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Business model innovation in electricity supply markets: The role of complex value in the United Kingdom

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HIGHLIGHTS

- Business models of energy supply markets shape energy transitions.
- The British system misses four opportunities of local electricity supply.
- Nine new business model archetypes of local supply are analysed.
- New electricity business models have complex value propositions.
- A process for policy response to business model innovation is presented.

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ABSTRACT

This research investigates the new opportunities that business model innovations are creating in electricity supply markets at the sub-national scale. These local supply business models can offer significant benefits to the electricity system, but also generate economic, social, and environmental values that are not well accounted for in current policy or regulation. This paper uses the UK electricity supply market to investigate new business models which rely on more complex value propositions than the incumbent utility model. Nine archetypal local supply business models are identified and their value propositions, value capture methods, and barriers to market entry are analysed. This analysis defines 'complex value' as a key concept in understanding business model innovation in the energy sector. The process of complex value identification poses a challenge to energy researchers, commercial firms and policymakers in liberalised markets; to investigate the opportunities for system efficiency and diverse outcomes that new supplier business models can offer to the electricity system.

1. Introduction

To achieve energy transitions, technological and business model innovation must co-evolve with policy and system regulation (Foxon, 2011). However, much of the literature on technical and business model innovation neglects the retail or 'supply' element of the energy value chain. In liberalised markets the dominant supply business model has been the corporate utility, selling units of energy to consumers in national markets (Hannon et al., 2013). Very little has been done by the energy research community to examine challenges to this dominant supply model, or the national scale at which it operates. Supply business models on smaller scales (from city-region to neighbourhood) have the potential to: expand the penetration of renewable energy, accelerate demand management, drive energy efficiency, and re-localise energy value. However, there has been no systematic analysis of the business models that can realise these opportunities, or understanding of why they remain uncommon in liberalised markets. Electricity supply business models that are designed to operate sub-nationally, pose a number of challenges to policymakers, regulators, and mainstream utilities.

This paper is structured as follows: Section 2 describes the literatures on business model innovation in the energy sector, focussing on the *value proposition* and *value capture* elements of the business model concept to frame four research questions. Section 3 describes the study methodology. Section 4 presents our results. Section 5 considers how the notion of 'complex value' is useful in understanding these business model innovations and describes how a complex value framing poses new questions for energy policy. Section 6 concludes with recommendations for policymakers across liberalised markets.

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We define 'Local Supply' as:

Local supply is the operation of an organisational form with either the legal ability, or in partnership with another agency with that ability, to supply electricity to commercial and domestic consumers predominantly within a single distribution network region or group of regions at the sub-national scale.

2. Literature review

This review is split into two parts. The first reviews the literatures on business model innovation in energy systems. The second identifies how the incumbent utility business model often misses opportunities to solve the energy trilemma; the provision of secure, affordable, low-carbon energy.

2.1. Business models and energy systems

A business model describes the benefit an enterprise will deliver to customers, how it will do so, and how it will capture a portion of the value it delivers (Teece, 2010; Chesbrough and Rosenbloom, 2002). Determining how to deliver benefits *and* capture value is key to designing business models (Teece, 2010; Boons and Lüdeke-Freund, 2013). Osterwalder and Pigneur (2010) describe nine 'building blocks' of a business model: key partners, key activities, key resources, customer **value proposition**, customer relationships, channels, customer segments, cost structure and revenue stream (equivalent to **value capture**).

Business model innovation is often broken into technological, organisational, and strategically driven categories (Boons and Lüdeke-Freund, 2013). Bocken et al. (2014) use these categories to further refine eight *generic* sustainability **value propositions**[1]. Of these eight, the most relevant to this research are those which: maximise material and energy efficiency; Substitute [fossil fuels] with renewables and natural processes; Encourage sufficiency (including demand management); and Re-purpose the business for society/ environment. To understand the policy implications of business model innovation in energy markets, system specific accounts are needed, which link the sustainable business model innovation literature to empirical cases. Business model innovation research in the energy field has focused on the deployment of specific *technologies* in the energy value chain such as: storage (He et al., 2011; Taylor et al. 2013), solar generation (Huijben and Verbong, 2013) and electric vehicle charging (San Román et al., 2011). These are useful contributions to our understanding of how new technologies can enable new entrants to compete with incumbent firms. Other research analyses how technology choice and business model design are iterative, and how revenue capture methods and business model design are interdependent (Kley et al., 2011; Okkonen and Suhonen, 2010). These contributions also demonstrate the relevance of business model research to the energy policy community, as they analyse where business model innovations can have both productive and disruptive effects across energy markets (Channell et al., 2013; Richter, 2011,2013).

However, the potential for business model innovation in electricity supply markets, the retail end of the value chain, is less well understood. The traditional energy supply business model operates a relatively simple value proposition; national utilities rely on increasing kWh units sold (relative to costs) to remain profitable (Blyth et al., 2014a, 2014b; Hannon et al., 2013). Both the national focus and the reliance on increasing unit sales affect the ability of new entrants to compete in or join the market (Hall and Roelich, 2015). The business model built on unit volume drives the whole energy value chain to increase throughput, locking system users into unsustainable practices (Unruh, 2002; Apajalahti et al., 2015; Roelich et al., 2015).

Despite the importance of business models in shaping the system, research into energy retail/supply markets tends to be limited to three categories: the drivers for consumer switching (Yang, 2014; Annala et al., 2013), the barriers to market entry (Littlechild, 2005), or the effect of market competition on final prices (Lehto, 2011; Defeuilley, 2009). The business models of these supply entities have received little attention, even as the notion of the business model as a critical element of system innovation is becoming an established concept (Zott et al., 2011; Chesbrough, 2010). There is a small but growing literature on the effect of supplier business models on whole energy systems (see: Hannon et al., 2013; Richter, 2011, 2013; Sousa et al., 2013; Apajalahti et al., 2015; and Littlechild, 2005). These contributions question the compatibility of current throughput-based models with solving the trilemma of secure, low carbon, and affordable energy (Sousa et al., 2013; Hannon et al., 2013). For the throughput-based utility model, reduction in final demand undermines revenues. Many tariffs also encourage higher usage by charging less for consumption over a certain threshold. As such, the mainstream utility model cannot reasonably pursue transformative energy efficiency without undermining its core value proposition. Furthermore, many of the value propositions from demand reduction accrue to those outside the energy system. This adds to business model complexity because in order to monetise these values revenue sharing across sectors becomes necessary.Energy Service Companies, or 'ESCos' are more likely to incentivise substantive efficiency (Fang et al., 2012; Roelich et al. 2015; Hannon et al., 2013). ESCos provide energy services (e.g. a warm home, efficient appliances/illumination) rather than supply energy by the unit. Revenues are drawn from providing these services for the fewest units possible, thus incentivising energy efficiency. However ESCos are only one possible business model innovation. This research contributes to the business model innovation field by analysing a suite of new business model archetypes in electricity supply markets. These archetypes transcend the national focus of the traditional utility, and create space for more geographically bound supplier models.

What is clear from the business model innovation literature is the need to be clear about **value proposition** and **value capture**. This is important to energy business models because they can deliver multiple benefits beyond the energy customer; to the energy system itself, such a demand-side management reducing the need to reinforce networks (Hall and Foxon, 2014), and to the wider economy, such as public health benefits associated with fuel poverty alleviation (International Energy Agency, 2014). This makes business model development more challenging; monitoring benefits accrued to different actors, and capturing value from these different actors to compensate the enterprise can be difficult.

