

---

**Defining Incumbency:**

**Considering the UK Heat Sector**

Richard Lowes, Bridget Woodman, Oscar Fitch-Roy

Working Paper: xxxxxx



University of Exeter,  
Penry Campus,  
Treliever Road.  
TR10 9FE

# ABOUT UKERC

The UK Energy Research Centre (UKERC) carries out world-class, interdisciplinary research into sustainable future energy systems.

It is a focal point of UK energy research and a gateway between the UK and the international energy research communities.

Our whole systems research informs UK policy development and research strategy.

UKERC is funded by The Research Councils UK Energy Programme.



For information please visit [www.ukerc.ac.uk](http://www.ukerc.ac.uk)

Follow us on Twitter @UKERCHQ

## Acknowledgements

The authors would like to thank Will Steggals at the Climate Policy Initiative for early discussions around incumbency. We are also very grateful to Ioanna Ketsopoulou and Jim Watson at UKERC for their comments on the paper.

## **ABSTRACT:**

Incumbency is frequently considered as a barrier to the transformation of unsustainable socio-technical systems such as energy systems. However, despite wide use of the term, 'incumbency' has never been fully or adequately defined within the sustainable transitions literature. This working paper considers the use and meaning of the term incumbency in relation to sustainable transformations, specifically in relation to the UK's heat system. It takes ideas of incumbency from other disciplines including economics, politics and innovation. Synthesising these literatures, the paper proposes a number of characteristics of incumbency. Finally we propose a definition of incumbency in relation to sustainability transformations, which suggests that incumbents are actors already present in a specific socio-technical system, who are likely to be involved with unsustainable practices, and who possess the capacity to affect system change.

**Keywords:** heat, incumbency, transformation, socio-technical system

**Contact:** [r.j.lowes@exeter.ac.uk](mailto:r.j.lowes@exeter.ac.uk)

**Date:** 22<sup>th</sup> January 2016

## Contents

1.	INTRODUCTION .....	5
2.	THE NEED FOR A SUSTAINABLE TRANSFORMATION OF HEATING IN THE UK .....	8
2.1.	<i>The current system .....</i>	<i>8</i>
2.2.	<i>A domestic and service sector heat transformation .....</i>	<i>10</i>
2.3.	<i>Change in the industrial heat sector.....</i>	<i>11</i>
3.	THE ROLE OF BUSINESSES IN THE TRANSFORMATION .....	13
4.	CONSIDERING INCUMBENCY WITHIN THE HEAT AND TRANSFORMATION DISCOURSE.....	16
4.1.	<i>Incumbency and sustainable transformations .....</i>	<i>17</i>
5.	EXISTING DEFINITIONS OF INCUMBENCY.....	19
5.1.	<i>Economics and business.....</i>	<i>19</i>
5.2.	<i>Politics .....</i>	<i>20</i>
5.3.	<i>Innovation .....</i>	<i>21</i>
6.	KNOWING AN INCUMBENT WHEN YOU SEE ONE – A SYNTHESIS OF INCUMBENCY CHARACTERISTICS	23
6.1.	<i>Characteristic 1 – Existence – Something is incumbent if it already exists .</i>	<i>23</i>
6.2.	<i>Characteristic 2 – Temporality – Something is incumbent if it is involved with the ‘old’ technologies.....</i>	<i>24</i>
6.3.	<i>Characteristic 3 – Scale – A business is incumbent if it is big player in a market</i>	<i>26</i>
6.4.	<i>Characteristic 4 – History – A company is incumbent if has existed for a long time .....</i>	<i>29</i>
7.	DEFINING INCUMBENCY.....	31

## 1. Introduction

UKERC's 'Heat, Incumbency and Transformations' project or 'HIT' is investigating the role of incumbent private companies or firms in a transformation of the UK heat system to a more sustainable model. This paper attempts to define incumbency in the context of sustainability transformations, focussing specifically on the heat sector in the UK as an example.

Incumbency is a widely used term within the energy discourse, but it has no firm definition in this area of research and only limited definitions elsewhere. However, use of the term 'incumbency' often engenders (normatively) negative ideas of path dependency and the role of political and institutional power in shaping governance towards the interests of the incumbents (e.g (Kern & Smith, (2008), Geels, (2014) and Hess, (2014)). The general understanding is that incumbents can slow or stop innovation.

Working towards a definition of incumbency will firstly fill a significant gap in the sustainability transitions literature. We also hope that this definition will also be a useful theoretical heuristic for researchers and others involved in sustainability transitions.

There is limited evidence to suggest that incumbency is a necessarily negative aspect of socio-technical systems. It is however worth noting that there is also limited evidence suggesting that incumbency can ease or support transformations. This lack of evidence possibly reflects a general lack of specific considerations of the effects of incumbency within the sustainable transition and transformation research. We currently take an agnostic view on whether incumbency is a negative or positive force and accept that it could be both of these things as has been recognised elsewhere (Pearson, 2016). The further stages of this research project will analyse the incumbency issues in relation to the UK's heat sector and the potential sustainable transformation of the heat system.

Within this paper, we firstly consider why a transformation of the UK's heat sector is needed and what a transformation may entail. We go on to consider the role of businesses in the UK's heat sector followed by investigating the use of the term within the sustainability transformations literature. We then consider theoretical approaches to understanding incumbency within the key research

areas that use the term, economics and business, politics and innovation studies. We go on to propose four characteristics we expect incumbents to possess and finally propose how these varying ideas of incumbency can be applied to the UK heat system attempting to provide a working definition of incumbency in this context of sustainability transformations.

Underlying this paper, our theoretical context for considering the UK's heat system is the multi level perspective (MLP) model on transitions as proposed by Geels (2011). The 2011 (revised from Geels (2002)) diagrammatic version of this model is shown below in figure 1. Of particular interest to those involved in incumbency is the socio-technical regime level, the level of socio-technical systems which is dominant, established and self-stabilising. In figure 1, the regime (the middle-level) is shown to be formed of industry, policy, technology, culture, science, market and user preferences. Our conceptualisation of the UK's heat system therefore takes a much wider view than simply the technological aspects of the energy system.

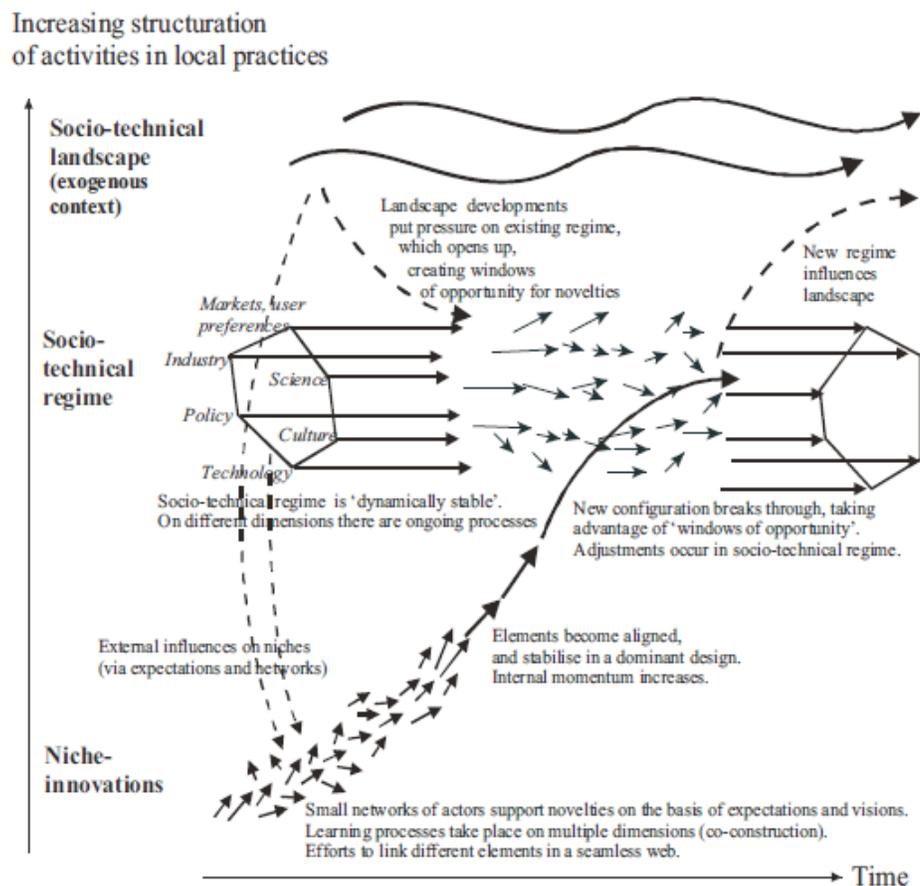


Figure 1. Multi-level perspective on transitions (Geels, 2011, p28)

