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Colin Nolden, Steve Sorrell,
Friedemann Polzin

University of Sussex

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Innovative procurement frameworks for energy performance contracting in the UK public sector

Colin Nolden[1]

Steve Sorrell[1]

Friedemann Polzin[2]

[1] Centre on Innovation and Energy Demand, Science Policy Research Unit (SPRU), University of Sussex, Falmer, Brighton, BN1 9SL, UK

[2] Utrecht University School of Economics (USE), Sustainable Finance Lab, Kriekenpitplein 21-22, 3584 EC Utrecht, The Netherlands

Corresponding author: Steve Sorrell, E-mail: s.r.sorrell@sussex.ac.uk Tel: +44(0) 01273 877067

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Abstract

Procurement Frameworks for Energy Performance Contracting (PFEPCs) simplify the process of negotiating, developing and implementing Energy Performance Contracts (EPCs) with Energy Service Companies (ESCOs). This paper analyses their role in promoting the implementation of cost-effective energy efficiency measures in the UK public sector. Compared to conventional approaches to procuring goods and services involving detailed specifications, PFEPCs translate the challenge of upgrading, retrofitting and replacing energy related equipment and infrastructures into required outputs through functional specifications. The innovativeness of specific PFEPCs often lies less in the diffusion of 'developmental' innovative energy efficient solutions, although partner bidding approaches create favourable conditions for innovation. However increasing standardisation and bundling prove successful at lowering transaction cost, which enables ESCOs to address projects which would not be considered in the absence of PFEPCs due to high transaction costs. This particular organisational innovation opens the market up to new approaches to implementing cost-effective energy efficiency measures.

Keywords

Energy efficiency; energy performance contracting (EPC); energy service companies (ESCOs); public procurement of innovation; public sector.

1 Introduction

It is well established that there is significant potential for improving the energy efficiency of public sector buildings (see IEA, 2013). Despite highly attractive rates of return, many public sector bodies struggle to finance and implement those improvements (Aasen, 2015; Gardner, 2013). Energy performance contracts (EPCs) provide a promising means of overcoming these difficulties and of accelerating the diffusion of energy efficient technologies (Polzin, 2015; Aasen, 2015). EPCs focus upon the delivery of final energy services, such as mobility and illumination, rather than individual end-use technologies (Sorrell, 2005, 2007). Typically, an EPC provider guarantees a specified level of energy savings over a defined period and finances the capital investment from these savings. Verification of those savings through agreed procedures for measurement and verification (M&V, see Appendix 7.1 for more information) may be undertaken by the EPC provider or an independent organisation. EPCs can allow public sector organisations to reduce operating costs, transfer risk and concentrate attention on core activities (Sorrell, 2005; Polzin, 2015). The client organisation typically negotiates the output required (i.e. energy savings, payback periods, maximum spend, etc.), rather than specifying the inputs (i.e. boiler replacement), thereby giving flexibility to the provider to innovate and deliver cost-effective solutions (DECC, 2012a). Companies offering EPCs and energy service contracts more generally are commonly referred to as energy service companies (ESCOs).

Public sector buildings have long been established as a primary market for EPCs, owing to factors such as the generic nature of buildings and the relevant technologies, the multiple obstacles to in-house energy management, the lack of finance for energy efficiency investment and the increasing reliance upon outsourcing (Hansen, 2009; Larsen, 2012). An important initiative in the UK public sector has been the development of *procurement frameworks* for EPCs (PFEPCs). Framework agreements are a common feature of public sector procurement and generally set out terms and conditions under which specific purchases or contracts ('call offs') can be made (see Appendix 7.1 for definitions}. Procurement frameworks for energy services involve standardised contracts that comply with EU procurement regulations and can be used with (in many cases pre-qualified) ESCOs for implementing energy efficiency projects. This type of framework is relatively novel in the UK but is growing in importance. The most important examples include those that have been specifically developed for local authorities, such as RE:FIT (RE:FIT, 2015) within the Greater London Authority; and those that have been developed for the UK's National Health Service (NHS) but which are open to other parts of the UK public sector, such as the Carbon and Energy Fund (CEF, 2013). These frameworks aim to streamline the procurement of EPCs for public sector buildings by providing pre-negotiated contracts that comply with relevant regulations. A key advantage of these frameworks is that they reduce the transaction costs of negotiating and establishing contracts and monitoring contract performance (Sorrell, 2005; Sorrell, 2007). The importance of PFEPCs in the UK public sector is reflected by the number of contracts that have been established under PFEPCs in recent years, the growing interest in this approach by a range of public sector bodies and the development of model contracts and guidance notes by UK government that are based upon those, specifically RE:FIT (DECC, 2015a).

Previous research in the area of EPCs and energy service contracting/ESCOs more generally has been primarily concerned about transaction costs (Polzin, 2015; Sorrell, 2005, 2007) and the evolution and nature of ESCO markets (Bertoldi, 2006, 2007, 2014; Hansen, 2009; Marino, 2010, 2011). Only recently has there been a surge in interest in the role of ESCOs in providing energy services at a local

authority and municipal level (Aasen, 2015; Hannon, 2015b, a; Jensen, 2013; Polzin, 2015). Procurement frameworks for energy services such as the PFEPCs analysed in this paper have received comparatively little attention with only a limited number of academic publications mentioning one of them (RE:FIT) (Chmutina, 2014; Chmutina, 2012; Hannon, 2015b).

In this paper, PFEPCs are understood as a form of public procurement for innovation (PPI) (Edquist, 2012; Edler, 2007; Uyarra, 2014a). The experience with these PFEPCs can provide insights into the opportunities for, benefits of and obstacles to energy performance contracting in the public sector, together with the role of procurement frameworks in diffusing the EPC business model and cost-effective energy efficiency measures. This paper adds a UK perspective to the growing international body of literature on drivers and barriers for EPCs in the public sector (Aasen, 2015; Patari, 2013; Polzin, 2015).The specific research question are:

- *How do PFEPCs compare?*
- *What have PFEPCs achieved?*
- *Do PFEPCs help diffuse innovative EPC business models?*
- *Do PFEPCs help diffuse innovative energy efficient solutions?*

The paper is structured as follows. Section 2 introduces the methodology, section 3 provides background information on energy services and public procurement, PFEPCs and *Public Procurement for Innovation* (PPI – see Appendix 7.1 for more information). Section 4 compares and analyses PFEPCs to develop a typology based on earlier work on PPI. The paper demonstrates how this typology can also be helpful in understanding the public procurement of EPCs. Section 5 discusses the findings and section 6 concludes. A list of definitions is included in the Appendices.

2 Methodology

Data about the cases was collected through two channels. First, primary information was gathered through the analysis of public tender documents, through interviews with energy service contracting experts and by attending conferences and workshops related to the subject area. In total, 23 interviews with experts in the field of energy efficiency and energy service contracting (see a detailed list of interviewees in appendix 7.3) were conducted. Where possible, the interviews were recorded and transcribed. Further primary information on PFEPCs was compiled by analysing academic publications, policy documents, press releases and reports. Different characteristics and outcomes of PFEPCs were identified through data content analysis of the interviews (Miles, 1984) and a review of the literature. Some of the information gathered in the interviews has not been used in this paper due to commercial sensibility. As a result, the numbers provided in this paper do not always provide the level of granularity that would be necessary for a more detailed comparison and analysis of PFEPCs, especially regarding the first two research questions. The empirical section nevertheless provides enough information to reach robust conclusions regarding the capacity of PFEPCs to diffuse innovative EPC business models and/or innovative energy efficiency solutions.

3 Energy services and public procurement

3.1 Energy service provision in the public sector

The fundamentals of providing energy services in the public sector are no different to energy service provision in other services. Selling final energy services (right of Figure 1) incentivises both the minimisation of supplying energy as a commodity (left of Figure 1) and the efficient use of useful energy streams (centre of Figure 1) using long-term EPCs. Figure 1 compares the scope of EPCs compared to energy supply contracts on a client site.

