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How Can Intermediaries Promote Business Model Innovation: The Case of 'Energiesprong' Whole-House Retrofits in the United Kingdom (UK) and the Netherlands

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How can intermediaries promote business model innovation: the case of 'Energiesprong' whole-house retrofits in the United Kingdom (UK) and the Netherlands

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Abstract
Business model innovation is increasingly important for the diffusion of sustainable innovations - particularly those that are *systemic* in nature. In this paper we outline how systemic innovations, such as whole-house energy 'retrofit', may require new business models before they gain widespread adoption. Through a series of semi-structured interviews and document analysis, we undertake a case study of the 'Energiesprong' retrofit business model - contrasting this with the incumbent 'atomised' market model. We highlight the central role of an *innovation intermediary* - the Energiesprong 'market development team', in this business model innovation, and how Dutch policymakers sought to promote business model innovation through creation of this intermediary. In doing so we develop a novel framework - combining the components of business models with the functions of intermediaries to illustrate this case. Finally, the paper suggests this case and framework could provide lessons for how intermediaries and in turn policymakers might foster business model innovation in other sectors.

Keywords
- Business models
- Energy efficiency retrofit
- Systemic innovation
- Business model innovation
- Intermediaries
- Innovation policy

1. Introduction

The concept of the 'business model' has gained widespread use: as a means of classifying different businesses; a lens for academic research; and as an entrepreneurial tool for management practitioners (Baden-Fuller and Morgan, 2010). Increasingly the role of the business model is seen as critical for the diffusion of technological innovations (Baden-Fuller and Haefliger, 2013; Teece, 2010) and for 'sustainability transitions' (Bidmon and Knab, 2018; Bolton and Hannon, 2016). This has led to a focus on 'business model innovation' as an important area for both incumbent and entrepreneurial firms (Chesbrough, 2010), in promoting sustainability, and in addressing climate change (Boons and Lüdeke-Freund, 2013; Sarasini and Linder, 2018). Thus, the governance of sustainability transitions may require new policies that foster business model innovation (Bolton and Hannon, 2016). However, very little has been written on how policymakers might actually promote business model innovation. We argue that one such approach is the support of innovation intermediaries (Kivimaa, 2014; Mignon and Kanda, 2018).

In this paper, we make three propositions. First, we argue that business model innovation may be particularly important for 'systemic innovations' – those which require integration and configuration with other complementary processes, practices and technologies, within a system that spans the boundaries of individual organisations (Midgley and Lindhult, 2015). Second, we build on the literature on innovation intermediaries (Kivimaa and Martiskainen, 2018a; Stewart and Hyysalo, 2008), and highlight the important role that these actors can play in business model innovation. Third, by developing a novel framework we suggest that policymakers can promote business model innovation through intermediaries to facilitate systemic change (Lente and Hekkert, 2003). We illustrate these ideas through the case of the Dutch Energiesprong initiative for whole-house retrofit, addressing the following research questions:

1. How can business model innovation enable the diffusion of systemic innovations such as whole-house retrofit?
2. How did an innovation intermediary promote the Energiesprong business model?
3. How might policymakers promote business model innovation for sustainability through innovation intermediaries?

Buildings, especially homes, are the largest single consumer of energy and producer of carbon emissions in most advanced economies (IPCC, 2014). These emissions can be reduced[1] by the 'retrofit' of three types of measure: energy efficiency improvements to the building fabric; the adoption of low carbon heating technologies; and electricity microgeneration such as solar photovoltaics (PV). Thus far, significant savings in the European Union have been achieved through incremental measures such as fluorescent lightbulbs, loft insulation and efficient boilers (Rosenow et al., 2016). These measures have been implemented through existing supply chains, requiring limited changes in consumer and industry practices.

However, it is increasingly recognised that this approach will be insufficient to achieve the savings required to meet climate change targets (CCC, 2018; IPCC, 2014). Instead, emphasis is placed on the need for '*whole-house retrofits'* involving multiple measures (Lewis and Smith, 2013). This involves the effective integration of multiple measures and systems and consideration of how they interact within a specific building - whether installed at once or over time (Fawcett, 2014). Thus, having the features of 'integrative' as opposed to 'modular' technologies (Sanchez and Mahoney, 1996). Recent research indicates that the diffusion of whole-house retrofit may therefore require business model innovation (Mlecnik et al., 2018) as well as significant policy support (Rosenow et al., 2017).

In this paper, we contrast the incumbent 'atomised' market model with the innovative 'Energiesprong' business model – considered to have greater potential for the delivery of whole-house retrofit. Drawing on in-depth interviews conducted in the UK and the Netherlands to formulate a case study; we outline how the Energiesprong business model was developed by an *innovation intermediary* or 'market development team'. Initially created by the Dutch government, although now operating independently internationally. We suggest this

[1] Aside from more efficient appliances and behavioural changes

approach could provide a template for policymakers looking to promote business model innovation in other sectors – requiring further research to other contexts.

This paper is structured as follows. Section 2 reviews the literature on systemic innovation, business models and innovation intermediaries, emphasising the lack of research on policy support for business model innovation, before outlining the conceptual framework. Section 3 summarises our case study methodology. Section 4 describes the operation and potential of the atomised market and Energiesprong business models and assesses the role of the innovation intermediary in the emergence of Energiesprong. Section 5 discusses these findings in light of the existing literature on business model innovation, systemic intermediaries and innovation policy, while Section 6 concludes and provides recommendations for further research.

2. Systemic innovation, business models and innovation intermediaries

2.1. Systemic innovation and whole-house retrofit

The literature on systemic innovation is increasingly the point of departure for scholars grappling with the innovation policy challenges of the 21st century. Systemic innovations require complementary changes in supporting technologies, technical skills, cultural norms, user competences, organisational practices and regulations (Midgley and Lindhult, 2015). Systemic innovation may therefore result in entirely new 'socio-technical systems' - where technological, social and institutional elements co-evolve; resulting in whole system change (Foxon, 2011; Midgley and Lindhult, 2015). The importance of systemic innovation and its role in economic and sustainable development is recognised by the Organisation for Economic Co-operation and Development (OECD), who provide the following definition:

> *"System innovations…alter existing system dynamics…entailing changes in both the components and the architecture of systems. They are characterised by three main features:*
>
> *1) disrupting or complementary types of knowledge and technical capabilities;*
> *2) fundamental changes in consumer practices and markets; and*
> *3) novel types of infrastructures, institutional rules and skill sets."* (OECD, 2015).

Systemic innovations contrast with incremental innovations; where gradual improvements in current technologies, processes or infrastructures can be easily adopted by incumbent actors, with little change required in underlying processes and practices (Mlecnik, 2013). Many of the sustainability challenges facing policy makers in a range of systems from: food and agriculture (Klerkx and Leeuwis, 2009); healthcare (McMahon and Thorsteinsdóttir, 2013); transport (Nykvist and Whitmarsh, 2008); buildings (Mlecnik, 2013); and energy provision (Foxon et al., 2005) – require such systemic innovation (OECD, 2015).