Recent advances in technology, such as smart meters and energy management systems, help to overcome the problems associated with capturing complex values. Technological and business model innovations are iterative, smarter systems pave the way for innovation in 'complex value business models'. Complex value being defined by the authors as: the production of financial, developmental, social and environmental benefits which accrue to different parties, across multiple spaces and times, and through several systems. Business models with complex value propositions

[1] Maximise material and energy efficiency; Create value from 'waste'; Substitute with renewables and natural processes; Deliver functionality rather than ownership; Adopt a stewardship role; Encourage sufficiency; Re-purpose the business for society/ environment; and develop scale-up solutions. (Bocken et al., 2014 p.48).

Table 1
Outcomes/motivations of local actors.

Area	Outcomes/motivations	Example evidence
Economic	Competitiveness and economic growth	Core Cities (2013), Gouldson et al. (2012, 2014).
	Job creation	Heinbach et al. (2014), Blyth et al. (2014a, 2014b).
	Revenue generation	Busch and McCormick (2014), Bristol City Council (2015).
Social	Fuel poverty reduction	Bale et al. (2014), Roelich and Bale (2014), Seyfang et al. (2013), Bale et al. (2012), Hannon and Bolton (2015).
	Regeneration	Aiken et al. (2009), Webb and Hawkey (2013).
	Skills and education	Blyth et al. (2014a, 2014b), Haggett et al. (2013), Gubbins (2010).
	Social cohesion	Seyfang et al. (2013), Walker et al. (2007).
	Fairness e.g. tariff discrepancy	Seyfang et al. (2013), Lehto (2011).
Environmental	Carbon emissions reduction	Fang and Miller (2013), Foxon (2013), Barton et al. (2013), Gouldson et al. (2014), Hannon and Bolton (2015).
	Air quality	Bale et al. (2012), Bulkeley and Betsill (2003).
Self-governance or self determination	Local accountability & control	Callaghan and Williams (2014), Seyfang et al. (2013).
	Energy independence	RTP Engine Room (2015), Hall et al. (2015).

must effectively capture several value streams across various systems in order to remain viable (also see Foxon et al., 2015). Before investigating complex value business models, it is important to understand why these value propositions remain uncaptured.

2.2. Value propositions as missed opportunities, the local level in energy supply

The emergence of smart technologies and distributed generation create additional value propositions that may be best captured by local supply enterprises; such as demand response, and smart loads (Pudjianto et al., 2013; Ceseña et al., 2015; Oren, 2013; Palensky and Dietrich, 2011). Increasing diversity of local generation and consumption patterns suggests local balancing could more efficiently optimise supply and demand within regions (Foxon, 2013; Cornwall Energy, 2014), and could complement/run in parallel to national balancing (Elexon, 2014). However, many contemporary electricity systems are based on 'top down' control (Mitchell, 2008), directing energy from centralised generation to meet demand at any point (Lockwood, 2014). Regulation and trading systems follow this centralised model. Energy trading arrangements assume organisations manage their physical position and achieve contracted balance nationally (Elexon, 2014). This research investigates the UK electricity supply market, which is dominated by the 'Big Six' major suppliers; utilities with throughput-based business models, accounting for circa 92.5% of domestic (Cornwall Energy, 2014b) and 80% of commercial supply (Ofgem, 2014). In 2013, there were 24 licensed supply companies offering electricity and/or gas supply to households and 30 companies offering electricity and/or gas supply to commercial consumers (Moss and Buckley, 2014). There is diversification in the UK supply market comprising a number of low-carbon energy suppliers, a co-operative supplier, a municipal supplier and a private supplier offering local white labelling. However this supply market structure is still operated at a national level, and the licences and industry codes mandate fully licensed suppliers to be party to the national Balancing and Settlement Code (BSC), and to offer services to all customers regardless of geography. The majority of new entrants are operating the national kWh unit volume model. The domestic supply market remains uncompetitive, with poor outcomes being realised by householders and SMEs (Competition and Markets Authority, 2015; Ofgem, 2014).

In response to these poor consumer outcomes, and to low civic participation in all parts of the energy system, there has been a search for business model innovation in the supplier market (Department of Energy and Climate Change, 2014; Ofgem, 2015; Platt et al., 2014; RTP Engine Room, 2015). Throughout the research the majority of interest in local supply market innovation did not come from private firms, but was from new actors in the supply space, including community groups, social enterprises and municipalities, which we refer to as 'local actors'. Bale et al., (2012) and Hannon and Bolton (2015) have shown that the convening power of these actors, in particular local government, can catalyse local energy programmes. There is potential for local actors to engage with all parts of the energy system, including generation, distribution, supply and demand reduction, but in the supply market non-corporate participation has been very low (Core Cities, 2013; DECC, 2014).

The motivations of local actors seeking to enter the energy supply market are diverse; Table 1 presents an analysis of motivations for engagement in local energy reported by local authorities and community groups (also see Roelich and Bale, 2014; Seyfang et al., 2013). Table 1 also identifies a growing evidence base that suggests pursuing these outcomes through the energy system is realistic.

A significant proportion of local supply actors are motivated by reasons beyond private returns. They are pursuing a mix of the outcomes/motivations categorised in Table 1. This is important because it impacts on the business models being pursued in the local supply space. The notion of complex value outlined in Section 2.1 is demonstrated by the different outcomes local supply actors seek to secure. This research links these outcomes to specific **value propositions**, and the **value capture** methods they require.

This review has highlighted business models in the energy supply space as important to system transitions, and an understanding of value proposition and capture as central to this research. The notion of complex value was proposed to explore the multiple system benefits and socio-environmental outcomes the adoption of innovative business models can bestow. This leads us to four research questions: (1) What opportunities or 'value propositions' are missed by a purely national supply market? (2) What are the business models needed to capture value from these value propositions? (3) What are the barriers constraining these business model innovations in the supply market? (4) How can understanding complex value business models contribute to energy policy?

3. Methodology

To answer these questions the research team utilised four methods. Firstly, a review of the academic and grey literatures on local energy opportunities was undertaken. Secondly, 12 semi-structured interviews were conducted with actors from across the local supply space comprising: six local authority interviews with five officers active in either setting up new supply structures or in municipal energy more widely, two CEOs of companies using local supply models, two innovation managers at distribution network companies, one provider of 'license in a box' services and one interview with three officers of the regulator. Thirdly, five expert members of the UK's Local Supply Working Group completed qualitative questionnaires describing archetypes of local supply in the UK, including their barriers to implementation. Finally, an intensive session of 15 focus groups was conducted at a Local Supply Workshop in February 2015, facilitated by the UK's Department for Energy and Climate Change and The Cabinet Office. This workshop ran five focus groups in three parallel sessions on: the future of local supply, experiences of local supply, and strategic options for local supply. Focus groups included 48 individuals: 16 representing private companies, 4 representing government agencies and 28 representing civil society organisations active in or investigating the local supply space. This multi-method approach generated: in-depth data on the motivations of local supply actors, a suite of archetypes (business models) of local supply, with various theorised benefits, and an analysis of the barriers that these archetypes face.

