets and system operators procuring balancing and ancillary services. Historically, these markets were dominated by large thermal generators and industrial demand side response. However, developments

in smart metering, batteries, internet of things (IoT) devices and the electrification of heat, are enabling flexibility services to be procured at the household level. Specialist aggregators may therefore procure flexibility from multiple distributed assets such as heat pumps or power from rooftop solar arrays or home batteries under the 'virtual power plant' concept. Unlike voluntary price signals through time of use tariffs, these models typically involve the direct control of assets, often with little involvement from prosumers themselves.

8. Vehicle To Grid (V2G)

V2G models involve a similar proposition to the domestic aggregator model through the significant flexibility potential of electric vehicles (EVs). However, the storage potential of EVs may be an order of magnitude larger than a typical home battery, and in many cases this flexibility will be present at different points in the network – depending on where the EV is parked. This potentially creates the demand for separate supply contracts from the domestic energy supply and new commercial relationships between prosumers, aggregators, vehicle manufacturers, charging infrastructure providers and energy suppliers.

3. EU energy market regulations & prosumer business models

In 2018, the EU updated its energy policy framework to facilitate the transition away from fossil fuels. This 'Clean Energy for all Europeans Package' [5] (CEP) marked a significant step towards the implementation of the Energy Union strategy published in 2015 [6]. In this section we provide an overview of the current energy market regulations that implicate prosumer business models in different member states. It is worth remembering that the regulatory regimes of member states and the rationale of EU energy policy were not originally conceived for a system involving prosumers. Indeed, many newer member states are still emerging from state-owned monopolies, whilst the liberalisation principles that have guided EU energy policy emerged in an environment dominated, large market players and a significant delineation between producers and consumers.

In building this picture, it is important to understand the typical composition of an EU electricity bill. As shown by Figure 2, only 37% of the *average* bill is actually energy costs. The remainder is comprised of network charges (25%), renewable/energy efficiency levies (13%), other taxes (11%) and Value Added Tax (VAT) at 14%. However, these charges vary significantly between member states and this variability can have a significant impact on the economics of prosumer business models. Equally, consumers and prosumers may benefit from renewable and energy efficiency levies or may be exempt from certain taxes and charges or pay these on a dynamic basis - depending on the level, time or location of their production and consumption.

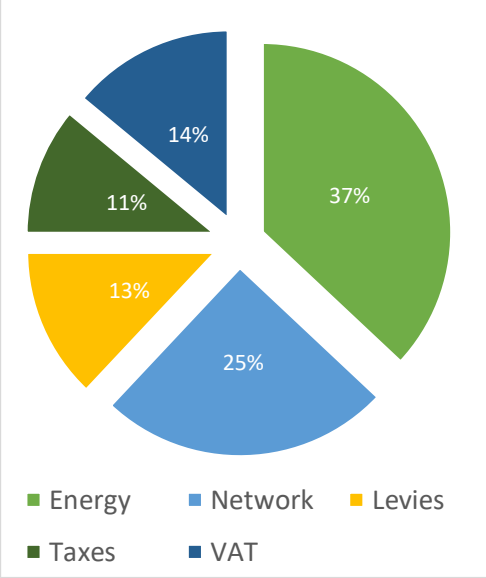

Figure 2 Composition of typical EU electricity bill (2018) Source: ACER

The following sections outline some of the key policy areas which affect prosumer business models. Our aim here is to consider the needs of both prosumers and non-prosumers and the implications for integration of renewable energy, overall system stability, fairness and efficiency. In building this picture, we draw on data from our series of business model co-creation workshops, interviews [3] and a literature review drawing on some key source material [2,7–11].

3.1 Incentive Schemes

Incentive schemes are financial instruments which foster investment in renewable energy. We outline different mechanisms of compensation below, the details of which can widely vary from state to state depending on the regulatory framework; they may also be combined.

3.1.1 Feed in Tariffs (FIT)

FITs are guaranteed long-term (15-25 years) contracts for renewable energy producers, based on the respective generation costs of certain technologies. Prosumers are paid a fixed price for every kWh, which is not self-consumed and therefore exported[2] to the public grid. In addition, grid access of self-generated electricity is guaranteed [12]. FITs have been a critical mechanism for establishing distributed renewable electricity generation in the EU [13]. FITs are still existent in some member states but decreasing in number and generosity across Europe.

