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'Demand pull' government policies to support Product-Service System activity: the case of Energy Service Companies (ESCos) in the UK

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ABSTRACT

Product-Service Systems (PSSs) constitute a family of service-based business models designed to satisfy our societal needs in an economically and environmentally sustainable manner. To date however PSS application has remained niche due to a variety of critical barriers. This paper explores how 'demand pull' national government policies could support PSS activity by addressing these barriers and cultivating market demand. Lessons are drawn from a case study of how *regulatory*, *economic incentive*, *informative* and *procurement* policies have supported Energy Service Company (ESCo) activity in the UK; a sub-set of the PSS family focused on energy service provision. Subsequently five policy recommendations are presented to support PSS activity: (1) balancing economic incentives and regulatory disincentives; (2) promoting indirect policy support; (3) redesigning existing market structures; (4) promoting locally-led PSS activity; and (5) creating stable policy frameworks. The paper warns however that national government policy cannot easily address all PSS barriers, such as customer preferences, international developments, technological progress and inherent business model weaknesses, pointing to the need for other complementary solutions. Furthermore, other governance actors beside national government could also implement PSS supporting policies.

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1. Introduction

There are growing concerns that many of the business models and underpinning socio-technical systems we rely on to satisfy our basic human needs are environmentally unsustainable, raising questions about their degree of functionality in the future. Consequently, there are calls to develop and implement novel business models capable of satisfying societal needs in a sustainable fashion (Boons et al., 2013; Lee and Casalegno, 2010; Wilson et al., 2009), a step considered as critical by some scholars to driving wider transitions for sustainable development (Hannon et al., 2013; Loorbach et al., 2010).

One group of business models that has received particular attention in this regard over recent years are known as Product-Service Systems (PSSs) (Roy, 2000; Mont, 2002; Maxwell and van der Vorst, 2003; Mont and Tukker, 2006; Tukker et al., 2004; Tukker, 2004; Tukker and Tischner, 2006; Stahel, 2007; Tukker et al., 2008; Hansen et al., 2009; Hannon, 2012; Boons et al., 2013; Loorbach and Wijsman, 2013). PSS businesses strive to present value propositions that simultaneously meet economic, ecological and social needs (Wilson et al., 2009; Boons and Lüdeke-Freund, 2013) by focusing on the final functionality or satisfaction that the consumer desires (Tukker and Tischner, 2006). Despite the wide range of benefits these models could provide, 'the adoption of such business strategies is still very limited because it often involves significant corporate, cultural and regulatory barriers' (Ceschin, 2013 p.74). Consequently, research has explored the barriers responsible for constraining the application of PSS models and the types of government policy interventions that could help to promote PSS activity (Mont and Lindhqvist, 2003; Ceschin and Vezzoli, 2010; Tukker et al., 2008).

This paper examines how 'demand pull' government policies might cultivate a greater demand PSS activity. It draws lessons from 43 interviews focused on one case of PSS activity in particular: Energy Service Company (ESCo) operation in the UK. The ESCo model is centred around providing customers with the physical benefit, utility or good that people derive from energy, referred to as energy services (EU, 2006). It has been identified as a potentially

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financially viable means of fulfilling our energy needs in a way that could help to address the mounting challenges of climate change, energy security and affordability, which are facing the international energy community (Vine, 2005; Fawkes, 2007; Hansen, 2009; Marino et al., 2011; Fang et al., 2012). This policy analysis is timely considering the details of the recent European Energy Efficiency Directive, which obligates member states to remove any regulatory and non-regulatory barriers that might impede the uptake of energy service contracting (EU, 2012). The paper builds on the authors' previous work that has analysed the coevolution of the ESCo model in the UK with other business models, technologies, institutions and user practices (Hannon et al., 2013), by examining in much greater depth how government policy can improve the prospects for ESCo activity.

The paper is set out as follows. Section 2 examines the core characteristics of PSS and ESCo models, the barriers they face, potential policy solutions and opportunities for further research. Section 3 outlines the paper's research methodology. Section 4 presents the results from the paper's empirical investigation, outlining how existing, emerging and possible government policies could support UK ESCo activity. Section 5 draws a number of lessons from the empirical work that could help to support PSS activity more broadly. Section 6 presents conclusions from the paper.

2. Key characteristics of PSS and ESCo models and the barriers to their uptake

This section briefly introduces the interrelated concepts of sustainable business models, PSSs and ESCos, highlighting their core characteristics, potential benefits, barriers to uptake and associated 'demand pull' government policy solutions. It concludes by identifying some opportunities for further research this paper aims to contribute towards.

2.1. Sustainable business models, PSSs and ESCos

2.1.1. PSSs as a sub-set of sustainable business models

Osterwalder and Pigneur (2010) define a business model as the rationale of how an organization creates, delivers and captures value by fulfilling the needs or desires of its customers. Extending this logic a business operating a sustainable business model is one seeking 'to deliver economic, social and environmental benefits … through core business activities' (Wilson et al., 2009 p.1). A PSS constitutes a sub-set of sustainable business models in the sense that it is a system of products, services, networks of players and supporting infrastructure (Goedkoop et al., 1999) designed to deliver value propositions that simultaneously meet economic, ecological and social needs (Wilson et al., 2009; Boons and Lüdeke-Freund, 2013) by focusing on the final functionality or satisfaction a consumer desires (Tukker and Tischner, 2006).

Three broad classes of PSS exist: *product*-, *use*- and *result*-oriented models (Tukker and Tischner, 2006). *Product-oriented* PSSs constitute the most basic form of PSS where the provider extends its traditional product-based offer with additional services such as maintenance, take-back and financing schemes. *Use-oriented* PSSs focus on providing the use or function of a product rather than just the product itself. These models often take the form of renting or leasing strategies and may involve sharing or pooling on the customers' side. *Result-oriented* PSSs contractually guarantee the satisfaction of the customer's needs to a certain level for a predetermined period of time. This model is considered to possess the greatest potential environmental benefit of the three but is also potentially the hardest to implement by product-oriented businesses given how characteristically different it is from their core business.

2.1.2. ESCos as a sub-set of PSSs

In the same way that the car-sharing business model represents an automotive subset of the PSS family (Firnkorn and Müller, 2012), the ESCo model represents an energy subset. ESCos provide their customers with the physical benefit, utility or good that consumers derive from energy, which are typically referred to as energy services (EU, 2006). ESCos provide energy services to their customers via energy service contracts, which constitute 'the transfer of decision rights over key items of energy equipment under the terms and conditions of a long-term contract, including incentives to maintain and improve equipment performance over time' (Sorrell, 2005 p.96). Importantly, ESCos operate in a fundamentally different way to the more common Energy Utility Company model, which is predicated on the sale of units of fuel (e.g. gas, oil) or electricity. Unlike ESCos, the Energy Utility model dictates that it is the customer who is ultimately responsible for converting these units of energy into the energy services that they desire not the supplier (Hannon et al., 2013).[1]

Energy service contracts fall into two broad categories: *energy supply contracting* and *energy performance contracting* (Fig. 1). An *energy supply contract* (ESC) represents a type of u*se-oriented* PSS model. Here an ESCo provides *useful energy* streams to its customers, which Sorrell (2007) defines as energy streams that have already been converted by primary conversion equipment (e.g. a boiler or CHP plant), such as hot water, coolant and electricity. Here the customer is usually charged per unit of useful energy (Sorrell, 2007) or a fixed price for the supply of a pre-determined level of energy service (Marino et al., 2011). ESCos take control over the primary conversion equipment necessary to generate these useful energy services in an ESC. This control provides the ESCo with the opportunity to reduce its customer's consumption of *delivered energy* (i.e. imported fuel or electricity), predominantly by improving the technical and operational efficiency of its primary conversion equipment (Sorrell, 2007), which in turn helps to reduce the production costs[2] associated with fulfilling its customer's energy needs. However, even though ESCs may provide a reduction in final energy consumption, the ESCo does not normally guarantee these savings as part of an ESC because 'it lacks control over both the efficiency of secondary conversion equipment and the demand for final energy services' (Sorrell, 2005 p.17).

An *energy performance contract* (EPC) represents a type of *result-oriented* PSS model considering that customers are provided with *final energy services* (e.g. lighting, heating, motive power). These represent energy streams that have been converted by secondary conversion equipment (e.g. radiators or fluorescent lighting) and can thus be enjoyed directly by customers, without the need for additional conversion processes (Sorrell, 2005, 2007). Here the ESCo assumes control over the secondary conversion equipment, as well as the distribution (e.g. hot water pipes) and associated control equipment (e.g. thermostats, light sensors).[3] As part of an EPC, the ESCo also controls primary conversion equipment, affording it even greater overall control over the quantity of energy required to satisfy its customer's needs (Sorrell, 2007). This high degree of control over the consumer's energy demand means that energy performance guarantees are typically included as part of an EPC, often in the form of a reduction in final energy consumption, which normally translates into a cost saving.

[1] A detailed breakdown of the core characteristics of the ESCo model can be found in both Hannon (2012) and Hannon et al. (2013).

[2] Production costs in this context refer to those incurred for the purchase of material inputs that create energy services. These include conversion, distribution and control equipment; as well as energy commodities (i.e. fuel & electricity) (Sorrell, 2007).

[3] Electronic or other controls monitor and control the flow of energy from conversion to consumption (e.g. thermostat) (Sorrell, 2007).