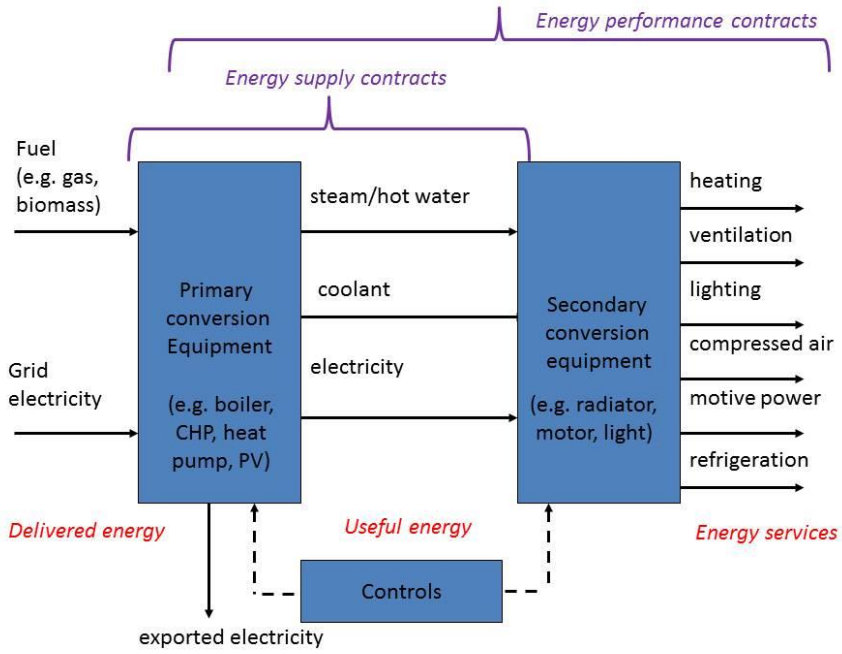

Figure 1: Energy supply versus energy performance contracts (Sorrell, 2015)

EPCs enable cost-effective energy efficiency investments to take place but contractual complexity limits their applicability. High transaction costs[1] and uncertainty regarding the risks involved hamper the widespread use of EPCs. Transactions costs comprise the costs associated with organising the delivery of energy services (Globerman, 1996; Sorrell, 2007). In the context of EPCs, direct transaction costs arise out of screening the EPC market and selecting an ESCO, negotiating contract details, establishing measurement and verification (M&V) criteria and associated legal costs, enforcing compliance and resolving disputes (Sorrell, 2005; Sorrell, 2007). Indirect transaction costs arise out of a lack of institutional awareness and trust, low priority and missing commitment, non-standardised measurement and verification (M&V) of energy savings, legal complexities, missing energy cost information, difficult access to finance, risk assessment and mistrust against ESCOs (Polzin, 2015; Sorrell, 2005; Sorrell, 2007; Pätäri & Sinkhonen 2014).

Dedicated intermediaries can help reduce transaction costs by helping clients identify projects, estimate savings, select a contractor and negotiate M&V criteria (Bleyl, 2013). Pre-negotiated

[1] Transaction costs are the legal, administrative, information gathering and other costs within markets or internally within organisations associated with the transfer of goods, services or property rights (Sorrell, 2005, 2007)

contracts minimising legal fees and project bundling within a single contract also contribute to streamlining the process of contract negotiation. PFEPCs, the organisations hosting them and their dedicated resources act as intermediaries to help simplify the EPC procurement process on behalf of potential public sector clients by preparing, evaluating and/or managing business models, finance, documentation, contracts and M&V as well as fostering competition among ESCOs for particular projects.

3.2 Procuring energy services in the UK public sector

Regular procurement of an energy infrastructure upgrade projects usually takes approximately 18 months. Benefits of cost-effective energy efficiency investment in the public sector are increased comfort, the reduction of running costs and mitigating against the impact of future energy price rises through reduced energy use. The procurement and delivery of energy services improvements in the health sector is also often used to reduce maintenance backlogs. Public procurement expenditure in the UK was approximately £190bn in 2010-2011 (Uyarra, 2014b) and utility consumption is typically the second highest overhead cost in the public sector after staffing (Hammond, 2014). Opportunities for improving energy efficiency in the public sector arise from common ownership and the homogeneous nature of facilities with common functions such as local authorities (municipalities), universities, schools and hospitals (referred to as the MUSH sector in the US, (Larsen, 2012)).

Wider energy efficiency benefit arise from reduced carbon emissions, easier compliance with climate policies, improved working environments and fewer equipment failures (DECC, 2015b). The possibility of investments in buildings and green technologies generating local jobs and improving local skills may also be a feature of energy efficiency investments (Singh, 2010). These aspects are of particular interest to local authorities. Project bundling can help address the small size and high transaction costs associated with many energy efficiency projects by creating larger projects. Bundled projects are more likely to attract large and international firms and financiers compared to individual projects as bundling creates clear incentives for (energy) service providers, reduces their market risk, and enables learning and economies of scale (Edler, 2007; Uyarra, 2014; Uyarra, 2014).

Typically the single largest purchaser in a country, the public sector has the capacity to harmonising procurement policies across and stimulate innovation (Singh, 2010; Uyarra, 2014 a,b) and EPCs are considered to be particular suitable for addressing untapped energy efficiency potentials in the public sector (DECC, 2015c; Larsen, 2012; Singh, 2010). OJEU compliant PFEPCs encourage the use of EPCs and potentially foster innovation by simplifying tendering procedures, by limiting bidding to (in most cases) pre-approved ESCOs, by including the associated fees and by providing access to all relevant procurement, technical and legal documentation (CEF, 2015). Compared to regular procurement, PFEPCs reduce procurement procedures by over a year, enabling Cost-effective energy efficiency measures to be installed within 6-9 months from start-up.

3.3 How PFEPCs work

A PFEPC is defined as an OJEU compliant framework agreement (see Appendix 7.1) with one or more operators (ESCOs) which allows the contracting authority to purchase energy services on behalf of

other contracting authorities. Selected ESCOs must be able to deliver and guarantee energy services to the client over the lifetime of the contract. The frameworks are not organisations per se. PFEPCs consist of no more than 10 people managing the process, usually employed by organisations governed by public law or regional or local authorities.

As facilitators, PFEPCs aim to reduce transaction costs and information asymmetry between clients and ESCOs (Sorrell, 2005) associated with negotiating and establishing EPCs in the public sector and monitoring contract performance by streamlining of tendering and bidding processes and by providing standardised ('package') contracts, delivery guidance and in some cases entire delivery frameworks throughout the project life (CEF, 2013; RE:FIT, 2015). The PFEPC offering is aimed at directing finance (which may be sourced from third parties) towards cost-effective energy efficiency investments where the expected reduction in production cost of supplying energy services can more than offset the transaction cost of negotiating and managing the relationship between the public sector organisation and the ESCO (Sorrell, 2005; Polzin, 2015).

The following five PFEPCs have been identified:

- **The Carbon and Energy Fund (CEF)**;
- **Essentia;**
- **Ecovate;**
- **RE:FIT** within the Greater London Authority (GLA, 2015) and **Local Partnerships** which is extending the RE:FIT concept nationwide;
- **P-EPC** developed by Peterborough City Council;

This list is not exclusive although these five cases represent the most prominent PFEPCs in the UK as identified by (GIB, 2014), conference organisers (EMEX, 2014), PFEPCs themselves (CEF, 2015; DECC, 2015c; Essentia, 2014; Ecovategroup, 2015; GLA, 2015; Honeywell, 2014; RE:FIT, 2015) and interviewees. The different PFEPCs have different host organisations and the degree of cooperation and collaborative development depends on the EPC approach and the different public sector sub-agencies that are specifically targeted, such as the National Health Service (NHS), local authorities or consortia of public sector organisations (Fawkes, 2007).

CEF was established in 2011 as a fund to support NHS projects to meet their energy efficiency and carbon reduction targets by simplifying the procurement process. CEF targets the largest public sector projects in terms of project value and client size (£m/a energy expenditure). Their approach requires very detailed contracts (300+ pages) as the resulting EPCs tend to be about large-scale infrastructural upgrades rather than retrofitting 'soft touch' generic, off-the-shelf energy efficiency measures (see Appendix 7.1 for more information). CEF originally focused on the installation of combined heat and power (CHP) plants before moving into energy efficiency. CEF's bespoke EPCs for large-scale infrastructure upgrades are derived from design, build, finance and operate contracts (DBFO, a construction industry concept). An EPC procured through CEF involves client-ESCO cooperation from the beginning. Any of the pre-selected ESCOs interested in bidding typically requires 3-4 months to prepare their final bid providing fully priced and costed measures. This bidding process is well in excess of an Investment Grade Audit usually required for EPC bidding. Following a mini-competition the best bid is selected according to pre-determined criteria, such as the net annual saving across a specific timeframe (i.e. 15-30 years after installation). The ESCO then

installs the measures and takes on delivery and performance risk. Once it passes the compliance tests the payments and guaranteed savings begin (CEF, 2013). Measurement and verification (M&V) is the responsibility of an independent provider (TEAM, undated).

Essentia was established in 2012 as a framework to support NHS trusts and public sector organisations to improve energy efficiency without upfront capital investments. Essentia clients may make use of its Energy Advisory Framework at their own cost to establish an independent benchmarking and potential measurement and verification (M&V) framework before entering a mini-competition to select one of the pre-approved ESCOs. The chosen ESCO completes an Investment Grade Audit to identify guaranteed energy saving measures before installing the measures and taking on delivery and savings risk. M&V is undertaken by an independent organisation signed up to Essentia's Energy Advisory Framework. As the Essentia offer extends beyond EPCs to potentially include management and property consulting as well as strategic estates development and healthcare planning (in the NHS), contract length and detail may extent significantly beyond the 40-50 pages of the EPC contract. In the case of strategic estates development alongside an EPC, Essentia's offer may resemble CEF's infrastructure upgrade approach.