3.1.2 Net Metering

Net metering ensures that prosumers only pay the net difference between the electricity fed into the grid and received from the grid over a set period. It allows prosumers to 'export' surplus electricity to the public grid and 'use' – in a balance sheet perspective – this 'exported' electricity later when self-production is not sufficient. In practice, net metering schemes vary widely from state to state by the amount of electricity which can be net metered in a certain period, how long a period is (instantaneous, one hour, one month, 1 year or indefinite) or how much the credits from exported electricity are worth [14]. Some net metering schemes raise controversy as network costs are partly or completely avoided and therefore shifted to consumers without distributed generation.

3.1.3 Export Guarantees

Export guarantees differ from FITs in that the price for exported electricity is negotiated with a supplier or utility company. Here a utility offers the prosumer a fixed or variable price per unit exported, which should theoretically reflect its market value. With the rollout of smart meters and digitalised billing it becomes more viable for utilities to integrate small generation units of prosumers in real time in the wholesale trading process. However, wholesale market participation schemes require smart forecasting from the utilities and a critical volume of prosumers participating to have a meaningful impact on their trading position.

3.1.4 Grants/Tax exemptions on hardware/installation

Another policy mechanism to support prosumers is the avoidance of VAT, sales or local taxes on certain types of hardware such as PV panels, batteries, heat pumps, energy efficiency measures or metering and control systems. These taxes can be charged at a reduced rate or avoided altogether and can provide a significant boost to the economics of installing prosumer systems. Equally, governments may also provide cash grants to achieve similar aims.

3.2 Smart infrastructure

The rates of smart infrastructure rollout differs widely across members states. For some of the prosumer business models smart meters and bi-directional EV chargers are a critical requirement.

3.2.1 Smart Meter Rollout

Advanced metering infrastructure integrates smart meters, communication networks and data management systems to allow 2-way-communication of prosumers with utilities and/or the wider grid [15]. With smart meters, prosumers are able to access dynamic price contracts (e.g. time-of-use tariffs) based on e.g. 15/30/60 minute settlement for imported and exported electricity. In addition, prosumers

[2] Although in some member states such as the UK FITs were also paid on self-consumed energy

with flexible electric loads such as battery storage, electric heating and cooling are able to capture additional value from offering this flexibility, through flexibility markets or price arbitrage. Smart meters are therefore a precondition for the aggregation of prosumer flexibility and access to wholesale markets, although their rollout has been extremely expensive and contentious in many countries.

3.2.2 EV Charger Rollout

Smart charging infrastructure is an essential to support EVs and V2G business models. With price signals through time-of-use tariffs, shifting charging from peak moments to lower demand periods (arbitrage) is viable and can have positive system effects. An advanced smart charging infrastructure can provide electricity to the grid for balancing purposes and managing grid capacity. For that, a European wide interoperable charging system for batteries and charging stations with standardization of 2-way-communication and charging protocols is crucial to access the value of flexibility [8].

3.3 Network Charges

Network charges allow network operators to recover the costs of building and maintaining the physical electricity networks and comprise ~25% of the average EU electricity bill [16]. These are split into distribution and transmission charges, with the distribution component usually comprising the largest share. These charges typically have varying volumetric and fixed components, while some regulators are moving towards a capacity or dynamic charging regime.

3.3.1 Volumetric network charges

Volumetric charges recover costs based on the total volume of consumption. Historically this was considered fair as higher users were charged more. However, 'behind the meter' prosumers can significantly avoid such charges, despite relying on the network during peak periods. This has led to concerns of a 'death spiral' with non-prosumers paying an increasingly large share of these costs [7].

3.3.2 Fixed network charges

Fixed network charges apply the opposite logic and apply a blanket rate - usually for sunk infrastructure costs. They can be based on capacity connected or other items. This approach typically penalises prosumers as they are not rewarded for avoided use of the network, also making energy efficiency less attractive. Most member states' bills comprise both fixed and volumetric components, although some are moving towards an increased fixed share to avoid the 'death spiral' [17].

3.3.3 Capacity based network charges

Capacity based charges are based on a customer's peak demand, as peak periods typically shape the capacity of the network and thus its costs. Capacity based charges are therefore considered a fairer means of paying for networks, although are more complex and costly to administer. Whilst in many member states larger consumers already pay capacity based charges, the advent of smart meters and 15/30 minute settlement is now enabling this at the household level. Capacity based charges could provide a significant cost benefit to prosumer models which incentivise demand side flexibility and therefore 'peak shaving' [9].