Whole-house retrofit is perhaps an archetypal example of a systemic innovation (Mlecnik, 2013) - needing complementary developments in regulations, financing, supply chain

competences and household practices (Wilson et al., 2015), all requiring policy and institutional changes to be fully and effectively realised (Brown et al., 2018).

2.2. Business model innovation and sustainability

Business models[2] describe of the nature of value delivered to customers, how organisations and networks create value and the means of capturing revenues from that value (Hellström et al., 2015; Teece, 2018). Whilst the innovation studies literature focusses primarily on technological artefacts, there is growing recognition of the integral role of accompanying business models - particularly for radical, path breaking or systemic innovations (Chesbrough, 2010). Although the majority of studies on business model innovation originate from the business and management literature (Massa and Tucci, 2013), the concept is increasingly prevalent in sustainability research (Boons et al., 2013). The importance of sustainable business model innovation is emphasised by Budde Christensen et al., (2012, p. 499):

> *"it might be that innovative technologies that have the potential to meet key sustainability targets are not easily introduced by existing business models within a sector, and that only by changes to the business model would such technologies become commercially viable."*

Hence, the economic, environmental and social value of innovation often remains latent, until commercialised through a complementary business model (Bohnsack et al., 2014). Radical innovations, which present challenges in capturing revenues, often pose the greatest need for new business models (Teece, 2010). Thus, business model innovation may be a particularly important component of systemic innovation (Boons et al., 2013). Incumbent business models may also be incompatible with long term sustainability and the direction of technological change (Roome and Louche, 2016). Business model innovation therefore presents two key opportunities; first to enable the diffusion of sustainable innovations, and second to reconfigure existing industries towards more sustainable practices (Massa and Tucci, 2013; Schaltegger et al., 2016). Recent studies therefore highlight the potential for integrated retrofit business models (Brown, 2018; Mahapatra et al., 2013; Mlecnik et al., 2018) and energy performance contracts[3] in the residential sector (Brown, 2018; Mcelroy and Rosenow, 2018; Winther and Gurigard, 2017).

However, organisations may face a range of barriers to business model innovation (Stubbs and Cocklin, 2008), including the 'dominant logic' of a firm or industry (Chesbrough, 2010) and wider cultural and structural barriers which have 'co-evolved' with incumbent business models (Bohnsack et al., 2014; Hannon et al., 2013). Organisations may thus lack the necessary knowledge, capabilities or complementary assets to innovate their existing business models, or enter new markets with new business models (Teece, 2018, 2010, 1986). These barriers and benefits may provide a rationale for policy intervention (Jaffe et al., 2005).

Yet, existing literature provides limited insight as to how business model innovation might be governed (Bolton and Hannon, 2016). Innovation intermediaries have been shown to

[2] A more detailed definition used in this paper is provided in Section 3.

[3] Energy performance contracts include guaranteed reductions in energy consumption or costs for the client

overcome barriers to systemic innovation (Lente and Hekkert, 2003) with authors emphasising polices to promote these intermediaries (Kivimaa, 2014). Although some authors have studied intermediation in the retrofit context (Kivimaa and Martiskainen, 2018b) few have linked these ideas to business models.

2.3. Intermediation for business model innovation

In this section we integrate the literature on business models, with that on innovation intermediaries to develop a new conceptual framework. We first outline the detailed components of business models before introducing the literature on innovation intermediaries. Due to the challenges of business model innovation, we argue that innovation intermediaries may be important in the creation and adoption of new business models.

2.3.1. Components of a business model

Following Boons and Lüdeke-Freund (2013), we identify the key components of a business model as the *value proposition, supply chain, customer interface, and financial model*. To this we add the *governance* dimension described by Zott and Amit (2010). This approach captures both the *content* of the business model (Osterwalder and Pigneur, 2010) and its mode of *governance* within organisations and wider networks (Hellström et al., 2015; Zott and Amit, 2010). These components are integrated by Brown (2018) and summarised in Table 1.

Table 1 Key components of a business model (Brown, 2018)

Component	Definition
Value proposition	The *value proposition* refers to the value or utility from goods and services that an organisation or network provides to the customer (Boons and Lüdeke-Freund, 2013; Engelken et al., 2016) .
Supply chain	The *supply chain* describes the upstream relationships between an organisation and its suppliers (Boons and Lüdeke-Freund, 2013). This comprises the logistical and technical elements that enable delivery of the value proposition (Osterwalder, 2004).
Customer interface	The *customer interface* covers all downstream, customer-related interactions (Boons and Lüdeke-Freund, 2013). This includes the relationship the customer has with the supplier organisations in terms of marketing, sales and distribution channels and the ongoing relationship with the product or service (Osterwalder and Pigneur, 2010).
Financial model	The *financial model* constitutes the combination of an organisation's capital and operational expenditures with its means of revenue generation (Osterwalder et al., 2005). This is linked to the value proposition, in terms of what products and services customers pay for and how revenues are collected and distributed.
Governance	Business model *governance* involves both the co-ordination and management of the other components and the organisational form of the business model (Amit and Zott, 2001; Zott and Amit, 2010). As such, business models may involve a single organisation or a network of interdependent firms that interact to provide a service or product (Hellström et al., 2015). The range of governance approaches lie along a continuum, with integrated, hierarchical firms at one end,

	and arm's-length, market-based contractual relationships at the other (Treib et al., 2007).

2.3.2. Innovation intermediaries and business models

A range of policy instruments to promote innovation are identified by Edler and Fagerberg (2017). These are grouped into six types; various stages of *research, development and deployment (R&D&D) funding*; polices to develop *capabilities and skills*; policies to promote *interaction and learning across networks; procurement policies* to generate demand; *regulations and standards*; and *missions and foresight policies* which envisage future needs and set the direction of change. Recently scholars have emphasised the need for systemic innovation polices, which move beyond a focus on individual instruments and technologies - instead seeking to promote whole system change (Wieczorek and Hekkert, 2012). Kivimaa (2014) therefore emphasises how government affiliated intermediaries may constitute a form of systemic innovation policy (Smits and Kuhlmann, 2004).

Innovation intermediaries have been studied in multiple contexts since the 1990s (Bessant and Rush, 1995), covering a huge array of activities from technology transfer to innovation management and systems of innovation (Howells, 2006). Intermediaries can be characterised by their intermediation functions: for innovation in general (Howells, 2006), or in the context of sustainability transitions (Kivimaa et al., 2018; Mignon and Kanda, 2018). They can be grouped into specific types of actors based on the level and scale in which their operate, their mandate and normative orientation (Kivimaa et al., 2018). These actors may be key bridges or brokers in innovation systems, providing linkages, advocacy or technical services between multiple stakeholders, including suppliers and end-users (Howells, 2006; Hyysalo et al., 2018). Kivimaa et al., (2018) define innovation intermediaries for sustainability as:

> *"actors and platforms that positively influence sustainability transition processes by linking actors and activities, and their related skills and resources"*

Van Lente et al (2003) contrast 'systemic' intermediaries, with those that have a more bi-lateral, or single technology focus (Klerkx and Leeuwis, 2009). The actions of these intermediaries may therefore play a crucial role in facilitating the emergence, development and diffusion of systemic innovations (Lente and Hekkert, 2003) - such as whole-house retrofit (Martiskainen and Kivimaa, 2018). In the retrofit context, intermediaries may include local authority agents, charities or NGOs, third sector or individual actors who facilitate projects (Kivimaa and Martiskainen, 2018).

