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The co-evolutionary relationship between Energy Service Companies and the UK energy system: implications for a low-carbon transition

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Abstract

The Energy Service Company (ESCo) business model is designed to reward businesses by satisfying consumers' energy needs at less cost and with fewer carbon emissions via energy demand management and/or sustainable supply measures. In contrast, the revenue of the incumbent Energy Utility Company (EUCo) model is coupled with the sale of units of energy, which are predominantly sourced from fossil fuels. The latter is currently dominant in the UK. This paper addresses two questions. Firstly, why has the ESCo model traditionally been confined to niche applications? Secondly, what role is the ESCo model likely to play in the transition to a low-carbon UK energy system? To answer these, the paper examines the core characteristics of the ESCo model, relative to the EUCo model. The paper then examines how ESCos have co-evolved with the various dimensions of the energy system (i.e. ecosystems, institutions, user practices, technologies and business models) to provide insight into how ESCos might help to shape the future UK energy system. We suggest that institutional and technological changes within the UK energy system could result in a more favourable selection environment for ESCos, consequently enabling the ESCo model to proliferate at the expense of the EUCo model.

Keywords

- Energy Service Companies (ESCos)
- Co-evolution
- UK energy system

1 Introduction

The UK is mandated by the 2008 Climate Change Act to achieve a 34% reduction in its Greenhouse Gas (GHG) emissions by 2020 and an 80% reduction by 2050, compared to 1990 levels (Crown, 2008). The UK energy sector has become an important focus as part of this drive to deliver this transition to a low-carbon economy, given the significant proportion of GHG emissions that can be attributed to energy generation and consumption in the UK. For instance, in 2011, the energy supply sector (i.e. electricity generation) accounted for approximately 35% of the UK's GHG emissions in 2011 (DECC, 2013). Additionally, the residential and business sectors accounted for a further 29% of GHG emissions, with the vast majority of this attributable to fossil fuel combustion for heat and electricity.

The CCC's *Progress Report to Parliament* indicated that whilst the UK has to date made some valuable progress towards decarbonising its energy sector, and the UK economy more broadly, there was a clear need for a 'step change' in its approach if it was to remain on track to meet its future carbon budgets (CCC, 2012). Consequently, a range of policy, technology and market oriented solutions are being sought that are capable of reducing the UK energy sector's GHG emissions and maintaining acceptable levels of both energy security and affordability, in a bid to accelerate the transition toward a sustainable UK energy system.

At present, the UK energy market is currently dominated by the Big 6 Energy Utilities (i.e. British Gas, E.On, EDF, nPower, Scottish Power, and Scottish and Southern Electric), which supply electricity to approximately 99% of British domestic consumers (OFGEM, 2008) and also dominate the gas retail market. These companies operate under a business model that we refer to as the Energy Utility Company (EUCo) model, in which their revenue increases with the number of energy units sold. Consequently, they are mainly concerned with keeping the cost of their energy as low as possible in order to maximize their volume of sales (UKERC, 2006). This provides a disincentive for these companies to take actions to minimize their customers' energy consumption (Eyre, 2008; Steinberger et al., 2009) and in turn the GHG emissions associated with satisfying their energy needs. This disincentive is reflected in the tariffs most EUCos offer their customers, who are generally invited to pay a lower rate for any energy they consume beyond a predefined level of consumption (Hulme and Summers, 2009). The EUCos also source the majority of their energy supply from fossil fuels (REDISS, 2012), meaning their energy supply has a high GHG emissions content.

In view of the EUCos' inability to value sustainable energy supply, scholars (Munns, 2008; Saunders et al., 2012; Szatow et al., 2012; Wüstenhagen and Boehnke, 2008), government/non-government institutions (COWI, 2008; IEA, 2010) and businesses (Company, 2011; IBM, 2010) have all identified the need to investigate alternative business models, which are capable of fulfilling people's energy needs in a more environmentally sustainable way. Some scholars have argued that the Energy Service Company (ESCo) model represents such a business model (Fawkes, 2007; Hansen, 2009; Marino et al., 2011; Vine, 2005), as it focuses not on the sale of units of energy (e.g. gas and imported electricity) but on the provision of energy services

(Sorrell, 2007), i.e. the physical benefit, utility or good people derive from energy (EU, 2006).

In contrast to the EUCos, which provide their customers with units of *delivered energy* (e.g. gas), ESCos provide their customers with *useful energy* (e.g. hot water, coolant etc.) via energy supply contracts (ESCs) or *final energy services* (e.g. space light, space heating, motive power etc.) via energy performance contracts (EPCs)[1] (Sorrell, 2007). ESCos normally seek to fulfil their customers' energy service demands with lower levels of energy supply than EUCos. They typically achieve this by reducing their customers' primary energy consumption through the implementation of energy demand management measures or by providing these services via more efficient forms of energy generation, such as combined heat and power (CHP) co-generation. This should benefit both the ESCo, which receives a share of the value of these energy savings, and the customer, whose energy service demand is met at a lower cost. Subject to take-back or 'rebound effects' (Sorrell, 2009; Sorrell and Dimitropoulos, 2008) under which more efficient provision stimulates additional service demand, these reductions in primary energy consumption translate into reductions in GHG emissions, an achievement that forms an integral part of their value proposition.

The ESCo model has so far failed to become a major component of the UK energy sector, despite having received significant attention from both industry and academia, particularly over the last 10 years (Bertoldi et al., 2006; Fawkes, 2007;

[1] A detailed description of ESCs and EPCs is provided in Section 5, below Table 2

Marino et al., 2011; Smith, 2007; Sorrell, 2007). It has been suggested that a plausible pathway for a UK low carbon energy transition could involve a significant role for ESCos (Foxon, 2013). This paper therefore seeks to address two questions. Firstly, why has the ESCo model been confined to niche applications to date? Secondly what role is the ESCo model likely to play in the transition to a low-carbon UK energy system? In order to answer these questions, the paper begins by examining the core characteristics of the ESCo model, relative to the EUCo model, using Osterwalder & Pigneur's (2010) business model framework. The paper then applies a coevolutionary framework for analysing a sustainable low carbon transition (Foxon, 2011) to understand how ESCos have co-evolved with the wider UK energy system (e.g. institutions, user practices, technologies etc.), in order to provide insight into how ESCos might contribute to a future UK low-carbon transition.

The paper is structured as follows. Section 2 briefly reviews the past development of ESCos in the UK energy system. Section 3 introduces the integrated analytical framework this paper applies, which draws upon two existing frameworks from both the business model and co-evolutionary literatures. Section 4 presents the methodology for the empirical study. Section 5 compares the ESCo and EUCo models, drawing on results from the empirical study. Section 6 analyses the past and present coevolution of the ESCo model with the UK energy system. Section 7 discusses the future coevolution of the ESCo model with the UK energy system. Finally, Section 8 draws conclusions.

2 The past development of ESCos in the UK energy system

We begin by presenting a brief history of ESCo operation in the UK to illustrate the extent to which the model has been adopted in the past and the current state of the ESCo market.

The first ESCo to operate in the UK, known as Associated Heat Services[2], was set up in 1966 as a subsidiary of the then publicly owned National Coal Board (Fawkes, 2007; Iqbal, 2009). It served as a down-stream energy management business to which organisations could outsource the management of their boiler houses (Dalkia, 2012; Fawkes, 2007). This was followed by others including the Utility Management Company (1980), Shell's EMSTAR (1982) and BP Energy (1983) (Fawkes, 2007). It is not particularly clear from the existing literature why or how ESCos emerged during this period of nationalisation.

During this period, the UK energy system was publicly owned and a number of national institutions were responsible for energy generation, transmission, distribution and supply (Ekins, 2010). However, the formation of the Conservative government in 1979 heralded a period of energy market privatization during the 1980s and energy market liberalisation during the 1990s, with a view to promoting competition within the newly privatized gas and electricity sector, considering that these sector lend themselves to the formation of natural monopolies (Ekins, 2010; Pearson and Watson, 2012).

[2] Known today as Dalkia (Dalkia, 2012)

These periods of privatisation and market liberalisation led to the emergence of an entirely new constellation of energy actors in the UK, which included generators; transmission operators (TNOs); distribution network operators (DNOs); electricity suppliers and a market regulator (i.e. Ofgem) (Ekins, 2010; Jamasb and Pollitt, 2011). It also incorporated a raft of new market legislation such as the British Electricity Trading Arrangements (BETTA) in 2005. These market changes led to the emergence of the small number of large, vertically-integrated EUCos that we see today in the UK (i.e. the 'Big Six'). These companies began to assume multiple actor roles by taking ownership of large swathes of the UK's centralised electricity generation, distribution and supply capacity. Many of these actors played an important role in the 'dash for gas' in the 1990s where the UK quickly shifted away from coal to gas as its primary source of fuel for both power generation and heating (Pearson and Watson, 2012).

Despite the growing dominance of the EUCos, the ESCo market for industrial energy users enjoyed a period of sustained growth during the 1990s, mainly due to the rise of industrial downsizing and outsourcing (Sorrell, 2005). This led to the emergence of large, new ESCos in the UK such as Enron Energy Services (Fawkes, 2007). However, growth began to slow down mainly in response to liberalisation, which had the effect of significantly reducing energy prices and thus limiting interest in energy efficiency measures (Bertoldi et al., 2006; Sorrell, 2005). The cheap price of energy has been highlighted as a key barrier to ESCo operation as it encouraged consumers to focus on financial pressures associated with other commodities rather than energy, given that it was relatively cheap in comparison (UKERC, 2006).

It was shortly after this period, during the 2000s, that some of the UK's EUCos began to venture into the energy services market with varying degrees of success. For instance, RWE Solutions was formed in 2002, which was a subsidiary of RWE Group who owns nPower (one of the 'Big Six' EUCos) (Fawkes, 2007). RWE Solutions was subsequently sold off by RWE in a move to focus its activities on its core business of electricity, gas and water (RWE Group, 2006). Additionally, EDF established Barkantine Heat & Power Company (BHPC) in 2000 jointly with the London Borough of Tower Hamlets Council's Energy Efficiency Unit and Defra (Travers and Arup, 2009). It also set up London ESCo in 2007 in partnership with the London Climate Change Agency (EDF, 2013; EST, 2008). Whilst BHPC now provides heat and electricity to 600 homes and a host of community buildings (Travers and Arup, 2009), London ESCo was disbanded only two years after it was established (Utility Week, 2009), highlighting how some of the Energy Utilities' forays into the ESCo market have fared better than others.

In contrast, whilst the ESCo model has enjoyed limited application, the EUCo model has grown to dominate the UK energy market. For example, Marino et al. (2010) estimate the UK energy services market to be worth approximately €400 million per annum, whilst Fawkes (2007) estimates it to be worth between £500 and £700 million per annum. If we compare this to Centrica (owners of British Gas), which is only one of the six large EUCos in the UK, their revenue stood at £18.2 billion[3] in 2012 (Centrica, 2012a). This comparison illustrates how much larger the EUCo sector is compared to the ESCo sector.