4. Results

4.1. Q1: What value propositions are missed by a purely national supply market?

this research identified a range of opportunities that are being missed by incumbent utilities. This section analyses how these missed opportunities represent **value propositions,** and why they go uncaptured by incumbent suppliers. The relationship between outcomes, actor motivations and value propositions has not always been clear, but it is important:

> "….if we can start with motivational scale then we can start to really get down to the segmentation, we can get down to the routes to market"

(Officer of the regulator, 2015)

The review of grey literatures was used with iterative investigation in the semi structured interviews to determine exactly what **value propositions** were being pursued, and why the national utility business model is incompatible with exploiting them. These are based on the UK context, though many will be relevant to other countries with liberalised energy markets. These opportunities and their associated value propositions are summarised below:

4.1.1. Opportunity #1: better routes to market for local generation

The current route to market for most distributed generation in the UK is through Power Purchase Agreements (PPAs) with a Third Party Licensed Supplier (TPLS) or market trader. There are routes to market for small scale generation that include exemptions from supply and distribution licensing and options for unlicensed supply (Ofgem, 2014a). However, these are for small-scale schemes and outside the scope of this research[2]. There are concerns that small to medium scale (up to 50 MW) schemes face unfavourable conditions in the wholesale market (Department of Energy and Climate Change, 2012). The price generators receive in their PPAs have been steadily declining, leading some to predict small, intermittent generators will be unable to secure fair deals for the power they produce (DECC, 2012). Also, where price support is rationed through an auction system, negotiation and financial modelling expertise are required alongside risk capital, which may block smaller schemes (Cornwall Energy, 2012). One expert member of the DECC Local Supply Working Group noted in written submission: *"In exploring community energy participation in local markets, we have been overwhelmed with interest from communities wanting to get a **better value from their own generation**…."*

Interviewees suggested that local suppliers could offer better PPA terms to independent generators because they are less concerned with overhead costs and intermittency. Further, they are more likely to ensure the generators' PPAs realise the full embedded benefits available (derived from the avoidance of various network and other charges), pass on more value from Renewable Obligation Certificates (which accrue to the retailer), and would avoid unnecessary charges being incorporated into poor PPA offers. Respondents in the Local Supply Working Group submissions felt new local supply structures would: *"put downward pressure on larger utilities to offer more favourable terms to community projects"*

Here, the value proposition is the reduction of overheads from national energy trading, reducing the cost of wholesale electricity and passing through additional revenue to local generation. Another value proposition for policymakers is the potential to accelerate the deployment of renewable technologies and thus accelerate system decarbonisation.

4.1.2. Opportunity #2: Fulfilling the potential of the demand side

Local supply business models could play an important role in balancing generation and demand at a local level, which could, in turn, make an important contribution to balancing at the national scale. Interviewees recognised the importance of connecting generation and demand at the local level when implementing demand-side measures: "*Yes, you'd never separate the two… If the government go ahead with just demand reduction projects …that's going to stimulate that particular market phenomenally I guess. We're looking at … demand reduction projects there in terms of small cuts and balancing" (*Local Authority Officer, 2014*).*

When generation and consumption of electricity are considered at the local scale, a number of potential value propositions result from better matching of generation and demand. These value propositions fall into two sub-fields: demand side response and participation, and time of use tariffs.

4.1.3. Demand side response and participation

Demand side response and participation (DSR/P) refers to the ability of a number of consumers to reduce their electrical consumption in response to signals from suppliers or network/system operators. Often demand *response* is thought of in terms of hard-wired, third party manipulation of a consumer's load and *participation* refers to customers scheduling demand differently. DSR/P can provide benefits to:

- suppliers, as a real time service to avoid balancing mechanism charges,
- distribution and transmission network operators for network constraint and fault management, or to defer/eliminate reinforcement expenditure,
- the system operator to use as operating reserves.

(See: Energy Networks Association, 2014; Ofgem Smart Grid Forum, 2014).

[2] See Hall and Roelich (2015) Page 22 'Existing Exemptions and Unlicensed Supply'

Each of these benefits represents potential value propositions and can be monetised and in some cases consumers are compensated. Crucially, they require a connection between generation and demand, a role that can be played by suppliers. However, the compensation of consumers can be problematic because the creation of benefit to one party could pose a problem to another. For example, if a Distribution Network Operator (DNO) was experiencing network stress on a sunny, windy day they may wish to access DSR/P in real time, yet if this were widely taken up this may affect the supplier position after gate closure[3]. Furthermore, the transaction costs associated with monitoring and verification of additional benefits are high and the distribution and supply function are legally separated in the UK. This makes it difficult to capture meaningful value from DSR/P for individual domestic customers.

Domestic aggregation projects have been attempted, but this requires complex business models, intentionally designed to avoid interfacing with national suppliers (Scottish Power Energy Networks, 2013). Technological innovation in smart metering offers new ways of aggregating customers with small demand by undertaking community level engagement to deliver load shifting, however all of these benefits are currently unable to be accessed by all domestic consumers. Many of these value propositions could be exploited if new local supply and/or aggregator business models could engage with the domestic, SME *and* larger commercial customers.

4.1.4. Time of use tariffs

The roll out of smart meters will enable time-of-use tariffs. These tariffs encourage consumers to use electricity at times when renewable generation is plentiful or shift demand to less expensive, off-peak periods. However, impacts on customer bills may be mixed if no behaviour change is assumed; in isolation these tariffs would offer limited benefits to either customers or network operators. Additional benefits could accrue if the behaviour of customers with smart meters were aggregated through local business models (Energy Local, 2014). This aggregation could also help to overcome distributional impacts of time of use tariffs associated with the heterogeneity of energy consumption profiles (Centre for Sustainable Energy, 2014). Time-of-use pricing applied to a group of households could substantively shift the load profile of a community, which may enable more local renewables to be connected without conventional re-enforcement. However, as consumers may switch supplier, planning for aggregated time of use tariffs is difficult, unless there is a third party engaging with customers on a specific geography. Further, if these aggregated consumers were settled half hourly behind a 'virtual meter', loads could be matched to generation profiles of local intermittent sources and netted off against demand supplied by the national market (ibid).

Both DSR/P and time of use tariffs are proposed as important mechanisms to introduce flexibility into the electricity system (Department of Energy and Climate Change, 2012a; Ofgem, 2015a, Ofgem Smart Grid Forum, 2014). However, discussion of their potential is limited to application at the national scale, the potential for balancing at the local scale has not yet been realised (Ofgem, 2015a). The value propositions in the demand side therefore relate to using power at cheaper times of day, matching local generation profiles with local loads, and systems benefits to infrastructure providers.

4.1.5. Opportunity 3: real energy efficiency gains

Significant reductions in per capita energy demand are fundamental to addressing the energy trilemma. However, the UK is making poor progress on demand reduction (UKACE, 2013). Even those energy efficiency investments that have short pay-back periods are underexploited (Department of Energy and Climate Change, 2012b). Demand reduction can provide many additional benefits which can be turned into value propositions, including fuel poverty alleviation, energy security, lower public health spending and job creation (IEA, 2014). Furthermore, it could reduce the need to invest in new generation capacity and grid reinforcement.

This missed opportunity is a 'local' supply issue because focus group participants cited the local focus, institutional trust, and buildings stock expertise of municipalities as a key resource in engaging citizens in energy efficiency retrofit. To date however the local expertise of municipalities have been divorced from supplier business models and the value proposition of incumbent utilities, based on increasing unit volume, cannot accommodate substantive demand reductions.