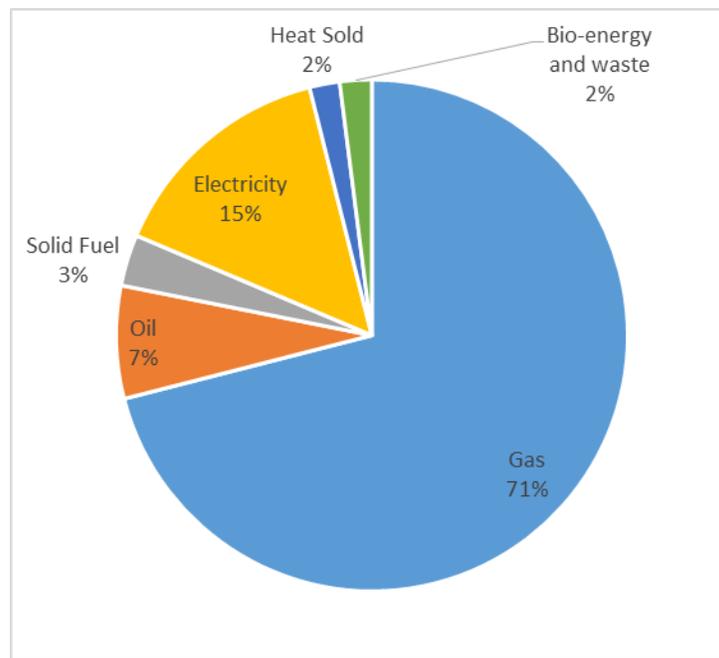
While the MLP model generally uses the term transition, we believe that in the context of the changes required to the UK's heat system, the term transformation is more appropriate. Stirling (2014, p13) explains that transitions are: 'mediated mainly through technological innovation implemented under structured control, presided over by incumbent interests according to tightly-disciplined knowledge, towards a particular known (presumptively shared) end'. However, transformations are: '...based more around wider innovations in social practices as well as technologies, driven by incommensurable, tacit and embodied knowledges, involving more diverse, emergent and unruly political re-alignments that challenge incumbent structures pursuing contending (even unknown) ends' (Stirling, 2014, p13). As we explain in the following section, the changes to the UK's space and hot water heating system appear transformative rather than transitional when considering the potential scale and impact of the required socio-technical changes.

## 2. The need for a sustainable transformation of heating in the UK

This section considers the UK's current heat system, explaining the requirement for system change. It goes on to consider the differences between space and hot water heating and industrial heat uses.

### 2.1. The current system

At 64,122 thousand tonnes of oil equivalent annually (based on 2012 estimates (DECC, 2013a)), the UK's heat consumption accounts for almost half of the UK's total energy consumption. As shown below in Figure 2, this consumption is fulfilled almost entirely by fossil fuels with gas being the predominant source of heat. Oil and electricity also have major shares. Small shares of heat consumption are provided by solid fuel, heat sold (i.e. through heat networks) and bio-energy and waste.



*Figure 2. Breakdown of fuels used for estimated UK heat use in 2012 (64,122 thousand tonnes of oil equivalent total heat consumption) based on DECC (2013) data*

Heating in the UK is responsible for 32% of all greenhouse gas emissions (DECC, 2012a) but the UK's Climate Change Act requires greenhouse gas emissions from the UK to be reduced by 80% by 2050 compared to 1990 levels. There is also a recognition that in the longer term, UK net greenhouse gas emissions may need to be zero in order to meet international climate change commitments

(Parliament, 2016). Both the UK Government and its independent advisor, the Committee on Climate Change have explained that emissions from the space heating sector need to be virtually eliminated by 2050 as emissions are likely to still be required in other areas such as industry and aviation where emissions cannot be reduced (DECC, 2012, Committee on Climate Change, 2015). A zero emission UK economy implies that fossil fuels are no longer used for heating (unless carbon capture and storage can be used) and as such implies a transformation of the UK's current heat system.

As well as the requirement to reduce carbon emissions, the UK is increasingly reliant on imported gas for heating which has both energy security and economic implications. 71% of the UK's heat is generated from gas (DECC, 2013a) but the UK has been a net gas importer since 2004 and in recent years has been importing around half of all gas (BEIS, 2016).

The UK Government has developed a heat strategy which considers potential technological pathways to meet the long term carbon reduction targets within the heating sector (DECC, 2013b). A number of other organisations have produced or utilised their own pathways and scenarios which considered heating in the future in line with climate change targets including the Committee on Climate Change (Committee on Climate Change, 2015), The UK Energy Research Centre (UKERC, 2013) and National Grid (National Grid, 2016). The implications of these pathways for different heat sectors are considered in more detail in the following sections.

Government data has generally broken down heat consumption data into three main sectors. Domestic, comprising households is responsible for the majority of heat demand use (57%); industrial which includes manufacturing and heavy industry is responsible for 24% of heat demand; the service sector which includes education, retail and hospitality is responsible for 19% of heat demand (DECC, 2013c). The different proportions of heat consumed from different fuels varies between sectors and is show below in Figure 3.

	Gas	Oil	Electricity	Solid fuel	Heat sold	Bio-energy and waste
Domestic heat use	80%	7%	9%	2%	0%	2%
Service sector heat use	67%	8%	21%	0%	3%	1%
Industrial heat use	54%	6%	23%	9%	5%	3%

*Figure 3. Percentage of heat produced in each sector broken down by fuel based on (DECC, 2013a)*

Since the production of the data used in Figure 2 and Figure 3, the share of bio-energy and waste used for heat in the UK has grown due to the introduction of the Renewable Heat Incentive Policy (see Connor et al., (2015) for more details of the scheme). In 2015, 5.6% of heat consumption came from renewables and the majority of this was biomass based (DECC, 2016) and this is likely to have offset some heat from other sources.

### 2.2.A domestic and service sector heat transformation

The domestic and service sectors share similarities in terms of both the fuels and technologies they use for space heating and hot water. For domestic and commercial space heating and hot water, in order to get to very low levels of emissions, various energy system models have considered future heating systems under carbon constraints (e.g. DECC (2013b), UKERC (2013)). The outputs from various models and scenarios for the domestic heat sector under carbon constraints have been synthesised and it has been shown that there is general agreement between the models and scenarios; major reductions in heat demand through energy efficiency are required combined with the rollout of district heating in urban areas and electric heating (often heat pumps) in more rural areas (Carbon Connect, 2014).

In densely populated urban areas, the use of district heating networks supplied by low carbon heat is seen as the best low-carbon option whereas in less densely populated rural areas, distributed forms of heat generation such as air-source and ground-source heat pumps are generally seen as the best option.

More detailed analysis of the various potential low-carbon heat technology pathways can be found in Carbon Connect's 2014 synthesis report (Carbon Connect, 2014) and in our video blog <sup>1</sup>.

The future of heat consumption in the service sector has generally not been considered in detail however, the service sector has similarities to the domestic sector. Heat demand is primarily for space and hot water heating and the sector has high levels of gas penetration; it is worth noting that gas use is slightly less common than the domestic sector and the role of electric heating is greater. As such, we expect low-carbon heat options in the service sector to be similar to domestic low-carbon heat options.

More recently, the use of hydrogen as an energy vector transported in the UK's existing gas network has been suggested as a potential low-carbon heat option by both industry and independent researchers (e.g. Northern Gas Networks et al., 2016, Maclean et al., 2016) and this idea has gained traction with Government bodies such as the Committee on Climate Change (The Committee on Climate Change, 2016). However, with very limited demonstration of hydrogen grids and large scale low-carbon hydrogen production, this is a technological option with significant uncertainties.