In recent years however, the prospects for ESCo market growth have improved in light of 'large increases in gas and electricity prices' and 'tightening environmental regulations' (Sorrell, 2005 p.42), which have arisen in response to a number of pressing energy challenges. For example, energy security is now a major concern with the UK becoming a net importer of energy in 2004 (DECC, 2011c), as its North Sea oil and gas reserves have steadily declined. A growing reliance on energy imports has coincided with soaring UK energy prices, which have plunged millions more people into fuel poverty (DECC, 2011c). Concerns over how climate change is likely to affect both the UK and other countries (e.g. rising sea levels, higher incidence of extreme weather events etc.) have also triggered regulatory changes, in particular the Climate Change Act in 2008 setting stringent GHG emissions reduction goals and requiring five-yearly carbon budgets (HMG, 2011). To meet these goals and carbon budgets, the UK has introduced a number of policies to increase levels of low-carbon energy generation and energy efficiency (Ekins, 2010). In Sections 6 and 7 we analyse the extent to which these developments are helping

[3] This includes operations of British Gas, Centrica Energy and Centrica Storage but not Direct Energy, their American arm. Centrica Energy do operate outside of the UK and so some of this revenue can be attributed to international operations.

to cultivate a more favourable selection environment for both incumbents and new entrants to adopt the ESCo business model.

We now introduce the analytical framework this paper adopts in order to analyse the core characteristics of the ESCo model and the role it could potentially play in helping to facilitate the transition to a low-carbon UK energy system.

3 Analytical Framework

The analytical framework this paper employs to analyse the coevolution of ESCos and the UK energy system integrates two conceptually distinct frameworks, drawn from the business model and co-evolutionary literatures. We now briefly outline these two frameworks, before explaining how they have been integrated.

3.1 Business model framework

Osterwalder & Pigneur (2010) explain that a 'business model describes the rationale of how an organization creates, delivers and captures value' (p.14) by fulfilling the needs or desires of its customers. A business model represents a story of what it is an organisation believes their customers want, how they want it, how it believes it should organize itself and interact with others to best meet those needs, and in turn, how it will generate revenue by being compensated for doing so (Magretta, 2002; Teece, 2010).

Various studies on ESCos have made reference to the ESCo business model (Hansen, 2009; Sorrell, 2005; Steinberger et al., 2009), however none have attempted to identify the various aspects that make-up an ESCo's business model from this perspective. Consequently, there is a poor understanding of the core components of an ESCo's business model. Developing a better understanding of this model will enable identification of the differences between the ESCo and EUCo models, which play an important role in determining the ESCo model's level of uptake. Developing a detailed understanding of the characteristics of the ESCo business model will also enable us to gain insight into the co-evolutionary relationship of ESCos with the UK energy system. To characterise the ESCo business model, we adopt Osterwalder & Pigneur's (2010) 9 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* (Table 1).

Table 1 The 9 Building Blocks of a Business Model (adapted from Osterwalder & Pigneur 2010)

<table>
<tr>
<td rowspan="2">Key Partners
Network of suppliers and partners that make business model work</td>
<td>Key Activities
Most important things a company does to make its business model work</td>
<td rowspan="2">Value Proposition
The bundle of products and services that create value for a specific Customer Segment</td>
<td>Customer Relationships
Relationships a company establishes with its Customer Segments</td>
<td rowspan="2">Customer Segments
The different groups of people or organizations an enterprise aims to reach and serve</td>
</tr>
<tr>
<td>Key Resources
Most important assets required to make the business model work</td>
<td>Channels
How a company communicates with and reaches its Customer Segments</td>
</tr>
<tr>
<td colspan="3">Cost Structure
All cost incurred to operate a business model</td>
<td colspan="2">Revenue Streams
The money a company generates from each Customer Segment</td>
</tr>
</table>

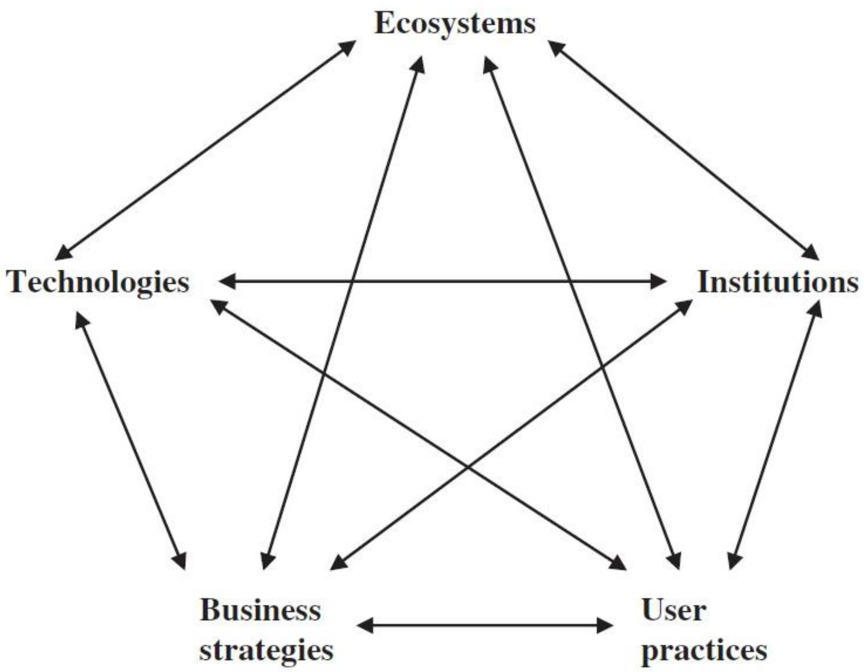
3.2 Co-evolutionary framework

Coevolution refers to how two or more populations can causally influence each other's evolution (Murmann, 2003; Norgaard, 1994), by affecting the fundamental evolutionary processes of variation, selection and retention these populations are subject to (Murmann, 2012). These causal influences arise through three avenues: a) influencing the processes that introduce new variations into the population (Murmann, 2012); b) by altering the selection criteria, and so influencing which individual entities in the population are selected (Murmann, 2003); and c) by changing the replicative capacity of entities, and so influencing the degree of variation within the population and the retention of attributes from one generation to the next (Murmann, 2003).

This approach has helped to provide insight into how technological, industrial and economic coevolution has been responsible for shaping wide-scale, long-term socio-technical system change in the past (van den Bergh et al., 2006). In particular, it has helped to illuminate how 'on going positive feedbacks between components of evolving systems' (Norgaard, 1994 p.82) have led to path-dependent increasing returns to adoption, responsible for technological (Arthur, 1989) and institutional (North, 1990; Pierson, 2000) lock-in. In particular, Unruh's (2000, 2002) work illustrates how co-evolutionary processes between technologies, institutions and organisations have resulted in positive feedbacks that have served to lock-in modern, carbon based energy systems, predicated on large-scale centralised electricity generation, preventing the development and take-up of alternative low-carbon technologies.

Here, we apply Foxon's (2011) coevolutionary framework for analysing a sustainable low carbon transition, which draws upon previous coevolutionary approaches. The framework borrows from Norgaard's (1994) earlier framework to focus attention on the two-way causal interactions between five heterogeneous key sub-systems, which are understood to comprise a socio-technical system: *ecosystems, technologies, institutions, business strategies* and *user practices*.

Figure 1 Coevolutionary framework (Foxon, 2011)

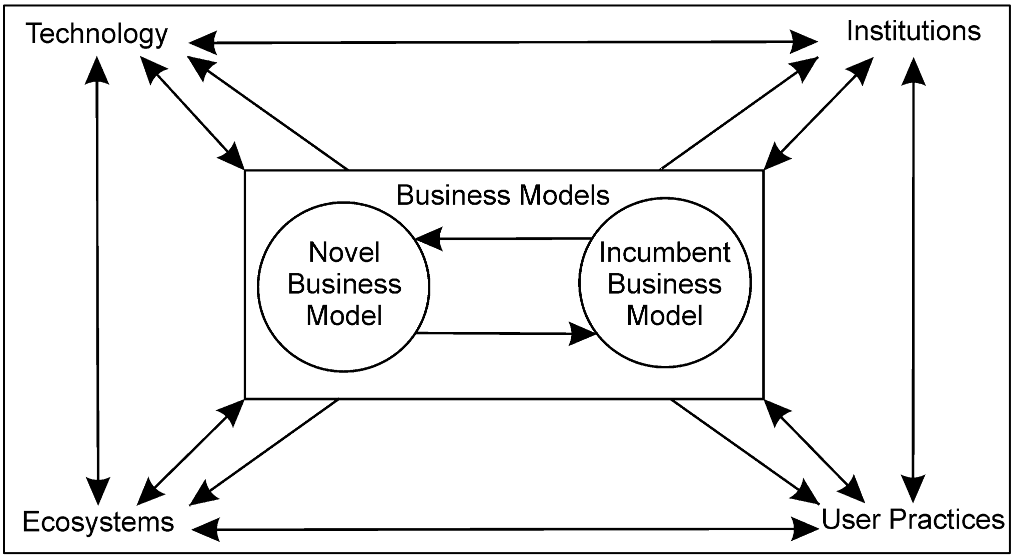


We argue that this coevolutionary framework can help us to better understand how changes in energy company business strategies and models have been causally influenced by relevant changes in the other four sub-systems, and have in turn exerted influence on the evolution of these other sub-systems. As we discuss below, this enables us to systemically analyse the influences on the development of the ESCo population, i.e. firms adopting the ESCo business model, as well as the competition between the ESCo and EUCo business models.

3.3 Integrated analytical framework

To illustrate how we have integrated the business model and co-evolutionary frameworks together, we provide a visual representation of our analytical framework (Figure 2)

Figure 2 The coevolutionary relationship between business models and the wider socio-technical system (adapted from Foxon, 2011; Norgaard, 1994)



In the process of integrating these two frameworks four changes have been made:

1. Compared to Foxon's framework, the business dimension has been centralised as this represents our unit of analysis.
2. In relation to the business dimension, *business strategy* in Foxon's framework has been replaced with *business model* because a business model constitutes the realization of a firm's business strategy and the locus of established routines and behaviours that characterize firms operating these models (Osterwalder & Pigneur, (2010), which in turn influence other aspects of the system.
3. We 'open-up' the business dimension by applying Osterwalder & Pigneur's (2010) framework in order to help us construct a more accurate and

detailed representation of a business model, which is key to understanding how and why they are co-evolving with their wider environment.

4. The business model dimension is split into firms adopting novel and incumbent business models because these are characteristically distinct from one another. In particular, incumbent populations tend to wield more economic and political power than non-incumbent or niche populations of firms.