3.3.4 Locational/marginal network charging

Locational and temporal marginal network charging is based on the principle that the costs to the network result not only from peak demand, but also the time and location of that demand [18]. Large consumers are already charged for the transmission network temporally during annual peak load periods. Research from the UK has indicated that 93% of distribution network costs occur only a few hourly periods each week [19]. Prosumer business models which match local generation with demand or 'share self-consumption' can also avoid utilisation of the higher voltage parts of the grid and thus reduce costs for network operators [18]. Although some network operators are experimenting with 'virtual private networks' or more dynamic locational pricing for local energy trading [18], challenges remain in making these models fair for all and cheap to administer.

3.4 Taxes and levies

Taxes and levies amounted to 38% of the average EU household electricity bill [16] in 2018, although vary significantly between member states.

3.4.1 VAT on energy

VAT is applied to energy in most member states, however some[3] such as the UK and the Netherlands apply a reduced rate for electricity – considered an essential service. By reducing these fixed components of bills, price signals to promote flexible consumption become more significant [8], conversely these tax exemptions improve the economics of self-consumed vs. imported power.

3.4.2 Taxes, levies and other charges

A large range of levies designed to support renewables, energy efficiency and environmental programs (as well as some non-environmental charges e.g. for nuclear waste) are paid via electricity bills. In some member states, such as Denmark and Germany, these costs rival the energy component of domestic bills [16]. While many were designed to support prosumers, regulators may further shield prosumers from these costs[4] - on self-consumed electricity, or virtual private networks for collective self-consumption models. Some have argued that electricity bills are overburdened and that gas bills or general taxation should share this burden, as electricity becomes increasingly decarbonised [20].

3.5 Supplier codes & licencing

National policy and EU directives have sought to ensure energy suppliers comply with various codes and levels of customer service, to protect consumers and system stability. The resultant complexity of modern electricity markets requires sophisticated and well-resourced participants, creating significant barriers to entry – with code compliance alone typically costing €100,000 per firm [2]. Policymakers may therefore wish to alter or relax these requirements to promote certain prosumer business models.

3.5.1 Small supplier license exemptions

Regulators can introduce derogations which shield small local energy suppliers from the full range of these costs, provided that these other functions are provided by a fully licenced supplier. In the UK small suppliers who provide <2.5MW can act as licence exempt suppliers and partner with a fully licenced supply to provide balancing and settlement.

3.5.2 Trade without licensed supplier

P2P models are predicated on removing energy suppliers as an intermediary between trading peers. However, traditionally EU market regulations necessitate that every consumer has a contract with a licenced supplier – known as the 'supplier hub' approach [7]. Under this arrangement, suppliers still have significant market power and typically allocate the network charges and imbalance costs paid on P2P trades. Advocates of P2P models therefore argue that the governance of electricity systems could become increasingly decentralised with prosumers providing these services directly to each other and to system operators, balancing the system in real time [21].

3.5.3 28-day supplier switching

The Clean Energy Package strengthens and extends the rights of consumers to switch supplier within 28 days. This key pillar of energy market liberalisation is the main way consumers can express preferences in the market and can defect from poor service or exploitation. However, the ability of all consumers to switch supplier mid-contract has negative effects on the types of energy business model they can select [22]. ESCOs cannot bundle financing for measures on energy contracts over long periods as these contracts are not portable between suppliers, meaning the finance arrangement has to be

[3] For the purposes of this document the UK is described as an EU member state as it currently complies with EU directives and until very recently was a member state

4 Germany prosumers partially pay these levies on self-consumed electricity, while in Spain this practice is now abolished.

attached to the property adding complexity and limiting growth. The ability to switch between supplier complicates the business model for private wire networks and can undermine the business case for a scheme. Local energy tariffs, that rely on longer term behaviour change and relationship building, are also difficult to build while the risk of consumer defection remains.

3.6 Market Access

The shift towards decentralised and prosumer-led energy systems challenges the traditional supplier-consumer relationship. This change creates the demand for new relationships and markets and necessitates market access for non-traditional actors.