### 2.3. Change in the industrial heat sector

The other main area of heating, responsible for around a quarter of the UK's heat consumption, is the industrial heat sector where heat is used for industrial processes (DECC, 2013a). The three industrial sectors which have the highest heat demand are the petroleum, chemicals and minerals sectors (DECC, 2013a). Industrial heat has generally received less policy and research focus than domestic heating. However, significant change is likely to be required in this sector if the UK's carbon reduction targets are to be met. The Government's 2013 heat strategy explained that emission reductions of around 70% from the industrial sector would be required by 2050 through energy efficiency, fuel switching and carbon capture and storage (DECC, 2013b).

Industrial heating has major differences to space and hot water heating in that energy (and heat) is a requirement for the production of goods which form a

---

<sup>1</sup> These various pathways have been discussed in our October video blog which can be viewed on Youtube (<https://www.youtube.com/watch?v=p44ubVXCEHk&t=4s>).

significant part of the UK's economy. Industrial heating can also require higher grade (i.e. hotter) heat than space heating and also may require specific sources of heat for certain processes. Reducing emissions and increasing energy costs for UK industry could push affected industries abroad if energy costs are cheaper elsewhere. This could reduce UK economic output and has the potential for carbon leakage (Babiker, 2005).

### 3. The role of businesses in the transformation

The technological change required for a transformation of the heat system implies major changes for heat system actors such as businesses currently operating in the heat sector. Reaching a zero carbon UK heating system would mean that businesses currently involved in fossil fuel heating will need to adapt or no longer operate.

The heat sector is characterised by a large number of different actors at all stages of the supply chain. This includes upstream fuel producers, fuel transporters, fuel suppliers, the installation and maintenance sector and heating appliance manufacturers. That largest heat business sector is associated with gas and includes gas producers, gas transmissions and distribution networks, gas suppliers, appliance manufacturers and heating installation and maintenance companies. The other heating fuels have their own vertical chains of companies from upstream to downstream although the markets are smaller as there are fewer non-gas consumers than gas consumers.

The businesses present and industry structure varies significantly between different heating fuel markets i.e. for example gas, electricity or oil. The companies active and market structure also differs between the heat demand sectors i.e. domestic, service sector and industrial.

As such, the heat system involves a number of different markets with some businesses acting across markets and some businesses acting in specific market areas. The structure of the heat system in the UK is therefore complex and inter-connected. One aim of this project is to produce a detailed map of UK heat businesses. The production of this map (forthcoming), which focuses on the market structure issue in more detail, has helped inform this paper and the results of the mapping will be released in due course.

However, even in the absence of a complete picture of the UK heat market, it is clear that there are significant sunk costs in this sector, some in the form of long term infrastructure such as the UK gas network (Dodds & McDowall, 2013). There are major financial interests for whom the potential of system transformation to low-carbon heating implies major business change and/or the potential for stranded assets. The responses of these businesses could therefore

have major implications for whether and how a system transformation takes place.

Businesses are not likely to be passive bystanders in this heat transformation and there is already evidence of businesses attempting to influence the UK's Renewable Heat Incentive policy (Lowes, 2016). But it is not just through influence on policy that businesses may be able to affect the transformation but also through their investment and innovation behaviour (or lack thereof). Businesses may choose to invest capital into sustainable heating practices and technologies for which there is already a small but growing market, effectively 'diversifying' their business away from fossil fuels. Businesses could also choose to invest in innovation and research and development in low-carbon heating, developing new products and services, thereby promoting and supporting a sustainable heat transformation.

However, it has been recognised that there are a number of reasons why businesses often do not pro-actively innovate despite external pressures (Freeman & Soete, 1997) and may continue to focus on existing products and investments rather than considering new markets. This understanding is rooted in the evolutionary economic description of 'path dependency' in the behaviour of firms, where firms have institutionalised routines and practices based on past routines and practices which can limit the scope for innovation and change of those companies (Nelson & Winter, 1982). The path dependency literature suggests that because of these routines and the resulting limited innovation, firms focusing on what they have done before can potentially lock in sub-optimal or inefficient technologies (e.g. Patel & Pavitt, 1997 and Stack & Gartland, 2003).

The sub-optimality of technologies can be for a number of reasons and one of the most widely cited examples of a locked-in sub optimal technology is the QWERTY keyboard design which, despite the existence of designs that type much more easily, remains the dominant design pervasive across society (David, 1985). Arthur (1989) argues that technological lock-in can also be caused due to increasing returns within firms as a result of (random) historical events and the subsequent advantage that an initial product advantage can have for the future, with revenues allowing for faster and more advanced innovation than is possible for other products. This lock-in, Arthur argues is akin to so called

'founder-effects', or more colloquially in genetic science debates, evolutionary bottlenecks (Arthur, 1989).

However, when considering energy systems and a transformation to sustainable energy systems one of the key issues or sub-optimalities associated with path-dependency is carbon lock-in. This is quite simply the idea that due to the existence of a high carbon system (in our case study the UK heat system) the existence and associated stability of the regime itself can limit or slow the transformation of a regime to a fundamentally different regime. Unruh (2000) suggests that as well as the path dependency within firms, wider networks of firms and institutions connected to and linking these firms create techno-institutional complexes which can lock-in high carbon technologies at a societal level thus creating a barrier for low-carbon transformations (Unruh, 2000). The implication for the UK heat system is that its inherent stability impedes the transformation to a different (more sustainable) system.

This path-dependency and associated lock-in is central to much of the debate around sustainability transitions, in particular the stability of regimes and their resistance to change (Geels, 2004). Within the multi-level perspective (MLP) on transitions (introduced earlier, see Geels, 2011) the socio-technical regime (in our example the UK heat system) would be seen as being stable, partly because of the technologies within the system and the associated firms (as well as because of the associated institutions, rules and practices) (Geels, 2004). The MLP would suggest that businesses operating within the current heat system, because of the role of path dependency within firms and associated networks, would look to avoid disruption and focus innovation and investment on existing products and services and attempt to ensure that the external environment suits current practices.

The wider question of this research is then, what is the potential role of these established companies in a sustainable transformation of the UK's heat system. Can/are established companies likely to slow or speed up the rate of a transformation?

## 4. Considering incumbency within the heat and transformation discourse

As described previously, the role of existing or incumbent companies is seen to be an important aspect of socio-technical systems such as in this case, the UK's heat system. The concept of incumbency is central to many applied energy policy and regulation discussions. For example, Ofgem and researchers often use the term when discussing the dominant 'Big 6' UK energy suppliers and attendant competition issues (Salies & Waddams-Price, 2004, Waddams, 2008, Ofgem, 2015). The term incumbency is also used frequently in relation to transitions to sustainability as an important element of socio-technical regimes (Geels, 2011). Unruh's (2000) paper which was discussed earlier on carbon lock-in uses the term 'incumbent' repeatedly (Unruh, 2000). Yet in all of these examples the characteristics or meaning of incumbency is not explicitly defined. In fact, incumbency is not clearly defined anywhere in relation to energy in general or in the theory around sustainability transitions.

There is however an assertion that incumbents have power to affect transformations, for example Stirling (2014, p86) explains: *'incumbent interests configure 'scientific' knowledges such as to condition wider social expectations over what is 'realistic' or 'unrealistic' as directions for technological change [177]. The overall, effect can be a powerful circular reinforcement of incumbency.'* However, the role of incumbents may not necessarily slow or negatively affect a transition to sustainability as Geels explains: *'Although large incumbent firms will probably not be the initial leaders of sustainability transitions, their involvement might accelerate the breakthrough of environmental innovations if they support these innovations with their complementary assets and resources. This would, however, require a strategic reorientation of incumbents who presently still defend existing systems and regimes'* (Geels, 2011, p25). Despite the recognised importance of incumbency, neither of these authors define it.

Defining incumbency is important both for our project, where it is a focus and the wider energy/sustainability transformations debate where it is widely recognised as being an important, if ill-defined concept. But it is not just within the sustainability and transitions literature where the term incumbency is used. The concept of incumbency has an important status within the economic and

political literature and the use of the concept in these areas may help to develop a definition of incumbency for the HIT project and sustainability transitions in general.