Ecovate was established in 2013 as an open procurement framework to enable NHS and public sector organisations to derive maximum strategic benefit from large-scale estate-development projects that are funded via guaranteed energy savings. Ecovate has not been active for long enough to allow a thorough analysis of their PFEPC approach in great detail but their initial project at King's College Hospital NHS Foundation Trust indicates that it is possible to encourage a collborative approach through open procurement. Rather than pre-approving ESCOs, Ecovate's PFEPC requires every ESCO interested in bidding to fill out a pre-qualification questionnaire (PQQ, see Appendix 7.1 for more detail), which takes around 4 weeks to complete, if it wants to bid for a project. This is considered acceptable for a contract that may last up to 15 years. The example of King's College Hospital NHS Foundation Trust's EPC indicates that Ecovate's collaborative approach encourages the selected ESCO to work in partnership with the Trust's estates team throughout the Investment Grade Audit as well as the implementation phase. This allows the scope of the project to extend beyond the initial project specifications. The ESCO's risk lies in doing a free Investment Grade Audit if they are unable to meet the client's cost and energy saving requirements to which they committed during the procurement process. Rather than establishing a conventional M&V methodology Ecovate relies on annual spreadsheets provided by the ESCO.

RE:FIT was established in 2010 as a programme to help public sector organisations in London achieve substantial financial savings, improve energy performance of their buildings and reduce their carbon footprint. In 2014 it was extended and altered to cover the whole of England. RE:FIT is an open book, public sector procurement framework with pre-approved ESCOs similar to CEF and Essentia. What sets it apart is its EU funded[2] Programme Delivery Unit (PDU) to support all public sector organisations in London that wish to make use of RE:FIT's EPC framework free of charge. The PDU acts as a dedicated intermediary providing technical support throughout the lifetime of the project as well as a free benchmarking service. The PDU also ensures that contracts always involve

[2] European Local Energy Assistance (ELENA) provides financial and technical assistance to help local and regional authorities attract funding for sustainable energy projects (http://ec.europa.eu/environment/ecoap/about-eco-innovation/policies-matters/eu/535_en.htm)

more than one measure and that the companies do not make excessive margins on easy to implement single measures such as lighting. It also provides help for the establishment of EPCs as well as post-implementation services such as M&V checks. Once a project brief has been prepared, the mini competition is launched to select on the pre-approved ESCOs. The ESCO then carries out an Investment Grade Audit, energy efficiency measures are installed. M&V is carried out by the ESCO. RE:FITs dedication to simplifying the procurement process compared to abovementioned frameworks implies that it lends itself to the installation of 'soft-touch' measures.

P-EPC was procured in 2013 as a contract to enable councils to deliver guaranteed energy performance improvements for council premises using third party finance. It was subsequently developed into a procurement framework in partnership between Peterborough City Council and Honeywell, the framework's pre-approved ESCO which was chosen as a framework delivery partner. This approach lends itself to close collaboration between ESCO and client, which reduces the transaction costs for addressing individual projects. Depending on the type of project, more or less detailed Investment Grade Audits are undertaken and measures, in some cases replicable measures across multiple sites, installed. M&V is also undertaken by this ESCO which implies that this model is dependent on a trusted relationship between ESCO and client.

A precondition for the establishment of competitive tendering and bidding environments, a feature of several PFEPCs, is the existence of appropriate service providers capable of implementing cost-effective energy efficiency measures. Energy management has been outsourced in the UK since the 1960s (Fawkes, 2007) although regulation has yet to recognise market developments to ensure cost-effective implementation of measures. There are around 50 ESCOs operating in the UK (see Appendix 7.5) although the market is difficult to define as few companies offering ESCO solutions such as EPCs do so as their core business. Around 25 ESCOs appear to be offering EPCs and 22 are currently approved EPC contractors.

3.4 Public procurement and public procurement for innovation

In this research context, PFEPCs are understood not only as intermediaries but also as procurement frameworks that encourage innovation. Innovations resulting from PFEPCs are not limited to the outcome as the process itself of setting up an EPC through a PFEPC may help build trust in alternative procurement processes and delivery business models. For most public sector organisations in the UK, EPCs are perceived as new. For small-scale projects (annual energy bills of <£500,000) the use of EPCs may be considered ground-braking as high transaction costs usually render these projects inoperable (DECC, 2012b). Smaller and/or replicable individual contracts reduce transaction costs by limiting negotiable aspects of EPCs. Organisational innovation encouraging alternative procurement processes and delivery business models that reduce transaction costs need to be recognised alongside the implementation of cost-effective energy-efficiency measures.

As PFEPCs encourage a variety of innovative outcomes they are examples of *public procurement of innovation* (PPI). Compared to regular public procurement involving detailed specification of relevant goods and services, PPI, as a demand-side measure (Edquist, 2012; Lords, 2011; Uyarra, 2014b), requires the translation of the identified challenge into functional specifications relating to

performance, quality and desired outcomes (Edquist, 2012). Recent findings suggest that procurers should focus on the whole "cycle of need" (Georghiou, 2014). In relation to energy this implies the negotiation of outputs (required energy services) by encouraging suppliers to propose alternative and innovative solutions through demand-side instruments rather than the specification of inputs. To ensure that procurement moves beyond regular, input focused procurement, the risk of procuring innovative services needs to be reduced as a risk-averse culture in the public sector often precludes the use of innovative solutions (Georghiou, 2014; Lords, 2011). This may be achieved by collaborative learning and close cooperation between procurement officers and suppliers throughout one or more of the stages of the procurement process (Edquist, 2012; NESTA, 2007). Learning is considered a key dimension of PPI and innovation more generally (Edquist, 2012; Uyarra, 2014 a,b).

Supplier involvement with project specifications can allow the supplier to gain a more in-depth understanding of requirements and issues that need addressing. It also allows the procurers to gain a deeper understanding of supplier offerings. Depending on the extent of collaboration and levels of trust between procurement officers and suppliers, opportunities to develop innovative solutions may arise (Edquist, 2012). Collaborative development of functional specifications creates favourable conditions for innovation by providing suppliers with the flexibility to design and deliver projects without major limitations and by increasing competition (Uyarra, 2014 a, b).

PFEPCs in this context be understood as frameworks that help procuring a partner for outcomes rather than technological inputs. To classify the different procurement approaches and frameworks we use a typology for the analysis of PPI originally developed by (Edquist, 2012). We have adapted this typology to reflect the specifics of PFEPCs. The distinction between *direct procurement* (the procuring organisation is also the end-user of the product or service and uses its own demand to stimulate innovation) and *catalytic procurement* (the procuring organisation serves as a 'catalyst, coordinator and technical resource for the benefit of the end-users'), for example, is not of relevance given the frameworks' catalytic nature. Ecovate and P-EPC emerged from the direct procurement of an EPC but the establishment of a framework implies that it is intended for use by other organisations than the contracting authority. The distinction between *incremental* or *developmental* procurement is of greater relevance in this context as the categorisation of PFEPCs as PPIs in the first place depends to a large extent upon the character of the innovation embedded in the product or service. The two main distinctions of PFEPCs are:

- *Incremental* (diffusion oriented) procurement refers to incremental products or services and innovation refers to the adaptation to local conditions.
- *Developmental* (emergence oriented) procurement refers to radically new products or services resulting from the procurement process.

Edquist and Zabala-Iturriagagoitia's (2012) specify the degree of cooperation as a third dimention to the classification of PPI although they consider it a matter of degrees rather than a dichotomous variable. For the sake of this research we have expanded their typology relating to the level of cooperation between ESCO and client and the degree to which a PFEPC aims at replicating the process.

- *Simplification* (reducing transaction costs) refers to the degree to which the EPC negotiation process is streamlined and modularised.
- *Cooperation* (development of trust) refers the degree to which ESCOs and clients are encouraged to establish a trusted relationship.

The distinction between replication and cooperation focused PFEPCs is critical for the type of projects that transaction costs are reduced for. The following section empirically investigates the PFEPCs according to this typology.

4 Empirical section

4.1 Background information on PFEPCs

Section 3.3 specified how PFEPCs work. The empirical section analyses PFEPCs using information derived from public tenders (Tenders, 2013a; TED, 2012b; TED, 2012a; TED, 2013c; TED, 2013a; TED, 2013b; TED, 2014; TED, 2015; Tenders, 2012; Tenders, 2013b) with information gained from interviews and other sources of information (CEF, 2013; CEF, 2015; DECC, 2015c; Essentia, 2014; Ecovategroup, 2015; GIB, 2014; GLA, 2015; Honeywell, 2014; RE:FIT, 2015) (see also Appendix 7.4 for more information). Table 1 provides information on the PFEPCs' contracting authority and the type of contracting authority.