We argue that innovation intermediaries may also play a role in promoting business model innovation. In their seminal work, Stewart and Hyysalo (2008) describe innovation intermediaries having three core roles: *facilitating, configuring and brokering* - which have been extensively applied in subsequent studies (Barnes, 2016; Kivimaa, 2014; Kivimaa et al., 2018). In Table 2 we develop these ideas and apply them to the context of business model innovation.

Table 2 Key functions of an innovation intermediary in business model innovation

Function	Definition
Facilitating	Facilitating enables networking and collaboration as well as knowledge dissemination and learning (Howells, 2006). In the context of business model innovation this involves the support and co-ordination of the networks involved in the delivery of the value proposition (Hellström et al., 2015). Thus, potentially facilitating new approaches to business model governance, towards integrated or more networked arrangements (Treib et al., 2007).
Configuring	Configuration involves the design and modification of technological, social and organisational innovations, to promote their appropriation and adoption among key stakeholders (Howells, 2006). Therefore, this involves the design, modification and testing of new business models with relevant users, suppliers and the wider regulatory environment. This is likely to include developing novel value propositions and financial models (Chesbrough, 2010), such as energy performance contracts (Nolden et al., 2016) but also capabilities in supply chains and the customer interface (Boons and Lüdeke-Freund, 2013).
Brokering	Innovation intermediaries may provide support through negotiation and representation with external sponsors or regulators (Stewart and Hyysalo, 2008). Thus, intermediaries may seek to raise financial or human resources to sustain and develop innovative activity or undertake advocacy or lobbying activities to alter the legal or policy environment (Howells, 2006). Intermediaries may also seek to create demand for the combination of products and services embedded within the business model they are seeking to promote (Klerkx and Leeuwis, 2009), what could be termed 'market formation' (Kivimaa et al., 2018).

Table 3 presents our conceptual framework used for examining the Energisprong case in Section 4. It connects Stewart and Hyysalo's (2008) innovation intermediary roles with business model components (Brown, 2018) highlighting the role they play in business model innovation.

Table 3 Conceptual framework linking innovation intermediation to business model components

	Facilitating – network formation and collaboration	Configuring – business model design	Brokering - advocacy and resource raising
Value proposition	Creating opportunities for new value propositions, by bringing new actors together- supporting and coordinating networks (Hellström et al., 2015).	Configuring the mix of products and services which form the new value proposition (Chesbrough, 2010). Includes testing of alternative value propositions with users, suppliers and regulators.	Advocacy and lobbying to modify regulatory or policy environment to be more favourable to new value propositions.
Supply chain	Creating opportunities for new supply chain interactions - developing the relationship between the core firm/businesses and their suppliers, which can be more complex in the case of systemic innovation (Mlecnik, 2013).	Setting rules and contract terms for suppliers, as well as training and capacity building (Mlecnik, 2013).	Advocacy and lobbying to modify regulatory or policy environment to be more favourable to new supply chain configurations.
Customer interface	Creating new connections to potential customers, interfacing between customer expectations and new business model designs.	Developing marketing and sales channels as well as new forms of customer engagement – including the use of new media (Brown, 2018).	Advocacy and lobbying to modify regulatory or policy environment to be more favourable to new customer interfaces. Creating new markets by influencing regulations or local rules (Martiskainen and Kivimaa, 2017).
Financial model	Creating links to new financial actors to develop new financial models through new sources of capital or revenue streams.	Developing new financial models – often linked to new value propositions, requiring interaction with finance providers and customers.	Advocacy and lobbying to modify regulatory or policy environment to be more favourable to new financial models. Seeking new financial resources such as research and development (R&D) funding or other private sector fundraising activities.
Governance	By facilitating new networks and links between the other business model components this may lead to new modes of governance, towards more integrated or networked arrangements (Treib et al., 2007).	Developing the linkages between different actors involved in business model governance. This may include an active role in organisational management and 'system building' activities during the early phases of business model development (Bolton and Hannon, 2016).	Advocacy and lobbying with regulators to overcome potential barriers to business model integration or outsourcing (Howells, 2006; Klerkx & Leeuwis, 2009; Kivimaa, 2014).

The combined business model and intermediation framework is shown in Figure 1 and illustrates how these elements work together to produce business model innovation.

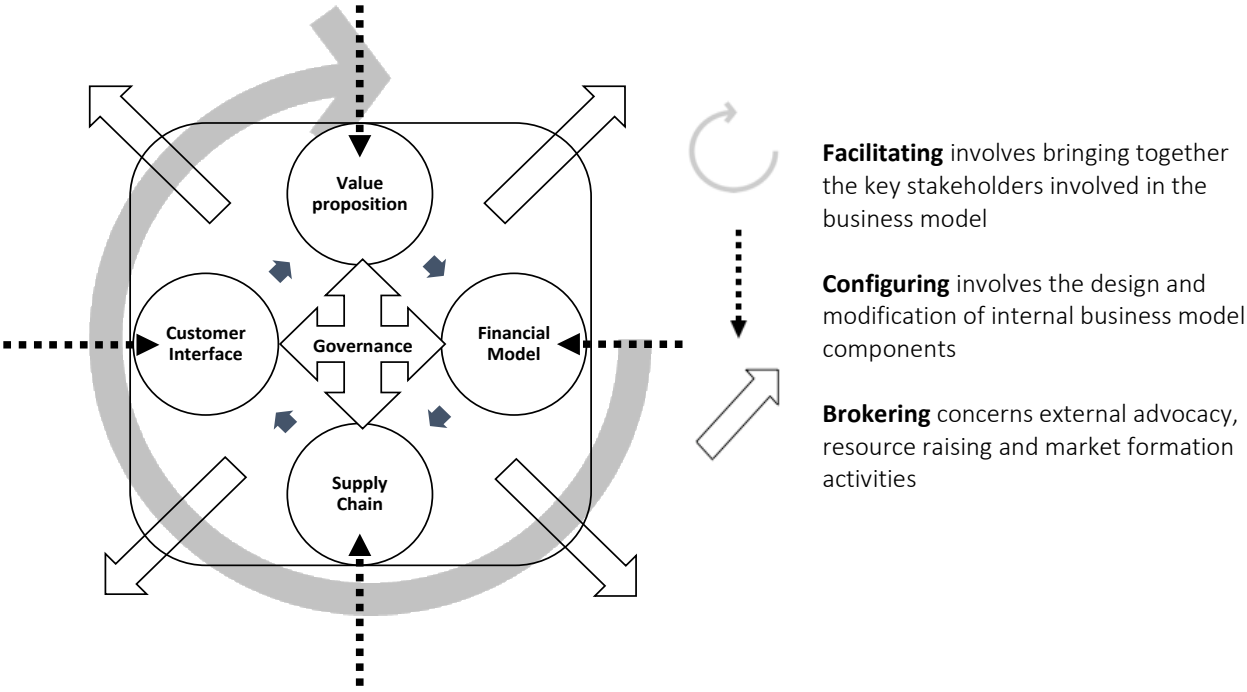

Figure 1 Business model innovation and intermediation framework

3. Methodology

This research involved a qualitative case study of a policy initiative to promote business model innovation for whole-house retrofit; the Energiesprong initiative. We draw on insights and empirical context from two wider research projects focussed on both (1) business models and finance mechanisms for residential retrofit and (2) the role of intermediaries in low energy housing innovation. Each project involved a total of thirty-nine and twenty-nine semi-structured interviews[4] respectively, conducted between November 2016 and June 2018. This included seven interviews with actors directly involved in the Energiesprong initiative. Other interviews provided background both on the range of business model archetypes and financing mechanisms adopted as well as the nature of intermediation in the sector. A qualitative case study approach was considered appropriate given the need to develop an in-depth understanding of these relatively understudied processes in the retrofit context, to answer 'how' or 'why' questions (Yin, 1994) that contribute to theory development (Flyvbjerg, 2006). In building this picture, the research was undertaken in three parts.