4 Empirical Methodology

We now introduce the methodology this paper has employed in order to apply the analytical framework outlined in the previous section.

We undertook an extensive review of academic, governmental, industrial and third sector literature relating to the theory of ESCos and energy service provision, and the application of this business model in the UK. From this, we identified a number of key energy service market stakeholders in the UK for interview, so as to provide a balanced account of UK ESCo operation. These included both stakeholders with extensive experience of ESCo management and/or working alongside 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 those with a broad range of professional backgrounds relevant to energy provision and use. A 'snowball sampling' method was also employed, whereby initial stakeholders were asked to identify other potential interviewees.

The research scope was restricted to residential and commercial energy service contracts, as the baseline of current industrial energy provision is relatively heterogeneous, making it difficult to draw generalizations from the research. In total, 45 semi-structured, in-depth stakeholder interviews were conducted, each lasting approximately 1 hour long, across 2 different phases. Phase 1 consisted of 29 interviews, which focused on operation of the ESCo model in the UK quite broadly. Interviewees were invited to talk about (1) the core characteristics of the ESCo model and its different variants, (2) the strengths and weaknesses of the ESCo model, (3) the factors which have enabled or hindered its ability to gain traction and (4) how the ESCos have influenced UK energy system change. Interviewees were encouraged to illustrate their responses with specific examples of ESCo activity.

Phase 2 consisted of 16 interviews, which focused on the narratives of 4 characteristically distinct ESCos in the UK, in order to develop a case study of each. Here interviewees were asked similar questions to those in Phase 1 but were encouraged to relate their answers back to the case study ESCo in question. These case studies are reported in the author's thesis (Hannon, 2012) and will be examined in a forthcoming journal publication. In both phases, thematic analysis was employed to make sense of the qualitative data using NVivo 8.

Considering the size of the energy services sector, the study cannot be considered wholly representative. Instead, it constitutes an instrumental case study (Stake, 2003), designed to provide insight into the coevolutionary relationship between the

ESCo population and the wider UK energy system, thus improving our understanding of how innovative business models can shape socio-technical transitions.

5 Comparison of ESCo & EUCo Business Models

We argue that in order to understand why the ESCo model has failed to proliferate to the same extent as the EUCo model within the same selection environment (i.e. the UK energy system), we must first build a detailed picture of various components that make up both of these business models in order to highlight the key characteristic differences between them. To accomplish this, we apply the business model dimension of our analytical framework (i.e. Osterwalder & Pigneur's (2010) framework) to our empirical evidence in order to identify the core characteristics of these two business models. The core characteristics of the EUCo model were populated primarily by drawing on insights from the interviews during Phase 1 of the empirical investigations, which included interviewees from 3 of the 6 major EUCos, as well as personal experience of EUCo operation in the UK. The core characteristics of these two models are introduced in Table 3 and are presented side-by-side to help highlight their characteristic differences.

It is worth noting that whilst the business model profiles presented in Table 2 constitute descriptions of business models that are understood to operate both within and outside of the UK, they have been constructed from qualitative data drawn from the UK energy sector. Consequently, we are sensitive to the fact that some of the characteristics identified could be UK-specific. We also acknowledge that these profiles constitute something of an 'idealised form' of the companies they represent and that in practice not all EUCos and ESCos will 'look the same'. This is supported by the empirical investigation this paper draws upon, which identified numerous different variants of the ESCo model (Hannon, 2012)[4]. Furthermore, variation amongst the EUCos was also identified, such as the degree to which they were vertically integrated. For instance, whilst some EUCos such as Scottish & Southern Energy and Scottish Power own both distribution and transmission assets, other EUCos in the UK do not (e.g. Centrica), illustrating different levels of vertical integration.

Finally, we also recognise that it is possible for companies to employ aspects of the EUCo and ESCo models simultaneously and therefore, the distinction between these is not so clear-cut in reality. For instance, some EUCos' core business is characterised by the EUCo model but they also undertake energy service contracting within separate divisions of the company (e.g. British Gas) (see Sections 2 and 7.1.1). However, we argue that there are clear conceptual differences between the two business models, as illustrated in Table 3.

[4] These ESCo variants will be the focus of a forthcoming paper

Table 2 Detailed account and comparison of EUCo & ESCo business models

Business Model Building Blocks	**Energy Service Company (ESCo) Model**	**Energy Utility Company (EUCo) Model**
Customer Value Proposition	- Fulfil energy needs at a similar or lower cost to EUCo model - ESCo assumes most financial and technical risk of fulfilling customer's energy needs - Bespoke and holistic energy solutions that closely fit the customer's needs - Energy needs met with fewer adverse environmental effects compared to EUCo model, meaning customer can enjoy more sustainable lifestyle, fulfil regulatory and Corporate Social Responsibility (CSR) obligations etc. - Societal benefits (e.g. alleviation of fuel poverty, climate change mitigation, localization of capital flows)	- Fulfil energy needs at low cost - Reliable energy supply - Short-term contracts mean flexibility for customer - Little interference with customer as they do not go 'beyond the meter' e.g. few behavioural stipulations

Target Customer	- Mainly commercial (focus on public sector), with some residential and industrial	- Residential, commercial, industrial and agricultural
Customer Channels	- On-line, TV, telephone, postal & door-to-door marketing, purchasing, metering, billing & customer feedback - Energy supplied via localized and often private distribution networks - Support via on-going customer interaction & project management	- On-line, TV, telephone, postal & door-to-door marketing, purchasing, metering, billing & customer feedback - Energy supplied via a national transmission & distribution network - Support via customer service call centre, metering & billing etc.
Customer Relationship	- Bespoke & holistic - Long-term service contracts - Close, cooperative, candid and trusting relationship to ensure customer's and ESCo's needs are met - Customer may invest in ESCo - Customer may manage ESCo (e.g. Community ESCo)	- Impersonal & standardised - Short-term supply contracts - Customer responsible for managing most conversion processes (e.g. gas to heat via boiler)

Key Activities	**Energy Supply Contracts (ESCs) & Energy Performance Contracts (EPCs)**[5] - Typically finance, design, build, operate and maintain small to medium scale demand management & low carbon supply energy projects **ESCs** - Energy generation, distribution, supply, metering and billing **EPCs** - Preliminary and investment grade auditing - Measurement and verification of energy savings	- EUCos typically engage in energy generation and supply. They may also engage in distribution and transmission but this is less common: **Generation** - Finance, design, build, operate and maintain large-scale, centralised energy generation & distribution infrastructure **Supply -** Electricity trading and metering & billing of energy supply. Rarely go 'beyond the meter'. Some installation & maintenance of small-scale conversion and control technologies (e.g. central heating) **Distribution & Transmission -** Within their vertically integrated organisation, some EUCos may engage in transmission and distribution via arms-length transmission and distribution network operators (i.e. TNOs & DNOs)
Key Resources	**ESCs & EPCs** - Financial resources and technical, financial and legal expertise to	- Financial resources and technical, financial and legal expertise to develop large-scale, centralised generation and distribution

[5] A detailed description of both ESCs & EPCs provided below this table

	develop small to medium scale demand management and low-carbon supply energy projects. - Customer facing services i.e. operation and maintenance, billing etc. **ESCs** - Technology: Decentralised, primary conversion technologies (i.e. generation) & distribution technologies - Fuel **EPCs** - Technology: Secondary conversion equipment and building controls	infrastructure - Customer facing services i.e. nationwide metering, billing and customer service network - Fossil fuels (e.g. gas, coal) - Centralised generation & distribution technologies
Key Partnerships	- Financial Institutions & Investors - Technical, Legal & Financial Consultancies - Property Developers - Sub-Contractors - Local Authorities	- Financial Institutions & Investors - Electrical Power Generation Companies - Transmission & Distribution Network Operators - Gas & Electricity Network Regulators

Revenue Streams	**ESCs & EPCs** - Bank finance - Capital grants - Customer investment **ESCs** - Customer payment for useful energy streams (e.g. hot water). Customer covers this cost in part via energy savings ESCo achieves through efficiency gains or utilisation of cheaper primary energy input - Low-carbon financial incentives for micro-generation (e.g. FiT, RHI) **EPCs** - Payment for predefined quality & quantity of final energy services (e.g. light). Customer covers this via energy savings the ESCo achieves through efficiency gains	- Bank finance - Sale of metered units of delivered energy (e.g. gas, imported electricity) - Low-carbon financial incentives (e.g. Renewables Obligation Certificates) - Trading of surplus electricity on the market

Cost Structure	**EPCs & ESCs** - Staff and contractors to implement projects - Marketing and communication - Operation & maintenance of infrastructure - Finance or investment repayments - Technical, financial and legal consultancy	- Similar costs to ESCos barring costs specific to EPCs
	ESCs - Acquiring the rights from gatekeeper organisations provide ESCs (e.g. property developer) - Metering & billing - Generation technology and/or wholesale purchase of energy - Fuel - Premises & land acquisition for generation	

	EPCs - Measurement & Verification of savings - Compensation for poor missing energy performance targets	

As Table 2 illustrates, our empirical investigation identified that there exists a number of important characteristic differences between the incumbent EUCo (EUCo) business model and the ESCo model in the UK. Broadly, the ESCo business model revolves around the provision of energy services as part of bespoke, value-added, long-term contracts (Sorrell, 2007), which require a close and open relationship with the customer. The key activities of an ESCo typically include the financing, design, building, operation and maintenance of small to medium scale demand management and/or low-carbon energy supply projects, as part of either energy supply contracts and energy performance contracts (Fawkes, 2007; Hansen, 2009; Sorrell, 2007).

Under an energy supply contract (ESC), an ESCo provides *useful energy* streams to its customers, 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). Energy performance contracting (EPC) involves the provision of *final energy services* (e.g. space lighting, space heating, motive power). The control an ESCo possesses as part of an EPC, over the conversion, control and distribution technologies required to satisfy its customer's energy needs, enables it to provide certain guarantees relating to the standard of energy service it provides, such as lighting levels, room temperature or humidity (EU, 2006; Sorrell, 2007).

In contrast, the EUCo model focuses on low-cost provision of gas and electricity via centralised energy generation and supply to customers via standardized short-term contracts with limited customer engagement[6]:

> 'Their business model has been said to be, purchase as low as you can and cost as low as you can, and have a call centre. That is what an energy supplier is. They send out bills, that's pretty much what they do' (Energy Efficiency Expert)

The starkest difference between the two models exists between EUCos and ESCos offering EPCs[7]. Under the EUCo model, revenue is coupled with the customer's energy consumption, whilst for an ESCo offering an EPC, revenue is decoupled from the customer's consumption because the firm draws their revenue from the savings they achieve on their customer's energy bill. Consequently, whilst ESCos offering

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[6] EUCos have traditionally sourced their electricity supply from high-carbon, finite fossil fuels (e.g. gas) but they could generate electricity from renewable energy sources (e.g. wind). As such, the EUCo model could operate as a more sustainable business model, as illustrated by the case of Good Energy in the UK

[7] The business model of ESCos offering ESCs depends on the terms of the supply contract, as discussed above. If the customer is charged per unit of useful energy then the ESCo has an incentive to maximise the supply of useful energy, but if it is a fixed price for a given level of energy service, then the ESCo still has the incentive to minimise the physical supply needed to provide that level of service.