3.6.1 Access to balancing and flexibility markets

These markets are critical for system stability and 'keeping the lights on'. Historically, these services were orchestrated directly by system operators, although since liberalisation these markets are still dominated by large thermal generators. Fair and transparent access to these markets for small-scale flexibility – including the use of aggregators – is critical for many prosumer business models. Essential elements for this transition include: the presence of a market; access for aggregators and pooled resources; transparency and simplicity in the qualification process (i.e. reducing barriers to entry); and, governance rules which facilitate interoperability and novel participants [9].

3.6.2 Distribution System Operator (DSO) flexibility markets

Traditionally, DSOs have managed the distribution network, with system balancing and control activities left to the Transmission System Operators (TSOs). However, there is increasing interest in DSOs actively manging systems with increasingly decentralised generation [23,24]. This includes warehousing smart meter data, active control of distributed energy and demand response as well as increased responsibility for system balancing [25]. This is often characterised as the move from distribution 'network' to 'system' operators and is a key market for business models which enable flexibility.

3.6.3 Multiple electricity suppliers

There may be instances where energy customers may have multiple contractual arrangements, such as with a local energy company, a flexibility aggregator, or an EV company procuring V2G services. Currently, the 'supplier hub' model necessitates a single electricity supplier to co-ordinate all of these transactions. However, some regulators (such as Ofgem/Elexon in the UK) are enabling multiple suppliers to provide these elements separately under a single meter [26]. Such arrangement would in effect allow the layering of multiple business models and transactions between unlicensed parties.

4. Regulations & the economics of prosumer business models in EU member states

The Renewable Energy Directive (Directive (EU) 2018/2001) (RED II), and the recast Electricity Market Directive (Directive (EU) 2019/944) (EMD), support moves towards a European 'Energy Union' where regulatory regimes across member states are increasingly rationalised and integrated. However, the *status quo* remains fragmented, with different nations taking very different approaches to the policy areas outlined above. Indeed, many of these issues are shaped by context-specific and legacy factors, which may prove very difficult to disentangle and unify – if this is the policy goal. These policy areas, arranged by the member states represented in the PROSEU consortium, are illustrated in Table 1. The table indicates the extent to which each policy is *present, partially present,* or *absent* as drawn from data in the SmartEn Network Tariffs and Taxes [8] and European Balancing Markets [9] report, and other primary [2,3,27] and secondary data sources.

Table 1 shows that the regulatory picture across the EU remains extremely diverse. Some member states such as Croatia have multiple active Incentive Schemes, whilst others like the UK have largely removed them. Equally, Network Charging also shows significant diversity with some member states such as Germany having a traditional system of fixed and volumetric charging, whilst others like France moving towards capacity and dynamic charging regimes. The complex situation for Taxes and Charges highlights nationally divergent fiscal policies, while Supplier Licencing is more homogenous – reflecting EU electricity market liberalisation policies. Finally, the Market Access dimension shows how certain flexibility markets like Spain and Portugal remain fairly closed - especially to non-traditional participants – while others like the UK are opening to new sources and providers of flexibility. However, it should be noted that as the CEP is transposed into national regulations, this picture will continue to evolve - potentially towards a more harmonised position.

Building on this analysis, in Table 2 we outline the potential impact of these policy areas on the prosumer business models introduced in Section 2. We have also compared the impact of a reference 'Non Prosumer' scenario – to reflect the impact of each policy on the overall electricity costs of traditional energy bill payers. Here we have chosen to focus only on the policies' impact on the economic viability of each business model. We have therefore chosen to exclude broader impacts on carbon emissions, energy poverty, energy democracy, local economic development etc. These broader normative goals are explored in more detail in Section 5.

Table 2 highlights how FiT and Net Metering Incentive Schemes benefit the Basic Prosumer Model, whilst increasing costs for Non-Prosumers as well as reducing the rationale for prosumer models which trade energy on public grids. The rollout of smart infrastructure is likely to beneficial for most models, although depending on how they're funded may increase costs for traditional consumers. Volumetric network charges can be avoided by models which incentivise self-consumption, passing these costs to Non-Prosumers as well as hindering models which incentivise dynamic grid usage. High levels of fixed charges are shown to be harmful, while capacity based and locational marginal network charging are shown to beneficial in the majority of cases. Avoided taxes and levies are shown to be beneficial for most prosumer business models, although risk passing an increasing share of these costs onto traditional consumers. Supplier Licence exemptions through derogations and sandboxes can be an important tool to enable prosumer business models, although a radical departure from supplier codes and licencing to enable true P2P business models could harm conventional consumers.