Part one focussed on the diversity of business models and finance mechanisms adopted for residential retrofit. This initially involved nine scoping interviews with key 'experts' in the retrofit space in the UK, EU and USA (see Appendix A, Table A1). These experts were selected on the basis of their technical, academic and policy eminence within the retrofit sector, with further interviewees sourced through snowballing techniques (Yin, 1994). This was

[4] The interviews were a mix of face to face and video conference calls

supplemented by extensive document analysis and attendance of industry events and seminars. The objective was to develop a typology of business models and finance mechanisms and understand how their design features contributed to their success in different contexts. The scoping interviews were followed by twenty-four interviews with key practitioners across the key business model and finance mechanism archetypes, to develop a rich understanding of their operation and the advantages and disadvantages of each approach. This identified two contrasting business model archetypes, which are explored in detail in this study. The 'atomised' market model that has typified the delivery of single residential retrofit measures, and highly innovative net-zero energy performance contracts; with the 'Energiesprong' initiative the only known residential example.

Part two provided context on intermediation in the UK low energy housing sector (see (Kivimaa and Martiskainen, 2018b, 2018a; Martiskainen and Kivimaa, 2017)) and provided a background setting for analysis of intermediation in this case study. This included twenty-nine in-depth interviews and a workshop organised with stakeholders in February 2017, in which Energiesprong were a speaker (see Appendix B, Table B1).

Part three involved an in-depth case study[5] of the Energiesprong initiative. This phase involved six[6] interviews during spring and summer 2018 with various actors in both the UK and the Netherlands. This included the *client* or housing provider; the construction *industry* partner; supporting *policymakers*, as well as the Energiesprong market development team *intermediary* themselves (see Appendix C, Table C1). The interviews focussed on understanding whole-house retrofit as a systemic innovation; the nature of the Energiesprong business model; the role of the market development team in enabling business model innovation; the policy approach that brought it into being and the ongoing interaction between the intermediary, policymakers and other stakeholders. Again, these interviews were supplemented by document analysis and attendance of relevant industry events and seminars.

Each interview was digitally recorded and transcribed and analysed using the NVivo™ qualitative analysis software. Interviewees were offered options as to the level of disclosure and anonymity (reflected in the appendices). Interview data was coded and analysed the based on the framework outlined in Section 2.3.2. This also involved triangulating these findings with public available reports such as Energiesprong (2018, 2017, 2014), to add validity to the claims made in the following sections.

4. Business model incumbency and innovation intermediation in residential retrofit

The following section explores two contrasting business models and the role of an innovation intermediary; based on the framework outlined in Section 2.3.2. This section first outlines the 'atomised' market, business model - considered typical retrofit practice. We then introduce the Energiesprong initiative, as a case study of retrofit business model innovation, delivered through a government funded intermediary.

[5] Phase one provided sufficient detail on the atomised market model
[6] One Energiesprong interview already took place in phase one

4.1. The 'atomised' market model

The majority of EU low carbon retrofit has involved single measures delivered by separate contractors, without guarantees on energy saving performance. This has typically required multiple points of contact and has tended to be funded by a number of changing subsidy regimes such as energy supplier obligations, tax breaks or feed in tariff type schemes. Although this approach has been fairly successful for incremental single measures (Rosenow and Eyre, 2014); this 'atomised market model' is considered problematic for undertaking whole-house retrofits. Creating issues for project co-ordination, energy performance gaps and unintended consequences such as air quality and damp issues - limiting consumer appeal.

4.1.1. Value proposition

The traditional offer to households has been framed in terms of energy cost savings, rather than home improvement or increasing comfort. This was considered to be a mistake by many of those interviewed:

> *"For most people … it's not the economics that's driving them, it really isn't. First and foremost, its comfort, its often aesthetics, what you perceive as aspirational… It's all these subtle things that are more cultural I think."* (Academic - Energy Efficiency Policy)

The focus on energy cost savings is especially problematic, given that energy savings are typically based on estimated rather than guaranteed performance:

> *"to guarantee you performance…that's a different mind-set…and…selling performance is good because it puts a line of blame and accountability, which is what we don't have at the moment"* (Director – BRE)

Therefore, the narrow offer of estimated energy cost savings without any guarantees or warranties on the work, severely limits the appeal of a whole-house retrofit. It was also commented that this approach results in poor-quality installations, with limited liability or recourse potential due to the lack of aftercare or performance guarantees.

4.1.2. Supply chain

The typical retrofit supply chain consists of multiple, fragmented installers, suppliers and consultants. It was discussed by several interviewees, that this is largely a reflection of the wider construction industry; typified by specialised subcontractors, each with their own division of labour and industry culture:

> *"Solid wall insulation it's like an…artisanal, industry…Rather than something which is at industrial scale, and those economies of scale are never going to happen, until you got the whole supply chain working" (*Energy Saving Trust)

This supply chain fragmentation, the lack of assured performance, measurement and verification alongside a skills gap were all seen to contribute to low quality retrofits, particularly for deeper measures such as solid wall insulation:

"we've got issues around external wall insulation … we've got … green algae growing on the outside…we've got so many complaints coming in from private residents" (Social Housing Provider)

4.1.3. Customer interface

In the atomised market model, consumer engagement[7] has typically involved single measures, leaving the customer to seek out and project manage more comprehensive work "largely the onus is on them at the moment" (Energy Saving Trust). In procuring multiple retrofit measures, customers therefore need to engage multiple consultants and contractors, each with their own marketing channels and points of sale:

"[referring to the UK's Green Deal[8]] what actually happened was the customer journey was a lot longer than expected." (Energy Efficiency Consultant).

This lack of co-ordination between different suppliers is therefore seen as complex, and likely to deter all but the most committed households. Without a trusted intermediary or a single point of contact, some interviewees also felt this made customers vulnerable to unscrupulous contractors *"if Mrs Jones goes direct to the company, the company can tell her anything can't they"* (Energy Efficiency Consultant).