4.1.6. Opportunity 4: re-localising energy value

A significant proportion of energy value 'leaks' out of UK city-regions due to the multi-national beneficial ownership of companies throughout the electricity value chain (Rutledge, 2012; Cumbers et al., 2013). New, local supply ownership structures are part of business model innovation (Ofgem, 2015). Respondents directly cited this value leakage as a key motivating factor in establishing local supply structures. This has become more important as recent research shows up to 10% of GVA 'leaks' out of the local economy through the energy bill (Gouldson et al., 2015), and that there are a number of opportunities to re-localise these values (Julian, 2014; Hall and Foxon, 2014; Britton and Woodman, 2014). The aspiration to re-localise this value is a key motivator for many stakeholders in the local supply sector. The values at stake in the energy system have attracted attention from economic development professionals across UK cities (Core Cities, 2013). One expert member of the Local Supply Working Group described the opportunity for municipalities to *"create financially viable and competitive business model*[s]*"* by taking a stake in the energy economy.

In answer to research question 1, the **value propositions** being missed in the local supply market are located within the four missed opportunities above. They include: better PPA agreements for generators, expansion of renewable energies, the benefits of time of use pricing and demand shifting, fuel poverty alleviation, public health benefits and retention of energy value. The question that follows is; what business models are needed to turn these value propositions into a value captured?

4.2. Q2: What are the business models needed to capture value from these value propositions?

these four opportunities present complex value propositions; some of which can be monetised. The authors have developed nine archetypes of local supply that characterise the complex value business models. These archetypes articulate how [local supply] business models turn value propositions into value capture methods. They allow policy makers to investigate how each business model would fit with the current system. Table 2 shows the theoretical ability of each archetype to secure each of the four opportunities of local supply defined in Section 4.1. The not for profit supplier discussed below is excluded from Table 2 as it is an enabler of other archetypes.

4.2.1. The current archetype: the corporate, national utility

Section 4.1 shows how the current archetype, the corporate national utility, makes little space for the growth of small to medium

[3] The point at which market trading ends and the system operator takes over (currently 1 h before actual consumption)

Table 2
Matching business model archetypes to opportunities/value propositions.

Archetypes	Enabling mechanisms	Opportunities/value propositions of local supply			
		Better routes to market for local generation	Fulfilling the potential of the demand side	Real energy efficiency gains	Re-localising energy value
Current archetype	Full supply license	– –	–	– –	– – –
Local white Labelling	Third party licensed Supplier partnership (TPLSP)	+	–	–	–/+
Local aggregator	TPLSP	+ +	+ + +	+	+
Local 'Pool and Sleeve'	License lite with TPLSP	+	–/+	–	+
Municipal utility	Full supply license	+ + +	+	– – –	+ +
Municipal ESCo	Full supply license	+ + +	+ +	+ + +	+ + +
MUSCo	Full supply license	+ + +	+ +	+ + +	+
Peer to peer	TPLSP	+ + +	-	–/+	+
Peer to peer with Local balancing Unit	TPLSP with local settlement unit	+ +	+ +	–/+	+ +

Key: – – – strongly negative effect, – – moderately negative, – weak negative, –/+ neutral or ambiguous effect, + weak positive, + + moderately positive, + + + strongly positive effect.

scale generators, disincentives local demand side services, is poorly matched with delivering household and SME energy efficiency goals[4] and does not retain value within the regions it serves. The current archetype is designed to provide cheap units of power to individual households and businesses and maintain a reliable supply. There is little potential to deliver additional value propositions to customers, the energy system or the wider economy. Large utilities constitute the bulk of generation and supply, and endeavour to match their generation profiles with their forecast demand; topping up from or selling into the wholesale market to tune their supply positions. Fig. 1

4.2.2. *Local white label archetype*

A white label provider is an organisation that does not hold a supply licence and instead partners with a Third Party Licensed Supplier (TPLS) to offer gas and/or electricity using its own brand. White labels are thought to engage energy customers through branded tariffs, better customer service and different sales channels (Ofgem, 2015b).

There is a difference between national white labels, which are motivated by capturing 'sticky' consumers, and local white labelling (See OVO Communities[5]) which can capture more of the value propositions covered in Section 4.1. Local white label offerings can serve as little as several thousand customers. In local white labelling, there is potential to link the local partner's supply to PPAs of local generators, which could contribute to growing local energy generation. Respondents argued that having local supply (through a local white label) enables a link to be made between local customers and local generation, allowing costs of local generation to be fed through to the local customer base. This means the white label partner can support local generation by buying its power, and can control costs along the supply chain. DSR/P is possible, but there are no examples of this to date, nor is re-localisation of energy value strongly signalled.

4.2.3. *The local aggregator archetype*

The local aggregator archetype (see Energy Local[6]) proposes half hourly metering for groups of domestic properties which would enable the matching of demand and local generation through DSR/P. A core part of the local aggregator archetype is the relationship between a Community Energy Services Company (CESCo) and a TPLS. This model would allow for the use of locally generated power without the need for community generators to obtain a full license, but relies on the participation of a TPLS. This archetype pools local generation, netting off local supply at a virtual meter point. This requires smart meter enabled energy management systems to support aggregation.

In this, and later archetypes, the distribution network operators and transmission system operators (DNO/TSO) are included, as the aggregator has the potential to contract DSR/P services that can be of use to these infrastructure providers. Capturing the value of these additional benefits requires bespoke contracting. Fig. 2

Under the local aggregator archetype there is significant opportunity to secure a better deal for local generation behind a virtual meter if this local production can be netted off against consumption at that scale. Here the CESCo[7] can decide how to allocate the benefits of being able to achieve a generation price closer to retail value. Further, this archetype is predominantly designed to enable automated DSR/P, moving the load curves of local consumers to periods when energy is relatively inexpensive. Theoretically, given the local community based focus, this model could also engage strongly in energy efficiency and retrofit but this has not been the focus of the archetype to date. As for the re-localisation of energy value, this depends on the beneficial ownership of the CESCo and generation assets.

4.2.4. *The local pool and sleeve archetype*

This archetype aggregates distributed generation from a local area (pooling) and then supplies a consumer or consumers within the same area with equivalent power, avoiding additional wholesale market intermediaries (sleeving); thus 'pool and sleeve'. This is a form of direct supply which 'License Lite' was introduced to facilitate. Licence Lite was introduced by Ofgem in 2009 to overcome market entry barriers experienced by distributed energy generators wanting to supply their energy to customers directly without incurring national balancing charges (Ofgem, 2014a). There is limited evidence to suggest that local pooling and sleeving would result in lower energy prices (Cornwall Energy, 2014). The main purpose of this archetype is to enable the direct supply of local generation to local consumers, which could encourage the growth of local energy generation. There has been no discussion to date of the role of local pooling and sleeving in demand reduction. Equally only weak potential for the re-localisation of energy value is seen beyond the growth of local generation.

[4] Though this business model does deliver some upstream efficiency in thermal generation.
[5] http://www.ovoenergy.com/energy-plans/communities/
[6] http://www.energylocal.co.uk/
[7] The definition of the community energy service company differs from the service oriented business model assumed for 'ESCos' and is as yet unclear.