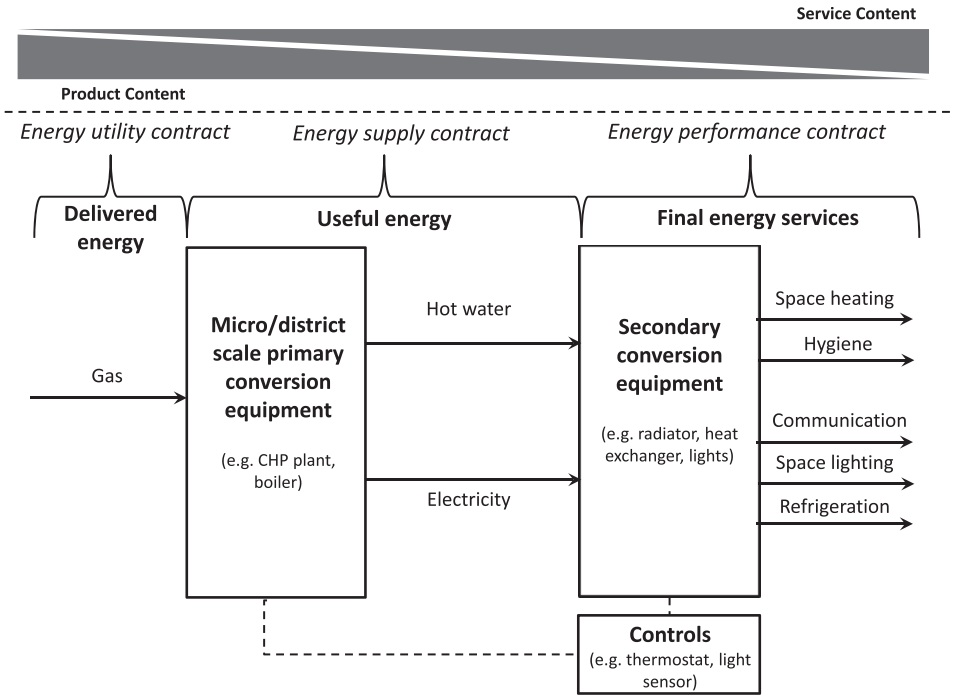


Fig. 1. Typical 'work space' of Energy Utilities and ESCos (adapted from Sorrell, 2007).

Fig. 1 uses the example of energy services desired from gas to illustrate the differences between these two types of ESCo contracts (ESCs and EPCs) compared to a typical Energy Utility offering, i.e. unit of gas. Functionality is highest at the right hand side of the diagram where gas has been converted into the energy services the consumer ultimately desires.

2.2. Barriers to PSS and ESCo application

This section outlines the key barriers to both PSS and ESCo activity, beginning with the former:

1. **Cultural status attached to product ownership**: Traditional culture in many societies often attaches status to the purchasing, ownership and control of products rather than services (Goedkoop et al., 1999; Manzini et al., 2001; James and Hopkinson, 2002; UNEP, 2002; Behrendt et al., 2003; Rexfelt and Ornäs, 2009; Steinberger et al., 2009; Geng et al., 2010; Ceschin, 2013).
2. **Organisational inertia:** Wholesale cultural and organisational changes are often required from product-oriented companies in order practice PSS models (Stoughton et al., 1998; UNEP, 2002; Wolf et al., 2009; Ceschin, 2013).
3. **Profitability of existing business models**: Many firms are financially successful in their current form and thus reticent to overhaul their existing, product-based business model or wider environment (Mont, 2002, 2004; Charter et al., 2008; Ceschin, 2013).
4. **Difficult to quantify savings**: PSS firms often struggle to quantify the economic and environmental savings/benefits arising from their services (UNEP, 2002; Ceschin, 2013).
5. **Lack of a supportive regulatory framework**: Government policy typically fails to internalise environmental impacts and reward sustainable business activity (Mont and Lindhqvist, 2003; Charter et al., 2008; COWI, 2008; Steinberger et al., 2009; Ceschin and Vezzoli, 2010).
6. **Lack of awareness and understanding**: Consumers and providers may be unaware of PSSs or fail to fully understand how they work, the latter potentially leading to mistrust in these models (White et al., 1999; Charter et al., 2008; COWI, 2008; Steinberger et al., 2009; Ceschin and Vezzoli, 2010).

As a subset of the PSS family many of the barriers affecting PSS uptake listed here also impede ESCo activity. For example, a lack of reliable energy consumption data from consumers makes it difficult to accurately quantify potential and actual energy savings delivered by ESCos (Sorrell, 2005; Bleyl-Androschin, 2011; Marino et al., 2011). Additionally, a generally unsupportive regulatory framework has also hindered ESCo activity. Specific examples include complex, costly and time consuming public procurement frameworks (Smith, 2007; Sorrell, 2007; Marino et al., 2011). More broadly, the ambiguity and complexity of energy regulatory frameworks has made energy service contracting challenging (Marino et al., 2011). Finally, poor levels of awareness and understanding amongst potential customers and/or adopters of the ESCo model has also served to limit demand for energy service contracts (Sorrell, 2005; Steinberger et al., 2009; Hansen, 2011; Marino et al., 2011).

Taking the opposite view there are some ESCo barriers that may have relevance to other kinds of PSS model. For example, ESCos have suffered from a lack of investment capital to cover the high upfront costs incurred by ESCos, following the financial crisis and economic downturn (Vine, 2005; Hansen, 2011; Marino et al., 2011). Additionally, a lack of standardised energy service contracts have meant that ESCos typically spend significant amounts of time and money drafting contracts from new, consequently increasing their transaction costs[4] (Vine, 2005; Marino et al., 2011). Finally, a hostile response from incumbent energy companies

[4] Transaction costs refer to those associated with organising (or 'governing') the provision of those streams and/or services, e.g. negotiating and writing the contract (Sorrell, 2007).

towards ESCos, on the basis that they view the ESCo model as a threat to their dominance, can have a negative impact on nascent energy services markets (Vine, 2005).

One group of ESCo barriers in particular that has relevance to other PSS models is the mismatch between the characteristics of contracts being offered by ESCos and the needs or desires of their potential customers. Issues include:

1. **Inflexibility of long-term contracts:** Energy service contracts typically last for between 5 and 30 years (Westling, 2003; Sorrell, 2005; Fawkes, 2007; Smith, 2007). Such a long-term commitment can constrain customers' flexibility; undesirable should their situation change (Sorrell, 2005; Boait, 2009; Marino et al., 2011).
2. **Disruption to customer activities:** Energy efficiency interventions can disrupt customers' normal routine (Sorrell, 2005; Marino et al., 2011).
3. **Threats to privacy:** Customers may be concerned that confidential data or information will become exposed as the ESCo 'over-hauls' aspects of their company's energy consumption (Bertoldi and Rezessy, 2005; Sorrell, 2005).
4. **Perceived high level of energy efficiency:** Some consumers wrongly perceive themselves to be very energy efficient, further pushing such investments down the corporate agenda that do not typically rank highly anyway (Sorrell, 2005; Vine, 2005; Marino et al., 2011).
5. **In-house technical expertise:** Some organisations already possess in-house technical energy efficiency expertise and so they do not require external help (Marino et al., 2011; Sorrell, 2005).
6. **Inability to sanction energy service contracts:** Many consumers do not have the responsibility to sign an energy service contract (Sorrell, 2005), most notably tenants. Conversely, landlords with the authority may opt against such contracts because they are not responsible for the energy bills, often referred to as the 'landlord-tenant problem' (IEA, 2007).

As a sub-set of the PSS family there are some barriers to ESCo application that may be distinct to ESCos and not PSSs in general. For example, whilst cultural status is often attached to the ownership of numerous products, such as property and vehicles, the same cultural status is not normally attached to the ownership of units of energy, such as gas and electricity. Another example might be in relation to energy specific regulation. For instance, Smith (2007) explains that electricity supply, generation, distribution or transmission licensing laws are often not structured to support small-scale, decentralised intermittent sources of electricity, typically utilised by ESCos providing ESCs. Finally, energy specific price signals such as low and fluctuating energy prices are not conducive to a strong ESCo market (Marino et al., 2011) given that a key part of the ESCo value proposition is a reduction in customers' energy bills. Nevertheless, we argue in Section 5 that a number of useful lessons can be drawn from the study of ESCos for policies to support PSS uptake in other sectors.

2.3. Supporting PSS and ESCo activity via 'demand pull' government policy

2.3.1. Defining and categorising 'demand pull' government policy

Innovation systems theory has been prevalent in exploring how government policy can help to support the development and deployment of innovations. Whilst this has traditionally centred on technological innovations (Carlsson and Stankiewicz, 1991; Hekkert et al., 2007), some of which possess a strong sustainable development focus (Krozer and Nentjes, 2008), this focus has been broadened recently to include non-technological innovations, such as novel environmentally-oriented business models and practices (Mont and Emtairah, 2008; Laukkanen and Patala, 2014; Smith and Crotty, 2008). The discourse frames innovation as an evolutionary, non-linear process (Grubler et al., 2012; Truffer et al., 2012), which can be supported via a combination of 'supply push' and 'demand pull' mechanisms, many of which take the form of government policy.

Grubler et al. (2012) explain that 'supply push' policies relate to forces that affect the generation of new knowledge, such as government sponsored research and development (R&D), tax credits for companies to invest in R&D, enhancing the capacity for knowledge exchange, support for education and training, and funding demonstration projects (Grubler et al., 2012; Gallagher et al., 2006; Nemet, 2009).