4.1.4. Financial model

Specific financial models are not intrinsic to the atomised market model. However, this approach in synonymous with government grant and supplier obligation schemes; typified by stop start funding for single measures. Thus, many interviewees felt that this approach had resulted in a marketplace that was very grant dependent. It was further discussed that this policy approach had contributed to the piecemeal nature of installations and the very limited diffusion of whole-house retrofits. Whilst the UK's recent Green Deal financing mechanism was intended to fund multiple measures, it still applied an incremental logic to financing:

"Green Deal was set up to fund things on a measure by measure basis. So, you have this, then you have this, then you have this. … With the supplier obligations we worked on things …in the order of cost-effectiveness; in an 'incrementalist' approach" (Energy Saving Trust)

4.1.5. Governance

The atomised market model is associated with a market-based mode of governance, characterised by limited integration between the different elements of the business model:

[7] Largely through the energy supplier obligations

[8] The Green Deal was a voluntary UK policy program based on a private sector finance mechanism, repaid on energy bills

"at the moment there is no integration in the retrofit market …somebody goes out and gets a lead …they may get £50…they then come up with 'yes it's got a solid wall yes it needs windows' it becomes a sum of parts without…a plan" (Director - BRE)

This mode of governance may be effective for large organisations, able to manage complex supply chains, multiple interfaces with suppliers and compare different financing options. However, it is considered a poor means of delivering whole-house retrofits for time poor households, who may have limited knowledge of the options available or the ability to undertake due diligence.

4.2. Case study: The Energiesprong initiative

In 2013, the Dutch government funded a large-scale (€45 million) market led initiative to achieve net-zero energy homes known as the 'Energiesprong' or 'energy leap' initiative (Energiesprong, 2014). The aim was to overcome many of the issues identified in the previous section, thus, facilitating a self-sustaining market for net-zero energy homes[9], through a new type of policy - delivered by a market intermediary. The Energiesprong market development team developed a radical solution based around a highly innovative business model involving: a net-zero energy performance contract; an integrated and industrialised supply chain; a single customer interface; a financial model based on the performance contract, and co-ordinated governance of these elements aided by the market development intermediary.

The Energiesprong initiative, since emerging from its pilot phase, has now begun a period of growth and expansion to other national contexts - having signed a deal with 175 housing industry partners in the Netherlands to deliver 110,000 net-zero energy homes by 2020 (Energiesprong, 2014). This included the creation of market development teams in the UK, France, Germany and in North America, building on the Dutch experience (Energiesprong, 2017). Thus far, 4,500 net-zero energy homes (a mix of new-build and retrofit) have been delivered in the Netherlands, with 10 and 24 retrofits completed in the UK and France respectively - with many more planned (Energiesprong, 2018). Initially entirely state funded, the initiative is now supported by national and European Union innovation funds and a range of local authority, industry and public sector partners in these respective countries. The following section explores the Energiesprong business model in more detail including its Dutch origins and recent translation to the UK market.

4.2.1. Value proposition

In the Energiesprong model, customers are offered a comprehensive whole-house retrofit, based on guaranteed net-zero energy consumption. This typically involves offsite manufactured, insulated facades, integrated with renewable heat sources and PV panels. The contractor offers a 30-year energy performance guarantee for net-zero annual energy consumption amortised over the calendar year. This is based on a guaranteed internal temperature of 21°c in living spaces, and a set allowance of hot water and electricity consumption; analogous to a mobile phone contract with usage limits. The aim is also to reduce

[9] The program is focused both on net-zero-energy whole-house retrofit and new build

the duration of the retrofit to under one week using offsite manufacture and modularisation. However, the model does not proscribe any specific measures but rather the performance outcome:

> *"This is a balanced scorecard…of outcomes, so that's energy, that's cost, that's overheating, that's noise, that's indoor air quality that do get genuinely measured, has sanctions if you do not meet them and it is over the long term"* (Energiesprong Contractor)

Another key aspect of the Energiesprong offering is the emphasis on the home improvement value of the whole-house retrofit. Homes are given a visual uplift and the retrofit typically includes a number of non-energy-based maintenance measures. Unlike the atomised market model, less emphasis is placed on energy costs savings, and instead on health and comfort benefits alongside property improvement value:

> *"I think…in terms of desirability…the push for such a scalable solution also needs to come from an angle where people actually want to have it."* (Energiesprong International Market Development)

4.2.2. Supply chain

The Energiesprong business model specifies performance rather than technical solutions. However, delivery of a net-zero energy retrofit requires an integrated supply chain, typically with a single 'solution provider'. The Energiesprong model is also driving a move to industrialisation and offsite manufacture; with integrated energy modules that can be miniaturised, and mass-produced. It is thought that this process innovation will drive down costs and installation times through economies of scale; with one-day retrofits now being achieved in the Netherlands – despite each retrofit being bespoke. The Energiesprong model therefore adopts a performance-based approach to procurement:

> *"In the past they would come up with a technical specification, price it up and invite competition on price. We are completely turning that round and saying you ask for a product performance to a fixed price point"* (Energiesprong Project Manager)

Moreover, this procurement route is seen to improve quality and collaboration between the client and contractor:

> *"Energiesprong however, has real teeth, so therefore the quality is driven up because we are concerned to get it right."* (Energiesprong Contractor)

4.2.3. Customer interface

In the Energiesprong initiative, the initial target market has been the social housing sector. Achieving scale is considered to be easier in this market where multiple homes can be retrofitted under a single deal, also tending to have a more uniform housing stock.

Interviewees felt that breaking into the owner occupier market would be much more challenging:

> *"They are managing larger volumes; it is much easier to converse with a provider who is managing 50, 60, 70,000 homes, than to talk to individual private landlords of one or two flats."* (Energiesprong Project Manager)

The customer interface involves a single product offering, rather than separate, sales, audit, measures and financing from different providers. Whilst for social housing this interface is initially with the housing provider, significant emphasis is placed on household engagement:

> *"there was quite an intensive consumer engagement process, which involved workshops with the tenants…in the local pub…so that the tenants could directly import what they wanted out of the scheme… It did genuinely make a difference"* (Local Authority Partner)

Moreover, a key marketing tool of the Energiesprong approach is the visual impact of the newly renovated house, creating what is termed 'kerbside appeal'.

4.2.4. Financial model

As with other forms of energy performance contract, the financial model relies on realised energy savings to fund the cost of the measures. Given the retrofit results in net-zero energy, the entire energy bill can be used to recover these costs. The model has thus far been adopted in the social housing sector, and benefits from the rolling up of future maintenance[10] from the housing providers' asset management budget:

> *"The financing model therefore is…the aggregation of maintenance, major repair works and the additional revenue stream for thirty years from the energy plan that comes with the property."* (Energiesprong Project Manager)

The strategy hinges on achieving economies of scale and learning rates, so that the financial model is viable based on energy costs savings and maintenance budgets alone - rather than reliant on subsidy as at present:

> *"the way I see it…is…this massive prize of a self-financing business model, if we achieve that then there are millions and millions of homes that could be retrofitted"* (Social Housing Provider)

However, for the model to become viable in the private housing sector, third party sources of finance are likely to be necessary. The Dutch government is therefore exploring the use of mortgage financing and performance-based energy service agreements tied to the property. Critical to this is the cost of capital; *"what we see now is cost of financing, structural cost of borrowing money is high in the UK, because it's fully commercial"* (Energiesprong International

[10] Such as those for wall and roofing repairs

Market Development). Therefore, several interviewees saw an ongoing role for government in bridging the funding gap and ensuring low interest rates.