CEF	Essentia	Ecovate	RE:FIT	P-EPC
Countess of Chester Hospital NHS Foundation Trust	Guy's and St Thomas' NHS Foundation Trust Essentia Trading on behalf of Guy's and St Thomas' NHS Foundation Trust	King's College Hospital NHS Foundation Trust	Transport for London (Premises Projects and Commercial Services on behalf of the Greater London Authority	Peterborough City Council
Body governed by public law	Body governed by public law	Body governed by public law	Regional or local authority	Regional or local authority

Table 1: PFEPCs contracting authorities

Table 2 provides the exact titles of the PFEPCs derived from tender documents. Apart from P-EPC they all are described as frameworks although their titles also provide insights into the different priorities attached to the delivery of EPCs. The relatively short contract durations are an indication of the limited addressable market for PFEPCs. According to one interviewee:

> *'…Reality is we're going to do NHS up to a certain point and then we will do universities and then I think what will happen is that other frameworks will follow on behind us and then I'll just give up and go home…' (PFEPC representative)*

CEF	Essentia	Ecovate	RE:FIT	P-EPC
National Framework Agreement to supply carbon and energy infrastructure upgrades	Strategic Sustainability Transformation Framework	National Framework for Energy, Carbon and Backlog Maintenance Management Services – Performance Contract	RE:FIT framework (public buildings retrofit programme)	Blue Sky Peterborough: Energy Performance Contracting Programme
Duration in months: 48	Duration in months: 48 with no possible renewal	Duration in months: 24 with one possible renewal	Duration in months: 48	Duration in months: 96

Table 2: Background information and contract duration of PFEPCs

Table 3 provides some information on the functional and technical specifications along with some detail on the objectives of the PFEPCs.

CEF	Essentia	Ecovate	RE:FIT	P-EPC
Fund and support projects that meet a certain level of carbon savings per £ of investment required	Guaranteed energy savings over lifetime of contract based on reduction of kWh or £ savings and guaranteed reduction of carbon emissions	Energy consumption savings delivered by a single supplier guaranteeing performance, kWh consumption reduction and financial savings	Improve the energy performance of public sector buildings, reducing carbon emissions and achieving guaranteed annual kWh and cost savings	20% guaranteed energy saving (known as the 80% guarantee)

Table 3: Functional and technical specification of PFEPCs

It is interesting to note that CEF does not specify guaranteed savings or performance while the other four specify guaranteed energy savings. Ecovate and RE:FIT specifically mention the improvement of energy performance although a savings guarantee precludes a link between contract payments and equipment performance. As mentioned above, CEF, Essentia and Ecovate are contracted by (health) bodies governed by public law, while RE:FIT and P-EPC are contracted by regional or local authorities (Table 4). The tender documents also provide information about potential clients (Table 4).

CEF	Essentia	Ecovate	RE:FIT	P-EPC
Health	General public services and Health	General public services and Health	General public services	General public services and Environment
NHS Bodies and various other public sector organisations	UK public sector bodies	UK public sector bodies	UK public sector bodies	Local authorities, educational establishments, registered social landlords, and equivalent contracting authorities in the UK

Table 4: Main activity and addressable clients of contracting authorities

4.2 Comparison of PFEPCs

Official tender documents (Tenders, 2013a; TED, 2012b; TED, 2012a; TED, 2013c; TED, 2013a; TED, 2013b; TED, 2014; TED, 2015; Tenders, 2012; Tenders, 2013b) reveal that CEF, Essentia, Ecovate and RE:FIT are contracting on behalf of UK public sector authorities (Table 4). P-EPC has a more narrow focus on local authorities and associated public sector organisations. P-EPC also offers property management as opposed to engineering services (see Appendices 7.4 and 7.5 for more detail) although in practice it is considered an alternative to RE:FIT. While RE:FIT, CEF, Essentia and Ecovate operate at slightly different scales across slightly different areas of the public sector, using a similar range of ESCOs (see Appendix 7.6), P-EPC works with one pre-approved supplier (Table 5).

CEF	Essentia	Ecovate	RE:FIT	P-EPC
16 ESCOs chosen for mini-competition	8 ESCOs chosen for mini-competition	Maximum number of 8 of the UK's 'most accomplished' ESCOs	12 ESCOs chosen for mini-competition	1 ESCO chosen

Table 5: Type of call and number of operators

CEF, Essentia and RE:FIT's pre-qualification and short-listing of ESCOs ensures that only fully qualified and capable ESCOs are invited to submit proposals. The criteria of pre-qualification vary according to the PFEPC and the sector it was originally designed to address. CEF's Essentia's and RE:FIT's mini-competitions allow ESCOs to submit project proposals without the need to engage in time consuming OJEU tendering procedures. In the case of CEF and RE:FIT usually around 5 ESCOs submit project proposals. 14 ESCOs responded to Ecovate's advert and filled out the PQQ, of which 5 were shortlisted, which indicates that around 5 ESCOs tend to apply for any specific project scale.

The sources of finance vary considerably between the PFEPCs (Table 6). CEF sources funding from the UK government's Green Investment Bank as well as high street banks and pension funds. Essentia provides the option of ESCO (co-)funding. P-EPC has been designed around clients sourcing finance from the Public Works Loan Board (PWLB). The PWLB lends money from the National Loans Fund to local authorities with a 4% interest rate, and collects the repayment (DMO, 2015). This implicitly limits P-EPC's application to local authorities and associated organisations. RE:FIT provides a wide range of funding options including dedicated energy efficiency funds such as London Energy Efficiency Fund, Salix and Sustainable Development Capital LLP as well as PWLB and banks. In practice, large projects tend to require finance from a variety of sources while smaller projects are often financed through funding sourced by client organisations.

CEF	Essentia	Ecovate	RE:FIT	P-EPC
- Funding sourced by the client organisation - Funding sourced by the CEF - Funding brought to the contract by the bidder - Off-balance sheet transactions	- Funding sourced by the client organisation - Co-funding with the bidder - Funding brought to the contract by the bidder	- Funding sourced by the client organisation - Grants - Government incentives - Capital borrowing - Off-balance sheet transactions - Mix of the above	- Funding sourced by the client organisation - Grants - Government incentives - Capital borrowing - Loans - Concession agreements - Finance/operating leases - Off-balance sheet transactions - Mix of the above	- Funding sourced by the client organisation (preferably Public Works Loan Board (PWLB))

Table 6: Sources of finance

'Soft touch' measures as opposed to infrastructure replacement projects are often financed through revenue budgets and a surprising number of projects (up to 80% of RE:FIT projects) are financed by the client organisation. Apart from revenue budgets this may include capital funding provided by the customer (from existing capital programmes or government). What all PFEPCs have in common is that funding is repaid through energy savings.

Differences between the PFEPCs are more apparent when comparing contract length and detail from information derived from literary sources and interviews, which is not immediately obvious from the information provided in the tender documents due to unspecified inputs on behalf of Essentia, RE:FIT and P-EPC (Table 7). CEF offers the longest contracts both in theory and in practice. Essentia contracts are slightly shorter while Ecovate's only contract to date is slightly shorter again although it does not necessarily reflect Ecovate's target market as specified in the tender documents (see Table 4). Average RE:FIT EPCs are significantly shorter than those resulting from PFEPCs targeting the health sector (CEF, Essentia and Ecovate). P-EPC needs to be seen in the context of competing with RE:FIT at a local authority level while the other four PFEPCs, including RE:FIT, may be applied to larger projects (see GIB, 2014 for an example from the NHS).

CEF	Essentia	Ecovate	RE:FIT	P-EPC
15-30 years (after installation) or the life of the plant installed	Not specified	maximum of 20 years from date of award	Not specified	Not specified
15-25 year contracts	10-20 year payback	11 year payback	5-12 year payback	15 year payback

Table 7: Anticipated contract durations and contract lengths in practice

4.3 Achievements of PFEPCs

Table 8 provides an overview of the achievements of the PFEPCs analysed in this paper. Due to a lack commercial sensitivity and a shortage of robust information, more precise figures are not available.