EPCs are intrinsically incentivised to reduce the amount of energy required to satisfy their customers' energy needs, EUCos are not. Assuming that some or all of the consumer's energy supply is sourced from fossil fuels, ESCos are also intrinsically incentivised to reduce the GHG emissions associated with satisfying their customer's demand, unlike EUCos.

Another key difference is that ESCos typically have a closer relationship with their customers than the EUCos as they offer bespoke and holistic energy solutions, as part of long-term contracts. In contrast, the EUCos have a more distant, standardized relationship with their customers.

The ESCo & EUCo models also differ in terms of their level of vertical integration (i.e. the bundling of assets together across the energy supply chain). Whilst the EUCos in the UK do to some extent exhibit differentiated levels of vertical integration in the UK[8], vertical integration is considered to represent an integral part of the EUCo model, given the benefits associated with the economics of scale (e.g. lower transaction costs). In comparison, ESCos providing EPCs typically operate 'beyond the meter' and focus largely on supply, and so are not vertically integrated.

In contrast, ESCos offering ESCs exhibit a level of vertical integration, especially those who own, operate and maintain CHP district heat networks, from which they supply their customers with heat and electricity. However, vertical integration in

[8] For example, Scottish Southern Energy & Scottish Power own both distribution and transmission assets, whilst other EUCos in the UK do not, such as Centrica

this context is typically at a much smaller scale (e.g. city-level) compared to the EUCos who operate at the national level. Consequently, the EUCos can enjoy significantly larger economies of scale. However, by operating at a smaller scale, ESCos can enjoy alternative cost savings such as reduced electrical losses because the electricity is generated close to the point of use (Carbon Trust, 2010) and lower energy infrastructure overheads (e.g. deployment, operation and maintenance) because less extensive infrastructure is required to supply their customer base (Brent and Sweet, 2007).

One similarity between the two models is that they both provide electricity as a *useful energy stream*. However, they differ in terms of how they provide this to their customers: ESCos typically engage in decentralised generation, often in the form of district energy or micro-generation, whilst EUCos typically engage in centralised generation.

The features of the ESCo model should, in principle, form an attractive package for a range of different customers, particularly when compared to the EUCo model, given the emphasis on low energy costs, bespoke energy solutions and wider societal benefits. However, as we discuss in Section 6, a number of key barriers have limited its uptake, which we argue can to some extent be attributed to coevolutionary processes.

6 Co-evolution of the ESCo business model with the UK energy system

We now apply the coevolutionary framework (Foxon, 2011) to analyse the two-way coevolutionary interactions between the ESCo business model and the various key dimensions of the UK energy system (i.e. business models and ecosystems, institutions, technologies and user practices relationships) and discuss how these interactions are influencing the competition between the incumbent EUCo model and the niche ESCo model. These interactions are illustrated using relevant quotations from interviewees[9].

6.1 Evolution of the ESCo population

As described briefly in Section 2, the population of business models within the UK energy system currently remains dominated by the EUCo Company (EUCo) model, with the ESCo model enjoying only niche level application, mainly being used for providing energy services to a small number of energy-intensive industrial energy users. As we have set out in Table 3 in Section 5, the attributes of the EUCo and ESCo business models are quite distinct, and so we can analyse these as separate groups. As the model is mature, the EUCo population exhibits relatively little internal variation. However, as the ESCo model is less mature, the ESCo population exhibits a significant degree of characteristic variation,

> "Everybody does everything slightly differently. You have got in the truest sense, the traditional [ESCo] model but in reality, it operates in different ways with different people" (EUCo manager)

[9] Every effort has been made to include as many quotes as possible to support the analysis. A more detailed, systematic analysis of these interviews can be found in the author's PhD thesis (Hannon, 2012)

Although it is not the purpose of this paper to explore these variants or the reasons why they exist in detail, we briefly outline how and why this degree of variation exists. Our empirical evidence indicates that ESCos in the UK predominantly vary with respect to following characteristics:

- Sector (private, public, third)
- Ownership (wholly owned, joint-venture, shareholders)
- Organisational form (Public limited company, Charity, Community interest company)
- Contract types (ESC, EPC)
- Core objectives (profit, carbon reduction, fuel poverty alleviation etc.)
- Size
- Wealth (i.e. level of profit and financial reserves)

This variation is due to the flexibility of the ESCo business model, through its focus on bespoke contracting, and a lack of energy service market regulation, providing few constraints or incentives that would encourage standardization and discourage business model experimentation:

> "There isn't a standard at the moment…Every scheme seems to be different at the moment…At the moment it is quite new and quite fluid. Therefore people are making it up as they go along" (EUCo manager).

However, the fact that energy service contracts last for many years has constrained variation, since the ESCo and its customers are contractually locked into a particular type of service agreement for a long period of time. Variation may also be inhibited by the risks to firms associated with being the first to experiment with a new configuration of an ESCo model.

Business models are selected on the basis of the perceived value they generate for both the providing firm and the customer. As we discuss below, the selection environment for business models is strongly influenced by the other populations within the UK energy system.

Retention of business models refers to the model's characteristics being passed on to future generations of organisations in the UK energy system via replication (Aldrich and Ruef, 2006). Whilst the EUCo model only changes incrementally, the bespoke nature of the ESCo model means that it is not particularly easy to replicate. This is compounded by the lack of nationally recognised standardized energy service contracts, by either government or trade associations. Recently however, local energy service contract procurement frameworks such as RE:FIT[10] have improved the ESCo model's prospects of retention by introducing, for example, standardised energy service contracts.

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[10] RE:FIT is a cost neutral, procurement framework led by the London Development Agency (LDA) that enables public sector bodies to sign EPCs with reduced procurement times and costs. It also provides on-going support during the process (LDA, 2011)

6.2 Coevolutionary interactions

6.2.1 ESCos and Ecosystems

The ecosystem dimension's causal influence on the wider UK energy system is largely mediated through the other dimensions of the UK energy system, such as institutions. For instance, over the last 30 years, the UK has relied heavily on the extraction of oil and gas from its North Sea reserves to satisfy its energy needs. However, these reserves have gradually dwindled, with the UK becoming a net importer of energy in 2004 (DECC, 2011c), which has been acknowledged as a threat to the UK's energy security (DECC and OFGEM, 2011). Additionally, extraction and combustion of fossil fuels has resulted in a number of adverse environmental effects, namely climate change, air pollution, disposal of solid waste, destruction of natural habitat etc. These ecosystem related developments have placed pressure on UK energy system stakeholders to implement energy solutions capable of not only improving the UK's energy security but also conserving the natural environment, consequently adding momentum to the pursuit of developing and implementing business models capable of delivering such solutions in a manner that is attractive to both suppliers and consumers:

> "It just isn't sustainable. Gas and oil are going to run out...It is about [re]positioning [our business] now" (Senior EUCo Manager)

No major ecosystem change can yet be attributed to ESCo activity, however it is likely that existing ESCos have alleviated the UK's reliance on fossil fuels to a very small extent, resulting in not only a small reduction in levels of fossil fuel related pollution (e.g. sulphur dioxide, nitrogen oxides etc.) but also UK GHG emissions. For example, Cofely indicate that their district heat schemes deliver approximately 65,000 tonnes of CO_2 savings per annum (Cofely, 2011).

6.2.2 ESCos and Institutions

New regulations and support schemes that either require or incentivise organisations to engage in sustainable energy supply and demand side management solutions has helped to improve the business case of ESCos. These policies include financial incentives (e.g. Feed-in Tariffs (FiT), Renewable Heat Incentive), capital grant schemes (e.g. Local Energy Assessment Fund), finance schemes (e.g. Green Deal, Salix[11]) and low-carbon obligations (e.g. Low-Carbon Building Regulations, CRC Energy Efficiency Scheme, CERT). One of the most important regulatory developments for ESCos has been the introduction of financial incentives (e.g. FiT) in place of many of the capital grant schemes (e.g. Low Carbon Buildings Programme). This provides a revenue stream rather than upfront capital grants, thus providing ESCos with the opportunity to deliver sustainable energy measures by taking responsibility for the associated upfront capital costs and subsequently, capturing these incentives as additional revenue streams.

[11] Salix is a not for profit, independent social enterprise that provides funding to public sector organisations, via loans and grants, for proven technologies which are cost effective in reducing GHG emissions (SALIX, 2012)

The emergence of this new institutional framework, designed to promote sustainable energy solutions, has helped to provide ESCos, as well as their partners and customers, with greater certainty that there is a significant national commitment to a low-carbon transition and that this commitment will last. This has helped to attract investment and encourage employers to develop the skills necessary to take advantage of this new market opportunity, a lack of which had been cited as a barrier to market development. However, many interviewees felt the framework wasn't robust enough in light of swift and unexpected changes to the regulatory framework, such as the Feed-in-Tariff (FiT) cuts that came into effect in 2012, where the generation tariff for retrofit PV ≤ 4kW fell from 43.3p (prior to 2^{nd} March 2012) to 16p (from 1^{st} August 2012) (Feed-In Tariffs Ltd, 2012), a reduction of over 50%. Interviewees complained that they lacked clarity relating to how the regulatory framework would develop in the future, undermining their ability to make informed decisions as to whether or not their energy service projects would be financially viable.

Other interviewees complained that this framework had not gone far enough to support sustainable energy supply and demand management projects, citing the lack of a mandatory GHG reduction target for cities and a law similar to Denmark's 1979 Heat Supply Law[12], as examples of the framework's deficiencies. In addition to this, some interviewees explained that the complexity of the regulatory framework

[12] Provides Danish local authorities the power to mandate that new and existing buildings connect to public heat supply (DEA, 2005)

made it difficult for them and others navigate and utilise the various supportive regulatory mechanisms available.

Not all recent regulatory developments have helped to improve the selection environment for ESCos. For example, under Ofgem's recent provision for third party access to private wire gas and electricity networks, in reaction to a change in European law following the Citiworks case[13] in Germany, customers now have the option to switch energy suppliers and thus avoid being subject to a monopoly (OFGEM, 2011). Although this is likely to promote fairer competition, it will also reduce confidence in the number of customers a supplier will be able to supply via private wire, thus undermining actors' ability to predict how commercially viable an ESCo's energy supply project will be.