4.2.5. Governance

The Energiesprong business model adopts an integrated mode of governance. Central to this has been the market development team, who have brought together the key stakeholders and facilitated collaboration and innovation towards a common goal:

> *"We've made an innovation of the Energiesprong, and I guess this is one of the biggest things…it's the way, more the governance…the way it was organised"* (Dutch Energy Policymaker)

> *"So, there was quite a lot of collaboration…when we were developing our tender we could do some market testing through Energiesprong, through the market development team"* (Social Housing Provider)

This 'partnership approach' has been central to developing a business model where customer interface, supply chain, financing and net-zero energy retrofit are integrated into an offering from a single solution provider - which can be easily understood by the customer. Thus, simplifying the customer journey, improving quality and is potentially scalable to create a mass market for whole-house retrofit.

Table 4 compares the atomised market model and Energiesprong business model, illustrating the difference across the components of the respective business models.

Table 4 Comparison of the atomised market model and Energiesprong business models. Adapted from: (Brown, 2018)

	'Atomised' market model	'Energiesprong' energy performance contract
Value proposition	• Single measures • Emphasis on energy cost savings • Savings are estimated rather than guaranteed	• Multiple measures or whole-house approach • Emphasis on home improvement and comfort • Energy performance contract • Energy service guarantee of temperature (21°c), hot water volume (150L/day) and electricity (fixed kWh/year) • Energy supply contract subsumed in energy service agreement
Customer interface	• Largely left to the market to promote and engage customers, with responsibility for the marketing and engagement for the different components (i.e. measures, audit, finance) of the retrofit typically separated	• One point of contact for the promotion, marketing and sales of the full package necessary to achieve the retrofit, provided by the host company as a one-stop-shop • Emphasis on customer engagement through housing provider and face to face workshops
Supply chain	• Fragmented relationship with traditional separated trades (plumbers, carpenters etc.) installing the retrofit measures in sequence with limited co-ordination	• Highly integrated package of measures, using offsite manufacture techniques - provided in house or through trusted subcontractors • Supply chain may require legal and finance skillsets • Additional supply chain for electricity supply required, can be through fully licensed supplier model or through a white label scheme
Financial Model	• Finance is arranged via third party with little involvement in the retrofit process	• Lender developer / investor seeking to use energy performance contract structure to fund retrofits • Lender captures energy savings and charges back to property owner based on historic consumption • Retrofit supplier assumes responsibility for payment of energy bill

	'Atomised' market model	'Energiesprong' energy performance contract
Governance	• Highly fragmented arrangement of suppliers with little co-ordination between the various elements – project management is left to the customer	• Integrated mode of governance where components of the business model are delivered and co-ordinated by a single organisation, who take responsibility for project delivery.

4.3. Innovation intermediary

The Energiesprong market development team was funded by a €45 million grant from the Dutch government, as an arm's length, market-led initiative; considered a radical step change in both innovation and energy efficiency policy in the Netherlands:

> *"There was a strong belief here in this ministry that we should not do this… ourselves. This is not [what] we are good at. [We] had to bring out new people with knowledge of the market to make a connection with the market... We are making policy… we're not judging business plans"* (Dutch Energy Policymaker)

To achieve its goals, the market development team performs three key forms of intermediation; *facilitating*, *configuring* and *brokering* that are crucial to business model innovation, and market formation.

4.3.1. Facilitating

The overarching role of the market development team is to co-coordinate the key stakeholders of the housing provider, the construction industry and policymakers, facilitating collaboration and learning.

> *"So, what we saw is that it's much easier if you put an interlocutor or a catalyst in the middle that understands where the market needs to go …what the financing conditions need to be, what the regulatory conditions need to be, that you organise some demand, and then the market is right there."* (Energiesprong International Market Development)

This has involved multiple project partners including large construction companies, social housing providers, local authorities and municipalities. The aim has been to create a shared vision for net-zero energy buildings and develop a diverse skillset and knowledge base through events, publications and pilot projects. Interestingly, the market development team sees this role as temporary. It is hoped that over time and with sufficient experience, its role would become obsolete as the business model becomes mainstream.

4.3.2. Configuring

The Energiesprong market development team were tasked to develop a novel solution that would overcome many of the issues surrounding the traditional atomised market model. Whilst funded by a large government grant in the Netherlands, it was effectively independent of the ministry that created it. This provided significant autonomy to fundamentally redesign the business model through which retrofit was delivered:

> *"In the beginning... were able to do pretty radical things, right? Because there was nothing out there yet. Performance guarantees for 30 years, energy service plans, retrofit solution in a week? Nobody had…there was no example to look at the time… So, we really had to do a lot of activation. That budget allowed us to do that."* (Energiesprong International Market Development)

This involved intensive innovation in partnership with contractors to determine what was technically possible, and extensive legal and policy work to develop the procurement approach and energy performance contracts. The Energiesprong team thus draws on extensive expertise, crucial in moving from concept to reality. However, the model has required re-configuration to the UK context due to the different regulatory environment, industry culture and consumer expectations:

> *"It was about promoting what had been done in the Netherlands, and saying, "This is how it works." I think what we've ended up with understanding… "It doesn't really work like that here."* (Social Housing Provider)

4.3.3. Brokering

The market development team has also played a critical advocacy role - brokering policy changes, procurement volumes and raising financial and human resources. This included lobbying the Dutch government to allow placement of energy service charges on rents, performance-based efficiency subsidies, and mortgage eligibility assessments to account for net-zero-energy performance. This was made possible, because despite its independence Energiesprong was essentially an arm's length government programme:

> *"Interesting, why could we play this role? We were funded by the government. So, the fact that we brought together these organisations and we always said.... we're going to work on the supply side. We're going to work on the demonstrable goal. Also, we're going to work with the legislator."* (Energiesprong founding partner)

The UK team have also secured innovation funding through various European Union grants and are now seeking a large UK government grant of over £150 million - for thousands of homes. It is hoped this scale will enable the financial model to be fully commercial. Critical to this is also securing demand volume; where in the Netherlands housing providers have agreed to retrofit 110,000 homes to net-zero standards (Energiesprong, 2014). However, significant work remains for the model to become self-sustaining:

> *“after you know, 45 million…. the idea was always that after that, the market would it do itself. That is still not the case here [Netherlands] and it's also not in the UK.”* (Dutch Energy Policymaker)

A summary of these intermediation activities and how they relate to the components of the Energiesprong business model is provided in Table 5.