CEF	Essentia	Ecovate	RE:FIT	P-EPC
- +50 NHS hospitals - £6m average project value - +£20m in saving - 15-20% average energy and carbon savings (up to 50%) - 15-25 year payback - Project value up to £100m including infrastructure schemes (biggest current project £36m)	- +14 NHS Trusts - £8-10 average project value - 14-16% average energy and carbon savings	- +1 NHS Trust - 9% energy and carbon saving - 11 years payback - Project value up to £10m	- +199 London public sector organisations - +460 buildings - +33,000t of carbon savings - +£68.6m of investment - 15-20% average energy and carbon savings (up to 47%) - 5-12 year payback (8 on average) - Project value up to £10m (biggest current project £6m)	- +50 local authority buildings and schools - +£2.1m in revenue and capital avoidance saving from £4.4 of investment - 20% energy and carbon saving - 15 year payback

Table 8: PFEPC achievements

Table 8 suggests that energy savings are broadly the same (in the range of 15-20%) across all PFEPCs. Ecovate's guaranteed energy savings are lower than the average but they need to be understood in the context of only one project to date. Ecovate's EPCs also need to be considered as 'fabric first' energy savings that other PFEPCs may not prioritise due to relatively long payback periods and relatively modest energy savings, especially if EPCs are designed around CHP installation. As the most established frameworks, CEF and RE:FIT provide the most detailed information on energy and carbon savings.

CEF's DBFO approach is based primarily on large assets despite being technologically neutral. CHP usually represents the cornerstone technology for retrofits. By displacing energy use, CHP in combination with other technologies such as lighting retrofits, variable speed drives, voltage optimisation and the installation of renewables can achieve savings of up to 50%. Its project range is from £1m to the £36m 25 year project at Addenbrookes, Cambridge University Hospitals, although its average projects size is £6m. The largest CEF project will eventually save around 25,000t/CO_2/a. CEF's 40+ current projects save 35-40,000t/CO_2/a, £7.5-8m/a and 90-95m/kWh/a (CEF, 2015).

RE:FIT has procured EPCs for a wide range of public sector organisations in London, ranging from councils to universities and hospitals, through its 12 appointed ESCOs. Its School and Small programmes address such projects using one pre-approved supplier each to help reduce transaction costs. Over 440 buildings have been retrofitted to date and it is aiming to retrofit 600 buildings by the end of 2015. The framework has triggered over £60m of capital investment and saved over 30, 000t/CO_2 from over 400 building retrofits. Annual energy savings amount to over £5m (GLA, 2015).

Essentia's target market for EPCs is similar to CEF's, with higher average investments and slightly shorter payback periods compared to CEF. However, as Essentia offers a wide range of other services, including strategic estates development, the final contract can be of a similar scale and complexity of CEF DBFO contracts. Ecovate targets the same market as Essentia and CEF although its focus lies more on a 'fabric first' approach to technologies and behaviour change, which are less likely to be prioritised in large infrastructural upgrades targeted by CEF in particular. Essentia appointed 8 ESCOs for the delivery of EPCs. Compared to CEF it is based more on a partnership approach and its emphasis on flexibility implies that contract lengths vary from 70 pages to 100+

pages compared to CEF's 300+ page contract. To date, Essentia has procured 14 EPCs in the health sector with an average project size of £8-10m.

Ecovate also encourages a partnership approach. Compared to CEF and Essentia's asset focused EPCs, Ecovate also encourages a 'fabric first' approach. As the focus is less on displacement of use, energy savings are lower compared to its health sector competitors. Its single EPC to date is a £8m hospital project which is set to reduce energy consumption by 9% with an 11 year payback.

P-EPC, at least in theory, is not limited to a particular scale but its focus on local authorities and associated public sector organisations implies that (hospital) district heating schemes are less likely to be procured using its framework than any of the others (GIB, 2014). P-EPC is the only framework with one pre-approved supplier for the entire EPC delivery. This implies that if a client wants to use the P-EPC framework, Honeywell will be the delivery partner. The lack of competition in the choice of an ESCO may be a factor which usually increases transaction costs for the client (Sorrell, 2007) but the trusted approach of working in partnership with a single delivery partner has proven useful for bundling and addressing the smallest of projects.

Figure 4 schematically compares the PFEPCs in relation to project scale ('soft touch' measurs vs. infrastructure replacement) and contract duration.

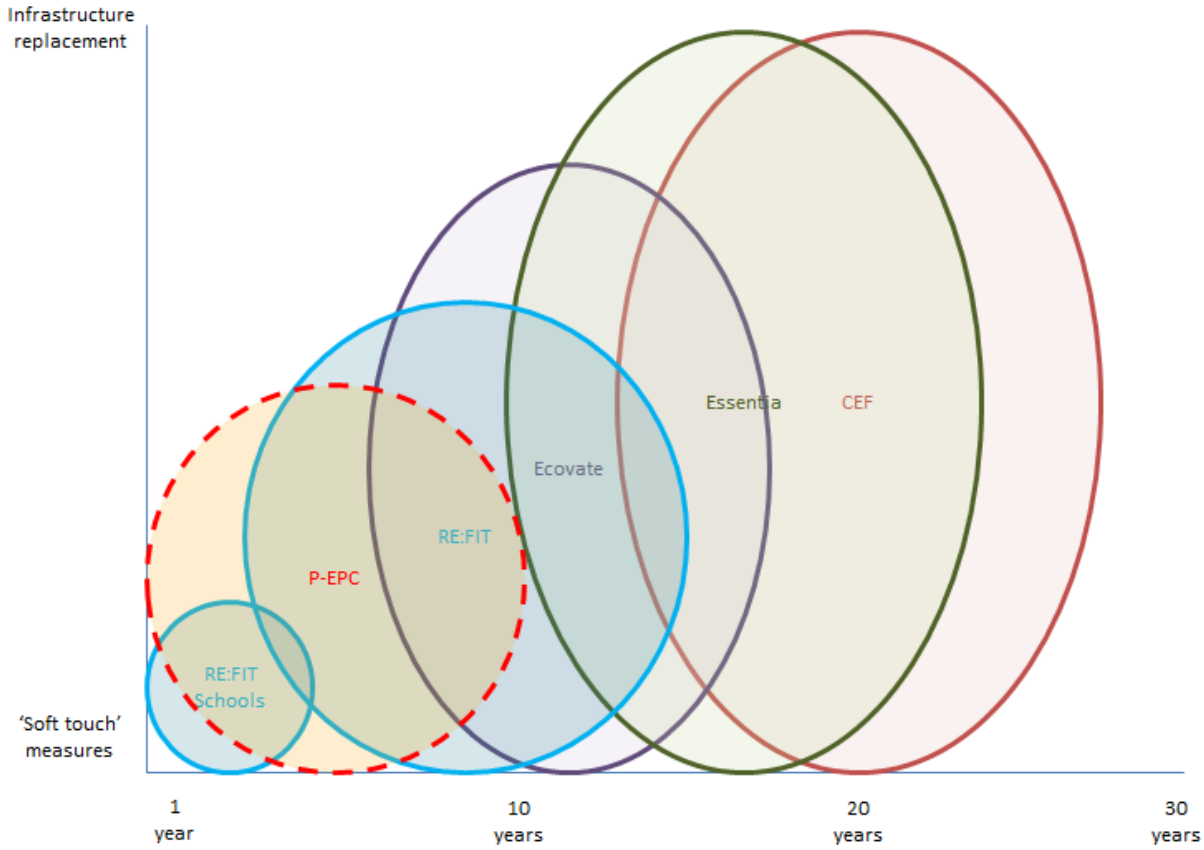

Figure 4: Comparing project scales and contract durations of PFEPCs in the UK public sector

4.4 Developing a typology of PFEPCs

4.4.1 Incremental vs. developmental procurement

Key to comparing PFEPC achievements and their capacity to diffuse innovative EPC business models and/or innovative energy efficiency solutions is the development of a typology which allows the comparison of procurement procedures and outcomes in relation to the criteria set out in 3.2 although there are some difficulties in deriving conclusions based on the achievements of PFEPCs to date. The figures provided in Table 8 (section 4.3) indicate the difference in project size between PFEPCs. Project size alone, however, is not the only criteria for success. A PFEPC encouraging incremental solutions using off-the-shelf measures for small-scale projects may be considered innovative as it may lend itself to replicating or 'productising' (Harkonen, 2015) long-term EPCs by reducing transaction costs. Retrofitting lighting, building energy management system (BEMS) and boiler improvement/replacement for example provide a low-risk replicable solution as these 'soft touch' measures do not require significant alteration of the building fabric or energy infrastructure.

This approach is pursued by both P-EPC and RE:FIT, specifically RE:FIT's School and Small programmes. In both cases one pre-approved supplier provides the energy services without the need to go through a mini-competition. P-EPC has successfully rolled out these technologies through Honeywell across more than 30 schools guaranteeing cost and energy savings of 20%. Such small projects would otherwise not be targeted by ESCOs as in one case the annual energy bills amounted to just £5,000, around 1% of the £500,000 threshold usually considered economical for EPCs (DECC, 2012b). RE:FIT pre-procured Mitie for its RE:FIT School programme with individual project values as low as £50,000 and British Gas for its RE:FIT Small programme with project values starting at £500,000. Both P-EPC and RE:FIT's School and Small programmes aim at reducing transaction costs at the small end of project scale through replication, which is only possible by allowing projects to be bundled. Technologically these solutions may be incremental but the key innovation lies in diffusing the EPC business model to projects usually considered too small in terms of project size and annual energy expenditure to be viable.