Existing non-energy regulation has also served to undermine ESCo growth. For example, the Landlord & Tenant Act has brought into question the legitimacy of landlords transferring their responsibility to provide their tenants with energy to a third party, such as an ESCo. It also casts doubt on the ESCo's legal right to generate profit from doing so, as the law requires landlords to pass on such services at cost price. Another example relates to the European Union Directives that govern the public sector procurement process for products and services for countries in the

[13] Citiworks, a German utility company, sued Leipzig Airport for breach of competition laws because it held a monopoly over energy supply on an on-site private wire scheme (CHPA, 2011)

EU. This was cited as a key inhibiting factor because it has made the process of procuring energy service contracts extremely time and resource (i.e. cost, expertise etc.) intensive, an important reason why RE:FIT has been established (Section 6.1).

Institutions also encompass the ‘rules of the game’ of the financial sector. The emergence of a low-carbon regulatory framework has improved ESCos’ prospects of securing finance, as it has provided investors (e.g. banks, pension funds etc.) with greater confidence in the projected rate of return they might expect from ESCo projects. However, many investors were perceived to be unfamiliar with the ESCo model, meaning that many of them have not sought out opportunities to support ESCos or have been sceptical of those opportunities that have presented themselves. This has led many financial institutions to continue to support the larger, more lucrative centralised energy projects they have traditionally financed, thus channelling valuable financial resources away from ESCos and towards EUCos, helping to reinforce their dominance (Aldrich and Ruef, 2006).

Their unfamiliarity with ESCos has also led them to recognize EPCs as capital debt because they commit the customer to make repayments to the ESCo, drawn from savings on their energy bill. Their classification as debt has made them unattractive to many customers particularly during a period of economic uncertainty. In some cases investors were perceived to be familiar with the ESCo model but chose not to support them as they felt uncertain about how the energy regulatory framework and economy would develop over the coming years. The difficulty ESCos currently face in securing finance from private sector investors is particularly damaging considering the decline of grant schemes in recent years.

In relation to the influence of ESCos on institutional change, the ESCo population has to date exerted some important influence over how the UK regulatory framework has evolved. The best example of this relates to the abolishment of the '28 day rule' in the UK. The rule allowed customers to switch supplier only four weeks after signing up with another supplier. It was established 'to prevent incumbent suppliers from hampering new market entry by reducing the liquidity of the market; and to ensure that customers were not definitively locked into arrangements that are to their detriment' (ESWG, 2003 p.7). In 2003, the Energy Services Working Group (ESWG) was established in 2003 by DTI, Ofgem and Defra to explore how to create an effective market for energy services in the domestic sector (BERR, 2007). One of their key recommendations was to relax the 28 day rule because suppliers were reluctant to make the necessary upfront investments associated with offering long-term contracts if their customers were free to leave within a matter of weeks, thus constraining ESCo activity (EST, 2008; ESWG, 2003; Smith, 2007; UKERC, 2006). After some considerable consultation, in 2007 Ofgem axed the 28 day rule in a move that they believed balanced 'improved protection for vulnerable customers [with] greater opportunities for innovation in the market' (OFGEM, 2007 p.1).

Another example of how the ESCo population has influenced regulatory change includes the repeal of an article within the Local Government Act 1976, prohibiting local authorities (LAs) from selling electricity not generated in conjunction with heat (DECC, 2010a), which had traditionally posed a barrier to Local Authority led ESCos. Chris Huhne, then Secretary of State for Energy and Climate Change, explained in 2010 explained that:

> "For too long Whitehall's dogmatic reliance on 'big' energy has stood in the way of the vast potential role of local authorities in the UK's green energy revolution. Forward thinking local authorities such as Woking in Surrey (the owners of Thameswey ESCo) have been quietly getting on with it, but against the odds, their efforts [have been] frustrated by the law. I've taken the early step of overturning the ban on local authorities selling renewable electricity to the grid" (DECC, 2010c)

Despite the ways in which ESCos have influenced regulation, they have on balance had a relatively small impact upon the regulatory landscape. For example, the ESCo model received minimal attention in recent white paper publications, receiving only a passing mention in both the previous government's 2010 *Warmer Homes, Green Homes; A Strategy for Household Energy Management* (DECC, 2010d), despite being referred to extensively in the preceding 2009 *Heat & Energy Saving Strategy* consultation (DECC, 2009). ESCos also barely featured in the current government's 2012 *The Future of Heating: A strategic framework for low carbon heat in the UK* (DECC, 2012d), despite representing a business model that is well suited to the provision of *useful energy streams* such as heat. Additionally, no regulation has to date has been introduced with the explicit purpose of supporting ESCo activity.

However, the ESCo model was referred to a number of times in the impact assessment for the government's planned Green Deal and associated Energy Company Obligation (ECO) for financing energy efficiency improvements (DECC, 2011b). We discuss the potential impact of the Green Deal and ECO on the ESCo population in Section 7.

6.2.3 ESCos and Technologies

The viability of the ESCo business model is strongly influenced by the costs and performance of relevant energy conversion, efficiency and, where included, supply technologies. The costs of a number of forms of primary, secondary conversion and control technologies have fallen due to learning and technological advances, such as the cost of PV systems (Hearps and McConnell, 2011). Despite this, some measures are still considered too expensive to be cost-effective for ESCos, such as external wall insulation, which is often used to improve the energy efficiency of properties without wall or loft cavities. In some cases new technologies have entered the market, such as residential and commercial LED lighting, which have considerably improved the business case of energy service contracts;

> "The thing about LED lighting is that instead of saving 10 or 30%, you can save 80%. And then the idea of a performance guarantee finance project becomes very easy, because the returns are so huge you can say to the client I guarantee I will save you 40% of your lighting costs" (ESCo expert)

Infrastructural constraints were also cited as an important barrier, such as the load capacity of district electricity distribution networks, which limits the number of PV installations that can be linked to the grid on anyone line. Numerous key infrastructural constraints relating to District Heat (DH) networks were also identified, such as the technical difficulty and cost of implementing a DH network in a historically, densely populated area. Despite these infrastructural limitations, the age and inefficiency of the UK's housing stock represents a large market for demand side management solutions. For example, at the start of October 2012 only 69 per cent of properties with cavity walls were fitted with cavity wall insulation and only 66 per cent of properties with lofts were fitted with loft insulation (DECC, 2012b).

The adoption of the ESCo model has triggered some small-scale but important changes to the UK's mix of energy technologies, as well as its energy infrastructure. During 2011, 123,758 PV installations at or below 4kW (approximately 360,291kW of total capacity) were registered for the Feed-in-Tariff scheme (DECC, 2012c)[14]. A significant number of these were domestic roof-top installations, installed free-of-charge to the consumer by ESCos, as part of energy supply contracts. The exact figures for total free installations are not available but *A Shade Greener*, a leading ESCo, claims to have installed nearly 21,000 free PV installations since 2010 (ASG, 2013).

[14] Any PV system installed after the 15th July 2009 is eligible for the FiT (Feed-in-Tariffs Ltd, 2012)

In 2010, Thameswey Energy in Woking (Woking Borough Council's ESCo) generated via a combination of generation technologies more than 10 Gigawatt hours (GWh) of low carbon electricity and 9 GWh of heat[15] (e.g. CHP, PV etc) to over 170 commercial and domestic customers (Thameswey, 2012). Another ESCo, Cofely GDF Suez, have installed a total of 35MW of CHP and 50km of district heating and cooling pipework in the UK. In Southampton alone they have are generating 40GWh of heat, 26GWh of electricity and 7GWh of chilled water per annum (Cofely, 2011).

6.2.4 ESCos and User Practices

Technological innovation, greater GDP per capita and falling energy prices combined to make energy services increasingly attainable for much of the UK population during the 19th and 20th centuries (Fouquet and Pearson, 2006). However, in recent years, the high level of demand for energy services, coupled with significant international oil and gas price rises (DECC, 2011c) and falling real wages due to the economic downturn, have meant that the costs of energy services have increased for most domestic and commercial consumers. This has helped to generate additional demand for ESCos, who seek to reduce their customers' overall energy costs.

Whilst users have struggled to meet the rising costs of fulfilling their energy needs, the profits of the Big 6 EUCos have grown and were almost a third higher in 2010

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[15] This is enough to provide electricity and heat to approximately 2,000 households (Thameswey, 2012)

than in 2008 (Consumer Focus, 2012). This has contributed to a dramatic fall in customers' satisfaction with the Big 6, where only 42% of surveyed customers believed their EUCo's services represented value for money in 2011 (uSwitch, 2011). This low-level of customer satisfaction is likely to provide added impetus for users to turn to alternative means of fulfilling their energy needs.

Many user practices have begun to alter in reaction to the challenges of reducing carbon emissions whilst maintaining affordability, with interviewees recognising a significant increase in demand for environmentally sustainable products & services in recent years, typified by the proliferation of Corporate Social Responsibility commitments. Many organisations have reacted to this by seeking to engage with sustainable energy supply and/or demand management measures to improve the sustainability credentials of their customer products and/or services, with a view to improve their value proposition for some of their more environmentally minded customers. Some have consequently turned to energy service contracting as a means of accomplishing this, such as Morrisons' move to sign an EPC with EDF to help reduce its total operational carbon footprint by 30% by 2020 (EDF, 2011).

The adoption of the ESCo model has also to some extent impacted upon the traditional consumer-supplier dynamic in the UK, where typically energy consumers have merely purchased and consumed energy, and have not engaged with energy generation, transmission/distribution or supply. By enabling consumers to take responsibility for these functions and in turn, acting as energy generators and suppliers rather than just consumers, the ESCo model has afforded consumers the opportunity to assume a significantly greater degree of control over how they satisfy their energy needs. Consequently, it has enabled users to adopt ways of satisfying their energy needs that share greater synergy with their broader set of objectives (e.g. supporting the local economy or alleviating fuel poverty), compared to those typically employed as part the prevailing consumer-supplier dynamic. The case of Meadows Ozone Energy Services Limited (MOZES), a community owned and run ESCo in Nottingham, helps to illustrate this change. Previously the residents were supplied by the EUCos but now they own and run a community ESCo that is responsible for financing, installing, operating and maintaining PV systems that supply them with renewable electricity via energy supply contracts. By providing renewable electricity to the community and reinvesting the profits from these supply contracts, MOZES aims to invest in additional measures capable of alleviating fuel poverty in the area, reducing the community's carbon footprint and developing the local area into a space for sustainable energy technology innovation.

The user practices of consumers that have contracted with existing ESCos, rather than establishing one personally, have also changed. For instance, traditionally the relationship between EUCos and their customers has been distant, but as part of an energy service contract, there is a larger degree of communication and collaboration between the user and the ESCo. For example, both supply and performance contracts often require the user to engage at the project-design stage, so that the ESCo designs a project which is in synthesis with their consumption needs and behaviours. Furthermore, EPCs often stipulate that the customer alters their consumption behaviour to ensure sufficient energy savings are created to cover the capital costs of the project. For instance, as part of Honeywell's EPC delivery, they typically employ technical measures and contractual arrangements that encourage their consumers to engage in more energy efficient consumption behaviours: "typically by getting them to participate in efficient interaction with the building, you can get between 6 and 10% additional savings" (ESCo manager).