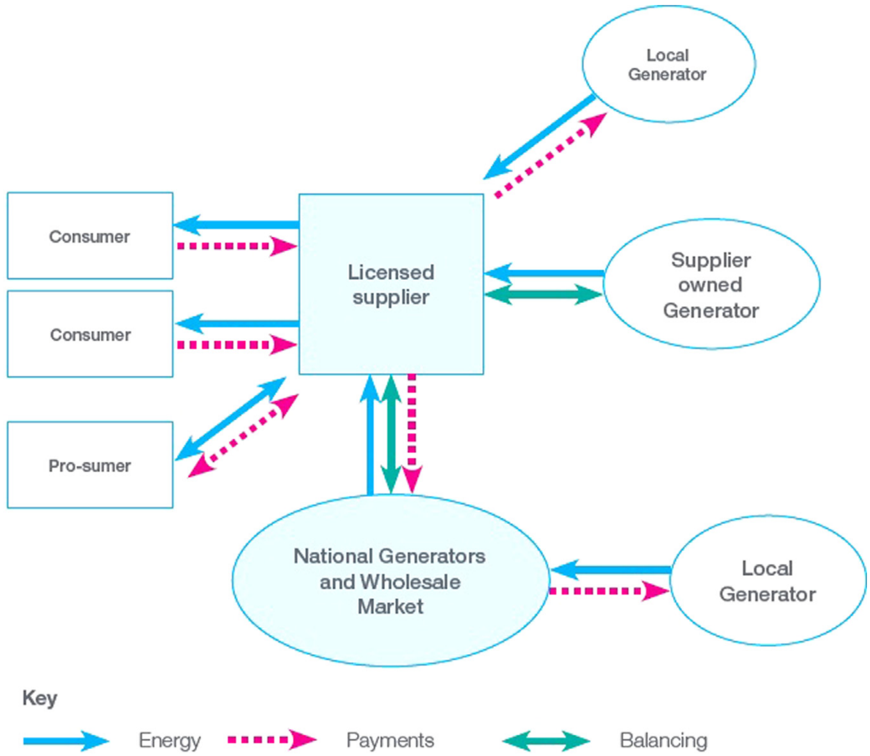

Fig. 1. the current archetype.

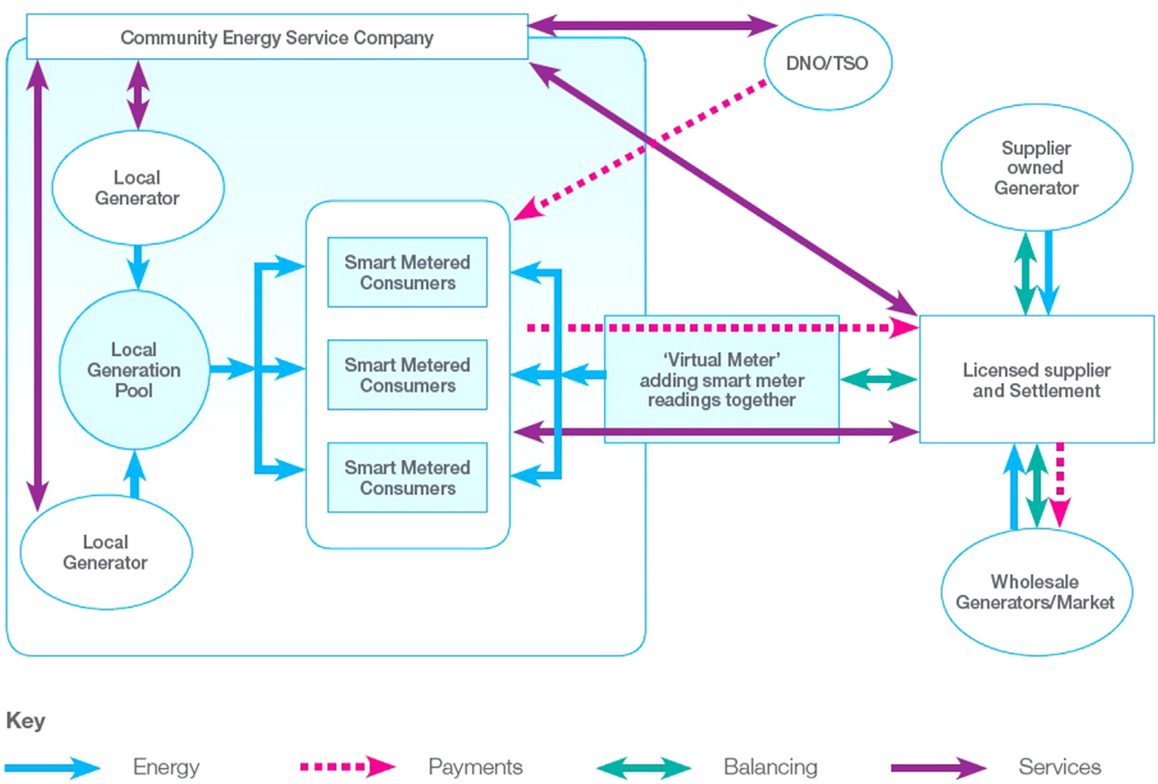

Fig. 2. Local aggregator archetype.

4.2.5. The municipal utility archetype

The Municipal Utility archetype (see Robin Hood Energy[8]) involves a local authority creating a fully licensed supply company concentrating on local market share and linking geographically proximate generation to consumption. The municipal respondents cited the ability to offer better routes to market for local generation and tariff fairness as primary motivations driving this

[8] https://www.robinhoodenergy.co.uk/ Robin Hood Energy is 100% owned by Nottingham City Council and is operated on a not for profit basis.

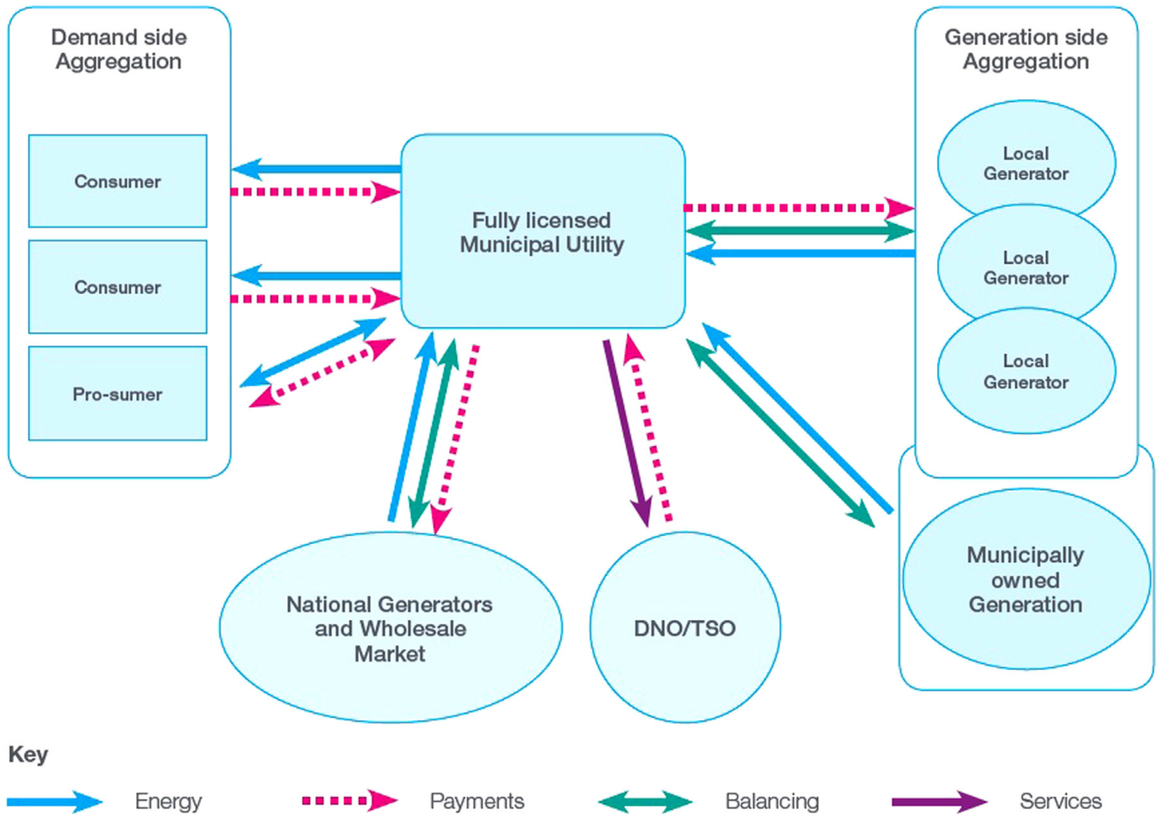

Fig. 3. Municipal utility archetype.