#### 4.1. Incumbency and sustainable transformations

Despite the recognition of the importance of incumbency within the sustainability transitions/transformation debates as mentioned previously, the word and concept is used frequently without any further specification or clarification. In many instances the use of the word incumbency refers not only to businesses but also regimes, actors and particular technologies.

For example Kern & Smith (2008) consider an 'incumbent energy regime' (p4093). Hannon et al., (2013) consider 'incumbent business models' (p1034). Arapostathis et al., (2013) and Hess, (2014) consider 'incumbent regimes' (p25 and p280 respectively). Kalkuhl et al., (2012) consider 'incumbent technology' (p2). Geels (2014) discussed 'incumbent actors' (p23), 'incumbent regimes' (p25), 'incumbent firms' (p26), 'incumbent discourses' (p35) and 'incumbent interests' (p35). Bolton & Foxon, (2013) consider 'incumbent national infrastructures' (p2195), 'incumbent actors' (p2199) and just 'incumbents' (p2205) among other uses.

While these uses may consider private businesses, they also consider many other actors such as organisations and institutions within a particular system who are already operating. These uses of 'incumbent', being linked to sustainability transitions also imply that the incumbents are unsustainable or form part of an unsustainable system; this therefore suggests that in the context of sustainability transitions, an incumbent is very often seen as unsustainable.

This assumed association of incumbency with unsustainable practice is potentially problematic. Unsustainable businesses may become sustainable by, for example, becoming market leaders in renewable energy (Stenzel & Frenzel, 2008). Several questions are raised: Does a company which transitions to sustainable business practices remain an incumbent from the perspective of sustainability transitions? If so, at what point does this switch from unsustainable to sustainable happen? After all, some companies may be half

unsustainable, half sustainable and engaged in both fossil fuels and sustainable practices.

We also recognise that issues associated with incumbency are not just about sustainability, although the two are clearly linked in the context of sustainable transformations. Even in a hypothetical future low-carbon UK energy system, the issues associated with incumbency (elaborated on further in this document) including market power and predatory practices could still be present.

For example EDF Energy, an integrated energy company operating in the UK, owns and operates all UK nuclear power stations and is involved in the development of new nuclear power stations. Most definitions of incumbency would see EDF as incumbent. However, in some visions of the future energy system, nuclear energy is seen to be a solution for climate change in that it is low carbon and could provide low carbon energy for heat. If our goal for a sustainability transition in the UK heat sector was only reducing carbon then it is possible that EDF may not be considered incumbent from the perspective of the sustainability transformations understanding of incumbency. However, simply because nuclear power may be low carbon, does not mean it is necessarily sustainable, and if our idea of a sustainable UK energy system does not include nuclear power then EDF would be considered as incumbent. It is also the case that many of the considerations of incumbency from outside the transitions literature would see EDF as incumbent.

Clearly considering sustainability as directly connected to incumbency has a number of issues (including the initial issue of defining sustainability (Morelli, 2011)). However, in the context of specific sustainable transformations with required or envisaged ends or conclusions makes some sense, suggesting that the context of incumbency is particularly important when looking to define and understand it.

## 5. Existing definitions of incumbency

The term incumbency is used in a variety of different contexts and this section considers the key uses and associated meanings of the term incumbency in different areas. The key areas of interest are: economics and business, politics, and innovation studies. The use and meaning of concept of incumbency in each of these sectors are considered in more detail in the following sections.

### 5.1. Economics and business

Despite the fact that the concept of incumbency is often used when describing firms and businesses, the economics and business literature on incumbency is rather limited. Neither is it well defined in economics dictionaries. For example, Ammer & Ammer, (1986) and Bannock, (1972) have no listing. However, the Oxford Dictionary of Economics does define an incumbent firms as '*a firm which is already in position in a market*' going on to suggest incumbent firms have competitive advantages by having a reputation and sunk costs (Black et al., 2012). The suggestion is that any firm that exists in a market is an incumbent and that the status as an incumbent confers and structures some incentives and capabilities.

Fudenberg & Tirole (1986) imply a similar definition to the one outlined above when they discuss the role of incumbents and their attempts to disadvantage new market entrants through predatory pricing practices. In this theoretical discussion, the incumbent is the company that is already doing something that has the ability to reduce prices in order to reduce the profits and potential of new-entrants potentially limiting new products or scope for competitive forces. This definition is also implied in more recent work on predatory pricing and the demise of entrepreneurial start-up businesses in Belgium which suggested the market power of incumbents was contributing to the exit of new businesses from the market; the authors in this study suggested that incumbents used strategic price reductions (predatory pricing) and also look to influence investors' perceptions of new entrants in order to starve them of finance (Huyghebaert & Van De Gucht, 2004). In these instances, while the incumbent is simply a business already active in a market, there is also a strong implication that these firms also possess the capacity to influence developments in that market.

This definition of incumbency, i.e. considering what is already there, is also implied in other literature from the economics and business field. For example, in the development of new brands, products and technologies, incumbents are the companies already active in a market in which new entrants are attempting to break into (Mahajan et al., 1993; Robertson et al., 1995). Zupan (1989) also suggests that in the USA cable TV franchise market, incumbents are companies that are already operating and have franchises.

The use of the concept of incumbency in the economics and business literature suggests that incumbency is merely the presence in a market or sector. While incumbency confers certain capabilities such as market power or incentives such as that to recoup sunk costs, incumbency is not necessarily directly associated with the scale or significance of firms within markets. While there is evidence that incumbency can be linked to market power and implies a strong position in the market, this is not a requirement for a company to be described as incumbent. Overall, the economic and business management view of incumbency generally sees an incumbent firm as one that is already operating in and has already sunk assets (invested) in a market. Incumbents often also have some privileged position in a market relative to new entrants such as the ability to wield market power.

## 5.2. Politics

The other key area where the term incumbency is widely used is within politics and political science. The term is much more widely used within the politics field than within the economics and business field and there are many thousands of politics and political science articles which use the term. Because of the much more frequent use of the term incumbency within the politics literature, a more systematic approach to reviewing the literature was taken to consider the definition of incumbency within the political setting.

A review of academic literature using Web of Science and Google Scholar considered the 10 most highly cited journal articles with the word 'incumbency' in their titles through each search engine. Across both search engines within the search results in articles relating to politics and political science, 9 articles appeared in both lists showing a high level of overlap and consistency between the search engines (search performed using the term 'incumbency', search in

Web of Science was for 'title', and in Google Scholar was for 'articles', performed 19/7/16).

In all of these most highly cited articles across both search engines incumbency simply relates to the individual or party already in office (Erikson, 1971; Cover, 1977; Jacobson, 1987; Gelman & King, 1990; Abramowitz, 1991; Cox & Katz, 1996; Levitt & Wolfram, 1997; Ansolabehere et al., 2000; Abramowitz et al., 2006. In all of these articles, all these incumbent politicians are seen to have an advantage because of their incumbent position.

The political definition of incumbency can quite simply be considered as the person or administration already in office or power. This definition is closely aligned with the definition considered in the previous section. Like in the economics and business literature, it is also the case that much of the literature considered above sees incumbents as having an advantage over non-incumbent politicians.

### 5.3. Innovation

Another area of research where incumbency is an often-used term is within the innovation literature. Ordover et al., (1981) suggest that product innovation can be limited as a result of the actions of incumbent companies because the incumbent has sunk costs and has an interest in maintaining and receiving income from those sunk costs. Innovation in products or services could threaten the company in question. The incumbent may then act to protect its existing business through so-called predatory behaviour.

Wagner (2011) recognises that large incumbent companies can overcome their often inherently poor ability to innovate by acquiring smaller firms involved in more radical research and development in order to maintain a competitive advantage. In this example, Wagner implies that incumbent companies are the ones already operating but suggests that these companies can be large or small and that the small incumbents can be the ones associated radical research and development (Wagner, 2011).

In both of these examples of incumbency, like in our previous understandings, incumbency is considered simply as the presence of a company within a market but is linked to the possibility of and capacity for particular behaviour including pricing, acquisitions and research and development.