6.2.5 Competition between EUCo and ESCo business models

Finally, we examine the co-evolutionary relationship between the ESCo population and the incumbent EUCo population. EUCos have become dominant in the UK energy system since they emerged post-liberalisation and their dominance has meant they have been able to use their strong position to out-compete new entrants for valuable resources (e.g. financial, technical, political etc.) (Aldrich and Ruef, 2006). Furthermore, their influential position in the UK has meant their actions have both purposely and inadvertently shaped the energy industry in their favour, helping to cultivate a selection environment that does not penalize their existing business model (Wüstenhagen and Boehnke, 2008). Because ESCos and EUCos are characteristically distinct, they perform differently in the same selection environment. This helps to explain why the EUCo model has thrived and remained incumbent, whilst the ESCo model has merely survived in niche applications.

The EUCo business model has become dominant in part due to increasing returns to its adoption (Arthur, 1989; North, 1990). *Learning effects* have led to a refinement of this model over the years, as new knowledge and skills have been acquired.

Adaptive expectations have meant that energy stakeholders (e.g. investors, policymakers, customers etc.) have become increasingly familiar with the model, reducing their uncertainty of it and making them more comfortable about engaging with it. EUCos have also benefitted from *economies of scale*, which means that as they have become larger and increasingly vertically integrated their transaction costs have fallen for each unit of energy they supply, helping them to become more cost-effective[16]. Lower costs have in turn attracted more customers, which has helped to further improve their economies of scale:

> "[They] all have one or 2 million customers. Their overhead costs of supply, billing etc. are as low as you can get them…It is difficult to see how you are going to be able to undercut British Gas or n.Power on a cost basis" (Energy efficiency expert)

The ESCo business model has not yet benefited from these types of increasing returns. For example, adaptive expectations are not yet relevant for the ESCo model, as only a limited number of potential customers are aware of the model (EST, 2008). However, awareness and understanding of the model are slowly being raised as more and more energy stakeholders come into contact with the ESCo model, through a small and informal social network of ESCo champions, some of

[16] If this increase in operational scale continues unabated, the company may begin to suffer from the diseconomies of scale (e.g. duplication of effort, increase internal communication costs etc)

whom have worked together to promote learning and collaboration within and outside the energy service market niche, in order to raise the ESCo model's profile and help to cultivate demand for it. This awareness raising has also been supported by customers who have switched to energy services and enjoyed a positive experience.

The strong success of the EUCo model can also be explained by mutually reinforcing, coevolutionary processes that have helped to cultivate a favourable selection environment for EUCos but not ESCos. For instance, the introduction of energy supplier obligations (e.g. Energy Efficiency Commitment, Carbon Emissions Reduction Target, Community Energy Savings Programme), which arose out of necessity to reduce the GHG emissions content of EUCos' energy supply. At first glance these obligations seem to undermine the EUCo model. For example, the Carbon Emissions Reduction Target (CERT, running from 2008-2012) obligates all EUCos with a customer base of over 250,000 customers to deliver measures that will provide overall lifetime carbon dioxide savings of 293 $MtCO_2$ (DECC, 2012a). Ofgem is able to impose a financial penalty of up to 10% of the utility's annual turnover if it fails to achieve this target (DECC, 2010b). The EUCos are expected to meet this target by promoting the uptake of energy efficiency or low carbon energy solutions to their domestic customers[17].

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[17] Monies raised from these obligations have to some extent been redistributed by government to support ESCo activity, predominantly via capital grants. For example, Aberdeen Heat & Power has received funding from both CERT & CESP.

Whilst these obligations include no provision that requires EUCos' revenue to be coupled with the volume of gas and electricity units they sell, they have neither encouraged nor mandated the EUCos to fundamentally change their business model. This liberalised regulatory framework has therefore not only enabled these companies to continue to operate their business model as usual but also in a way that remains continues to generate profit. This has helped them to retain their current levels of political power and wealth in the UK and in turn afforded them the opportunity to exert considerable influence over regulatory developments, primarily via political lobbying (Gkiousou, 2011; Hekkert et al., 2007; Mitchell, 2012; Murmann, 2003; Stenzel and Frenzel, 2008; Unruh, 2000; Wüstenhagen and Boehnke, 2008). For instance, both British Gas and Scottish & Southern Energy responded to DECC's Energy Company Obligation and Green Deal consultation, with a specific set of recommendations to shape these regulations (Centrica, 2012b; SSE, 2012).

In the context of this lobbying, the latest energy supplier obligation (i.e. the Energy Companies Obligation (ECO) (DECC, 2011b)) continues the tradition of incorporating no obligation on the EUCos to fundamentally restructure their business model so that their revenue is no longer coupled with the sale of energy, predominantly sourced from fossil fuels. It is however worth noting that the ECO does go one step further than its predecessors by introducing a brokerage platform, which constitutes a market-based mechanism that allows Green Deal Providers to auction future ‘lots’ (e.g. 10,000 tonnes of carbon saving) of ECO streams *Carbon Saving Obligation, Carbon Saving Communities* and *Affordable Warmth* to ECO obligated EUCos in return for payment (DECC, 2012f). This mechanism is likely to provide the EUCos with an incentive to adjust their business model to provide sustainable energy solutions because the outputs of these schemes can be sold at a premium via the brokerage platform. However, we argue that this is unlikely to fundamentally alter their business model because it represents an optional market based mechanism and one that could be easily ignored given the continued profitability of the EUCo model in the UK (Consumer Focus, 2012). These examples help to illustrate how the political strength of the EUCo population has helped to shape regulatory responses that avoid undermining the effectiveness of their business model. However, as we discuss in the next section, a number of the Big 6 EUCos are beginning to experiment with offering ESCo-type contracts, although their core business continues to be aligned the EUCo model.

In summary, recent UK energy system developments have begun to positively alter the ESCos’ selection environment, helping to improve the ESCo model’s degree of fitness. However, many factors continue to inhibit ESCo activity and reinforce the dominance of the EUCos.

7 Future coevolution of ESCo business model with UK energy system

We now discuss how the adoption of the ESCo model is beginning to cause changes to other elements of the business model population, and how its adoption may coevolve with changes in the wider UK energy system in the future. This should provide insight into how ESCos are likely to evolve and their potential to help shape a low-carbon transition.

7.1 Changes to the business model population

7.1.1 Changes to the EUCo Business Model

The emergence of the ESCo model in the UK is beginning to affect change in the business models of a number of incumbent businesses, including the EUCos. Five of the six major EUCo companies were found to have recently delivered demand and/or supply side energy service contracts to their customers. Of these, 3 EUCos offered both demand and supply side energy services, although their core business remains the sale of units of energy. For example, EDF has recently signed an EPC contract with the supermarket Morrisons, guaranteeing £1 million worth of energy savings per year across its stores (EDF, 2011). EDF also currently hold a 34% stake in Dalkia, one of the world's leading providers of energy supply contracts for heat provision. This example illustrates that even despite the continued profitability of the EUCo model (Consumer Focus, 2012) that some EUCos have begun to diversify their business portfolio by developing energy services divisions or acquiring shares in ESCos.

Interviewees working for the EUCos explained that they had adopted aspects of the ESCo model because they regarded energy service contracting as an effective means of adding value to their service propositions, which could help them to gain competitive advantage over their competitors and grow their market share. In contrast to the past situation, where the regulatory environment has so far helped to stabilise the EUCo model, some respondents explained that the EUCos acknowledged that a period of accelerated energy system change was underway, which posed a long-term threat to the viability of their traditional business model. They highlighted factors such as the introduction of a low-carbon regulation, changing customer demand, rising energy prices etc. Their entrance into the energy service market was evidence of restructuring their business model so that they could take advantage of this change, as opposed to being a potential victim of it, as argued in a speech by the CEO of Centrica, owners of British Gas:

> "Within a few years, we want energy services to be just as big a part of British Gas as energy supply…Indeed as I see it, the old utility business model is dead…It is my belief that the energy company model we know today will, within this decade, seem just as much a thing of the past as the Gas Light and Coke Company. And from where I stand, I can already see it happening" (Sam Laidlaw, 2010)

7.1.2 New entrants to the energy services market

The greater accessibility of the ESCo business model compared to the EUCo model means that some organisations, not traditionally engaged in energy provision, have entered the energy market by offering energy service contracts. These have included organisations such as local authorities (e.g. Woking Borough Council, Aberdeen City Council), property developers (e.g. Galliford Try, Willmot Dixon), equipment manufacturers (e.g. Honeywell, Siemens) and facilities management companies (e.g. Mitie, Amey).

Alongside this influx of new entrants practicing the ESCo model, there have also emerged a number of new actor partnerships between a range of public, private and third sector organisations. Some of these have taken the form of joint-venture ESCos, such as the Birmingham Energy Savers ESCo developed by Birmingham City Council and Birmingham Environmental Partnership (a Local Strategic Partnership which serves deliver a better quality of life in Birmingham) (BEP, 2012), whilst others have taken the form of contractual agreements, such as between Cofely and Southampton City Council. Many of these partnerships have emerged as a means of pooling the different organisations' resources and capabilities, in order to deliver a more successful energy service project. This trend seems likely to continue into the future.

7.1.3 Future Variation of the ESCo Population

In view of the above developments, it is expected that the ESCo population will remain heterogeneous, partly because replication of business models is normally imperfect (Murmann, 2003), either due to accident, experiment or design (Hodgson and Knudsen, 2004), serving to introduce additional variation to the population. A high degree of variation is also expected to persist because of the heterogeneity of the adopting firms and their partners' objectives. Furthermore, the ESCos' customer base has a heterogeneous set of needs. This is likely to encourage a variety of ESCos to emerge in order to satisfy this variety of organisational and customer requirements:

> "There are very large, sophisticated, multisided, multi-International or national companies and then you get smaller, medium-sized commercial buildings… [there are] different ESCos to meet different requirements" (ESCo Director)

Variation will be moderated as some ESCos fall victim to selection pressures and are consequently disbanded, as has happened previously (e.g. London ESCo, Caithness Heat & Power). Variant failures, coupled with learning effects (see Section 6.2.5) may lead to one or more ESCo variants becoming dominant, analogous with dominant technological designs (Nelson and Winter, 1982). Additionally, variation is likely to be moderated by the introduction of standardized energy service contracts, as outlined in Article 14 of the European Energy Efficiency Directive (EU, 2012). These will help to make replication more accurate and thus limit the scale of replicative imperfections (*i.e.* in the sense of copying errors from generation to generation of ESCos). Taking these factors into account we expect the degree of variation in ESCo population to remain broadly similar and as such, the *type* of influence this population exerts on the wider UK energy system to also remain similar.