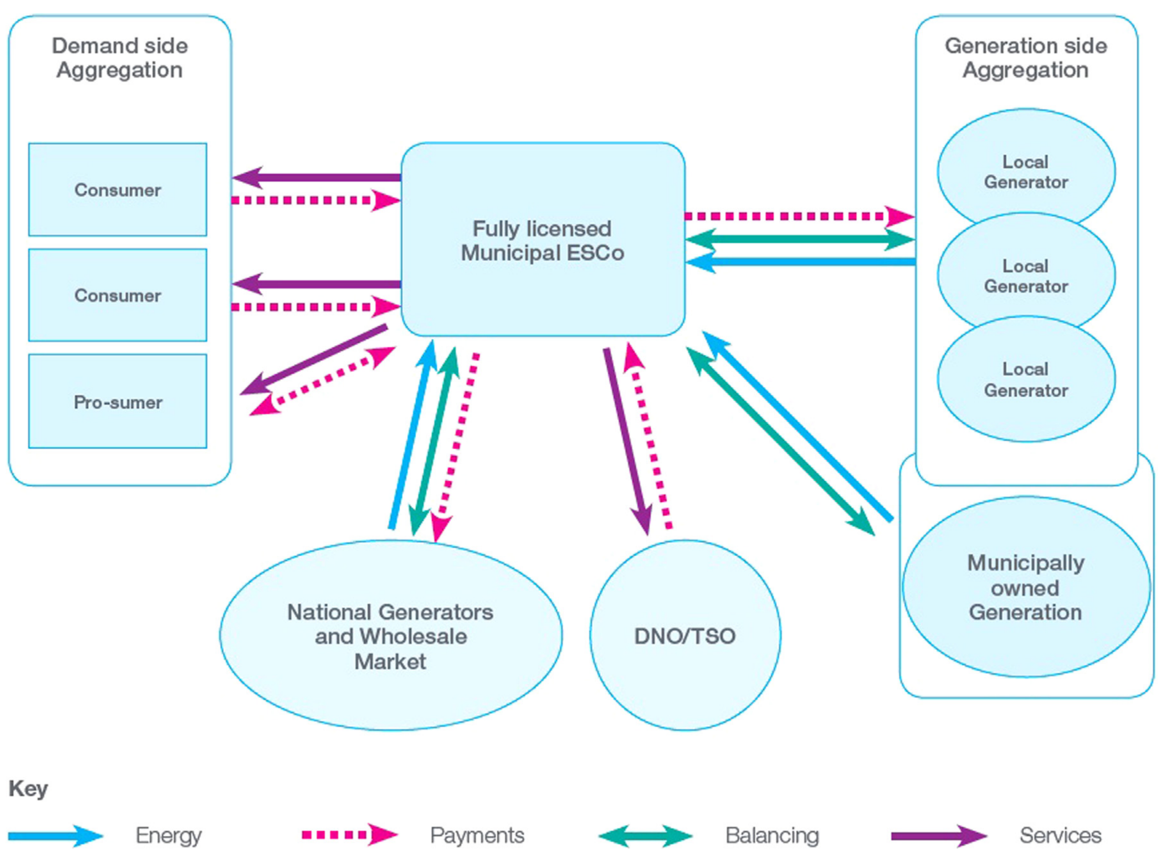

Fig. 4. The municipal ESCo archetype.

structure. With this aggregation of local generation, DNO/TSO services may be possible. Equally, demand side services have greater potential with geographically aggregated customer bases. Whilst municipal utilities are well established in Europe (Hall et al., 2016), municipal supply in the UK is extremely rare. A critical message however, is that the establishment of a municipal utility, based on a throughput-based model, does not remove the disincentives to real energy efficiency gains. A geographically constrained utility has a finite customer base, were that customer base to adopt deep retrofit, there would be few opportunities to compensate the loss in value capture by expanding market share. As such, the municipal utility model is compatible with better PPAs for generators, incentivising demand side services, and re-localising energy value, but may fail to drive significant energy efficiency gains.Fig. 3

4.2.6. The municipal ESCo archetype

ESCos are a growing phenomenon in the UK but ordinarily operate on a business-to-business basis, because larger businesses and/or public bodies have the administrative capacity to separately account for energy savings through contracts outside the supplier relationship. The monitoring and verification of services in a domestic setting requires more sophisticated meters that are currently in-situ; though the roll out of smart meters will reduce this barrier. Thus in the Municipal ESCo archetype, all the value propositions of a municipal utility are present, but meaningful energy efficiency is also enabled by providing a service in return for revenue as opposed to units of energy; value capture is maximised when demand reduction is maximised. There is also potential to capture value from demand side services to DNOs and TSOs. The authors call attention to the relationship between the Municipal ESCo and the consumer/prosumer, which is service based (Fig. 4).

4.2.7. The multi utility service (MUSCo) archetype

The delivery of multiple utilities within the same contract can deliver resource and cost efficiencies. There is potential for this model to extend the Municipal ESCo approach, but for electricity supply purposes this model is similar to the Municipal ESCo archetype.

4.2.8. Peer to peer archetype

A Peer to Peer (P2P) archetype has been proposed (see Open Utility[9]) that uses a software platform to allow commercial customers to select a mix of distributed generation to meet the majority of their demand. This can result in a better PPA deal for generators and a tariff that meets the needs of the consumer, which may be price-based but can also incorporate socio-economic or environmental values. This model requires the software platform operator to partner with a TPLS for the billing and balancing functions, and to ensure secure supply where a consumer's selected generation package is insufficient to cover demand. Similar to 'sleeving' the consumer's load is preferably met by distributed generation, but here the distributed generation can be pooled by the software platform as opposed to being met by one generator.

The P2P model operates an exchange outside incumbent wholesale trading agreements; it is distinct from other exchanges which provide an alternative route to market for independent generators such as the 'e-power' exchange[10]. The e-power exchange acts as a market-place for short-term PPAs or surplus contracted volumes of power, whereas a P2P relationship links generators and consumers directly. As formulated, this archetype is best suited to operating within a single distribution network to secure full embedded benefits. Demand side management and participation are outside the scope of this model, as are energy efficiency improvements. Re-localisation of energy value is only weakly signalled.