Using an example of radical product innovation, a firm is considered incumbent if it manufactured or sold products that belonged to the previous product generation on the introduction date according to Chandy & Tellis (2000). An example of this could be the move from camera using film to digital cameras (Chandy & Tellis, 2000).

The definition of incumbency within these innovation debates is associated to specific product innovations as well as the existence of companies within a market. This understanding therefore differs slightly to the understanding in the economics, business and politics literature, which focusses primarily on actors i.e. politicians in the case of politics and firms in the case of economics.

The technological focus implied by the innovation literature may indeed be useful for considering incumbency within socio-technical transitions, as it is fossil fuel technology that needs to be replaced with low-carbon technology in the heat example. However, technology is just one aspect of socio-technical systems and is intrinsically linked to businesses that manufacture, sell and maintain technologies. As such, focussing on businesses would potentially cover the technological aspects of socio-technical systems.

## 6. Knowing an incumbent when you see one – A synthesis of incumbency characteristics

In light of the previously considered uses and conceptualisations of the word incumbency from across different areas of research, this section considers a number of potential characteristics by which incumbents may be identified, and the benefits and drawbacks of each characteristic.

### 6.1.Characteristic 1 – Existence – Something is incumbent if it already exists

Incumbents can be thought of as **firms that are already active in a market**. In the context of our heat research, this would mean all the companies that are active across the whole heat market are incumbent/incumbents. This is similar to Smink's (2015) basic definition considered previously in the context of transitions who proposed that incumbents are organisations already present in a sector. It is also similar to the definitions considered previously associated with economics, business and political science. It should be noted that Smink's view, which considers organisations, could also potentially include organisations wider than just business interests such as Government bodies and other actors and institutions.

This view links to Unruh's (2000) idea of carbon lock-in which suggests that as well as solely technology, it can be public and private institutions alongside businesses and technologies which can evolve together to form techno-institutional complexes in which the effects of lock-in and regime stability are further compounded. However, as we have discussed previously, it is generally only actors and technologies which are seen as being incumbent as opposed to institutions and rules being incumbent themselves. Incumbency could therefore be an actor or technology that is already active in a market.

While this view is easily applicable, in the case of systemic transformations and many other circumstances, it is overly simplistic because it captures all firms and actors currently operating in a market, be they large, small, old or new as well as all institutions and technologies. Considering the heat system as an example, there are a very wide variety of actors: those with fossil fuel interests, those with sustainable heating interests (much fewer and smaller) and those with an interest in both. Under this definition all of these companies and actors would be considered incumbent which clearly does not fit with a view of

incumbent companies as somehow exerting power over or dominating a market or sector or somehow having an unbalanced effect on a sustainable transformation of a system.

This definition also has issues associated with the scale of analysis. When we say a company is active in a market do we mean active in the energy market, the heat market, an aspect of the heat market or even a specific technology? At the largest scale of market, all companies would be included whereas at the smallest scale, companies of relevance to the particular socio-technical system may be excluded. This therefore implies that this definition of incumbency would require context in order to be of use for analysis of socio-technical systems.

The view of incumbents as simply active players in a market has a number of problems and defining incumbents as companies that already exist in a market or solely as companies that exist in a market does not provide a full or accurate description of incumbency in the context of sustainability transitions. However, this idea of incumbency could form part of a definition, if it considers company context and market scale.

## 6.2.Characteristic 2 – Temporality – Something is incumbent if it is involved with the ‘old’ technologies

It may be that a firm can be considered incumbent **if it manufactured or sold products or provided services that belonged to the previous product generation** on the introduction date of the new technology.

In the example of the move from film to digital photography (Chandy & Tellis, 2000) this change and its subsequent impact on the development of social media has had a profound impact on society, a socio-technical transition of sorts. However, whether this technologically specific focus of incumbency can be applicable to sustainable transformations is questionable.

As discussed earlier, technological change is likely to be an extremely important aspect of a transformation to sustainable heat but this transformation is likely to include a number of complex and potentially revolutionary technologies. Many of these technologies such as heat pumps and heat networks exist today and so the technology may not be new, it may just be different and so this may not necessarily be a case of new technologies, just their use within new contexts.

In many cases, firms that may be selling the existing (i.e. fossil fuel) technologies are in many cases also selling low-carbon heating technologies. Under this technology based idea, these firms would be incumbent even if they were manufacturing or selling sustainable heating technologies because they may still be selling technologies which belonged to a previous generation i.e. are fossil fuel based. However, energy firms that have previously focussed on fossil fuels have in some cases moved their focus to sustainable energy and driven change. This is the case with wind energy in Spain where incumbent utilities companies including Iberdrola have driven both the development of the regulatory framework for wind energy and have been the largest investors in the technology (Stenzel & Frenzel, 2008).

The tight focus on technology also ignores the non-technological aspects of incumbency, which may have an important role in transformations. It is expected that much more than just technological changes will be required in order to reach a low-carbon heating system. There may also be required changes to social practices such as how heating systems are used in homes and businesses, with for example heat pump users accepting long periods of low-temperature heating as opposed to the short bursts of heat provided by gas boilers twice a day (Energy Saving Trust, 2010). There may need to be changes to business models as new heating technologies have different financial characteristics, for example greater electrical consumption at different times of the day or higher levels of capital expenditure associated with heat pump systems. There could also be changes to heat governance structures such the development of specific heat regulation as opposed to regulation of gas and electricity, there are already new advisory governance guidelines for heat networks for example (CIBSE, 2015). All of these aspects of regimes could be considered incumbent but would not necessarily be captured by the specific focus on technology.

Overall then this idea of incumbency has limits for socio-technical transitions because it ignores both the non-technological aspect of transformations and in considering specific technology changes does not consider the complexity of various interlinked and evolving technologies within large socio-technical systems. This definition alone may be of limited use to understanding incumbency within sustainability transformations. However, the idea of

involvement in specific industries or technologies is one characteristic an incumbent may demonstrate.

### 6.3.Characteristic 3 – Scale – A business is incumbent if it is big player in a market

Incumbency may be related **to the size of a business** and normative views of incumbency may not generally see small companies as incumbent. Gilbert (1989) suggests that the economic literature on barriers to market entry has considered incumbents as either a single dominant firm, or a perfectly coordinated cartel. This theoretical economic understanding implies that within a specific market, if incumbency is present, there will be one company dominating or there will be a perfectly equal fully colluding cartel. In both of these hypothetical situations, the dominant size or situation of incumbents can give them market power.

In reality, socio–technical systems in general or specifically the UK heat system cannot rightly be described as either of these things. Firstly the heat system is not formed of one technology or industry but includes, upstream gas and fossil fuel companies, distribution companies, energy suppliers and appliance manufacturers to name but a few. The varying levels of (vertical) integration between sectors and specific companies and the companies themselves involved in a socio–technical system could be involved in extremely diverse sectors, from the drilling of gas wells at one end to the writing of copy for a member association at the other. With many hundreds of firms involved, the UK system could not be seen as being dominated by one particular company although there are of course large companies operating in certain areas.

An economic approach may consider incumbency and related issues of market power and business concentration in relation to specific markets or sectors, for example upstream, downstream and transportation. We are however interested in a socio–technical system rather than a specific market. Following on from previous discussions, this again suggests that market context may be an important aspect of defining incumbency in relation to sustainability transitions.

Even if we consider specific markets within the heat sector from the perspective of market dominance, this market dominance idea of incumbency is difficult. The main markets in the heat system are energy supply, distribution, upstream

production and appliances. There are significant differences in the governance and geographical base of each of these sectors.

Gas distribution networks are geographically split by the Government and are economically regulated and their regulated nature means that they do not fit with the idea that they can use their scale to dominate a market because their market size is set by the Government. However, while these networks may not have traditional market power they may, due to their size, have the capacity to have some influence on system change through other means such as socio-political power.

Non-gas distributors of energy for heating such as oil, liquefied petroleum gas and biomass firms are geographically based around an absence of gas distribution network (itself linked to government policy) and the more local nature of these businesses mean that they are often small and diverse companies. These companies may have local market power but this is not necessarily correlated with their size relative to the UK heat system.

Within the UK heat/energy supply businesses, while concerns have been raised, there is no firm evidence of collusion or indeed a cartel although there has been recognition that 'incumbent' (in this example the big 6) companies are at an advantage in the market because of a lack of supplier switching by some customers (Competition & Markets Authority, 2015).