'Demand pull' policies on the other hand refer to those that shape the demand for innovations (Grubler et al., 2012). Margolis (2002) divides these into three categories: *direct purchases* (e.g. public procurement schemes), *regulation* (e.g. technical standards) and *economic* incentives (e.g. tax breaks, subsidies etc.) (see Fig. 2).

Edler (2010, 2013) and Edler et al. (2012) add another dimension to this framework titled *indirect government support*, which typically includes schemes to raise awareness, stimulate innovation user–producer interaction, improve capabilities via training and articulate innovation needs or preferences. Synthesising these related 'demand pull' policy analytical frameworks the following four 'demand pull' policy categories are presented, which forms the analytical framework for this paper (see Section 3):

- **Regulation** – actions aiming to modify agents' behaviour by defining or changing sets of rules (e.g. restrictions, standards, and controls) (Ceschin and Vezzoli, 2010);
- **Economic incentives** – actions aiming to modify agents' behaviour through a market-based incentives (e.g. tax breaks, subsidies etc.) (Ceschin and Vezzoli, 2010);
- **Informative policies** – actions aiming to disseminate knowledge to agents (e.g. companies, consumers) (Ceschin and Vezzoli, 2010);
- **Direct public sector purchasing** – where the state buys for own use and/or to catalyse private market via procurement schemes (Edler, 2013).

A separate but related theme presented by Edler (2013) relates to how these different 'demand pull' government policies fit together and thus how these policies might be designed holistically.

2.3.2. 'Demand pull' policies to support PSS activity

By applying this framework to the types of PSS 'demand pull' policies that have been identified in the extant literature we find that a common theme is the need for *regulation* that internalizes the inherent environmental cost of production and consumption, thus encouraging firms to engage with more resource-efficient service-based solutions (Mont and Lindhqvist, 2003; Tukker et al., 2008; Ceschin and Vezzoli, 2010). Some other authors have recommended the need for *economic incentives*, most notably cheaper finance to cover the upfront costs of PSS projects (Tukker et al., 2008; Bilsen et al., 2013). With respect to *informative policies* both public and private sector engagement could be encouraged via the establishment of learning initiatives designed to improve both understanding and awareness of PSS models amongst both suppliers and consumers (Tukker et al., 2008; Ceschin and Vezzoli, 2010; Krämer and Herrndorf, 2012; Mont and Lindhqvist, 2003). Finally, to stimulate public sector PSS engagement, some authors (Larsen and Svane, 2005; Tukker et al., 2008; Ceschin and Vezzoli, 2010) have recommended the redesign of *public sector purchasing*

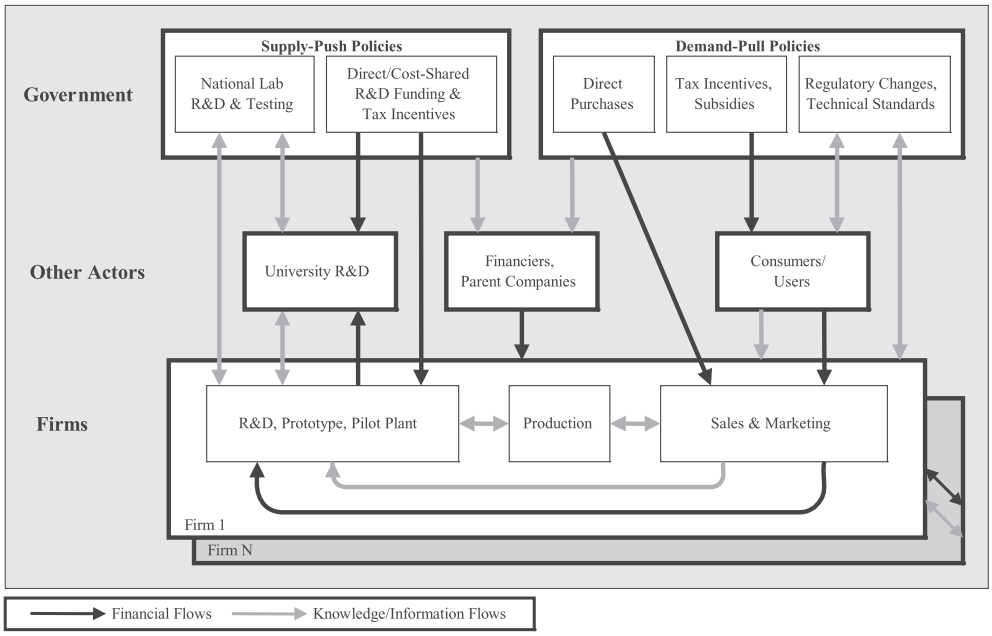


Fig. 2. An illustration of actors and their interactions in energy-technology innovation (Margolis, 2002 p.271).

or procurement procedures to include eco-efficient PSS solutions in their purchase guidelines and prioritise these over product sales.

More broadly, Krämer and Herrndorf (2012) recommend the need for *holistic approaches to policy design* that champion a stable and consistent policy environment that provides prospective PSS firms with the confidence that in the future they will be operating their business in a broadly supportive environment (Krämer and Herrndorf, 2012).

2.3.3. 'Demand pull' policies to support ESCo activity

Echoing the point made in Section 2.2, many supportive PSS policies may also promote ESCo activity, given that they are related. Examples include awareness raising amongst both prospective ESCos and ESCo customers (Sorrell, 2007; Steinberger et al., 2009; Marino et al., 2011), schemes to help ESCos more easily leverage finance (Bertoldi et al., 2006; Steinberger et al., 2009; Hansen, 2011; Marino et al., 2011) and incorporating energy efficiency as a criteria for public procurement of energy (Marino et al., 2011).

In contrast some policy solutions are specific to the ESCo model and not PSSs in general. In terms of *regulation*, recommendations include the establishment of Energy Utility energy efficiency obligations (Bertoldi et al., 2013) and building regulations that incorporate very high energy efficiency standards (Smith, 2007). In terms of *economic incentives*, Lindgren and Nilsson (2009) identify the importance of financial incentives to install energy efficiency measures. Recommendations for *informative policies* include training programmes that cultivate the skills necessary to deliver energy service contracts (Steinberger et al., 2009; Marino et al., 2011), energy service accreditation and standardisation schemes to build market confidence (Sorrell, 2007; Marino et al., 2011) and establishing an ESCo association to act as a reference point for ESCos customers and suppliers, as well as a unified voice to represent its members (Marino et al., 2011). Finally, *public sector purchasing* policy recommendations include the provision of energy service contract templates to avoid using resources to draft these 'from new' during procurement (Bertoldi et al., 2006; Sorrell, 2007; Steinberger et al., 2009; Marino et al., 2011).

2.4. Opportunities for further research into PSS and ESCo policy drivers

To help frame the contribution of this paper we briefly discuss the opportunities for further research in the PSS and ESCo field that have been identified by other scholars.

With respect to the PSS literature, Tukker and Tischner (2006), Baines et al. (2007) and Ceschin (2013) all emphasise that surprisingly little attention has thus far been paid to how policy could support PSS activity. Additionally, Beuren et al. (2013) explain that the existing PSS literature would benefit from additional empirical evidence to refine many of its theoretical insights. Consequently this paper aims to present an empirically based investigation into how government policy has influenced the adoption of the ESCo model, from which lessons are drawn for PSSs firms more generally.

With respect to the ESCo literature the authors argue that there has been relatively few contemporary studies on UK ESCo activity, with much of the existing work having been conducted a number of years ago now (Sorrell, 2005, 2007; Smith, 2007; Sorrell, 2007), during which time UK energy policy landscape has changed dramatically. Whilst Marino et al. (2011) have conducted a more recent study on UK ESCo market developments as part of a wider international study but incorporated only a handful of expert interviews. Consequently this paper offers an up-to-date and in-depth examination of the UK ESCo market developments, drawing upon 43 interviews for a single country. The paper also builds on our previous work, which investigated factors affecting the uptake of the ESCo model in the UK by analysing the coevolution of the ESCo model with other business models, technologies, institutions and user practices (Hannon et al., 2013). The current paper examines in much greater depth how government policy can improve the prospects of ESCo activity.

3. Methodology

The methodology outlined in this paper mobilised the analytical framework presented in Section 2.3.1, which is used to order the results and discussion presented in Sections 4 and 5 respectively. In

doing so this paper employs a similar approach to that adopted by Ceschin and Vezzoli (2010) as part of their research on supportive PSS policies, also focusing explicitly on 'demand-pull' policies rather than 'supply push' too. This is because PSSs are consumer-facing businesses operating, looking to bring together an innovative mix of technologies, services etc. into an attractive market proposition. They are therefore not normally engaged in 'supply push' policy influenced activities like basic or applied R&D at the lower end of the innovation chain.

Prior to any primary data collection an extensive review was undertaken of academic, governmental, industrial and third sector literature on energy service provision and UK ESCo activity. From this, a variety of key energy service market stakeholders in the UK were identified as potential interviewees. A 'snowball sampling' method was also employed, whereby interviewees with desired traits or characteristics give names of further appropriate interviewees (Black, 1999), helping to identify individuals for interview that were previously unknown to the researcher (Bryman, 2012).