Despite its limitations, a technologically incremental approach may also provide greater savings than the 20% targeted by P-EPC. Proven technologies such as combined heat and power (CHP) replacing inefficient boilers can significantly reduce energy demand. These projects, however, move beyond the 'soft touch' measures and 'fabric first' approaches and usually entail contracts of increasing complexity and a greater emphasis on construction akin to DBFO contracts. Contracts exceeding 70 pages in length only address the >£1m project size and >£1m annual energy expenditure market. Projects at this scale benefit more from competition to reduce transaction costs and a combination of development oriented procurement and cooperative project development to achieve the best outcomes for the client organisation. Key to the diffusion of innovative (developmental) energy efficiency solutions is therefore competition among ESCOs but this approach is only viable for projects in excess of £1m in both project size and annual energy expenditure market. For PFEPCs targeting the health sector this figure is the absolute minimum with average project sizes varying between £6m-£10m. According to one interviewee:

> *'…you don't need us if you're doing a £1m project […] and I would advise you to do it yourself […] but if you're going to rip out the guts of a hospital in a live environment and replace the*

boilers, and people die if they don't work, and you're arguing over £5-10m contracts, you don't want to be left on your own…' (PFEPC representative)

4.4.2 Simplification vs cooperation

The other main distinction aside from incremental or developmental EPC approaches is the degree of cooperation. The degree of cooperation is not a dichotomous variable but rather a matter of degree as there is always some form of cooperation between procurers and ESCOs (Edquist, 2012). It affects the transaction costs for establishing EPCs as high levels of cooperation between the procurer and the ESCO can lead to the development of trusted relationships. Rather than implementing EPCs with low risk technologies for low risk clients a cooperative approach may encourage more innovative approaches both in terms of the EPC business model and energy efficiency solutions. Table 9 gives an indication of cooperation between procurers and ESCOs.

CEF	Essentia	Ecovate	RE:FIT	P-EPC
- 3-4 months auditing and bid drafting process (in excess of Investment Grade Audits) - Scoring system for net annual guaranteed savings across 15-25 years determines choice of ESCO	- Essentia provides all parties with the criteria at the beginning of the project - 'Fabric first' approach - Partnership approach allows clients to improve long-term energy outlook the establishment of a cooperative relationship with suppliers	- Interested ESCOs need to fill out a pre-qualification questionnaire before they can bid - The successful ESCO undertakes a 6 month IGA - 'Fabric first' approach - Close cooperation with the ESCO resulted in annual spreadsheets chosen over M&V	- Focus on simple tendering in line with public procurement requirements - RE:FIT England encourages closer cooperation through partner bidding	- Single supplier approach entails high levels of cooperation for project identification - Level of cooperation for individual projects limited which enables school projects with energy bills as low as £5,000 to be included in the EPC

Table 9: Degree of cooperation in the procurement process

One of the key determinant for cooperation is the bidding approach (Table 10, see Appendix 7.1 Definitions). The difference between target bidding and partner bidding lies in the flexibility of targets and measures installed. Target bidding involves the specification of a target (or key driver), such as a carbon, cost or energy saving, which may coincide with targets set out by other authorities (such as Carbon Reduction Commitments[3]). The guaranteed savings are identified at the tendering stage. Partner bidding implies that no target is specified. This allows the project to develop further through closer cooperation between procurer and ESCO before the savings are guaranteed. Partner bidding encourages innovation as it is perceived to be less prescriptive by the ESCO.

[3] Carbon Reduction Commitment Energy Efficiency Scheme is a mandatory carbon emissions reporting and pricing scheme to cover large public and private sector organisations in the UK

CEF	Essentia	Ecovate	RE:FIT	P-EPC
Target bidding	Partner bidding	Partner bidding	RE:FIT London: Target bidding, RE:FIT England: Target or partner bidding	Target bidding

Table 10: Approach to bidding

Table 9 shows that the degree of cooperation may appear high in the case of CEF as ESCOs preparing bids spend 3-4 months auditing. However, CEF's perceived inflexibility as well as their detailed information gathering approach, high costs and its scoring system based on savings guaranteed across 15-25 years are considered too rigid and complex by some interviewees as it effectively results in target bidding (Table 10). Essentia, according to this view, provides all parties with all the information at the beginning of the process which encourages more flexible partnership approaches (Table 9 and 10). Despite the complexity of the CEF procurement process it has proven successful for 40+ projects and wide variety of project scales. Ecovate encourages the development of the project in partnership between the ESCO and the client throughout the Investment Grade Audit. The scope may extend beyond energy saving to improve operational efficiency and address backlog maintenance, which is similar to Essentia's partner bidding process. Ecovate's £8m EPC with Schneider Electric for example was chosen over a £10m project, which would have included windows, and a £24m project which would have included a chilled water system. The £8m project was chosen as it removed £3.1m of backlog maintenance including asbestos removal. Schneider Electric's 'fabric first' approach the development of a district Low Temperature Hot Water (LTHW) scheme, the installation of plate heat exchangers, thermal pipe insulation and an overhaul of the BEMS in close cooperation with the in-house energy management team.

For smaller projects, particularly the <£1m project size and <£1m annual energy expenditure market, partner bidding is often considered unviable as it entails higher transaction costs than target bidding. RE:FIT England has nevertheless embraced partner bidding for its mini competitions as is allows projects to move away from limited budgets and ESCOs can sometimes increase savings significantly with only a moderate budget increase. P-EPC's approach is based around the '80% guarantee', which implies that Honeywell guarantees that energy expenditures amount to 80% of what they were before the implementation of the EPC. Close cooperation between procurer and ESCO is nevertheless evident with school project bundling which has enabled schools with annual energy expenditures as little as £5,000 to be part of an EPC.

4.4.3 PFEPC typology

In general, collaborative development of functional specifications through partner bidding creates favourable conditions for innovation by providing suppliers with the flexibility to design and deliver projects without major limitations and by increasing competition (Uyarra, 2014 a, b). For PFEPCs the degree of cooperation is of particular relevance as the individual PFEPCs entail different approaches, either to reduce transaction costs or to encourage trusted relationships between the ESCO and the client (Table 9). The latter is more likely to encourage collaborative development and developmental procurement while the former is more likely to encourage technologically incremental solutions. Innovation may nevertheless result from incremental technological approaches through by

developing ‘packages’ of technological solutions that can be rolled out across homogeneous estates and/or facilities with common functions.

According to Edquist and Zabala-Iturriagagoitia’s (2012) PPI framework, which has been modified for the purposes of this analysis, the PFEPCs can be classified as follows:

	Incremental procurement	Developmental procurement
Replication oriented	P-EPC; RE:FIT London	CEF
Cooperation oriented	RE:FIT England	Essentia; Ecovate

Table 11: PFEPC typology

This typology suggests that PFEPCs which have emerged from the health sector can generally be classified as developmental. This is the result of large project size and annual expenditure which allows ESCOs to implement a wide range of energy efficiency measures. The difference lies in their approach to replication and cooperation. CEF’s developmental DBFO approach is characterised by a lack of flexibility in comparison of Essentia and Ecovate but its benefit lies in the replicability of its approach. This is reflected by number of EPCs that have been procured using the CEF framework. Essentia and Ecovate are more cooperation oriented although their target is to ultimately provide a replicable framework that can be rolled out across the public sector. The benefits of their approaches, particularly Ecovate’s, is the focus on savings that are less likely to be targeted if the focus lies on replicability. By encouraging a ‘fabric first’ approach ESCOs are less inclined to implement proven technologies that displace use, such as CHP.

PFEPCs that have been developed by local authorities are classified as incremental due to the relatively small project sizes, which usually limits the range of energy efficiency measures installed. What is more important than the diffusion of innovative energy efficiency solutions is their ability to encourage project bundling, replication and simplification. Associated innovative EPC business models have enabled RE:FIT and P-EPC to target schools with annual energy bills as low as £50,000 and £5,000 respectively.

To summarise, PFEPCs targeting primarily local authorities tend to focus on incremental procurement in terms of technologies installed using innovative EPC business models to reduce transaction costs for small projects. PFEPCs targeting primarily the health sector tend to emphasize competition to reduce transaction costs for large projects and provide greater opportunities for developmental procurement approaches.

5 Discussion

Apart from brief references particularly to RE:FIT (Chmutina, 2014; Chmutina, 2012; Hannon, 2015b), UK PFEPCs have not been researched to date in an academic context. The choice of theoretical framework arose out of the PFEPCs’ remit to close a gap in energy efficiency investments and their success developing EPCs ranging from public sector organisations with annual energy bills as low as

£5,000 to estates development projects worth £36m although no PFEPC covers the entire spectrum. Different PFEPCs address different public sector markets and their approaches vary accordingly.