At an appliance level, a large number of heating appliance manufacturers exist in the UK and although this sector has often not been considered by policy makers or researchers in detail, there is no indication of market dominance and a variety of appliance manufacturers.

As described previously, within the UK's heat system, there are a number of different heat technologies. While the vast majority of heat is supplied by gas, some households use oil, liquefied petroleum gas (LPG), electricity or biomass for heat and within each of these technological options, there will be sectors such as upstream, distribution, supply and appliances. Within each of these sectors, there may be may be certain companies that dominate particular technologies or sectors of the market. For example, Calor Gas may dominate the LPG market and under this definition could be considered incumbent despite only having a few hundred thousand customers. But, compared to a large 'big 6'

supplier with 10 million customers, Calor is very small. So, Calor could be incumbent in the context of the LPG market but not incumbent in the larger scale heat market. Again this suggests that considering the incumbency in context of a specific market or sector may be of use.

If considering company size specifically as an indicator of incumbency, one key issue is defining or measuring company size. It is widely recognised that there are many metrics for measuring company size.

Dang & Li (2015) suggest that the three key metrics are (1) market value/market capital/equity value, (2) Sales/turnover and (3) asset value. However, previous authors have also included metrics such as number of employees and market value at year end (Shalit & Sankar, 1977). Al-Khazali & Zoubi (2005) suggest however that nearly all empirical studies in accounting and finance have used total assets, total sales, book value of equity or market value of equity.

However there is a general recognition that each of these metric has issues in terms of measuring company size:

1. Turnover or sales can vary significantly between years and also includes pass-through costs rather than value added. These pass through costs could for an energy supplier include the value of actual energy supplied i.e. gas and power wholesale costs which are not actually value added by that particular firm
2. Number of employees depends very much on the sector and type of business being undertaken. Technology companies may for example have small numbers of employees but high levels of turnover. The opposite would be true for more labour intensive industries.
3. Market capital or market equity i.e the sum of all the value of all the shares of a company can be volatile and linked to short term levels of profitability within stock exchange listed firms
4. Market value i.e. the value of a company at sale can be impossible to measure if a company is not for sale
5. Book value of equity is linked to physical assets only and that is a metric of only one aspect of a firm

None of these methods alone is perfect and there are clear difficulties for determining company size using these metrics. Using a number of these quantitative measures together may provide a more useful indicator and the UK

Office for National Statistics measures both company turnover and number of employees when considering firm size<sup>2</sup>.

Overall then, relying solely on the size of a firm does not appear to be a fully indicative measure of incumbency and there are clear issues with measuring company size. Not only does size itself not indicate incumbency because of the complexity of regimes and the large numbers of actors within them, the difficulty of measuring size causes further problems. While company size may give incumbents both market power and financial ability to invest in particular areas or give them capacity to have socio-political power, it is not size alone which makes companies incumbent.

#### 6.4.Characteristic 4 – History – A company is incumbent if has existed for a long time

**Longevity may be an aspect of incumbency.** If technological change has occurred, one company may take over from another company that has previously been present in the market for a number of years. However, the question arises: could the actual number of years a company has been in a market make a company incumbent?

Thompson (1987) suggests that in the situation where national organisations are privatised, the previous years of experience in a market can give incumbents '*product reputation*' (p373) and therefore an incumbency advantage. The company has a product advantage because it has been operating for a number of years but not all incumbents will have that specific advantage or attribute and just because something has existed for a long time does not make it incumbent. It could also be argued that companies that have existed for a number of years understand the social and institutional framework within which they exist. For example in the energy industry, actors who have existed for a long time may have a competitive advantage because they understand detailed and relatively hidden governance issues such as network codes (Lockwood et al., 2016). This phenomenon of increasing returns in political and regulatory frameworks for established players is also recognised in the more general politics literature (Pierson, 2000).

---

<sup>2</sup> Personal communication with ONS

It is also the case that incumbents can grow very rapidly. For example in the London (and also global) taxicab markets, Uber has rapidly become a very large actor. In October last year in London there were 22,500 black 'Hackney' cabs and a similar number (20,000) of registered Uber drivers; up from near zero just two years earlier (Business Insider London, 2015). Uber would not be considered an old company but it has significant market share (based on the above numbers of vehicles) and is a technological leader and for these reasons it could be considered incumbent based on our previous definitions. It exists and it dominates a market. This then suggests that existence for a long length of time may not necessarily be that important to make a business incumbent but rather it is a company's current position in the market. This example also shows that businesses that are clearly incumbent such as the London black cabs, can have their market position disrupted very rapidly.

There are also examples of companies that have been around for a long length of time that may not necessarily be described as incumbent. Specialist high-end brands such as Rolex or Barbour have a long history and while they are popular and large companies, they are not market leaders in watches or jackets (respectively) in terms of size or dominance compared to the whole watch or jacket market. Having said that, within the context of their own small luxury (niche) market they are market leaders and this again implies that incumbency is very much context and scale specific, as previously discussed.

Therefore, while a company may have existed for a long time, that may not necessarily mean that a company is incumbent because it has existed for a long time but rather because it is already in place in a market. Clearly age alone is not a good metric of incumbency but there are incumbency advantages that can come as a result of the age of a company. Having said this, even the most comfortable companies within markets can be rapidly disrupted.

## 7. Defining incumbency

In this working paper, we have considered the various definitions of incumbency from across different literatures. We have synthesised this information, considering it alongside approaches to sustainable transformations and more specifically the UK's heat sector, an area where a transformation is widely seen as being necessary. We hope that our attempt to define incumbency fills a gap in the literature and provides researchers involved in the various associated research areas with a useful analytical tool.

We have highlighted a number of ways that incumbency is considered (both explicitly and implicitly) across various debates including economics and business, politics and innovation. Our first idea suggests that if a company is already in a market, then it is incumbent, however we believe business contexts and the scale of the particular market means that this description alone does not match with the complex nature of socio-technical regimes.

The second idea which considers primarily technological development i.e. a new product replaces an old product does not appropriately represent both the scale and technological complexity of systems and the wider social aspect of socio-technical systems and this definition does not describe incumbency in the context of system transformations.

We have also suggested that while the size of a company may give a company market power, it does not necessarily make them incumbent as in the context of transformations, they may be driving the transformation utilising that market power. We have also suggested that in the context of sustainable transformations, the age of a company is not a good metric for incumbency.

The various definitions of and approaches to incumbency show that defining incumbency is not simple. A useful definition of incumbency in relation to sustainability transformations is clearly multi-dimensional and requires consideration of the values of the various elements of incumbency that can be present within socio-technical systems.

We believe therefore that in the context of sustainability transformations, considering different attributes of businesses together, including considering the institutional and governance settings of these businesses can give the best idea of incumbency. This includes recognising that incumbency can be market

and scale specific i.e. it must be in the context of a particular socio–technical system, understanding that actors must have a current position in the market and that actors are likely to be involved in unsustainable practices. We also believe that incumbency is not just limited to businesses but on a systemic level could include other actors such as Government and consumers. We have therefore produced a working definition of incumbency related to sustainability transformations on which we would be pleased to receive comments.

**We define incumbency in the context of sustainable transformations as the presence of existing actors within a specific socio–technical system. An incumbent will be currently active in the socio–technical system or a part thereof and therefore likely to be or have been involved in unsustainable practices. Incumbents have the economic, social or technological capacity to influence system change.**

When we consider the UK heat sector, our definition would mean that any companies (and other actors) currently operating within the heat system are incumbent. Determining which actors are incumbent would vary depending on the issue you are investigating and will be context specific. We also recognise that the specific capabilities that actors will have to influence system change are varied and depend on that specific actor.

While unsustainable incumbents may be able to diversify and move into sustainable heating operations, because these companies currently profit from unsustainable practices, they have an interest in continuing their current practices. Companies and actors also present in the low–carbon heat sector also have an interest in continuing their current practices. It is this interest in continuation and maintenance of the existing heat system that is the future focus of this project.