4.2.9. Peer to peer with local balancing unit

Current peer to peer models are not bounded by geography. Generators and consumers in different regions would be free to trade on the software exchange. Recent work identifies an archetype in which senior suppliers would be able register a bespoke unit in settlement on behalf of a junior supplier in a single geography (Cornwall Energy, 2014). This would require the creation of a settlement unit enabling export and import meters within a defined area to be consolidated separately then added to a TPLS's position its own (ibid; also Elexon, 2014). This enables the junior supplier to net production and consumption by area without incurring or being subject to the full cost of the BSC. This reduces the exposure of the junior supplier to balancing charges, and makes the senior supplier's administration of associated data flows easier. It also allows the junior supplier to be clear on the net embedded benefits they are entitled to (as embedded benefits are only applicable when produced and consumed within a single grid supply point group), making them better placed to capture value in return for this benefit. The archetype here is based on the P2P schematic presentation by Cornwall Energy (2014a). The peer to peer archetype with a local balancing unit would allow for the benefits of the P2P model but also allow an aggregator to bundle consumers and operate demand side activities based on the location and load of several parties. Energy efficiency gains are not clearly incentivised by this model. The re-localisation of energy value would depend on the beneficial ownership of the junior supplier and aggregators. Fig. 5

4.2.10. Not-for-profit national supplier

The Local White Label, Local Pool and Sleeve, Local Aggregation and both Peer to Peer archetypes all require a TPLS for regulatory compliance and system services such as billing and metering. These are referred to as 'intermediary archetypes'. It was reported throughout this research that intermediary archetypes of this kind face significant challenges engaging and agreeing favourable terms with TPLSs. Focus group participants from civil society organisations argued for a ninth archetype, a not for profit licensed supplier, whose role was to facilitate intermediary archetypes. Participants cited the need to secure a profit margin when operating a licensed supply business as one element of electricity pricing which could be re-directed into securing business models compatible with the outcomes in Table 1. Published figures by the regulator (Ofgem, 2015c) demonstrate recent operating margins or pre-tax profits on average electricity bills to vary between 0–3% from January 2009 to December 2013, representing between £2–20 on each average household bill. Projected future profit margins are forecast to vary between 6–9% or £37–£52 per average household electricity bill of between £549–567. Ostensibly then, at least in the near term, there is the potential to recycle some of this value into administration of the archetypes of local supply.

4.3. Q3: What are the barriers constraining these business model innovations in the supply market?

The next phase of this research identified the specific barriers which prevent these business model innovations developing and proliferating in the UK Market. Hall and Roelich (2015) offer an extensive account, here these barriers are summarised in three groups: regulation, capacity/scale and uncertainty/risk.

[9] https://www.openutility.com/
[10] http://www.epowerauctions.co.uk/howitworks.htm

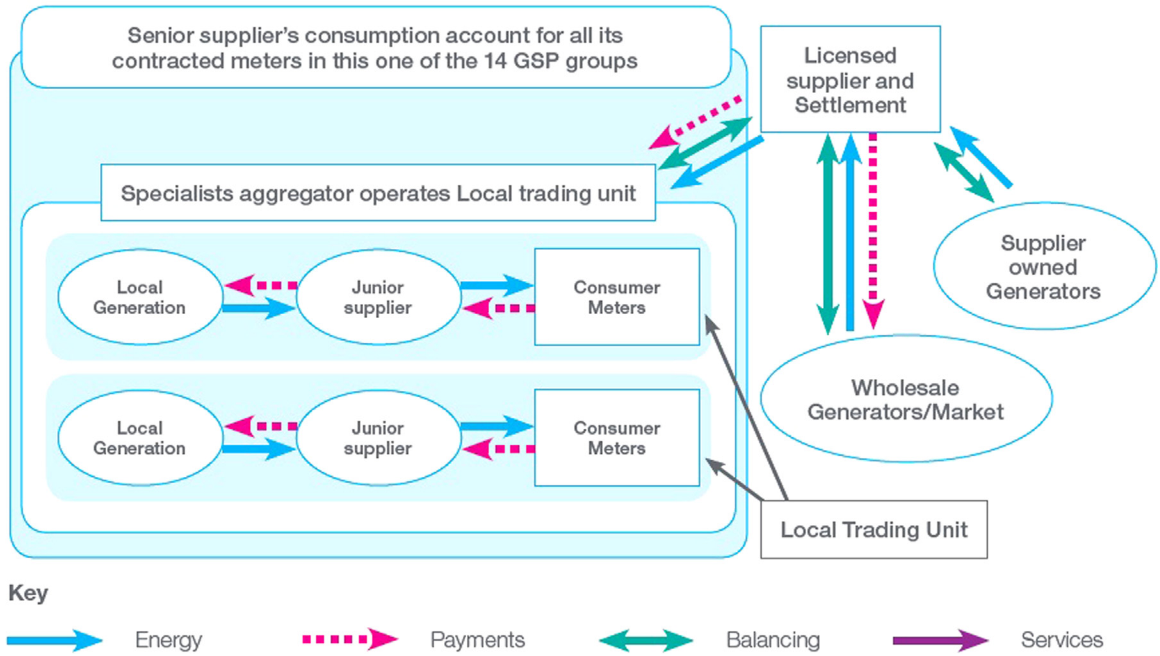

Fig. 5. The Peer to peer with a local balancing unit archetype.

The regulatory barriers identified included a cap on the number of tariffs suppliers were able to offer the UK market; the lack of a regulatory mechanism enabling a local balancing unit; and the requirement that suppliers offer services across the national geography, The ability of SME and domestic consumers to access the ESCo model is hampered by the supplier switching mechanism, and the need for long-term contracts to justify the large upfront capital investment.

Secondly, the capacity/scale barriers referred to the ability of new entrants to take on the burden of electricity market trading. Two critical issues arose, the first related to the revenue outlay required to reach market entry (i.e. the costs associated with becoming a licensed supplier), the second, and most significant, was the collateral required to trade on wholesale markets. In the first years of operation, collateral requirements may reach several million GBP in order to secure sufficient contracted supply to fulfil demand. When dealing with municipally backed businesses or new social enterprises, this collateral requirement represents a real barrier.

Finally, there is significant uncertainty and risk involved in the operation of a complex value business model in an already complex sector, particularly in relation to the value capture mechanism. Once complex value propositions are identified, new suppliers often find monetising, negotiating and contractually agreeing revenue streams very difficult. Whilst the software and metering technologies exist, municipalities or social enterprises lack the electricity market expertise needed to operate these models. Furthermore, many of the complex value propositions within the four opportunities of local supply are new to the sector as a whole and significant uncertainty exists as to their actual monetary value. Hall and Roelich (2015) present short, medium and long term policy recommendations particular to these business models for the UK market; the authors refer readers with specific interest in the UK market to the full report. However, in this contribution the authors are concerned with the lessons this *process* of complex value analysis holds for energy policymakers seeking to unlock the potential of local electricity supply across *all* unbundled and liberalised markets.

The barriers identified in Hall and Roelich (2015) all stem from the alignment of market and regulatory systems with the current, national suppliers operating incumbent business models. Regulation in particular makes value capture from complex value propositions difficult, restricting diversity in business models. If the opportunities for additional value propositions are to be fully exploited, then policy and regulation across liberalised energy markets must enable and incentivise business model innovation which challenges the incumbent utility model.

5. Discussion, Q4: How can understanding complex value business models contribute to energy policy?

By using framings from business model innovation literatures, we were able to unpick the outcomes being pursued by local supply actors, define the **value propositions** missed by incumbent utilities, and investigate the **value capture** methods that local supply actors are constructing innovative business models to exploit. Energy innovation research needs to consider what values are created, and how they might be captured within current system boundaries such as policy, regulation and trading. Policy and regulation that does not account for new value proposition and capture concepts could limit the contribution of new technologies to system change. Neither should business model innovation be investigated without consideration of the enabling technology required to capture values, such as domestic demand-side management. Crucially, both technology and business model innovation need to be facilitated by supportive policy and regulation in a more structured way.