All PFEPCs spread risk by transferring the technical and delivery risks from clients to ESCOs. Major differences between PFEPCs are apparent in the way finance is sourced, which reflects their target markets. Large EPCs often require finance from a wide range of sources including commercial banks and government subsidised banks such as the UK's Green Investment Bank. Smaller EPCs may be entirely financed from revenue and maintenance budgets. Local authorities can make use of PWLBs at favourable conditions. Small projects often see clients source their own finance, especially. Compared to other countries (Patari, 2013) and sectors (specifically the SME sector, (WSBF, 2013)), there does not appear to be a shortage of finance for public sector EPCs and energy efficiency projects in general. This research therefore contributes to the development of our understanding of how transaction costs associated with energy service delivery can be reduced (Sorrell, 2007) and energy efficiency markets effectively developed (Fawkes, 2013).

By combining accessible finance with simplified procurement procedures, PFEPCs can contribute to the accelerated diffusion of incremental and in some cases more developmental energy efficiency innovations in the public sector, which may result in significant energy and carbon savings. Classifying PFEPC procurement as truly 'developmental' according to (Edquist, 2012) categorisation may be too optimistic due to the inherent risk the application of untested technologies entails (Uyarra, 2014b). Displacing use for instance by replacing inefficient boilers with CHP can nevertheless yield significant total savings although significant energy demand reduction appears to be a more likely result of 'fabric first' projects.

The key innovation often lies less in the diffusion of 'developmental', innovative energy efficient solutions but rather in the reduction of transaction costs through innovative EPC business models. While large projects may include innovative estates development solutions alongside energy service delivery and infrastructure replacement projects, projects bundling small organisations such as schools in a single EPC allows ESCOs to concentrate more on retrofitting and the installation of replicable 'soft touch' measures with low associated transaction costs.

By providing 'package' solutions the significant upstream services (pre-implementation) including energy audits, equipment sales and costings as well as downstream services (post-implementation) including O&M and M&V (see Appendix 7.1 for more information) usually associated with the implementation of energy efficiency technologies are less costly and time consuming. The transactions costs associated with providing such upstream and downstream services are often considered prohibitive for EPCs (Sorrell, 2005, 2007). The fewer upstream and downstream services are included, the lower the transaction costs.

With single pre-approved suppliers removing competitive pressures, RE:FIT schools and P-EPC can offer 'package' EPCs to schools with energy bills as low as £50,000/a and £5,000/a respectively. In the commercial sector it is usually assumed that only organisations with energy bills exceeding £500,000/a can be successfully targeted using EPCs (DECC, 2012b) although new forms of project bundling are also changing the nature of cost-effective energy efficiency measure financing and implementation. Minimising upstream and downstream services included enables the EPCs to be productised, turning them effectively into regular procurement akin to ready-made 'off-the-shelf' products.

PFEPCs may also enable ESCOs to bundle particular steps required to implement energy efficiency projects. By providing standardised contracts, PFEPCs help address the legal complexity associated with long-term energy efficiency contracts (Marino, 2010; Patari, 2013). Some PFEPCs also address uncertainty surrounding M&V by either including independent M&V or scrutinising M&V performed by the ESCO. Bundling, standardisation and monitoring of M&V reduce transaction costs (by reducing general uncertainty regarding energy efficiency investments – see (Aasen, 2015; Patari, 2013; Polzin, 2015) but different approaches result in different outcomes.

For more developmental, radical innovations, partnership approaches appear to prove more successful than 'productised' incremental approaches aiming to establish EPCs as a regular procurement option as they enable the development of a trusted relationship between the ESCO and the client. The downside of more developmental approaches is that they are associated with higher transaction costs than contracts based on standardised bidding processes. These can be offset by allowing for contingencies such as technological advancement (Fawkes, 2013). The main benefit of PFEPCs to the public sector nevertheless lies in the reduction of both direct and indirect transaction costs of installing cost-effective energy efficiency measures despite the PFEPCs' tendency to reduce the incentive to innovate (as one interviewee put it: *'…frameworks stifle innovation…'* –see also (Uyarra, 2014b)).

6 Conclusion

EPC market activity in the public sector is receiving a significant boost with the launch of PFEPCs, hence the achievements of the frameworks are clearly visible. The RE:FIT framework for example has contributed significantly to building retrofits accounting for 41% of the overall investment required to achieve the Mayor's 60% carbon cut by 2025 (RE:FIT, 2015). CEF appears to be on track for upgrading 240 NHS trusts over 16 years. The growing number of PFEPCs is an indication of their success in expanding the UK EPC market, particularly for projects that would traditionally not have been addressed due to prohibitively high transaction costs.

Main differences in approaching the procurement process result firstly from the call and number of operators targeted. Approaches to reduce transaction costs range from pre-qualified ESCOs to mini-competition among bidders. Second the sources of funding vary considerably ranging from funding of the client organisation to public loans. Larger projects tend to be financed by a number of different sources. Third the average contract length relates to the sector in which the PFEPCs are applied. RE:FIT targets local authorities, which in general have smaller buildings (which results in the shortest payback period of 5-12 years) than the hospitals targeted by CEF, Essentia and Ecovate (resulting in 10-25 years payback time). Fifth the developmental and incremental approaches can be found among the procurement frameworks which influences the kind of technologies applied. Sixth the degree of cooperation which is influenced by the bidding approaches vary from target bidding with a guarantee to a more flexible partner bidding approach that allows for more novel technologies.

Overall, the variety of approaches and scale of EPC application enabled by the different PFEPCs is contributing to increasing the viability of EPCs in the public sector by building trust in alternative procurement processes and delivery business models. The innovativeness of specific PFEPCs often lies less in the diffusion of 'developmental' innovative energy efficient solutions although partner bidding approaches create favourable conditions for innovation (Edquist, 2012; Lords, 2011; Uyarra,

2014b). On the other hand, these approaches which increase standardisation and bundling prove successful at lowering transaction cost, which enables ESCOs to address projects which would not be considered in the absence of PFEPCs due to high transaction costs. This particular organisational innovation opens the market up to new approaches to implementing cost-effective energy efficiency measures. A danger of losing in-house energy management capacity is something clients need to be aware about when considering EPCs and outsourcing more generally but some of the PFEPC approaches actually play an important role in pooling skills and resources within public sector organisations.

These aspects point towards PFEPCs as successful examples of PPI and towards the usefulness of PPI typologies for the classification and analysis of PFEPCs. We have expanded Edquist and Zabala-Iturriagagoitia's (2012) typology relating to the level of cooperation between ESCO and client and the degree to which a PFEPC aims at replicating the process. Even if the technologies installed may not necessarily be innovative, their application in locations where they were not applied before as well as the reduction of transaction costs to enable EPCs to address high energy demand in the first place can be considered innovative. Combined with competitive and/or partner bidding processes and cooperative development approaches, PFEPCs have the potential provide innovative approaches to energy management and retrofitting in some areas of the public sector.

There are some potential issues arising out of developing EPCs on the basis of supply technologies in relation to energy demand reduction as projects based on CHP for example may lend themselves less to energy demand reduction. Reducing transaction costs through the implementation of incremental technology may also miss the opportunity to implement more innovative solutions although the development of trusted relationships through successful EPCs may encourage alternative approaches in the future. Whether PFEPCs provide appropriate incentives for the diffusion of developmental and radical innovations required to achieve energy efficiency and carbon savings targets is unclear but 10-20% average guaranteed energy and CO_2 savings, in some cases up to 50%, are significant and may build confidence in the EPC model and energy efficiency investments more generally. What is yet unclear is how outsourcing to large ESCOs may contribute to lock-in associated with long-term contracts between ESCOs and clients and what a loss in control over in-house energy management capacities implies in the long-term. It is also unclear in how far projects focusing on infrastructure replacement and addressing investment backlogs can contribute to saving energy and carbon beyond low-risk technological efficiency gains.