The interviewees typically had extensive experience of residential and commercial ESCo operation and/or working alongside these types of ESCos, either in an operational (e.g. provision of financial, technical or legal expertise) or strategic capacity (e.g. design of ESCo related policy) and spanned a broad range of professional backgrounds relevant to energy provision and use. In total, 43 semi-structured, in-depth stakeholder interviews were conducted between 22nd July 2010 and 22nd May 2012, each lasting approximately 1 hour long (see Appendix A). Interviewees were invited to talk not only about the factors that have supported or inhibited ESCo activity in the UK but also the types of government policy interventions that have helped to support ESCo activity in the past, as well as additional measures that might address market barriers in the future.[5] They were encouraged to illustrate their responses with specific examples of ESCo activity.

To make sense of the qualitative data, thematic analysis was employed using the coding software NVivo 8. This was undertaken in line with the principles of Straussian Grounded Theory in order to assist theory building (Strauss and Corbin, 1998), which strikes a balance between inductive and deductive approaches. According to Ezzy (2002) this approach dictates that the researcher is free to draw upon existing theory, such as that presented in Section 2.3, to shape their research questions and inform how they interpret their data. However, they must not allow this pre-existing theory to constrain what is noticed.

Taking into account the size of the interviewee sample compared to that of the UK ESCo sector, it is difficult to draw generalizations from the outputs of this study. Instead, the empirical investigation constitutes a qualitative exploratory study, designed to provide insight into not only how UK energy policy has served to either support or hinder ESCo activity but also how lessons from this case could help to support PSS activity in other sectors.

4. Results

4.1. Existing, emerging and possible demand policy drivers for UK ESCo market growth

This section presents a range 'demand-pull' government policies identified by the interviewees as having already helped to support ESCo activity in the UK or those that have the potential, namely *emerging* (i.e. policies under development) and *possible* (i.e. policies that could plausibly be developed) policies. Appendix C presents the details of some existing policies that require further explanation, alongside how they have supported ESCo activity and the number of interviewees referenced them using the notation 'n = X', which is also used in the main body of text. All policies are categorised according to the analytical framework presented in Section 2.3.1.

4.1.1. Regulation

Regulatory demand-pull policies that have helped support ESCo activity in the UK include energy efficiency obligations and low-carbon building and planning regulations. Moves to devolve more power to local municipal authorities and further changes to electricity trading arrangements could also positively influence the take up of the ESCo model.

4.1.1.1. Energy efficiency obligations.

The UK has over the years had in place a series of energy efficiency obligations on large energy suppliers that obligate them to deliver a certain level of greenhouse gas emissions savings via the delivery of consumer energy efficiency measures. Failing to do so incurs a heavy fine unless they acquire purchase allowances. A number of interviewees identified these as an important policy driver (n = 7), for instance because they have encouraged larger energy suppliers to team up with smaller ESCos to achieve these reductions, thus opening up a revenue stream to this market:

> *'There are all sorts of obligations imposed on the [Energy Utilities] that we have tapped in, and not just for the CHP. We tap into it all the time and we have had a lot of money out of them over the years' (Manager, Local Authority ESCo)*

Importantly however, this research finds that these obligations provide little incentive for Energy Utilities to radically alter their business model because they do not remove the Energy Utilities' 'volume sales driver', an issue also identified by Eyre (2008). It does little to stimulate major interest across the major UK Energy Utilities to move away from their traditional business model, where their revenue increases with the number of units of gas and electricity sold. In contrast, the ESCo model would either wholly or partly decouple revenue from energy throughput. The obligations could be strengthened to either mandate or encourage Energy Utilities to fundamentally restructure their business model in a way that satisfies their customers' energy needs in a sustainable manner rather than making a few minor operational changes that are capable of satisfying the obligation's requirements.

It is also important to note that the UK's energy supplier obligations relate only to domestic energy supply. To help improve the efficiency of commercial energy supply the CRC Energy Efficiency Scheme was established, which is an obligation on commercial consumers rather than on suppliers. It requires large energy consumers to buy annual allowances to cover the emissions associated with their energy consumption. A number of interviewees identified this as an important driver (n = 11), largely because it has driven energy efficiency up the corporate agenda by imposing financial penalties on large corporations who exhibit poor levels of energy efficiency:

> *'[With the CRC] you are now getting the likes of Diaggio and BP going 'Oh God, I've got to write a cheque for £2 million, where's that come from? … Think of their energy spend, it is massive' (Director of Sustainable Energy Finance, Multi-national Bank)*

There is currently some debate around whether these efficiency obligations should be placed on commercial suppliers or on

[5] See Appendix B for a set of typical interview questions.

consumers (Bertoldi et al., 2013). This research identifies that both approaches have proved effective in the UK and so government should consider placing obligations on *both* the supplier and the consumer to improve the efficiency with which users consume energy. This would avoid the issue of 'split incentives' between the two parties with regards to improving energy efficiency levels. For ESCos this would mean that not only would they be well-placed to discharge this obligation but that there would be greater interest amongst consumers in the value proposition of their energy efficiency solutions, given the obligation placed upon on them to improve their levels of energy efficiency. However, further research is required to understand whether these two policy approaches could work alongside one another in practice.

4.1.1.2. Electricity trading arrangements.

Some interviewees (n = 2) explained that the current UK electricity trading arrangements (i.e. BETTA) were not supportive of small-scale, decentralised energy generation, distribution and supply, particularly those which rely on intermittent sources of renewable energy. One LA chief executive explained that the current market structure is biased towards the need of large-scale Energy Utility companies, arguing that: *'the rules are written for them'* and that *'the transaction and membership costs are inhibitive'*. Their colleague, a managing director of the LA's ESCo, explained that to enter the electricity market to trade their electricity and that *'it would cost us £500,000 minimum to join that pool … far too much as a small supplier'*.

This presents a critical barrier to ESCos who typically engage in this type of activity, one that has been highlighted previously (Section 2.2). The research finds that the prospects for ESCos could be improved if the market were re-structured so that companies sourcing their electricity from intermittent (renewable) sources of energy were not penalised to the same extent that they are now. Additionally, relaxing the caps imposed by electricity licence exemption rules on the scale of generation, distribution and supply would enable companies, who were ill-equipped to trade on the electricity market, to operate at larger scales and harness greater economies of scale. In turn, this would reduce their transaction costs per kWh of electricity sold and consequently improve their profit margin. Alternatively, the system could be re-structured so that smaller-scale electricity companies are not subjected to the same membership costs as larger scale companies; such is the high cost of connectivity to the grid.

4.1.1.3. Low-carbon planning and building regulations.

Planning permission relates to a Local Authority's (LA) formal permission to erect or alter a building or similar development and is largely dependent on the type of impact it will have on its immediate environment. A number of interviewees (n = 5) highlighted how important planning was to whether or not an ESCo could deliver a project or not was the extent to which LAs prioritised the need for developments with energy efficiency and/or renewable energy solutions:

> *'[If] planning people say I want CHP on that site otherwise I will not give you planning permission, then you have to provide a gas fired CHP. If they believe in that and insist on that because they believe it gives a low carbon solution … you cannot get your site off the ground [without it]' (Sustainability Director, Private Sector ESCo)*

Following successful planning permission in the UK, whoever constructs the building must adhere to building regulations. In recent years these have incorporated more stringent standards around energy efficiency and the UK government has set a target within the building regulations requiring new domestic homes to be 'zero-carbon' by 2016 and new commercial buildings to be zero-carbon by 2019. These targets present a huge challenge to developers, and many observers are sceptical that they will be met. A number of interviewees (n = 3) explained that highly energy efficient building regulations can help to support ESCo market growth because some developers opt to transfer this responsibility to ESCos, who deliver low-carbon energy solutions on their behalf:

> *'Developers have this requirement on them to meet a … carbon reduction or … renewable [target]. They don't know how to deal with this … They would say 'look, I don't want to deal with this hassle. I want you guys take it away from me' … So what they do is employ us to design, build, fund and operate an ESCo company [and] take that responsibility for meeting their planning conditions' (Head of Community Energy, Energy Utility ESCo Division)*

It should be noted that building regulations are mostly relevant to new-build projects and whilst the research found evidence of developers contracting ESCos to meet these efficiency standards on their behalf, ESCos have traditionally engaged with retrofit projects. Consequently, opportunities to implement policy that obligates landlords of *existing* buildings to meet certain energy efficiency standards rather than just *new-build* should be explored.

4.1.1.4. Local government powers.

A lack of Local Authority (LA) willingness to engage with and support ESCo projects was identified as a critical barrier to ESCo projects by a range of interviewees (n = 9), largely because LAs in the UK are capable of either establishing their own arms-length ESCos, facilitating the development of energy service contracts being developed by other ESCos (e.g. via planning) or by acting as a customer for an independent ESCo (see Bale et al., 2012; Hannon, 2012; Hannon and Bolton, 2015).

At present one approach to encourage LAs to engage with low-carbon energy initiatives is through voluntary emissions reduction schemes, such as the Covenant of Mayors movement in Europe where covenant signatories aim to meet and exceed the European Union 20% CO_2 reduction objective by 2020 (Covenant of Mayors, 2013). However, the voluntary nature of these initiatives means that LAs are free to ignore them. Obligatory city-level emissions reduction targets as recommended by the CCC (2012) could address this issue and encourage LAs to engage with ESCo model to meet these targets via energy efficiency gains.