## References

- Abramowitz, A., 1991. Incumbency, Campaign Spending, and the Decline of Competition in United–States House Elections. *Journal of Politics*, 53(1), pp.34–56.
- Abramowitz, A., Alexander, B. & Gunning, M., 2006. Incumbency, Redistricting, and the Decline of Competition in U.S. House Elections. *Journal of Politics*, 68(1), pp.75–88.
- Al–Khazali, O.M. & Zoubi, T.A., 2005. Empirical testing of different alternative proxy measures for firm size. *Journal of Applied Business Research*, 21(3), pp.79–90.
- Ammer, C. & Ammer, D., 1986. *Dictionary of Business and Economics*, New York: The Free Press.
- Ansolabehere, S., Snyder, J.M.J. & Stewart, C.I., 2000. Old voters new voters, the personal vote: using redistricting to measure the incumbency advantage. *American Journal of Political ...*, 44(1), pp.17–34. Available at:  
<http://www.jstor.org/stable/10.2307/2669290>  
<http://academic.research.microsoft.com/Publication/3480338/old-voters-new-voters-and-the-personal-vote-using-redistricting-to-measure-the-incumbency-advanta>.
- Arapostathis, S. et al., 2013. Governing transitions: Cases and insights from two periods in the history of the UK gas industry. *Energy Policy*, 52, pp.25–44. Available at:  
<http://www.sciencedirect.com/science/article/pii/S0301421512006957> [Accessed January 24, 2014].
- Arthur, W.B., 1989. Competing Technologies, Increasing Returns , and Lock–in Events Historical. *The Economic Journal*, 99(394), pp.116–131.
- Babiker, M.H., 2005. Climate change policy, market structure, and carbon leakage. *Journal of International Economics*, 65(2), pp.421–445.
- Bannock, G., 1972. *Dictionary of Economics*, Middlesex: Penguin.
- BEIS, 2016. *Digest of United Kingdom Energy Statistics*, London. Available at:  
[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/552060/DUKES\\_2016\\_FINAL.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/552060/DUKES_2016_FINAL.pdf).

- Black, J., Hashimzade, N. & Myles, G., 2012. *A Dictionary of Economics* 4th Editio., Oxford: Oxford University Press.
- Bolton, R. & Foxon, T.J., 2013. Urban infrastructure dynamics: market regulation and the shaping of district energy in UK cities. *Environment and Planning A*, 45(9), pp.2194–2211. Available at: <http://www.envplan.com/abstract.cgi?id=a45575> [Accessed February 1, 2014].
- Business Insider London, 2015. This insane stat shows how Uber is taking over London. Available at: <http://uk.businessinsider.com/uber-statistics-boris-johnson-on-ubers-growth-in-london-2015-10> [Accessed June 9, 2015].
- Carbon Connect, 2014. *Pathways for Heat: Low Carbon Heat for Buildings*, London. Available at: [http://www.policyconnect.org.uk/cc/sites/site\\_cc/files/carbonconnect\\_pathwaysforheat\\_webcopy.pdf](http://www.policyconnect.org.uk/cc/sites/site_cc/files/carbonconnect_pathwaysforheat_webcopy.pdf).
- Chandy, R.K. & Tellis, G.J., 2000. The Incumbent 's Curse. , pp.1–17.
- CIBSE, 2015. *Heat Networks: Code of Practice for the UK*, Available at: <http://www.cibse.org/Knowledge/knowledge-items/detail?id=a0q200000090MYHAA2>.
- Committee on Climate Change, 2015. *The Fifth Carbon Budget: The next step towards a low-carbon economy*, London. Available at: <https://documents.theccc.org.uk/wp-content/uploads/2015/11/Committee-on-Climate-Change-Fifth-Carbon-Budget-Report.pdf>.
- Competition & Markets Authority, 2015. Energy market investigation: summary of provisional findings report. , (July 2015), pp.1–46.
- Connor, P.M. et al., 2015. The development of renewable heating policy in the United Kingdom. *Renewable Energy*, 75, pp.733–744. Available at: <http://linkinghub.elsevier.com/retrieve/pii/S0960148114006831> [Accessed January 5, 2015].
- Cover, A.D., 1977. One Good Term Deserves Another: The Advantage of Incumbency in Congressional Elections. *American Journal of Political Science*, 21(3), pp.523–541.
- Cox, G.W. & Katz, J.N., 1996. Why Did the Incumbency Advantage in U . S . House Elections Grow ? Author ( s ): Gary W . Cox and Jonathan N .

- Katz Published by : Midwest Political Science Association Stable  
URL : <http://www.jstor.org/stable/2111633>. , 40(2), pp.478–497.
- Dang, C.D. & Li, F., 2015. Measuring Firm Size in Empirical Corporate Finance. , (519). Available at:  
[http://extranet.sioe.org/uploads/isnie2015/li\\_dang.pdf](http://extranet.sioe.org/uploads/isnie2015/li_dang.pdf).
- David, P.A., 1985. Clio and the Economy of QWERTY. *The American Economic Review*, 75(2), pp.332–337.
- DECC, 2012a. *Emissions from Heat: Statistical Summary*, London.  
Available at:  
[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/140095/4093-emissions-heat-statistical-summary.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/140095/4093-emissions-heat-statistical-summary.pdf).
- DECC, 2013a. *Estimates of heat use in the United Kingdom in 2012*, London. Available at:  
[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/244735/4\\_estimates\\_of\\_heat\\_use\\_in\\_the\\_uk\\_2012.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/244735/4_estimates_of_heat_use_in_the_uk_2012.pdf).
- DECC, 2016. *Renewable energy in 2015*, Available at:  
[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/532963/Renewable\\_energy\\_in\\_2015.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/532963/Renewable_energy_in_2015.pdf).
- DECC, 2012b. *The Future of Heating : A strategic framework for low carbon heat in the UK*, London. Available at:  
[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/48574/4805-future-heating-strategic-framework.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48574/4805-future-heating-strategic-framework.pdf).
- DECC, 2013b. *The Future of Heating : Meeting the challenge*, London.  
Available at:  
[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/190149/16\\_04-DECC-The\\_Future\\_of\\_Heating\\_Accessible-10.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/190149/16_04-DECC-The_Future_of_Heating_Accessible-10.pdf).
- Dodds, P.E. & McDowall, W., 2013. The future of the UK gas network. *Energy Policy*, 60, pp.305–316. Available at:  
<http://www.sciencedirect.com/science/article/pii/S0301421513003625> [Accessed January 27, 2014].
- Energy Saving Trust, 2010. Getting warmer: a field trial of heat pumps – Phase 1. , p.22. Available at:  
[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/48327/5045-heat-pump-field-trials.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48327/5045-heat-pump-field-trials.pdf).

- Erikson, R., 1971. The Advantage of Incumbency in Congressional Elections. *Polity*, 3(3), pp.395–405.
- Freeman, C. & Soete, L., 1997. *The Economics of Industrial Innovation* 3rd Editio., Pinter, London.
- Fudenberg, D. & Tirole, J., 1986. A “ Signal–Jamming ” Theory of Predation. *The RAND Journal of Economics*, 17(3), pp.366–376.
- Geels, F.W., 2004. From sectoral systems of innovation to socio–technical systems. *Research Policy*, 33(6–7), pp.897–920. Available at: <http://www.sciencedirect.com/science/article/pii/S0048733304000496> [Accessed January 20, 2014].
- Geels, F.W., 2014. Regime Resistance against Low–Carbon Transitions: Introducing Politics and Power into the Multi–Level Perspective. *Theory, Culture & Society*, 31(May 2013), pp.21–40. Available at: <http://tcs.sagepub.com/cgi/doi/10.1177/0263276414531627>.
- Geels, F.W., 2002. Technological transitions as evolutionary reconfiguration processes: a multi–level perspective and a case–study. *Research Policy*, 31(8–9), pp.1257–1274. Available at: <http://www.sciencedirect.com/science/article/pii/S0048733302000628> [Accessed January 31, 2014].
- Geels, F.W., 2011. The multi–level perspective on sustainability transitions: Responses to seven criticisms. *Environmental Innovation and Societal Transitions*, 1(1), pp.24–40. Available at: <http://linkinghub.elsevier.com/retrieve/pii/S2210422411000050> [Accessed January 22, 2014].
- Gelman, A. & King, G., 1990. Estimating Incumbency Advantage without Bias. *American Journal of Political Science*, 34(4), pp.1142–1164.
- Gilbert, R.J., 1989. Chapter 8 Mobility barriers and the value of incumbency. *Handbook of Industrial Organization*, 1, pp.475–535.
- Hannon, M.J., Foxon, T.J. & Gale, W.F., 2013. The co–evolutionary relationship between Energy Service Companies and the UK energy system: Implications for a low–carbon transition. *Energy Policy*, 61, pp.1031–1045. Available at: <http://www.sciencedirect.com/science/article/pii/S0301421513004941> [Accessed February 15, 2014].
- Hess, D.J., 2014. Sustainability transitions: A political coalition