7 Appendices

7.1 Definitions

- *Call off*: An individual contract under a framework agreement whose length is determined by the purchases in question and value for money considerations[4].
- *Contracting Authority:* 'means the State, regional or local authorities, bodies governed by public law, associations formed by one or several of such authorities or one or several of such bodies governed by public law'[5].
- *EPC:* Energy Performance Contracts focus upon the delivery of final energy services, such as mobility and illumination, rather than individual end-use technologies.
- *EPC provider:* guarantees a specified level energy savings over a defined period, finances the capital investment from these savings and verifies those savings through agreed procedures for monitoring and verification.
- *ESCOs:* Energy Service Companies offering contracts (commonly termed *energy service contract, of which EPCs are a subset*) for the provision of energy services.
- *Innovation:* new technological or organisational processes and products.
- *Investment grade audit*: IGAs involve the analysis of technical components of individual or multiple technologies, sometimes entire buildings or sites, to establish the economic feasibility of installing energy efficiency measures.
- *M&V:* Measurement and Verification is the process of quantifying and monitoring energy savings resulting from the installation of energy efficiency measures
- *Mini-competition*: To shorten the procurement procedure some frameworks pre-approve suppliers which may bid for a contract through a mini-competition.
- *O&M:* Operation and Maintenance involves fixing equipment and ensuring that equipment performs according to specification.
- *OJEU procurement rules*: European Union Procurement Directives[6] [7] establish public procurement rules. These rules apply to any public purchase above the defined threshold throughout the EU and are designed to open procurement and ensure free movement. Contracts must be advertised (contract notices published) in the Official Journal of the European Union (OJEU)[8][9] (see Annex).
- *Partner bid:* The client and an ESCO enter into a partnership to develop the project before the targets are guaranteed. This approach is conducive to fostering innovation.
- *PFEPC:* OJEU compliant procurement frameworks for EPCs that reduce the transaction costs of negotiating and establishing contracts and monitoring contract performance.

[4] OGC, 2008, Framework Agreements – OGC Guidance on Framework Agreements in the Procurement Regulations, Office of Government Commerce, London.
[5] EU, 2004, Directive 2004/18/EC of the European Parliament and of the Council, Official Journal of the European Union, Brussels, Article 1.9.
[6] EU, 2004, Directive 2004/17/EC of the European Parliament and of the Council, Official Journal of the European Union, Brussels.
[7] EU, 2004, Directive 2004/18/EC of the European Parliament and of the Council, Official Journal of the European Union, Brussels.
[8] DCLG, 2014, ERDF National Procurement Guidance ERDF-GN-1-004, Department for Communities and Local Government, London.
[9] Design Buildings Wiki, 2015. OJEU procurement procedures, < http://www.designingbuildings.co.uk/wiki/OJEU_procurement_procedures >.

- *Pre-qualification questionnaire*: Assesses the commercial, technical and financial suitability of parties. PQQs help the contracting authority shortlist interested organisations according to minimum qualification criteria.
- *Procurement framework:* a legal document setting out terms and conditions under which public organisations can purchase goods or services from pre-approved suppliers.
- *Public Procurement:* the purchase of goods and services from third parties by a Contracting Authority.
- *Public procurement for innovation:* purchasing the fulfilment of certain functions within a reasonable period of time.
- *Regular public procurement:* purchasing standard products 'off-the-shelf' with only price and quality of the product taken into consideration.
- *Soft-touch measures*: Energy efficiency measures which do not require construction work or the replacement of infrastructure such as lighting/light fittings, building energy management systems (BEMS), boiler replacement and voltage optimisation as opposed to the installation of district heating systems, chilled water systems or replacing windows.
- *Target bid:* The client suggests targets in percentage of energy savings, capital costs savings and payback periods. This approach may limit innovation as it is perceived to be too descriptive by ESCOs.

7.2 Box 2 Award criteria for tenders

The procedure for the award of a contract depends on whether the tender is:

- Open procedure which does not involve a pre-qualification process or short-listing process. Anyone responding to the OJEU notice is issues with the full contract documentation.
- Restricted procedure involves a pre-qualification process. Only short-listed candidates are invited to tender.
- Competitive dialogue procedure involves a pre-qualification process. Short-listed candidates are invited to take part in a dialogue process and upon completion, final tenders are invited.
- Competitive negotiation procedure involves a pre-qualification process. Short-listed candidates are invited to take part in a negotiation process, which can continue even after the preferred bidder has been appointed.

7.3 List of interviews

1	19.2. 2014	Verification expert
2	26.2.2014	Verification expert
3	6.3.2014	Fund manager
4	7.3.2014	Market analyst
5	14.3.2014	Finance expert
6	28.5.2014	Trade Association
7	5.6.2014	ESCO
8	20.6.2014	PFEPC
9	1.7.2014	ESCO
10	17.7.2014	ESCO
11	23.7.2014	PFEPC
12	23.9.2014	PFEPC
13	24.9.2014	Legal advisor
14	23.10.2014	ESCO
15	7.11.2014	PFEPC
16	19.11.2014	ESCO
17	20.11.2014	ESCO
18	20.11.2014	PFEPC
19	20.11.2014	ESCO
20	20.11.2014	ESCO
21	1.4.2015	Researcher
22	12.6.2015	PFEPC
23	12.6.2015	Legal advisor

7.4 PFEPC tender information

	CEF	Essentia	Ecovate	RE:FIT	P-EPC
Contracting authority	Countess of Chester Hospital NHS Foundation Trust	Guy's and St Thomas' NHS Foundation Trust Essentia Trading on behalf of Guy's and St Thomas' NHS Foundation Trust	King's College Hospital NHS Foundation Trust	Transport for London (Premises Projects and Commercial Services on behalf of the Greater London Authority	Peterborough City Council
Type of contracting authority	Body governed by public law	Body governed by public law	Body governed by public law	Regional or local authority	Regional or local authority
Main activity	Health	General public services and Health	General public services and Health	General public services	General public services and Environment
Contract on behalf of other contracting authorities	NHS Bodies and various other public sector organisations	UK public sector bodies	UK public sector bodies	UK public sector bodies	Local authorities, educational establishments, registered social landlords, and equivalent contracting authorities in the UK
Title	National Framework Agreement to supply carbon and energy infrastructure upgrades	Strategic Sustainability Transformation Framework	National Framework for Energy, Carbon and Backlog Maintenance Management Services – Performance Contract	RE:FIT framework (public buildings retrofit programme)	Blue Sky Peterborough: Energy Performance Contracting Programme
Type of contract	Service category No 12	Service category No 12	Service category No 12	Service category No 12	Service category No 14
Number of operators	10 ESCOs chosen for mini-competition	8 ESCOs chosen for mini-competition	Maximum number of 8 of the UK's 'most accomplished' ESCOs	12 ESCOs chosen for mini-competition	1 ESCO chosen
Contract length	15-30 years (after installation) or the life of the plant installed	Not specified	maximum of 20 years from date of award	Not specified	Not specified
Duration of the framework agreement	Duration in years: 4	Duration in months: 48 with no possible renewal	Duration in months: 24 with one possible renewal	Duration in months: 48 (from the award of the contract)	Duration in months: 96
Estimated total value of purchases for the entire duration of the framework agreement	Range: between 1 000 000 and 1 000 000 000 GBP excluding VAT	Range: between 1 and 500 000 000 GBP excluding VAT	Range: between 1 000 000 and 500 000 000 GBP excluding VAT	Range: between 1,00 and 500 000 000,00 GBP excluding VAT	Range: between 1 000 000,00 and 500 000 000,00 GBP excluding VAT
Source of finance	Client organisation, funding sourced by the CEF, funding brought to the contract by the bidder and off-balance sheet transactions	Client organisation, co-funding with the bidder or funding brought to the contract by the bidder	Client organisation, grants, government incentives, capital borrowing and off-balance sheet transactions or a mix of the above	Client organisation, grants, government incentives, capital borrowing, loans, concession agreements, finance/operating leases and off-balance sheet transactions or a mix of the above	Preferably Public Works Loan Boards (PWLB)
Award criteria	The most economic tender	The most economic tender (weighted)	The most economic tender	The most economic tender (weighted)	The most economic tender
Date of dispatch of contract notice	1.5.2015	28.9.2013	4.10.2013	11.5.2012	25.5.2012
Date of contract award decision		1.4.2014		9.1.2013	14.8.2013

7.5 Service categories according to Directive 2004/18/EC

Service category No 12: Architectural services; Engineering services and integrated engineering services; Urban planning and landscape engineering services; Related scientific and technical consulting services; Technical testing and analysis services.

Service category No 14: Building-cleaning services and property management services.

7.6 List of PFEPC ESCOs

Company	CEF (Framework 3)[10]	RE:FIT	Essentia
Ameresco (previously ESP)	*		
Bilfinger	*		
Bouygues	*	*	
Breathe Energy (MCW)	*	*	*
British Gas		*	*
Cofely	*	*	*
Cynergin	*		*
Doosan Babcock	*		
EDF	*	*	
ENER-G	*		*
E.On	*	*	*
Honeywell[11]		*	
Imtech	*	*	*
Kier	*		
Mitie	*	*	
Norland		*	
Schneider Electric[12]			
Skanska		*	*
SSE	*		
Veolia (previously Dalkia)	*		
Vital Energi	*		
Willmott Dixon		*	

[10] CEF has procured 3 individual frameworks under its name with a different range and number of ESCOs
[11] Honeywell is also the pre-approved supplier for P-EPC
[12] Schneider Electric was contracted through Ecovate to undertake an EPC at King's College Hospital

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SPRU – Science Policy Research Unit
University of Sussex
Falmer, Brighton, BN1 9SL,United Kingdom
www.sussex.ac.uk/spru
Twitter: @SPRU
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