Instead of constraining LAs decision making via obligations, one alternative is to widen their powers. For instance, the UK's 2011 Localism Act provides LAs in England and Wales with the power to implement any policy that they consider to have the potential to promote the economic, social and environmental well-being of their area, unless these measures are explicitly prohibited by national legislation (DCLG, 2011). Some interviewees explained that these additional powers have helped some LAs to implement energy projects (n = 8) who have traditionally found it difficult due to their limited powers. The Localism Act also makes provisions to provide community organisations with additional powers, such as the right to draw up neighbourhood plans allowing them to bring forward building developments that the majority of the community would like to see built (DCLG, 2011). These additional powers could enable local groups to establish their own energy initiatives: *'If the community wants to go ahead with it, why should some higher level stop them doing it?' (Committee Member, Community ESCo)*.

Some interviewees (n = 3) also highlighted how important it was that LAs had been granted wider powers to implement energy supply projects via deregulation, namely the repeal of a clause in the 1976 Local Government Act in 2010 that had previously prohibited LAs 'from selling electricity which is produced otherwise than in association with heat [e.g. CHP]' (DECC, 2010 p.4):

'There were until this year restrictions on the ability [of] Local Authorities to supply electricity. Those have been removed which opens up a greater ability certainly for Local Authorities to become involved in energy related schemes' (Partner, Law Firm)

Finally, research found that a UK policy similar to the Danish Heat Law, which provides Danish LAs with the powers to mandate owners of new and existing buildings to connect to local low-carbon energy schemes (DEA, 2005), could provide ESCos providing ESCs with a much larger potential customer base and in turn help to make the schemes more financially viable.

4.1.2. Economic incentives

Economic incentives were identified as crucial in supporting ESCo activity in the UK. These include capital grants and long-term financial incentives for low-carbon energy projects. In addition, new forms of green finance for energy efficiency measures have the potential to further support ESCo activity.

4.1.2.1. Capital grants & long-term financial incentives.

The research found a major policy drivers of ESCo activity in the UK has been the provision of financial incentives (n = 16) (i.e. Feed-in-Tariff and the Renewable Heat Incentive) and capital grants (n = 9) designed to alleviate concerns around the high costs often associated low-carbon energy projects, a solution to an ESCo barrier identified by other research (Sections 2.2 and 2.3). For instance, long-term financial incentives have represented a real boon for ESCos providing ESCs because they provided them with long-term (typically 25 years) payments for low-carbon generation of electricity or heat, bolstering their revenue streams.

'[They are] brilliant for ESCos … It is guaranteed income, RPI linked for 25 years. Where do you get that sort of guaranteed money? It is safe as houses [and] government backed' (Sustainability Project Manager, Private Sector ESCo)

Additionally, capital grant schemes have helped to provide many ESCos, who do not have easy access to finance or external investment, with the necessary capital to cover the upfront costs of energy service contracts.

'We were fortunate because we got DECC Low Carbon Communities challenge money. We were awarded £400,000 from that which enabled demonstration [of our] community projects … to try some of these ideas out' (Committee Member, Community ESCo)

A number of interviewees (n = 6) highlighted that the decline of these capital grant schemes in recent years in the UK has therefore made it difficult for less wealthy ESCos to secure the necessary 'start up' capital to implement projects. Interestingly however, the decline of capital grant schemes was also seen as a positive development by some interviewees because a reduction in grant funding for sustainable energy projects meant that energy consumers had reduced access to capital in order implement these projects themselves, meaning they were more inclined to contract with ESCos to cover all or most of the upfront capital costs themselves:

'[The] FiTs are a bit of a bonkers idea … because the barrier [to energy projects] is the upfront capital cost, so why are we giving them a long-term revenue stream? … The institutional and policy arrangements might lead you to an ESCo [because] if you gave a grant, what is the role for ESCo? [But] if you've got a FiT, you might get a role for an ESCo. The RHI will be the same issue' (Energy Efficiency Expert, University)

In light of these findings government should strike a balance between the provision of long-term financial incentives and capital grant schemes. Carefully designed capital grant schemes could help to ensure that ESCos have sufficient access to capital to cover some of the upfront costs of their projects and avoid a situation where capital is so freely available to consumers that they do not need to engage with ESCos to finance energy measures. Additionally, long-term financial incentives have been very successful in bolstering ESCos' revenue streams, making the ESCo model more attractive to potential adopters. However, this research suggests that subsidies are not offered indefinitely but only until the point at which the costs of implementing these technologies (i.e. design, installation, operation, maintenance etc.) fall sufficiently low following technological and learning advances that they become affordable without government subsidises.

4.1.2.2. Green finance.

A handful of interviewees (n = 10) explained that finance for ESCo projects was more readily available than it had been in the past, however various interviewees (n = 11) still highlighted a lack of private sector finance and investment in ESCo projects as a key barrier:

'No matter how good the project was, you need the right kind of money and the right kind of money just isn't available' (Partner, Low-carbon Agricultural Think Tank).

As highlighted in Section 4.1.3.1, ESCo awareness raising initiatives could play an important role in leveraging finance by raising awareness amongst investors and financiers about the potential benefits of investing in energy service contract projects. These should focus on investors who prefer low-risk, long-term, medium-return investments (e.g. pension funds), which broadly match the characteristics of energy service contracting. A more direct solution identified by the research and previous work (Section 2.3) is to introduce schemes that enable ESCos to leverage finance more easily. The most recent and high-profile example of such a scheme in the UK is the Green Investment Bank, established to help organisations engaging in sustainable development activities circumvent many of the existing barriers they face in accessing finance. It has enjoyed a promising start, investing £700 million in 21 projects in its first year (GIB, 2013).

Another finance scheme is the Green Deal,[6] introduced by the UK government in January 2013, to stimulate the financing of domestic low-carbon energy improvements. In response, an industry-led consortium set up the Green Deal Finance Company (GDFC, 2012) was established to provide the lowest cost finance necessary to fund Green Deal projects. However, the uptake of the Green Deal has so far been modest with only 2,248 households having had Green Deal Plans signed or completed up to the end of June 2014 (DECC, 2014). Whilst a number of reasons for this poor uptake have been identified by previous research (UKGBC, 2014), such as poor communication, complexity and high interest rates, the interviews were conducted prior to the schemes launch so whilst this research identifies the need for this kind of green finance schemes it does not present any new evidence to inform the redesign of the Green Deal. Nevertheless, this research finds that this type of innovative

[6] Constitutes a financial mechanism that eliminates the need for householders to pay upfront for sustainable energy supply (e.g. PV panels) and/or energy demand management measures (e.g. loft insulation) as these are covered by the savings they will generate on the customer's energy bill in the future (DECC, 2012c).

financing mechanism could potentially stimulate the adoption of the ESCo business model by making finance more freely available to them.

4.1.3. Informative policies

Informative policies could help to address the barrier associated with the lack of awareness and understanding of the ESCo model by key actors. Awareness initiatives, training schemes, energy service contract standardisation, and accreditation and certification schemes were identified by the interviewees as potential policies to overcome this barrier.

4.1.3.1. Awareness initiatives.

One of the most significant barriers to UK ESCo activity highlighted by the interviewees (n = 18) was a lack of awareness of the ESCo model. This was sometimes coupled with a poor understanding of the ESCo model and in particular damaging misconceptions of the business model, amongst both prospective ESCos *and* customers (n = 6). For instance one interviewee explained that:

> *'Getting the market to understand what is on offer … is a key constraint … I don't think that the market genuinely understood what we were trying to do when we first explained to them' (Sustainability Director, Private Sector ESCo).*

Some interviewees (n = 5) also identified that the ambiguity and complexity of the energy policy landscape presented an important barrier to ESCo activity, with one interviewee commenting that:

> *'Everyone is trying to find their way through this structure, this crazy and difficult financial world, alongside the carbon imperatives … [It's] very complex' (Sustainability Project Manager, Private Sector ESCo).*

In light of these findings this research supports the need to establish publicly funded initiatives to promote understanding and awareness of energy service contracting amongst both prospective ESCos and ESCo customers, a call echoed by previous work (Section 2.3). Additionally, these educational initiatives should also make provision for helping both prospective ESCo and customers to understand the wider energy policy landscape, in order to help them navigate it. The research finds that government could be well placed to not only fund but also manage these initiatives. This is evidenced by DECC's Community Energy Online Portal (DECC, 2012a), which is designed to raise communities' awareness of energy funding, best practice case studies, planning issues etc., and to help them establish community energy organisations. However, non-departmental public bodies (e.g. Energy Savings Trust) or trade associations (e.g. Energy Service and Technology Association (ESTA)) could also deliver these schemes. Importantly, EU member states will soon have to consider how best to implement these recommendations given that the new European Energy Efficiency Directive (EEED) obligates them to disseminate clear and easily accessible information about arrangements for energy service contracting and the various energy policies in existence that support energy service projects (EU, 2012).

4.1.3.2. Training schemes.

A number of interviewees (n = 5) identified that there is a lack of people in the UK with the necessary skills to develop and deliver energy service contracts, particularly the measurement and verification of energy savings, as well as the operation and maintenance of low-carbon energy equipment:

> *'Finding people who understand [energy service contracts] and can structure them correctly is not easy. They are rare and not easy to find' (Product Development and Energy Services Manager, Energy Utility ESCo Division).*

This research consequently supports the need to establish programmes that develop the skills necessary to deliver energy service contracts and in turn help grow the ESCo market, a recommendation outlined in other research (Section 2.3). These initiatives may be subsumed within, or take a similar approach to, initiatives such as Scotland's Low Carbon Skills Fund (SDS, 2012) and the UK government's Green Deal Skills Alliance (Green Deal Initiative, 2012), that are designed to cultivate the skills necessary to deliver sustainable energy measures in the UK.