- perspective. *Research Policy*, 43(2), pp.278–283. Available at: <http://www.sciencedirect.com/science/article/pii/S004873331300187X> [Accessed April 30, 2014].
- Huyghebaert, N. & Van De Gucht, L.M., 2004. Incumbent strategic behavior in financial markets and the exit of entrepreneurial start-ups. *Strategic Management Journal*, 25(7), pp.669–688.
- Jacobson, G., 1987. The Marginals Never Vanished : Incumbency and Competition in Elections to the U . S . House of Representatives , 1952–82. *American Journal of Political Science*, 31(1), pp.126–141.
- Kalkuhl, M., Edenhofer, O. & Lessmann, K., 2012. Learning or lock-in: Optimal technology policies to support mitigation. *Resource and Energy Economics*, 34(1), pp.1–23. Available at: <http://www.sciencedirect.com/science/article/pii/S0928765511000479> [Accessed January 27, 2014].
- Kern, F. & Smith, A., 2008. Restructuring energy systems for sustainability? Energy transition policy in the Netherlands. *Energy Policy*, 36(11), pp.4093–4103. Available at: <http://www.sciencedirect.com/science/article/pii/S030142150800308X> [Accessed February 23, 2014].
- Levitt, S.D. & Wolfram, C.D., 1997. Decomposing the Sources of Incumbency Advantage in the U.S. House. *Legislative Studies Quarterly*, 22(1), pp.45–60.
- Lockwood, M. et al., 2016. Innovation and the governance of energy industry codes 1 . Energy industry codes and code governance in Britain. In *BIEE 2016, Innovation and Disruption – the energy sector in transition*. pp. 1–18.
- Lowes, R., 2016. Political power and the development of the GB renewable heat incentive. In *BIEE Innovation and Disruption: the energy sector in transition*. Available at: [http://geography.exeter.ac.uk/media/universityofexeter/schoolofgeography/images/researchgroups/epg/Lowes\\_Political\\_Power\\_Renewable\\_Heat\\_Incentive.pdf](http://geography.exeter.ac.uk/media/universityofexeter/schoolofgeography/images/researchgroups/epg/Lowes_Political_Power_Renewable_Heat_Incentive.pdf).
- Maclean, K. et al., 2016. Managing Heat System Decarbonisation: Comparing the impacts and costs of transitions in heat infrastructure. , (April). Available at: <http://provpol.com/wp->

- content/uploads/2016/05/Heat-infrastructure-paper.pdf.
- Mahajan, V., Sharma, S. & Buzzell, R.D., 1993. Assessing the Impact of Competitive Entry on Market Expansion and Incumbent Sales. *Journal of Marketing*, 57(3), pp.39–52. Available at:  
<http://www.jstor.org/stable/1251853>  
<http://www.jstor.org.proxy.lib.umich.edu/stable/pdfplus/1251853.pdf?acceptTC=true>.
- Morelli, J., 2011. Environmental Sustainability: A Definition for Environmental Professionals. *Journal of Environmental Sustainability*, 1(1), pp.1–27. Available at:  
<http://www.environmentalmanager.org/wp-content/uploads/2011/09/Article2Morelli.pdf>.
- National Grid, 2016. *Future Energy Scenarios*, Warwick. Available at:  
<http://fes.nationalgrid.com/fes-document/v>.
- Nelson, R.R. & Winter, S.G., 1982. *An evolutionary theory of economic change*,
- Northern Gas Networks et al., 2016. *Leeds City Gate H21*, Leeds. Available at: <http://www.northerngasnetworks.co.uk/wp-content/uploads/2016/07/H21-Report-Interactive-PDF-July-2016.pdf>.
- Ofgem, 2015. *Submission to the CMA*, London. Available at:  
<https://www.ofgem.gov.uk/ofgem-publications/92601/cmasubmissionincumbency.pdf>.
- Ordover, J.A. et al., 1981. An Economic Definition of Predation : Pricing and Product Innovation. *The Yale Law Journal Company*, 91(1), pp.8–53.
- Parliament, 2016. House of Commons Debate 14th March 2016. Available at:  
<http://www.publications.parliament.uk/pa/cm201516/cmhansrd/cm160314/debtext/160314-0003.htm> [Accessed September 19, 2016].
- Patel, P. & Pavitt, K., 1997. The technological competencies of the world's largest firms: Complex and path-dependent, but not much variety. *Research Policy*, 26(2), pp.141–156. Available at:  
<http://www.sciencedirect.com/science/article/pii/S004873339700005X>.
- Pearson, P., 2016. Path dependence & path creation: roles for incumbents

- in the low carbon transition? In *British Institute of Energy Economics: Innovation and Disruption: the energy sector in transition*.
- Pierson, P., 2000. Increasing Returns, Path Dependence, and the Study of Politics. *The American Political Science Review*, 94(2), pp.251–267.
- Salies, E. & Waddams–Price, C., 2004. Charges , Costs and Market Power : the Deregulated UK Electricity Retail Market. *International Association for Energy Economics*, 25(3), pp.19–35.
- Shalit, S. & Sankar, U., 1977. The Measurement of Firm Size. *The Review of Economics and Statistics*, 59(3), pp.290–298.
- Smink, M., 2015. *Incumbents and institutions in sustainability transitions*. Utrecht.
- Stack, M. & Gartland, M.P., 2003. Path Creation, Path Dependency, and Alternative Theories of the Firm. *Journal of Economic Issues (Association for Evolutionary Economics)*, 37(2), pp.487–494.  
Available at:  
<http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=994687&site=ehost-live>.
- Stenzel, T. & Frenzel, A., 2008. Regulating technological change—The strategic reactions of utility companies towards subsidy policies in the German, Spanish and UK electricity markets. *Energy Policy*, 36(7), pp.2645–2657. Available at:  
<http://linkinghub.elsevier.com/retrieve/pii/S0301421508001341>  
[Accessed February 6, 2014].
- Stirling, A., 2014. Transforming power: Social science and the politics of energy choices. *Energy Research and Social Science*, 1, pp.83–95.  
Available at: <http://dx.doi.org/10.1016/j.erss.2014.02.001>.
- The Committee on Climate Change, 2016. *Next Steps for UK heat policy*, Available at: <https://www.theccc.org.uk/wp-content/uploads/2016/10/Next-steps-for-UK-heat-policy-Committee-on-Climate-Change-October-2016.pdf>.
- Thompson, D.J., 1987. PRIVATISATION IN THE U . K . De-regulation and the Advantage of Incumbency. , 31, pp.368–374.
- UKERC, 2013. The UK energy system in 2050: Comparing Low–Carbon, Resilient Scenarios. , p.68. Available at:  
<http://www.ukerc.ac.uk/publications/the-uk-energy-system-in->

2050-comparing-low-carbon-resilient-scenarios.html.

- Unruh, G., 2000. Understanding carbon lock-in. *Energy policy*, 28, pp.817-830. Available at:  
<http://www.sciencedirect.com/science/article/pii/S0301421500000707> [Accessed February 17, 2014].
- Waddams, C., 2008. *Competition Issues in UK Retail Energy Markets Policy background*,
- Wagner, M., 2011. To explore or to exploit? An empirical investigation of acquisitions by large incumbents. *Research Policy*, 40(9), pp.1217-1225.
- Zupan, M.A., 1989. Cable Franchise Renewals: Do Incumbent Firms Behave Opportunistically. *The RAND Journal of Economics*, 20(4), pp.473-482.