Table 5 Intermediation activities for the Energiesprong business model

	Facilitating – network formation and collaboration	Configuring – business model design	Brokering - advocacy and resource raising
Value proposition	Bringing together the necessary skillsets for energy performance contracts including expertise in offsite manufacture, asset and energy management, law and finance.	Designing performance contracts and developing the customer offer through collaborative design with the stakeholders in the network. Testing the customer offer through small scale trials and feedback with the end user.	In the Netherlands the intermediary secured regulatory changes surrounding energy service charges on social rents.
Supply chain	Co-ordinating actors within the supply chain to deliver net-zero energy retrofits through greater integration – facilitating learning and adoption of offsite manufacture techniques and modular solutions through collaborative procurement.	Managing procurement, tender process and contract terms with suppliers, as well as training and capacity building with SMEs in the retrofit supply chain.	Securing agreement from housing providers for large order volumes for net-zero energy homes – providing security for the supply chain to scale up operations.
Customer interface	Network formation and involvement of local community actors as well as public and private sector partners, holding regular events and outreach activities.	Developing marketing materials and customer outreach in collaboration with the housing provider or other representatives of residents. This included social media channels as well as more conventional forms of engagement, including focus groups.	Recruitment of housing association executives into the market development team to lobby for procurement of large numbers of net-zero energy retrofits within their host firms.
Financial model	Incorporating key financial stakeholders from both the private sector and government into the consortium from the earliest stages.	Mobilising financial resources and designing contracts, building on dedicated financial and legal expertise to develop the financial model.	In the Netherlands securing policy changes: for both efficiency subsidies and mortgage eligibility to be based on energy performance. UK and EU level: lobbying for innovation funding under EPRD; Interreg; and UK Industrial Strategy Challenge Fund.
Governance	A system building role – improving the links and between the elements of the business model towards an integrated mode of governance, ideally through a single solution provider.	Formalising the links within the supply chain and wider network. In the UK, case this involved the creation of a new business venture 'Melius Homes' which will act as an integrated solution provider.	Widespread PR and advocacy campaign across UK and EU to promote the Energiesprong business model with business leaders, local authorities and the Industry. With the aim of creating a network of 'advocates'.

5. Discussion

The goal of this paper was to understand how and why intermediaries - and in turn policymakers, might support business model innovation. We illustrate this though the case of an innovative business model for whole-house residential retrofit: the Energiesprong approach.

In understanding the role of new business models in systemic innovation, the case of whole-house retrofit is particularly instructive. Whole-house retrofit involves the assemblage and co-ordination of a complex mix of technologies, processes, human and financial resources which interface both user *and* industry practices. Among these groups the imperative of saving energy remains a low priority. Equally, the wider regulatory and institutional environment remains poorly aligned to achieving this, particularly as it also constitutes a shift toward a more distributed energy supply system (Richter, 2013). Whole-house retrofit thus represents an archetypal example of a systemic innovation (Mlecnik, 2013).

This paper builds on an earlier phase of research involving a systematic comparison of alternative retrofit business models (Brown, 2018). We show that the traditional atomised market business model, whilst suitable for the delivery of single retrofit measures is poorly suited to whole-house retrofit and is a weak driver of demand. The Energiesprong initiative radically overhauls this approach, through an integrated business model.

Thus, our findings support recent research on the potential for supply chain integration (Mahapatra et al., 2013; Mlecnik et al., 2018, 2012, n.d.) and energy performance contracts for promoting whole-house retrofit (Brown, 2018; Winther and Gurigard, 2017). Therefore, these findings emphasise how the 'integrative technologies' - which characterise whole-house retrofit are best suited to hierarchical or integrated modes of governance (Hoetker, 2006; Sanchez and Mahoney, 1996).

Consequently, business model innovation is able to exploit the added value of systemic innovations like whole-house retrofit - such as improved energy services and household comfort (Roelich et al., 2015). New business models achieve this by reconfiguring relationships within supply chains, mobilising financial resources and engaging customers in new or improved ways (Boons et al., 2013). Our case further emphasises how the *governance* of the business model is critical for the integration and management of these components, and the impact this has on the customer (Hellström et al., 2015). Business model innovation thus reconfigures organisational practices and their management to enable systemic innovations to become viable:

> *"of significance is the business model's ability to create a fit between technology characteristics and (new) commercialisation approaches that both can succeed on given and new markets."* (Boons and Lüdeke-Freund, 2013)

However, the adoption of innovative business models, such as the Energiesprong approach remains challenging - due to a range of cultural and structural barriers (Stubbs and Cocklin, 2008). Our findings show how the incumbent business model is a product of the wider construction industry - characterised by fragmentation, lowest cost procurement, and few

guarantees on performance. This reflects established ways of undertaking construction work and contract design, based on the 'dominant logic' of the industry (Chesbrough, 2010). Many SMEs lack the necessary knowledge for whole-house retrofits, capabilities such as energy monitoring and finance, or complementary assets such as energy management ventures - preventing them from offering long term energy performance contracts (Teece, 2018, 2010, 1986). As identified by Budde Christensen et al., (2012) incumbent firms may thus be locked into a path dependent business model, with a limited demand for whole-house retrofit, providing few incentives to change.

Crucial to overcoming these barriers has been an open approach to innovation, where learning is widely disseminated rather than held within individual firms (Chesbrough, 2006). Thus, the market development team created standardised contracts and procurement processes, critical in reducing transaction costs for energy service contracts (Nolden et al., 2016). The intermediary also played an instrumental role in lobbying for policy changes and financial resources. Moreover, the negotiation of delivery volumes and the targeting of the social housing market is ostensibly an organisational 'strategy' rather than a business model (Teece, 2010). Thus, the intermediary roles of configuring, facilitating and brokering (Stewart and Hyysalo, 2008) were critical for business model innovation, market formation *and* strategy for the diffusion of whole-house retrofit. Interestingly, the temporary nature of the market development team was also observed in Kivimaa's (2014) study of two Finnish innovation agencies. Both studies emphasise the risks of too short an intervention and the importance of maintaining neutrality whilst retaining policy influence - a challenging balancing act (Kivimaa and Martiskainen, 2016; Klerkx and Leeuwis, 2009).

Where this study breaks new ground is by highlighting the role of an innovation intermediary in overcoming these barriers to business model innovation. We develop a novel framework (Table 3 and Figure 1) which integrates the components of the business model with intermediation functions for the first time. The Energiesprong market development team is therefore shown to be instrumental in developing the concept of a net-zero energy retrofit, engaging the supply chain to develop innovative approaches, as well as developing the legal and policy framework necessary for it to work. By highlighting the specific processes by which intermediaries can support business model innovation; these findings are an important contribution to the literature on innovation intermediaries (Klerkx and Leeuwis, 2009), and business model innovation (Bolton and Hannon, 2016) – emphasising how one can promote the other.

Our case study also contributes to understanding the role of intermediaries and business model innovation in innovation policy. Drawing on Edler and Fagerberg's (2017) typology; the formation of the market development team was primarily a policy to promote *interaction and learning across networks.* What is interesting is that the intermediary was able to engage with the market and influence policy in a range of other areas. This included: securing *R&D&D funding* in the form of European Union grants as well as changes to the energy efficiency subsidy regime; *procurement policies* to generate demand through volume agreements with public housing providers; changes in *regulations and standards* to allow energy service charges to be bundled with rent; *and missions and foresight policies* including the goal for net zero energy homes by 2050 and the gradual disconnection of neighbourhoods from the natural gas grid in the Netherlands.