Section 4.1 categorised four missed value propositions in the UK electricity systems. Each of these specific opportunities map to some degree onto Bocken et al.'s framework eight generic types of sustainability business model[11], opportunity 1 'better PPAs for generators' maps onto to the replacement of incumbent technologies with renewable resources. Opportunity 2 'fulfilling the potential of the demand Side' is directly related to 'encouraging Sufficiency'. Opportunity 3 'real energy efficiency gains' relates to 'maximising material and energy efficiency' and opportunity 4 'relocalising energy value' links to Bocken et al.'s 'repurpose for

[11] In fact Bocken et al. (2014) use 'archetypes' to describe the eight generic business models of sustainability, but we avoid this term in describing Bocken's et al.'s, work as we felt it would interfere with our own framing of local supply archetypes.

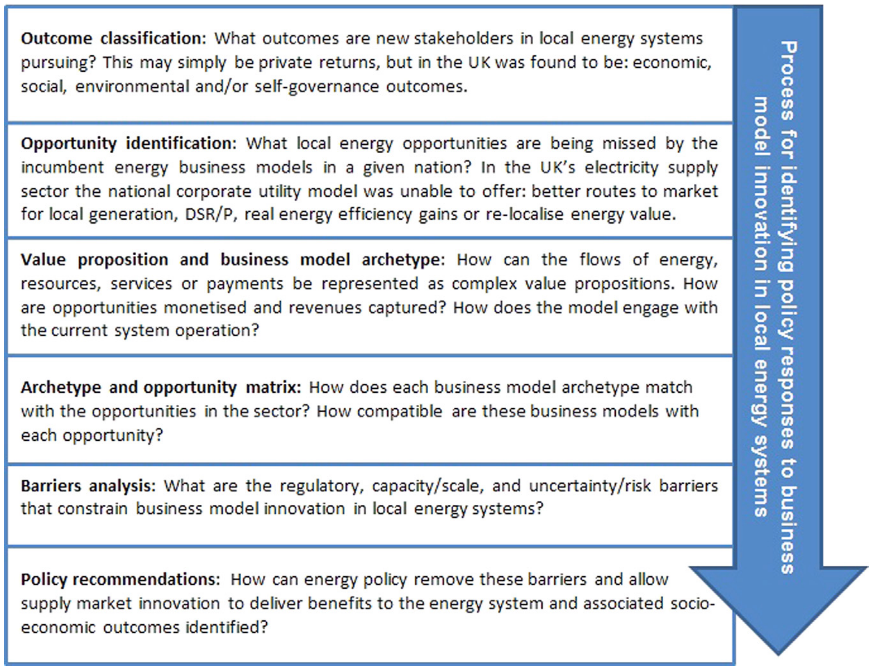

Fig. 6. Complex business model process.

society/environment' typology.

We argue these new value propositions are 'complex' because they produce financial, developmental, social and environmental benefits which accrue to different parties, across multiple spaces and times, and through several systems. Consider the local aggregator archetype. Here, aggregated demand could be leveraged to provide services to: the DNO in terms of network management, traded with the supplier to tune the suppliers position after wholesale trading has ended (to avoid balancing charges), traded with the system operator for direct balancing, or deployed to avoid periods of high retail price. All of these value propositions are additional to the core proposition of matching local generation more closely with local demand to get a better deal for both consumers and producers. Additionally, some of these value propositions have positive effects on decarbonisation and fuel poverty alleviation which are yet more difficult to quantify and monetise, and may need to rely on policy support. Similar mixes of primary and secondary incentives operate within each archetype (Table 2), constructing a value capture method for each requires a flexible policy and regulatory structure that can allow for 'ground truthing' of these theoretical values within the system.

At the same time policy and regulation need to ensure security of supply, equity of access, consumer protection and system wide decarbonisation. This research shows that local electricity supply models have significant potential to contribute to all of these policy goals, more so than the incumbent utility model has to date. The political economy of energy systems varies markedly from country to country (Mitchell, 2008), even within the EU which operates an ostensibly common market framework. This militates against specific recommendations being applicable across liberalised markets.

In order to make space for this complexity of values, and unlock to potential of local supply models, energy policymakers and regulatory authorities should adopt a *process* of complex value identification. This process should analyse the *specific* value opportunities in the system, the latent business models able to exploit them, and make space for business model innovation in the electricity supply market.

Firstly, it is important to recognise the range of outcomes that motivate stakeholders engaged in energy provision. This creates a broader landscape within which business models could be created. Regulating to optimise for one outcome (for example reduced cost per unit of energy) could severely limit the range of business models investigated. Secondly, the opportunities for the wider energy system and consumers should be identified to aid understanding of innovative value propositions. This also enables greater connection between business model innovation and technology innovation by identifying where new technologies unlock new value propositions in the system. Thirdly, opportunities should be expressed as value propositions, recognising the different forms that value can take, and that capture and monetisation of complex values may need to be enabled by new energy policy. Building on this understanding of value, technologically literate business models can be tested against system goals. Finally, a focus on value, rather than on individual technologies or business models, can help to identify how policy can enable greater diversity and deliver systemic change. This process is summarised in Fig. 6:

By being specific about the values at stake in the local supply space, and the business models needed to capture them, this process enables critical scrutiny of the shortcomings of incumbent business models in fostering innovation and driving energy transitions. It also highlights the barriers to innovation presented by the regulatory regime.

6. Conclusions and policy implications

The literatures on business model innovation in the energy sector have been largely concerned with routes to market for specific technological innovation, as opposed to the net effect of technological innovations on market incumbents and system operation. This research identified the motivations of a new set of actors in the UK electricity supply market, and analysed how these motivations were being pursued by exploiting four opportunities that are being missed by system incumbents. Each of these missed opportunities relied on a complex value proposition, exploitable by a novel set of business models.

The recommendation from this work is for policy makers to pay close attention to latent and/or emerging business models in the supply market as they have significant potential to lead to substantive benefits, both in terms of system efficiency but also in terms of socio-economic gains. The identification and classification of value propositions, value capture, and business model archetypes can guide supply market policy. There is no one size fits all policy package to encourage new local supply structures, but the approach adopted by this research produces a suite of archetypes that may be applicable across international contexts. In order to undertake similar analysis in other liberalised markets, we proposed a process to identify the effect of these and similar archetypes. This has been applied in the UK and has delivered specific policy recommendations which have already been utilised in national energy policy (Department of Energy and Climate Change, 2015 p.36). Attention to complex value business models and their barriers to adoption has the potential to fundamentally reconfigure energy systems and contribute substantively to sustainable energy futures.

Finally, in electricity markets incumbent actors are responsible for the delivery of critical infrastructures which on aggregate define capacity margins, affordability and decarbonisation rates. While business model innovation can capture new value propositions, it is unclear what effect the proliferation of local supply models may have on the wider system. Decentralised renewables are already undermining the volume based business models of incumbent utilities at the generation end of the electricity value chain. If local supply models begin to do the same at the consumer end, the edifice of the modern corporate utility may be further challenged. The incumbent model will need to evolve if critical assets are to remain available or be replaced. How this evolution occurs, and how policy and system regulation can manage incumbent decline, are vital questions for the energy policy community to answer.

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