4.1.3.3. Energy service contract standardisation.

A number of interviewees (n = 7) explained that the lack of standardized energy service contracts in the UK has made the sales process lengthy and resource intensive as ESCos currently spend significant amounts of time developing bespoke service contracts with customers. One interviewee explained that:

> *'The time that gets spent negotiating these contracts is ridiculous [because] the terms of the individual supply agreements, the leases, all require substantial amount of rework generally and you go through this process with each project of explaining the conflicts and limitations … Regulation would hopefully speed up the process [by] standardising the arrangements' (Partner, Law Firm)*

One way of addressing this situation might be through the provision of freely available energy service contract templates, which ESCos are able to use when drafting their own contracts, could present a way forward. Some interviewees explained that lessons about how to provide these templates from the Greater London Authority's (GLA) RE:FIT energy service contract procurement framework, which offers pre-negotiated, EU-regulation compliant framework contracts as part of the procurement procedure (see Section 4.1.4). Alternatively, contract templates could be offered by ESCo associations such as Energy Services and Trade Association (ESTA) in the UK or the European trade association EU-ESCo.

Another option could be to promote standardisation via the provision of clear contractual definitions and protocols that provide customers with some peace of mind that the ESCo will provide a high-quality of service. One example has been the introduction of International Performance Measurement & Verification Protocol (IPMVP) for EPCs, initially developed by a collection of organisations in the US, constitutes an important step forward in this regard as it provides an overview of current best practice techniques available for verifying results of energy efficiency, water efficiency, and renewable energy projects (DOE, 2002). Following such 'good practice' protocols, energy service contract accreditation and certification schemes could also help to promote standardisation, alongside building consumer trust.

The research warns however that energy service contract standardisation is difficult to achieve given the bespoke nature of energy service contracting, where part of an ESCo's value proposition is that its contracts are tailored to the specific needs of the customer and their built environment. Even so serious consideration will have to be given to this issue given that the recently ratified EEED requires member states to provide model contracts for energy performance contracting in the public sector (EU, 2012).

4.1.4. Direct public sector purchasing

The research identified that public sector organisations tend to be well suited to energy service contracts considering that they

typically occupy large buildings with high levels of energy service demand over the long-term. Also, contracting with a single large energy users means the ESCos is able to capture good economies of scale compared to contracting with multiple customers occupying smaller sites, helping to reduce their transaction costs (Section 2.1.2). Furthermore, public sector organisations are also attractive to ESCos because they are financially backed by government. As one interviewee explained '*the public sector never goes bust*' *(Associate, District Heat and Electricity Association)*, thus giving the ESCo confidence that its public sector customers will not default on their payments. Despite this strong fit a number of interviewees (n = 8) found that the current public procurement framework, based on the Official Journal of the European Union's (OJEU) guidelines, has hindered the uptake of energy service contracts by the public sector:

> *'If you want to do [an EPC] with more than a certain amount of money you will have to go through OJEU to procure an ESCo in this costs money and time … It takes two years and it will cost £250,000 to procure from scratch … It is easier to say I'm doing nothing' (Project Leader of Energy Services Procurement Framework, Regional Development Agency)*

In the context of these findings the research supports the need for procurement protocols that are more supportive of energy service contracting, echoing calls in previous research (Section 2.3). In particular clear, a number of interviewees (n = 5) emphasised that lessons could be learnt from the GLA's RE:FIT scheme. They highlighted how it had offered practical and ready-to-use guidelines to help organisations navigate the energy service contract procurement process, as well as pre-negotiated, EU-regulation compliant framework contracts as part of its procedure (Section 4.1.3.3), meaning that organisations procuring energy service contracts through this framework had typically reduced their procurement time from 12 to 18 months period via OJEU to approximately 3 to 6 months (Managenergy, 2011).

4.2. Holistic approach to policy design

None of these policies operate in isolation; instead operating alongside one another. Consequently, it is important for government to consider how compatible and sustainable these policies are over a number of years to ensure a stable and robust policy framework is developed. A host of interviewees (n = 7) explained that this had not necessarily been achieved in the UK and that a key barrier to the delivery of innovative, low-carbon energy projects in general is the uncertainty surrounding the future energy policy developments generated in part by the frequently changing of UK energy policy:

> *'[UK energy] policy has been communicated and implemented in such a mishandled and volatile way. It means confidence is very low in any external monetary incentive … Policy is a moving goalpost' (Director, Private Sector ESCo)*

Consequently, many potential ESCos, as well as their investors and customers, have shied away from long-term energy service contracts because they are uncertain whether the policy landscape will be supportive of their project in the future. Uncertainty was largely attributed to the UK government's various swift and unforeseen changes in energy policy over recent years, such as the much contested FiT cuts of early 2012. The findings suggest that a clear policy roadmap, alongside a strong commitment from the government to adhere to this strategy, is needed in order to build actors' confidence that engaging with an energy service project would prove financially and operationally viable in the future. However, it is important to understand that, like energy suppliers and users, policymakers do not have perfect foresight either and that unforeseen developments (e.g. natural disasters, geopolitical conflicts, economic downturns) often require swift policy responses.

4.3. Barriers not easily addressed by UK government policy

Whilst UK government policy is already making a valuable contribution to addressing key barriers to ESCo activity or is likely to in the future not all barriers to ESCo activity identified in the UK can easily be addressed by policy alone, especially those tied to international developments. For instance, international economic trends can be damaging to ESCo activity, such as the global economic downturn in the late 2000s that limited the availability of much needed finance for ESCos. Additionally, whilst national government can have an important bearing on consumer fossil fuel prices in domestic markets through mechanisms such as subsidies and tax breaks, these are dictated in large part by the international energy market, which is sensitive to a wide variety of developments that are largely beyond the control of the UK government (e.g. geopolitical conflicts, global production levels etc.). The UK government has also made efforts to subsidise the cost of a variety of low-carbon, distributed energy technologies that are well suited to the ESCo model. Examples include the subsidisation of low-carbon electricity and heat micro-generation technologies through the FiT and the RHI respectively. However, the 'per unit' cost of these technologies is very much dependent on international R&D efforts and the development of global supply chains, which the UK government has limited control over.

Government policy is also unlikely to address some of the intrinsic characteristics of the ESCo model that limit its uptake (see Section 2.2). These include the long-term contracts ESCos provide which limit consumer freedom, the small scale at which ESCos normally operate that can constrain the economies of scale they enjoy and ESCos' focus on bespoke contracting, which limits their ability to easily replicate contracts from one project to the next:

> *'The big problem with the Distributed Energy (DE) ESCo model is that it is very bespoke and as a result it is very costly, lawyers make a fortune. It doesn't tend to be highly replicable and that is a problem' (Director, Private Sector ESCo)*

Finally, UK government policy is subject to decisions taken at a European or international level, which can sometimes undermine ESCo activity. For example, European State Aid Rules cap how much government funding that commercial organisations can receive, which has served to constrain the activities of certain community and LA owned ESCos who are very reliant on government subsidy:

> *'You can only have state aid up to the de minimus threshold, which is 200,000 euros … If you go above it you are breaking [the law]' (Committee Member, Community ESCo).*

5. Learning from the UK ESCo case: policies to support PSS uptake in other sectors

This section situates the findings from the ESCo case study in the context of the broader PSS research landscape in an attempt to identify some lessons about how government policy could help to support PSS application in other sectors.

5.1. Balancing the mix of direct policy incentives and disincentives

Previous research has identified the importance of both direct policy incentives and disincentives in supporting both ESCo and PSS activity (Section 2.3). Whilst this research supports this view it goes one step further to call for *both* economic incentives (Section

4.1.2) and regulation (Section 4.1.1) to be implemented simultaneously, as well as for a balance to be struck not only between these policies but also within these policy categories. For example, a balance between long-term economic incentives versus one-off capital grants (Section 4.1.2.1) and supplier versus consumer oriented efficiency regulations (Section 4.1.1.1).

Given that PSS models are normally structured to satisfy common human needs and desires, with lower associated environmental degradation compared to traditional business models, many scholars have recommended the introduction of economic incentives and regulation that helps to 'level the playing field' between PSS and incumbent, product-based firms (Mont and Lindhqvist, 2003; Tukker et al., 2008; Ceschin and Vezzoli, 2010). This is considering that the high-costs typically associated with new markets due to immature technologies and underdeveloped supply chains. This research identifies similar needs but with some important caveats.

Focusing on economic incentives, the ESCo case study identified that both 'one-off' capital grants schemes and long-term financial incentives for low-carbon energy generation have proved invaluable to the establishment of this PSS model, particularly during a period when private sector investment was not forthcoming due to the immaturity of the sector. However, recently in the UK there has been a move away from capital grants towards long-term financial incentives, such as the FiT and RHI. This has raised issues around how ESCos can source the necessary start-up funds to cover the various up-front capital costs associated with establishing their business.

Whilst this paper supports the need for government to make funding available to support the delivery of PSS projects (Mont and Lindhqvist, 2003; Tukker et al., 2008) a balance should be struck between these two types of subsidies to help PSS firms manage both high initial start-up capital costs *and* high, ongoing operational costs typically associated with operating a business in an immature market. Alongside these government subsidies, the ESCo case study also underlines the importance of low-cost finance in enabling PSS firms to cover initial upfront capital costs (Tukker et al., 2008; Bilsen et al., 2013). This presents a very important step in the transition of PSS firms away from government subsidies towards private sources finance.