7.2 Future coevolutionary interactions

Taking into account emerging developments, the evidence suggests that over the coming years the fitness of the ESCo model within its selection environment should continue to improve. This is likely to encourage growth in the ESCo population and increase the causal influence they have on the evolution of the wider UK energy system. The continuing and potentially worsening effects of climate change are likely to help support a sympathetic selection environment for the ESCo model, for example by exerting pressure on government to develop and maintain a supportive regulatory framework that support GHG emissions reductions. Energy insecurity is expected to worsen as the UK's finite fossil fuel reserves are steadily depleted and existing generation facilities are retired (DECC and OFGEM, 2011). This in conjunction with increased global demand for energy are likely to have an impact on energy prices, which are expected to continue to rise (DECC, 2011a). High energy prices coupled with projections of very modest economic growth for the UK in 2013 and 2014 (IMF, 2013) means consumer demand for a reduction in energy bills is likely to remain high, consequently making energy service contracting more attractive. In particular, public sector organisations are likely to take measures to reduce their energy costs in order to reduce their overheads in reaction to public sector cutbacks, which have resulted from the economic downturn.

The institutional change that is likely to most strongly influence the selection or otherwise of the ESCo model in the next few years is the introduction of the Green Deal, which came into operation in Autumn 2012. It 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, 2012e). As part of the Green Deal, a Green Deal Provider will be responsible for identifying, designing, installing, financing and servicing a suite of energy solutions in the resident's home, the cost of which it recuperates via the cost savings they generate on the resident's energy bill. Consequently, Green Deal Providers will operate much like ESCos.

The key benefit of the Green Deal is likely to be that it will help to open up the residential market to ESCos, which they have traditionally struggled to harness. This is because it puts in place the necessary legal framework to allow for the cost of the measures to be repaid via the customer's energy bill by attaching their costs to the property, not the householder. Therefore, even if the house is sold, the new householder will continue to pay off the costs of the measures to the Green Deal Provider. It was also considered by a number of interviewees that in light of the Green Deal, many financial institutions are likely to be more forthcoming with finance to fund residential EPCs than at present given these legal provisions and the added context of government support for this type of contracting. For instance, the Green Deal Finance Company has recently been set up to provide an affordable source of finance to Green Deal Providers (GDFC, 2012).

Despite the potential boost the Green Deal may provide ESCos, concerns were raised that it may not have the desired impact the government is hoping for, in part because attaching the debt from the cost of the energy measures to the property could make it difficult for the householder to sell their home, making it undesirable:

> "You are taking it on as a debt and you are forcing anybody who comes in and buys the property to take on that debt, that long-term obligation as well…I don't think it will be attractive to a mainstream property owner" (ESCo Manager)

Furthermore, the Green Deal is an optional scheme and some interviewees were concerned that if either households or providers did not consider the Green Deal to be sufficiently attractive they would not engage with it. It was expected that the extent to which customers will take up the Green Deal is likely to depend largely upon the implicit interest rate being charged by the Green Deal Provider and thus the scale of the customer's cost savings:

> "So you are creating a structure where capital is being invested and the interest can be repaid. That doesn't mean that...people are going to rush out and do it" (ESCo Expert)

Under the Green Deal, a proportion of the savings on the customer's energy bill are repaid to the Green Deal Provider via the customer's EUCo bill. Consequently, in most cases, units of electricity and gas will continue to be provided to the customer by a EUCo. In this sense, the Green Deal reserves a role for the EUCos and the EUCo business model as savings are repaid via the contracts the EUCos share with their customers. Therefore, unless the EUCos engage in the scheme as a Green Deal Provider, they are unlikely to overhaul their business model in accordance with this policy.

Other developments that are likely to support ESCo growth include the establishment of the Green Investment Bank, which is likely to help make finance more freely available for ESCos, given that the funding priorities of this body are set to include support for the Green Deal, non-domestic energy efficiency and energy from waste generation (BIS, 2011). Additionally, the Renewable Heat Incentive will provide generators of small to medium scale low-carbon heat with a financial incentive similar to the FiT, in turn supporting the business case of ESCos looking to provide heat as part of energy supply contracts. Finally, the recent European Energy Efficiency Directive (EU, 2012) obligates EU member states to set their own energy savings targets, which is likely to encourage EU members to consider energy service contracting as a means of meeting their targets. Additionally, the Directive makes provision for member states to support energy service market growth by making lists of providers and model contracts available, which is likely to reduce the amount of time and money currently spent involved in developing service contracts from new.

Continued technological innovation could also play an important role in supporting ESCo activity, as incremental innovations and learning processes help to improve the cost-effectiveness of energy conversion and control equipment. Additionally, the articulation of visions and expectations associated with technological innovations will help to reduce consumers' scepticism of innovative technologies often utilised by ESCos. However, a different set of technological innovations could have a negative impact on ESCos. For example, the process of hydraulic fracturing, or 'fracking', has made vast reserves of shale gas available for extraction that were not accessible before. These reserves could be utilised in place of renewable sources of energy, helping to reinforce the dominance of the fossil fuel oriented EUCos (Stevens, 2012).

Positive feedbacks are also likely to help support growth of the ESCo population. Any growth of the ESCo market could serve to further support the EUCos' belief that the energy system is not only undergoing radical change but also that the ESCo model is likely to play an important role in the future, potentially encouraging EUCos to further develop their energy service portfolio. However, although the UK EUCos have exhibited some degree of movement towards the ESCo model, it is difficult to ascertain how sweeping this change may be going forward because EUCos continue to generate extremely healthy profits from operating their traditional business model (Consumer Focus, 2012). This presents a persuasive argument to shareholders and board members to continue with their traditional business model.

> "People are sitting there making money on those contracts…The innovation models say you should innovate and change but the reality of life is that people don't most of the time because [they] are making money" (ESCo Director)

Another example of a positive feedback cycle that could support ESCo growth arises from the idea of adaptive expectations (Arthur, 1989; North, 1990), where more widespread adoption of the ESCo model will help to raise its profile amongst other actors and in turn improve their understanding of it. Taking financial institutions as an example, we can see how these institutions may be more willing to provide ESCos with finance if they become more aware of their existence and have possess a clearer understanding of how the ESCo model functions.

In summary, we anticipate that the ESCo model's degree of fitness with its selection environment will improve in the future. Although much of this change will be a consequence of developments beyond the control of ESCos, some is likely to be attributable to ESCo related positive feedbacks. Even so, many of the significant barriers identified in Section 6.2 are likely to remain, potentially continuing to limit ESCo operation to niche deployment.

8 Conclusions

This paper developed an analytical framework integrating analysis of business models (Osterwalder & Pigneur, (2010) and co-evolution (Foxon, 2011), and applied it to analyse the development of the Energy Service Company (ESCo) business model in the UK. This approach sought to address two questions: Firstly, why has the ESCo model traditionally been confined to niche applications? Secondly, what role is the ESCo model likely to play in the future transition to a low-carbon UK energy system?

In relation to the first question, this paper indicates that ESCos' failure to proliferate can largely be attributed to a hostile selection environment, which has traditionally been unsupportive of energy service contracting. Furthermore, we find that the poor fitness of the ESCo model with its selection environment can to some extent be attributed to the dominance of the EUCo model and the coevolutionary relationship EUCos share with the wider energy system. We find that positive feedbacks between the EUCos and the wider energy system have helped to cultivate a selection environment that is supportive of EUCo operation but not the application of the ESCo model. This dynamic has contributed to a 'locking in' of the EUCo model and consequently, the marginalisation of the ESCo model.

Considering the second question, we expect ESCos' influence on energy system change to increase in magnitude over the coming years as the current emergence of a more favourable selection environment is likely to support future uptake and operation of the ESCo model. Additionally, variation within the ESCo population is expected to remain broadly similar to that at present, as forces encouraging standardisation of ESCo business models are balanced by the heterogeneous nature of energy service contracts. Thus, we envision that any future changes to the UK energy system that can be attributed to ESCo activity are likely to be qualitatively similar to those that have occurred in the past, although we expect that these are likely to occur on a larger scale as the ESCo population grows larger. Most interestingly, we observe that the incumbent EUCos have reacted to the changing selection environment by developing their own ESCo divisions, perhaps signalling a transformation of the UK energy sector's *status quo*.

Proliferation of ESCos and consequently their growing influence on energy system change is also likely to be attributable to coevolutionary positive feedbacks. Here, ESCo induced changes to the energy system are likely to help cultivate a more sympathetic selection environment for ESCos, in turn encouraging ESCo growth and thus amplifying their effect on the energy system. This would see ESCos benefitting from similar feedback mechanisms to those that have helped the EUCos to dominate the UK energy system.

In conclusion, the empirical evidence indicates that ESCos could play an increasingly important role in a low-carbon transition of the UK energy system, as suggested in some scenarios. However, this role is not assured because numerous key barriers still remain that continue to constrain ESCo growth, particularly customers' unfamiliarity with the model and financial organisations' perception of it as a higher risk business model than the conventional EUCo model. Additionally, unforeseen future perturbations in the energy system, such as a radical change to energy policy, could jeopardise growth in the ESCo market and ensure the ESCo model remains confined to niche applications.

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Table 1

<table>
<tr>
<td rowspan="2">Key Partners
Network of suppliers and partners that make business model work</td>
<td>Key Activities
Most important things a company does to make its business model work</td>
<td rowspan="2" colspan="2">Value Proposition
The bundle of products and services that create value for a specific Customer Segment</td>
<td>Customer Relationships
Relationships a company establishes with its Customer Segments</td>
<td rowspan="2">Customer Segments
The different groups of people or organizations an enterprise aims to reach and serve</td>
</tr>
<tr>
<td>Key Resources
Most important assets required to make the business model work</td>
<td>Channels
How a company communicates with and reaches its Customer Segments</td>
</tr>
<tr>
<td colspan="3">Cost Structure
All cost incurred to operate a business model</td>
<td colspan="3">Revenue Streams
The money a company generates from each Customer Segment</td>
</tr>
</table>

Table 2

Business Model Building Blocks	Energy Service Company (ESCo) Model	Energy Utility Company (EUCo) Model
Customer Value Proposition	- Fulfil energy needs at a similar or lower cost to EUCo model - ESCo assumes most financial and technical risk of fulfilling customer's energy needs - Bespoke and holistic energy solutions that closely fit the customer's needs - Energy needs met with fewer adverse environmental effects compared to EUCo model, meaning customer can enjoy more sustainable lifestyle, fulfil regulatory and Corporate Social Responsibility (CSR) obligations etc. - Societal benefits (e.g. alleviation of fuel poverty, climate change mitigation, localization of capital flows)	- Fulfil energy needs at low cost - Reliable energy supply - Short-term contracts mean flexibility for customer - Little interference with customer as they do not go 'beyond the meter' e.g. few behavioural stipulations
Target Customer	- Mainly commercial (focus on public sector), with some residential and industrial	- Residential, commercial, industrial and agricultural