Table 1 Prosumer energy market regulations across PROSEU partner member states

Policy Area	Policy	Belgium	Croatia	France	Germany	Italy	Netherlands	Portugal	Spain	United Kingdom
Incentive Schemes	Feed in Tariff									
	Net Metering									
	Export Guarantees									
	Grants/Tax exemptions on hardware/installation									
Smart Infrastructure	Smart Meter Rollout									
	Smart EV Charging									
Network Charges	Volumetric network charges									
	Fixed network charges									
	Capacity based network charges									
	Locational marginal network charging									
Taxes and levies	Reduced VAT on energy									
	Tax, levy and charge exemptions									
Supplier Licenses	Small supplier licence exemption									
	Trade without licensed supplier									
	28-day supplier switching									
Market Access	Access to balancing and flexibility markets									
	DSO flexibility markets									
	Multiple electricity suppliers									

Policy present Partially present Policy absent

Table 2 The impact of energy market regulations on the economics of prosumer business models

Policy Area	Policy	Non Prosumer	Basic Prosumer	Micro-grid	Communal self-consumption	Local Energy Tariff	P2P Trading	ESCO	Flexibility Aggregator	V2G
Incentive Schemes	Feed in Tariff									
	Net Metering									
	Export Guarantees									
	Grants/Tax exemptions on hardware/installation									
Smart Infrastructure	Smart Meter Rollout									
	Smart EV Charging									
Network Charges	Volumetric network charges									
	Fixed network charges									
	Capacity based network charges									
	Locational marginal network charging									
Taxes and levies	Reduced VAT on energy									
	Tax, levy and charge exemptions									
Supplier Licenses	Small supplier licence exemption									
	Trade without licensed supplier									
	28-day supplier switching									
Market Access	Access to balancing and flexibility markets									
	DSO flexibility markets									
	Multiple electricity suppliers									

Improves economics Neutral impact Worsens economics

5. Policy pathways for prosumer business models

Despite the regulatory factors identified in the previous section, in many cases these business models are already technically viable and indeed may offer an economic advantage over traditional energy supply contracts. Yet, as generous incentives are increasingly reduced, the limited adoption and penetration of novel prosumer business models suggests simple regulatory fixes may be insufficient to see their widespread adoption. Thus, it may not simply be a matter of 'levelling the playing field' in a market dominated by multinational energy suppliers. Instead, policymakers may need to actively shape and nurture these markets through explicit recognition of the social, economic and environmental benefits to households, business and communities that a prosumer led energy system might present.

Consequently, policymakers may incentivise prosumer business models to address broader issues of energy poverty, justice and democracy, social inclusion, local economic development and environmental protection. In this section we build on the regulatory dimensions identified in Section 3 to outline policy pathways which can enable prosumer business models to scale up and deliver on these wider normative objectives. These pathways are focused on three key distinct groups of *community, municipal* and *market* actors likely to play a part in a prosumer led energy transition.

5.1 Community actors

Community actors are increasingly central in the development, governance and ownership of decentralised energy systems. By empowering local cooperatives, social enterprises, citizen collectives etc., policymakers can facilitate democratic engagement, increase local legitimacy and distribute ownership of energy systems. Below we outline some specific areas where policymakers can support community actors in developing prosumer business models:

- In several member states the legal and administrative barriers to community energy are high [10]. Policymakers should reduce these barriers and provide dedicated grant programs to support communities in the early stages of project development and planning
- Community energy projects create social value and local economic development - often missed in traditional cost benefit analysis [28]. This value should be explicitly recognised in planning legislation and through ringfenced access to wholesale market auctions, flexibility markets and minimum equity % shares in local renewable energy projects [29]
- Community groups could therefore be guaranteed participation in flexibility markets such as those being proposed for DSOs, enabling them to partner in complex business models such as domestic aggregators, virtual power plants and V2G approaches – where they may otherwise be crowded out by more powerful market actors [30]
- Equally, policymakers can promote communal self-consumption through virtual private networks which allow self-consumption on the public network. These models can be explicitly designed to avoid/refund network charges and taxes for projects have are under community/not for profit ownership – as is the case in the Netherlands. Further, local energy tariffs and P2P models can be supported through dynamic network tariffs which recognise the local provenance of electricity produced from community owned assets [18]
- Finally, policymakers may wish to support community led initiatives through special FITs or other incentive schemes that provide financial support to certain types of organisation or project that deliver social value or have a not for profit status