The catalytic role of the intermediary can thus be seen both in terms of market *and* policy formation. Recognising the limited generalisability of our case study approach, we suggest that by bringing together the literature on systemic innovation, business models and innovation intermediaries - our findings and framework (Table 3 and Figure 1) provide some transferable theoretical insights. We demonstrate how government affiliated intermediaries like the Energiesprong market development team can be viewed as a decentralised and highly effective form of innovation policy (Kivimaa, 2014). This policy created an intermediary who facilitated business model innovation, which in turn has enabled systemic innovation in the form of whole-house retrofit. Accordingly, policymakers wishing to promote business model innovation in other sectors, may achieve these aims through the creation of innovation intermediaries such as the market development team.

However, the transferability and wider significance of these findings, both for the empirical context of retrofitting and intermediation for business model innovation, requires qualification. For now, the Energiesprong business model requires significant scale before it is viable without subsidy; thus, contingent on promising but as yet unrealised learning rates (Energiesprong, 2017). The findings also emphasise the greater challenges in entering the owner occupier market, where diversity of building forms and consumer preferences make mass produced solutions more challenging (Haines and Mitchell, 2014). Equally, these findings highlight issues of compatibility for the transfer of radical business models to new contexts. The absence of 'net metering' for renewable microgeneration, the lack of public financing support through low cost loans, or a general unwillingness for policymakers to promote specific technological solutions are all significant challenges for the UK. Therefore, these findings highlight the difficulty in transferring systemic innovations and new business models to different institutional contexts (Hall et al., 2016) and political economies (Baker et al., 2014).

6. Conclusion

In this paper we advanced three related propositions. First, we outline how business model innovation may play a key role in unlocking the potential of systemic innovations. We illustrate how the radical 'Energiesprong' business model, based on zero-energy performance contracts, an industrialised supply chain, integrated governance and a simple customer offer, could greatly improve the appeal, delivery and scalability of whole-house energy retrofit.

Second, we show how a range of barriers to business model innovation may be overcome through an innovation intermediary; in our case the Energiesprong market development team. This intermediary has played an instrumental and catalytic role, facilitating stakeholder collaboration, configuring the design of the business model, and brokering the policy changes, financial resources and procurement volumes needed for the business model to be viable.

Third, we described how such entities can be created by policy, and in turn shape the policy and institutional landscape towards new business models. Our case demonstrates how the creation of a market facing intermediary enabled the Dutch government to achieve its policy aims through a decentralised body - the Energiesprong market development team. This intermediary's role in market formation and business model innovation could thus present a

template for both policymakers and academics looking to facilitate and study systemic innovation in a range of other sectors.

Concisely, these findings show how policymakers can promote business model innovation through the creation and support of innovation intermediaries. These organisations may further shape the policy and institutional landscape, in a process of feedback between policy and market design in ways that market or government actors alone cannot.

Given the limited generalisability of this single case study, future research could incorporate this framework into a more representative cross-sectional research design of the sector at large. Future research could also explore these processes in other sectors such as food, transport, healthcare or manufacturing - using the theoretical links we make in this paper. Future research on business models for whole-house retrofit could also incorporate quantitative methods, such as on project performance or customer satisfaction to add validity to the claims made here.

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Appendix A

Table A1 Business Model interviews

Business model archetype	Organisation	Actor
Expert Scoping		
All	University of Oxford	Senior Research Fellow - energy efficiency policy
	United Kingdom Green Building Council (UKGBC)	Policy Advisor
	Energy Saving Trust (EST)	Senior Insight Manager
	Building Research Establishment (BRE)	Director (Wales)
	Energy Programs Consortium	Counsel and Director of Finance Programs (USA)
	Buildings Performance Institute Europe (BPIE)/Reshape innovation	Innovation Strategist - Founder (Reshape Innovation)
	Georgia Institute of Technology (USA)	Professor of Energy Policy
	Association for Environmental Studies and Sciences (AESS)	Principal and Independent Consultant
Practitioner		
Atomized market model	Building Research Establishment (BRE)	Director (Wales)
	Sustainable Design Collective	Architect – Managing Director
Market intermediary model	Greater London Authority (RE:NEW)	Program Manager -Energy
	Nottingham Energy Partnership	Contracts Manager
	Birmingham Energy Savers (BES) (Consultant)	Sustainability Consultant
One stop shop	Retrofit works / Parity projects	Director
	Segel AS - Norway	Business Development Consultant
	Brighton and Hove Energy Services Company (BHESCo)	CEO

Energy Service Agreement	Energies POSIT'IF - Paris France	Innovation Strategist - Founder (Reshape innovation)
	ICF Habitat- Paris France	Head of Energy & Water
	RENESCO – Riga, Latvia	Managing Director
Managed Energy Service Agreement	Energiesprong – UK, Netherlands	Project manager /Rainmaker

Table A2 Finance Mechanism Interviews

Finance Mechanism	Organisation
Expert Scoping	
All	Climate Strategy and Partners
	United Kingdom Green Building Council (UKGBC)
	Building Research Establishment (BRE)
	Energy Programmes Consortium (USA)
	Climate Bonds Initiative
	Marksman Consulting LLP
	Energy Pro Ltd
Practitioner	
Public/credit enhancement	Energy Saving Trust Home Energy Efficiency Programme Scotland (EST-HEEPS)
	Amber Infrastructure (LEEF/MEEF)
On Bill Finance and Repayment	National Conference of State Legislatures (NCSL)
	Business Energy and Industrial Strategy (BEIS)
Energy Service Agreement	Servizi Energia Ambiente (SEA)
	Joule Assets Europe
	RENESCO – Riga, Latvia
PACE	RENEW Financial
	PACE Nation
Energy Efficiency Mortgage	European Mortgage Federation (EeMAP)
Community Finance	Brighton and Hove Energy Services Company (BHESCo)

Appendix B

Table B1 Low energy housing intermediaries: Sequence of interviews, interviewee types and focus.

Interview round	No. of interviews	Type of interviewees	Focus	Timing of interviews
1st	10	I1 NGO, I2 charity, I3 charity, I4 research organisation, I5 charity, I6 campaign, I7 NGO, I8 membership organisation, I9 network organisation, I10 ex-government	UK building energy efficiency policy development	July–September 2014
2nd	12	I11 social enterprise, I12 community organisation, I13 anonymous, I14 social housing fund, I15 charity, I16 research organisation, I17 social enterprise, I18 local administration, I19 social enterprise, I20 local administration, I21 social enterprise, I22 membership organisation	Developments in UK low-energy homes; activities of specific organisations	May 2015–March 2016
3rd	7	I23 membership organisation, I24 network organisation, I25 ex-government, I26 academic-practitioner, I27 network organisation, I28 academic-practitioner, I29 consultancy	Activities and influence of intermediary organisations on policy development	May 2017, February–March 2018

Appendix C

Table C1 Energiesprong case study interviews

Actor Type	Organisation	Role
Intermediary	Energiesprong Market Development Team X3	Project Manager
		Head of International Market Development
		Founding Partner
Client	Nottingham City Homes	Head of Energy and Sustainability
Contractor	Melius Homes	Director
Policymaker (Netherlands)	Ministry of the Interior and Kingdom Relations	Director Building & Energy
Policymaker (UK)	Nottingham City Council	Head of Energy and Sustainability

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