Customer Channels	- On-line, TV, telephone, postal & door-to-door marketing, purchasing, metering, billing & customer feedback - Energy supplied via localized and often private distribution networks - Support via on-going customer interaction & project management	- On-line, TV, telephone, postal & door-to-door marketing, purchasing, metering, billing & customer feedback - Energy supplied via a national transmission & distribution network - Support via customer service call centre, metering & billing etc.
Customer Relationship	- Bespoke & holistic - Long-term service contracts - Close, cooperative, candid and trusting relationship to ensure customer's and ESCo's needs are met - Customer may invest in ESCo - Customer may manage ESCo (e.g. Community ESCo)	- Impersonal & standardised - Short-term supply contracts - Customer responsible for managing most conversion processes (e.g. gas to heat via boiler)
Key Activities	**Energy Supply Contracts (ESCs) & Energy Performance Contracts (EPCs)**[1] - Typically finance, design, build, operate and maintain small to medium scale demand management & low carbon supply energy projects	- EUCos typically engage in energy generation and supply. They may also engage in distribution and transmission but this is less common: **Generation** - Finance, design, build, operate and maintain large-scale, centralised energy generation & distribution infrastructure

[1] A detailed description of both ESCs & EPCs provided below this table

	ESCs - Energy generation, distribution, supply, metering and billing	**Supply -** Electricity trading and metering & billing of energy supply. Rarely go 'beyond the meter'. Some installation & maintenance of small-scale conversion and control technologies (e.g. central heating) **Distribution & Transmission -** Within their vertically integrated organisation, some EUCos may engage in transmission and distribution via arms-length transmission and distribution network operators (i.e. TNOs & DNOs)
	EPCs - Preliminary and investment grade auditing - Measurement and verification of energy savings	
Key Resources	**ESCs & EPCs** - Financial resources and technical, financial and legal expertise to develop small to medium scale demand management and low-carbon supply energy projects. - Customer facing services i.e. operation and maintenance, billing etc.	- Financial resources and technical, financial and legal expertise to develop large-scale, centralised generation and distribution infrastructure - Customer facing services i.e. nationwide metering, billing and customer service network - Fossil fuels (e.g. gas, coal) - Centralised generation & distribution technologies
	ESCs - Technology: Decentralised, primary conversion technologies (i.e. generation) & distribution technologies - Fuel	

	EPCs - Technology: Secondary conversion equipment and building controls	
Key Partnerships	- Financial Institutions & Investors - Technical, Legal & Financial Consultancies - Property Developers - Sub-Contractors - Local Authorities	- Financial Institutions & Investors - Electrical Power Generation Companies - Transmission & Distribution Network Operators - Gas & Electricity Network Regulators
Revenue Streams	**ESCs & EPCs** - Bank finance - Capital grants - Customer investment **ESCs** - Customer payment for useful energy streams (e.g. hot water). Customer covers this cost in part via energy savings ESCo achieves through efficiency gains or utilisation of cheaper primary energy input - Low-carbon financial incentives for micro-generation (e.g. FiT, RHI)	- Bank finance - Sale of metered units of delivered energy (e.g. gas, imported electricity) - Low-carbon financial incentives (e.g. Renewables Obligation Certificates) - Trading of surplus electricity on the market

	EPCs - Payment for predefined quality & quantity of final energy services (e.g. light). Customer covers this via energy savings the ESCo achieves through efficiency gains	
Cost Structure	**EPCs & ESCs** - Staff and contractors to implement projects - Marketing and communication - Operation & maintenance of infrastructure - Finance or investment repayments - Technical, financial and legal consultancy	- Similar costs to ESCos barring costs specific to EPCs
	ESCs - Acquiring the rights from gatekeeper organisations provide ESCs (e.g. property developer) - Metering & billing - Generation technology and/or wholesale purchase of energy - Fuel	

	- Premises & land acquisition for generation	
	EPCs - Measurement & Verification of savings - Compensation for poor missing energy performance targets	

Figure 1

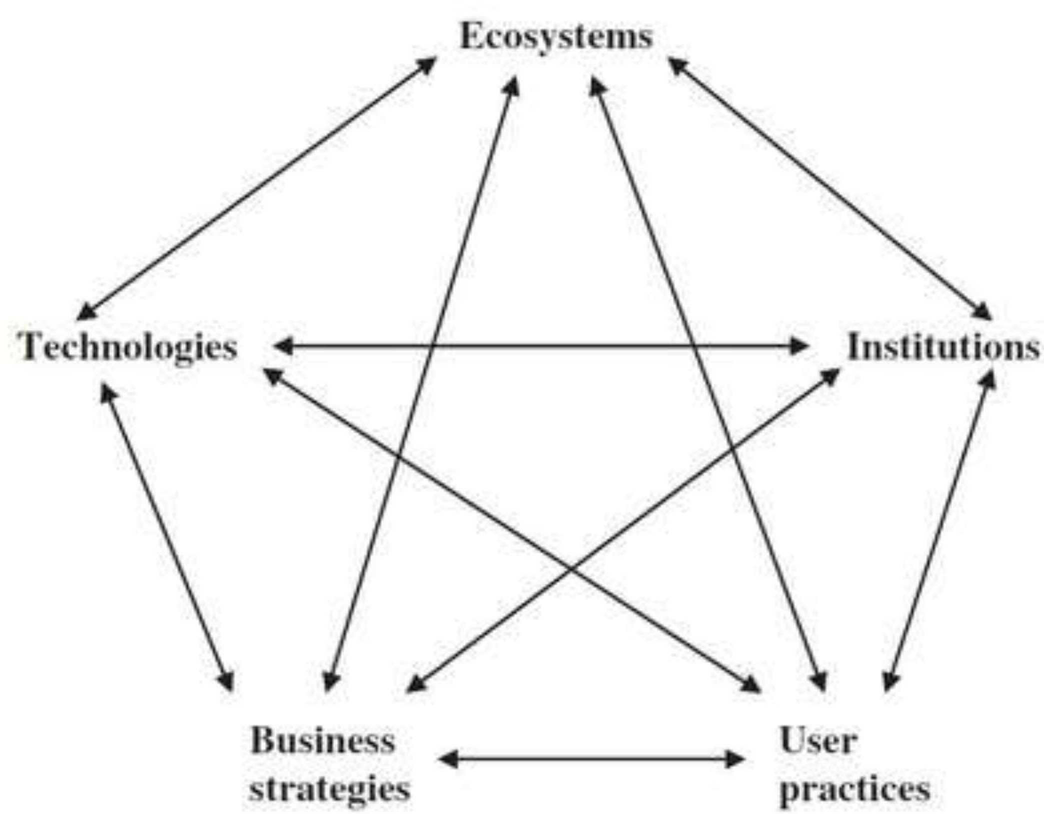
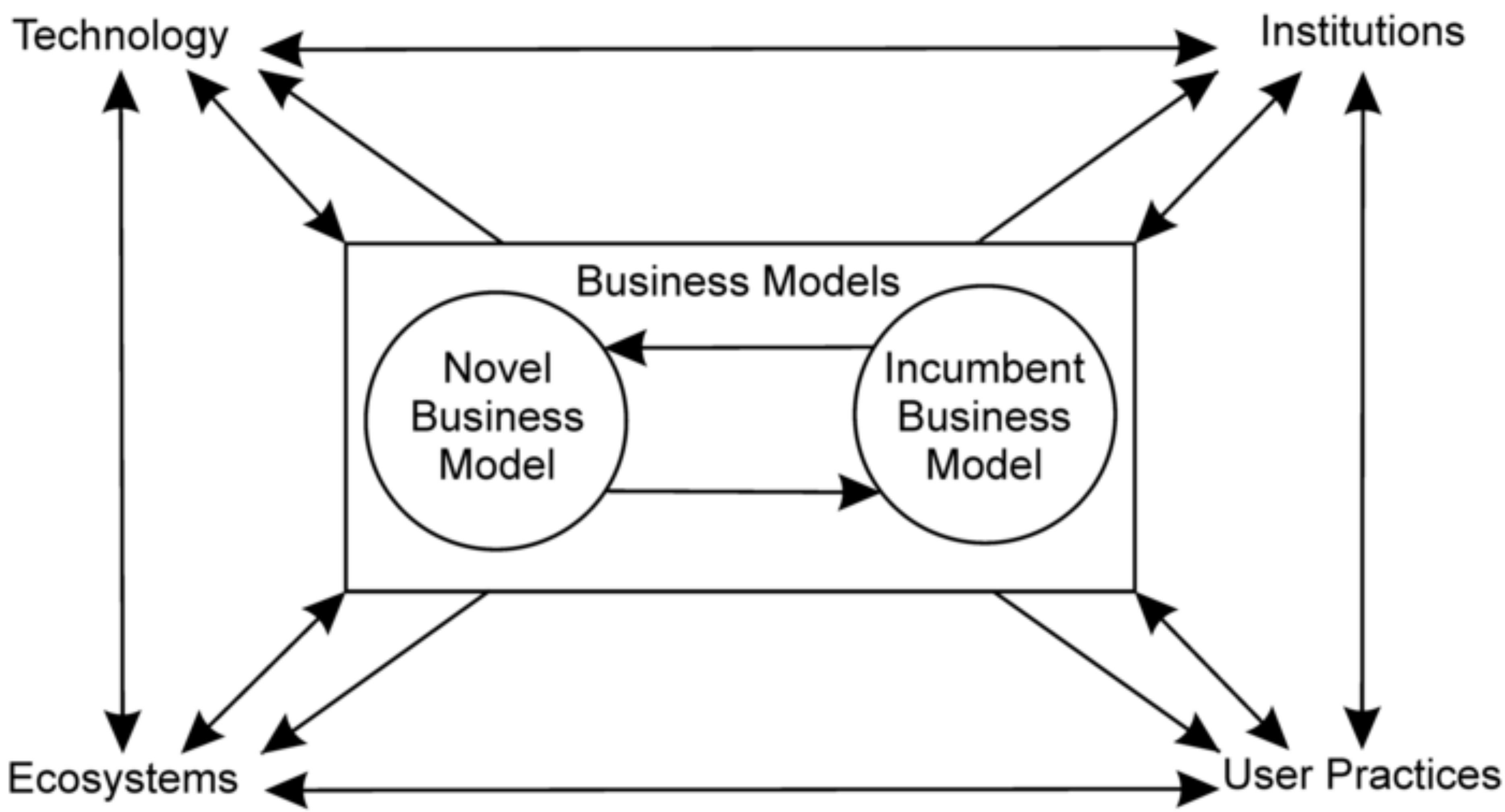

Ecosystems
Technologies
Institutions
Business strategies
User practices

Figure 2


Technology
Institutions
Business Models
Novel Business Model
Incumbent Business Model
Ecosystems
User Practices