The paper also identifies an important role for regulation in improving the selection environment for PSSs by encouraging both suppliers *and* consumers to move away from engaging with traditional, unsustainable, product-based business models. Focusing on suppliers first, incumbent firms employing these types of models are unlikely to question their 'business as usual' approach whilst their current mode of business remains profitable (Mont, 2002, 2004; Charter et al., 2008; Ceschin, 2013). Therefore, there is a need for policies such as UK energy supplier obligations that impose financial penalties on companies who choose to operate unsustainable, product-based business models, thus translating any environmentally adverse effects of companies' core business activities into costs upon the company (Mont and Lindhqvist, 2003; Tukker et al., 2008; Ceschin and Vezzoli, 2010). This type of supplier oriented regulation can also be usefully complemented by obligations that focus on encouraging consumers' to improve their levels of resource consumption efficiency, such as the CRC Energy Efficiency Scheme in the UK. Therefore, the paper identifies a need to establish a balance between both supplier *and* consumer oriented efficiency obligations to ensure that both parties are incentivised to improve levels of resource efficiency.

5.2. Acknowledging the importance of indirect policy support

Measures that facilitate rather than directly stimulate PSS activity are identified by both this research (Section 4.1.3) and previous work (Section 2.3) as important to PSS activity.

Such policies include learning initiatives designed to improve both understanding and awareness of PSS models amongst both suppliers and consumers (Tukker et al., 2008; Ceschin and Vezzoli, 2010; Krämer and Herrndorf, 2012), which could be led by trade associations such as ESTA in the UK. Alongside PSS-specific learning, these initiatives could also help to provide prospective PSS firms with insights into the workings of the wider regulatory framework and how this might impact upon PSS activity for better or for worse, such as DECC's Community Energy Portal in the UK (Section 4.1.3.1).

Government could also help to develop certification and accreditation schemes to promote 'best practice' standards for PSS activity to build trust amongst their potential customer base and to reduce transaction costs associated with developing PSS contracts, such as the IPMVP for ESCos (Section 4.1.3.3). Transaction costs may also be significantly reduced by the development and provision of model contracts for particular PSS models, as provided via the London's RE:FIT programme for ESCos (Section 4.1.3.3). Start-up PSS firms could use these as a basis for their business development, helping them to avoid costly mistakes and research into contract design.

Finally, this paper identifies the need for government-led and funded skills training initiatives to support the uptake of PSSs by ensuring that there is a sufficiently large skills base from which PSS firms can recruit the necessary staff to operate their business (Ceschin and Vezzoli, 2010). These skills are likely to range from specific skills associated with delivering PSS projects to other professional skills that PSS firms call upon to support the delivery of these, such as law, finance, engineering etc. For example, the case study identified schemes such as the UK's Green Deal Skills Alliance (Section 4.1.3.2) as a potentially important means of developing the skills based for the monitoring and verification of energy savings or the installation of micro-generation and energy efficiency measures.

5.3. Redesigning existing market structures

As highlighted in previous research (Section 2.3.2) greater flexibility in market structures could support PSS business model experimentation. This view is supported by the case of the UK ESCo sector where this research (Section 4.1.1.2) identified that the current electricity trading arrangement favour large-scale, non-intermittent energy generation, not typically undertaken by ESCos who operate at a smaller scale, often with intermittent renewable energy generation technologies. Another example included the redesign of public procurement procedures (Section 4.1.4), so that ESCo solutions should be included in public sector purchase guidelines and are prioritised over product sales, which has been echoed for other PSS sectors (Larsen and Svane, 2005; Tukker et al., 2008; Ceschin and Vezzoli, 2010). These examples serve to highlight how existing market structures can inhibit the application of innovative business models that operate differently to incumbent models. Consequently, the research supports the need for government to regularly review market arrangements to identify whether or not current market structures are bias towards incumbent business models at the detriment of innovative forms of business that might offer some advantages in terms of sustainable development.

5.4. Promoting locally-led PSS activity

A key finding of this research that has not been explicitly identified by previous work is the importance of local-level coordination and facilitation of PSS activity, primarily by LAs (Section 4.1.1.4). This is primarily because LAs represent key decision

makers at the local-level (e.g. local-level funding allocation, town planning etc.), which is where the majority of grassroots, sustainable development initiatives begin. Consequently, national government should take a two-track approach to mobilising LAs to support PSS activity. The first is to impose regulations on LAs that either obligate or incentivize them to actively support PSS firms, through policies such as city-level GHG emissions targets. The second is to implement legislation that provides them with sufficient decision making powers to be able to support PSS activity, such as the UK's 2011 Localism Act. Importantly, these policies may also encourage LAs or community groups to establish their own PSS initiatives, which could play a key role in enabling these to meet their core objectives (e.g. economic growth, sustainable development etc.).

5.5. Creating a stable policy framework

Both previous work (Section 2.3.2) and this research (Section 4.2) underlines the importance of establishing a sufficiently stable and robust policy framework that existing or prospective PSS firms can foresee, with a relatively high degree of confidence, that they will be operating their business in a policy environment that is broadly supportive of PSS activity in the future. This stability is also likely to stimulate investment in this area as investors also possess a strong degree of confidence that policy will remain supportive of PSS activity. A similar trend was highlighted by Lüthi (2010) with respect to solar PV investment. Consequently, this paper supports the view that governments should avoid making sudden and drastic changes to their regulatory frameworks and ensure that the rationale for any new energy policies is clearly communicated with both suppliers and consumers. However, the authors acknowledge a certain degree of regulatory flexibility is essential given that unforeseen events commonly take place and that subsequent policy changes may be required.

6. Conclusions and policy recommendations

This paper examines how government 'demand pull' policies present a potentially powerful means of stimulating the uptake of service-based, sustainable business models, commonly referred to as PSSs. Lessons are drawn from an empirical investigation into how government 'demand pull' policies have helped to support UK ESCo activity; a PSS business model centred on the efficient provision of energy services to consumers. Consequently, the paper offers an empirically grounded and up-to-date contribution to the debate on how government policy can stimulate not only ESCo activity but PSS market growth more broadly (see Section 2.4). It therefore provides insights into how government can help advance sustainable business practices and support the move to a more sustainable economy.

These 'demand pull' policies are examined using an analytical framework synthesized from the innovation systems literature, which categorises them in terms of *regulation*, *economic incentives*, *informative policies and direct public sector purchasing*. In terms of *regulation* the research supports the need for energy efficiency obligations that cover both energy suppliers *and* consumers, as well as supplier obligations that fundamentally challenge the 'volume sales driver' that forms the basis of many energy companies' business models. Other recommendations include a restructuring of electricity trading arrangements to help ESCos capture stronger economies of scale, as well as building and planning regulations that require more stringent low-carbon energy solutions for both new-build *and* retrofit property developments. Finally, a mix of regulation that enables, encourages and requires LAs to deliver energy service projects at the local-level should also help stimulate ESCo activity.

In reference to *economic incentives* the research supports the need to strike a balance between low-carbon energy capital grants and long-term financial incentives in a bid to help address both capital and operational cost barriers. There is also a need to maintain and refine 'green' finance schemes capable of leveraging funding for ESCo projects. In terms of *informative policies* the research recommends initiatives that raise awareness of the characteristics and benefits of the ESCo model across the energy market, as well as training initiatives to develop the skills necessary to deliver energy service contracts. The research also recommends the introduction of standardised energy service contract templates to reduce transaction costs associated with drawing up contracts, as well as ESCo accreditation and certification schemes to improve consumer trust. Turning to direct *public sector purchasing* the research calls for public sector procurement protocols that stimulate the procurement of energy service contracts rather than inhibit them.

More broadly the paper identifies the need for these policies to be designed in a more holistic fashion in a bid to develop in a robust energy policy framework that gives confidence to both potential providers and users of energy service contracts that the policy landscape will remain supportive of these activities in the future.

Building upon the ESCo case study this paper draws five evidence-based policy recommendations to support PSS activity: (1) a balanced portfolio of economic incentive and regulatory policies; (2) a combination of 'direct' financial policy incentives/disincentives and 'indirect' policy support such as informative schemes to raise PSS awareness, develop PSS skills and standardise PSS contracts, alongside PSS industry accreditation and certification schemes; (3) a (re)design of market structures (e.g. trading arrangements, procurement frameworks etc.) to enable PSS activity; (4) policies that encourage locally inspired PSS activity with key roles for Local Authorities and community organisations; and (5) a stable policy framework that inspires confidence in existing or potential PSS firms that the future policy landscape will be supportive of their business activities.

Despite the critical role government policy could play in supporting the proliferation of PSSs, the research finds that policy cannot easily alter all aspects of socio-technical systems to support the activity of PSSs, such as customer preferences, international economic developments and technological progress. Additionally, government policy is also not particularly well-equipped to address inherent weaknesses within the structure of PSS models, such as high transaction costs due to the bespoke nature of service contracting and the long-term contract period of these contracts. This emphasises that whilst government policy represents an important means of supporting PSS activity, it constitutes only part of the wider solution. Therefore, further research into the types of approaches that could effectively remedy PSS barriers that cannot easily be addressed by government policy would be welcomed.