5.2 Municipal actors

Municipal and local authorities may also play important roles in decentralised energy systems. Municipalities often own and manage a significant building and housing stock, and typically have a

remit for the health, prosperity and wellbeing of their citizenry. This makes them ideally placed to address the related concerns of energy poverty, building performance, heat and transport decarbonisation – typically beyond the purview of private energy suppliers. However, few are sufficiently resourced to do so. Below we outline some specific areas where policymakers can support municipal actors in developing prosumer business models:

- The centralisation of energy policy and planning in many member states, has often been exacerbated by EU directives. Greater devolution to the city/regional level [31] would allow regulations, incentives and decisions to be tailored to local needs and be more democratically accountable [32]
- Allowing and encouraging municipalities to purchase distribution network assets - as in German 'Stadtwerke' approach [33] – could enable municipal network operators to implement the DSO flexibility markets, dynamic network charges, and smart infrastructure which are critical enablers of many business models in this report
- Equally, municipalities can engage in energy supply, or partner with community owned companies -facilitating prosumer energy markets - potentially on more favourable terms than with corporate suppliers [34]. National and local governments can encourage municipal energy companies to be created, including using the municipal energy company as the default supplier [8] for inactive or 'sticky' customers
- Further, municipalities may play a key role in reducing energy poverty. Grant schemes can provide PV panels, energy efficiency, smart heating and control systems to disadvantaged groups who otherwise could not afford to become prosumers
- Municipal ESCOs, such as in the Energiesprong initiative are bundling multiple energy vectors into service agreements for social housing tenants. Although Dutch policymakers have removed some barriers to these 'energy as a service models' [1], requirements for 28 day switching hamper long term contracts which bundle energy supply with retrofit financing [22]. Further, performance based compliance for planning/building regulations would incentivise energy performance contracts - reducing the ~20% gap in measured vs. modelled energy efficiency in new build housing [35]
- Finally, member states can modify the fiscal and fiduciary constraints of local governments, enabling municipalities to borrow for investment through municipal bonds [36] - developing finance mechanisms to deliver low cost patient capital for the business models outlined above

5.3 Market actors

Advocates of increasing marketisation of energy system through prosumer business models, point to the efficiency and customer empowerment potential of P2P and aggregator models. This may see a diminishing role for traditional energy suppliers and the opening up of energy markets to proactive prosumers who use blockchains and sophisticated algorithms to participate in decentralised markets with multiple sources of generation and flexibility. Below we outline some specific areas where policymakers can support market actors in developing prosumer business models:

- Although 'market' actors dominate most EU energy regimes, in most cases markets are controlled by a small oligopoly of incumbents who have little incentive to facilitate prosumer business models. This means that new market entrants – especially those with radical business models – may struggle to disrupt heavily regulated markets originally designed for a centralised system
- Prosumer flexibility is key to enabling renewable and decentralised energy systems. However, prosumer business models often cannot fully valorise this flexibility - through aggregators or platforms - due to market access barriers [37]. System operators should therefore re-design these markets to be open and accessible to new market entrants and aggregated small scale flexibility including from EVs [9]

- P2P and transactive business models face a range of barriers relating to data protection surrounding blockchain transactions [38], interoperability issues (especially around metering and charging infrastructure [7]) , and the requirement for transactions to be managed by a single energy supplier [21]. Regulatory sandboxes and derogations can therefore be a key means of trailing new governance arrangements with a view to eventual mainstream adoption [39]
- Smart metering and EV charging infrastructure is an essential pre-requisite for most prosumer business models – especially those involving dynamic tariffs and prosumer flexibility. These models also involve an ecosystem of renewable hardware, digital platforms, metering and monitoring infrastructure and IoT enabled devices. EU and national policymakers have a core role to play in ensuring these emerging supply chains are effectively regulated and accompanied with appropriate product and installation standards