The research also identifies that no single governance actor is primarily responsible for developing supportive PSS policy. The ESCo case study highlights that whilst national government plays a central role in developing policy, other governance actors such as European Union, trade associations, non-departmental public bodies, community organisations and Local Authorities are also active in this regard. Therefore, future research could examine in greater details how governance actors other than national government might support PSS activity. It is also important to note that whilst a large number of experts were interviewed as part of this research the sample is not necessarily representative of the

UK ESCo market as a whole and that further empirical work could potentially uncover additional or contrasting insights and this should be encouraged. Similarly, the research has examined only one sub-set of PSS activity and similar empirical work into different types of PSS activity should be conducted. Finally, the paper has focused explicitly on 'demand pull' policies and that future research might examine how 'supply push' policies focused at the earlier stages of innovation might also help to support PSS activity by developing innovative technologies that are more amendable to sustainable, service-oriented business models.

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Appendix A. Anonymised list of interviewees

Firm type	Job title	Date
Local Authority ESCo	CEO	22/7/2010
Local Authority	Head of Environment Unit	22/7/2010
Private sector ESCo	Director	9/8/2011
Local Authority	Principal Designer & Energy Engineer	11/8/2010
Investment Company	Head of New Energy and Power Research	17/9/2010
Private sector ESCo	Sustainability Project Manager	17/9/2010
University	Senior Research Fellow	21/9/2010
Energy Utility	Head of Community Energy	18/10/2010
Local Authority	Head of Sustainable Development	19/10/2010
ESCo	Head of Energy Efficiency & Environmental Care	8/12/2010
Low-carbon Energy Consultancy	Associate Director	17/1/2011
Community ESCo	Committee member	8/7/2011
Low-carbon Agricultural Think Tank	Partner	12/7/2011
Law Firm	Partner	13/7/2011
Private sector ESCo	Energy Solutions Marketing & Strategy Director	13/7/2011
Private sector ESCo	Finance Director	14/7/2011
Bank	Director of Sustainable Energy Finance	20/7/2011
Private sector ESCo	Director	20/7/2011
Energy Utility ESCo Division	Emergent Technology Specialist	21/7/2011
Private sector ESCo	Sustainability Director	21/7/2011
District Heat and Electricity Association	Associate	22/7/2011
Local Authority ESCo	Manager	4/8/2011
Community ESCo	Chairman	9/8/2011
Law Firm	Partner	15/8/2011
Regional Development Agency	Head of Environment & Project Leader of Energy Services Procurement Framework	15/8/2011
Government Department of Energy & Climate Change	Policy Advisor	16/8/2011
Energy Utility ESCo Division	Director of Community Energy	22/9/2011
Energy Utility ESCo Division	Product Development and Energy Services Manager	28/9/2011
Consumer Oriented Think Tank	Chief economist and Head of Fair markets	10/10/2011
Private sector ESCo	Director	11/1/2011
Private sector ESCo	Knowledge Transfer Partnership Associate	31/1/2012
Local Authority	Chief Executive	10/1/2012
Local Authority ESCo	Managing Director	10/1/2012
Private Sector ESCo	Director of Business Development Public Services in Community Energy Division	16/1/2012
Private Sector ESCo	Head of Energy Solutions	19/1/2012
Private Sector ESCo	Business Development Manager in Community Energy Division	24/1/2012
Private Sector ESCo	Senior Business Manager Commercial Energy Division	1/2/1012
Community ESCo	Director of MPT & Meadows Resident	2/2/2012
Community ESCo	MPT Trust Accountant	7/2/2012
Community ESCo	Chair of Meadows Partnership Trust (MPT) & Meadows Resident	9/2/2012
Energy Utility ESCo Division	General Manager	3/4/2012
Energy Utility ESCo Division	Business Development Manager	4/5/2012
Energy Utility ESCo Division	General Manager	22/5/2012

Appendix B. Typical questions posed in semi-structured interviews

Strengths and weaknesses

a) What is your experience and understanding of the ESCo model?
b) What do you believe are the key strengths and weaknesses of the ESCo model?

Drivers and barriers

a) What are the key drivers and barriers to ESCo adoption and operation? E.g. Governmental policy, economic climate, public perception of climate change etc.
b) Which UK government policies currently support the ESCo market?

ESCos and the future UK energy system

a) What role do you imagine ESCos playing in the transition to a low-carbon UK energy system?
b) How important do you believe this role might be?
c) What are likely to be the key factors that will enable or inhibit ESCos to fulfil this role in the future?
d) How might UK government policy support growth in the ESCo market?

Appendix C. Existing 'demand pull' policy drivers in UK ESCo market

Policies	Description of policy	Policy's influence on ESCo model	Nos. of interviewees who cited policy driver (n = 43)
Regulation			
Carbon Reduction Commitment Energy Efficiency Scheme (CRC)	The CRC Energy Efficiency Scheme began in 2010 and requires all organisations consuming more than 6 GWh of electricity per annum to buy allowances each year to cover their emissions. For Phase 1 allowances started at £12/tonne of CO_2 in 2011 and discussions are ongoing about the appropriate levels for Phase 2 (Carbon Trust, 2012). Participants' performance is also ranked in a publicly accessible league table, designed to 'name and shame' poor performers.	Puts energy efficiency on corporate agendas	11
Local government powers	The Local Government Acts 2000 and 2003 and Localism Act 2011 have provided LAs with the 'power of well-being', thus increasing their level of political autonomy. These allow LAs in England and Wales to implement any policy they believe will promote the economic, social and environmental well-being of their area, unless explicitly prohibited by national legislation (CLG, 2009).	Provided greater opportunities for Local Authorities and communities to establish 'arm's length' ESCos	11 (split as 8 for localism regulation and 3 for deregulation)
Energy supplier obligations	The Energy Company Obligation (ECO) builds on previous supplier obligations, the Energy Efficiency Commitment (2002–2008) and the Carbon Emissions Reduction Target (CERT) (2008–2012). The ECO places an obligation on energy suppliers to achieve carbon and cost savings in respect of three distinct targets: 20.9 MtCO2 savings under the carbon emissions reduction obligation (CERO), 6.8 MtCO2 savings under the carbon saving community obligation (CSCO) and £4.2 billion savings under the home heating cost reduction obligation (HHCRO). The targets are divided between suppliers according to a formula proportionate to their share of domestic customers (Ofgem, 2014). Failure to meet these can result in a fine of up to 10% of their global turnover (DECC, 2011). These targets are under review at the time of writing.	Made upfront capital available and encouraged Energy Utilities to diversify their business activities	7
Planning regulations	Most new buildings or major changes to existing buildings or to the local environment need consent, known as planning permission to ensure that the development is acceptable to the local community. Whilst it is informed by the National Planning Policy Framework, each Local Authority sets a 'local plan', which outlining planning policies for the local area. A combination of these has led to a prioritisation of low-carbon building developments in some cases.	Some Local Authorities have prioritised developments that contain strong energy efficiency and/or renewable energy credentials	5
Building regulations	The energy efficiency requirements of the Building Regulations are set out in Part L of Schedule 1 to the Building Regulations and in a number of specific building regulations. They stipulate minimum legal levels of energy efficiency performance for different types of buildings. The Code for Sustainable Homes also provides a single national standard for the design and construction of sustainable new homes, ranging from grades 1 to 6. Highly energy efficient properties with on-site low-carbon energy generation typically score highly in the energy category. It is predominantly a voluntary scheme but is enforceable where: (1) the level 3 energy standard is now incorporated in the building regulations, (2) if the Local Authority require developers to comply with the code by including a requirement in their planning policy or (3) if it is affordable housing is funded by the Homes and Community Agency that requires homes to be built to code level 3 (DCLG, 2014). Under development are the 'zero carbon' homes regulations that stipulate the requirement for net carbon emissions from the regulated energy use (i.e. space heating and cooling, hot water, lighting and ventilation) associated with new residential developments will required to zero by 2016, with new commercial developments following suit in 2019. It is proposed that this target could be met by a combination of: (1) fabric energy efficiency, (2) on-site low carbon heat & power and (3) off-site allowable solutions (Zero Carbon Hub, 2013)	Raised energy efficiency standards for buildings, which ESCos can help achieve	3
Economic incentives			
Low-carbon energy generation financial incentives (e.g. Renewable Heat Incentive (RHI) & Feed-in-Tariff (FiT))	The FiT scheme began in 2010 and provides a long-term revenue stream and is much more focused on supporting small to medium-scale, decentralised generation of low-carbon electricity. A generation tariff is available for each unit of electricity generated, which is dependent on the form of generation, whilst an export tariff is available for the sale of excess electricity to the grid (DECC, 2012b). The RHI is similar to the FiT but instead provides generators with a long-term revenue stream for the small to medium scale generation of low-carbon heat (DECC, 2013). It commenced in 2011 for domestic properties and 2014 for commercial.	Provide a reliable, long-term revenue stream for ESCos	16

(continued on next page)

(*continued*)

Policies	Description of policy	Policy's influence on ESCo model	Nos. of interviewees who cited policy driver (n = 43)
Grant schemes for low-carbon energy projects	Low-carbon capital grant schemes offer energy consumers and some small energy companies with one-off payments to subsidies the installation and running costs for energy equipment that meets specific energy efficiency and/or renewable energy standards. One ongoing scheme is the Renewable Heat Premium Payment, and two recent schemes are the Low Carbon Buildings Programme and the Microgeneration Certification Scheme.	Made upfront capital available for delivering energy service projects	9
Direct public sector purchasing			
London's RE:FIT procurement framework	Greater London Authority (GLA) introduced the RE:FIT procurement framework, which streamlines the procurement process for energy services by providing pre-negotiated, EU-regulation compliant framework contracts through which a group of prequalified ESCos can undertake the design and implementation of energy conservation measures (GLA, 2013).	Streamlined energy service contract procurement	5

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