6. Conclusions & policy recommendations

This report first outlined eight 'families' of prosumer business model operating in the EU: Basic Prosumers; Micro-grids: Communal Self Consumption; Local Energy tariffs; Peer-to-Peer (P2P) Trading; Energy Service Contracts; Domestic Aggregator & Vehicle To (V2G). Subsequently, we introduced a range of energy market regulations that implicate prosumer business models including: incentive schemes; smart infrastructure; network charging; taxes and levies; supplier codes & licencing and market access. We then illustrated where these polices are present, partially present, or absent across the nine member states of the PROSEU project. Subsequently, we identified how policy options to promote the adoption of prosumer business models may achieve broader social, economic and environmental policy objectives. These findings suggest that the implementation of regulatory reforms in specific member states as well as at the EU commission level could make these new business models increasingly viable across the EU. These recommendations are summarised below:

Incentive Schemes

Incentive schemes such as FITs and Net Metering have played an important role in the early adoption of prosumerism. As markets mature and the levelized costs of DES approach grid parity, these schemes should increasingly be designed to reflect the true value of power exported to the gird. Incentives which blunt the impact of temporal price signals and flexibility– such as Net Metering – should be reconsidered in favour of Export Guarantees with a dynamic and cost reflective design. Further, policymakers can maintain higher levels of these incentives for specific groups and governance approaches – such as the energy poor or energy communities – recognising the social value they create.

Smart Infrastructure

The rollout of smart metering and EV chargers is an essential pre-requisite of many of the business models in this report. Levels of smart meter rollout vary significantly across member states and there are often concerns over their suitability and interoperability. EV chargers, (especially V2G enabled) are less diffused and face even greater issues surrounding lock-in and interoperability. Nations with successful rollouts of smart meters have tended to have a central role for public institutions & DSOs – such as in Spain – whereas nations with slower rollout – such as the UK have taken a more market led approach. Non-EU member states such as Norway have also seen impressive growth in EVs through a program of publicly funded EV charging infrastructure, although many of these are not V2G enabled.

Network Charges

Network charging regimes play a critical role for prosumer business models. Achieving a balance between rewarding prosumers and protecting traditional consumers whilst paying for networks is crucial. Our

analysis suggests that a shift away from fixed and volumetric charging regimes towards those based on capacity, location and temporal factors is a critical step in developing a decentralised energy networks. As smart infrastructure diffuses DSOs and regulators should look to reward local energy markets for smart use of the networks through cost reflective network charging or allow communal self-consumption through virtual private networks.

Taxes and levies

The burden of taxes and levies from government energy programs has historically fallen on energy and especially electricity bills. This blunts the impact of price signals from wholesale and flexibility markets [9] and has tended to make fossil heat sources artificially cheap, when compared to electricity [20]. By shifting more of these costs onto heat supply or general taxation, policymakers can incentivise greater flexibility and significantly improve the business case of electrified heat and transport. Policymakers can also allow certain groups or business models to avoid some or all of these charges as a means of rewarding the additional value they create – as in the Netherlands.

Supplier Codes & Licenses

For the wider energy market, mandatory 28 day supplier switching is compatible with the goals of the Clean Energy Package. For prosumer business models, the opportunity to relax these rules should be explored, especially where consumers participating in an innovative business model can be protected by recourse to a tariff cap. Equally, increasing involvement of smaller local actors can be encouraged through supply licence exemptions which allow these actors to perform part of the role of traditional suppliers whilst focussing on other forms of value such as energy poverty alleviation. Further, local energy markets and P2P trading can be incentivised by reducing the requirement for energy suppliers involvement in mediating these transactions and payments. Experimenting with relaxing these requirements for new prosumer business models across the Union is therefore likely to expand citizens choices on how they engage with the energy transition rather than narrow them.

Market Access

In most member states prosumers and aggregator business models face significant barriers to accessing wholesale, balancing and flexibility markets. In many cases these markets need to be fundamentally re-designed for a future where small distributed energy sources and storage may eventually provide the majority of this flexibility. Following the UK's early moves in this direction, regulators should hasten the move towards DSO flexibility markets as a key new means of balancing the system at the local scale. Finally, opening up energy supply contracts to multiple suppliers through a single meter can enable the increasing diversity and specialisation with the potential for multiple business models i.e. local energy markets, flexibility aggregators and V2G to operate in parallel for a single prosumer.

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