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Past management of energy demand: promotion and adoption of electric heating in Britain 1945-1964

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Abstract: Changes in energy use have been a key part of many dramatic social, economic and environmental changes during the twentieth century and before, making energy interesting to environmental historians. Today policy makers seek reductions in energy use and carbon emissions to mitigate climate change through demand management policies which attempt to reduce usage or shift it in time away from peak demand. To understand the impact of such policies it is necessary to understand both how they were promoted and received. This article discusses electric heating in early post-war Britain, which was seen as a particularly problematic energy use, as electric fires were used at peak times. The Electricity Development Association (EDA) tried to simultaneously reduce undesirable peak demand while encouraging increased demand more generally. In the late 1940s it advertised against peak use of electric fires, whereas in the 1950s and 1960s it instead concentrated on promoting off-peak heating appliances, first under-floor heating and then block storage heaters. I will analyse how the London County Council and its tenants adopted and adapted electric underfloor heating, illustrating the complicated way demand is made and unmade. The paper concludes that while demand management has been attempted by the electricity industry since well before the 1970s, these attempts only had a limited effect on the overall trend towards increasing demand, in part to do with how these messages were adopted.

Introduction

Radical changes, or transitions, in energy use have been a key part of many of the dramatic social, economic and environmental changes during the twentieth century. Energy is thus an important topic for environmental historians, especially given current debates about climate change and its mitigation through reductions in carbon emissions.² Today heating uses three fifths (60 per cent) of the average household's energy.³ In Britain one of the key transitions in domestic energy use has been the shift

¹ Author's address to be inserted, together with acknowledgments.

² Smil 2003, Rome 2002, Sabin 2010

³ Cooper and Palmer 2011 Great Britain's housing energy fact file

away from coal fires to other types of heating systems. While gas-fuelled individual boilers heating water-filled radiators today dominate, many different systems were used in the past. This article discusses the dynamics of change, using the particular case study of electric underfloor heating.

Within contemporary energy and climate change policy debates, demand management (reducing demand, shifting it off peak or energy efficiency measures) are frequently discussed. Demand management is often said to have the potential to lead to substantially reduced energy use, and thus reduced carbon emissions, though the effects have been difficult to establish clearly.⁴ The success of such tactics depends on how the messages are adopted by the final users. While demand is promoted and made possible by the industry, it is only made by users, in this case the users of electric heating systems. Understanding the dynamics of change in the past requires attention to both supply and demand. Therefore this article discusses the actions of the Electricity Development Association (EDA), a supply-side organisation promoting electric underfloor heating. It also discusses demand side action by the London County Council which extensively used underfloor heating in tall blocks of flats, and finally the action of the Council's tenants who much less extensively used this heating system

There is relatively little historical work on attempts to reduce demand for energy, though there is a substantial historical literature on other aspects of energy. For the British case between the late 1940s to the early 1960s, this literature discusses why the electricity industry failed to use pricing to reduce demand and the debates about demand shifting within the upper levels of management of the electricity supply industry, but pays relatively little attention to actual practical demand management.⁵ There is also relatively little work on how demand for energy has been made: how have Britons' changed their practices to increase their demand for energy? Much of the existing work focuses on large scale averages or economic considerations, but contemporary work on energy is increasingly focusing on what people do.⁶ How did people heat their homes in the past, what was the socio-technical dynamic of change and what did this in turn do to energy demand?

This paper does two things: it is a historical discussion of a specific tactic – load-shifting – which contemporary policy makers argue will help solve our energy and climate problems. It analyses past attempts by the electricity industry to use this same tactic to

⁴ Lopes et al 2012, Moezzi and Lutzenhiser 2010

⁵ Chick 1990 and 1998, Hannah 1979 and 1982. While sociologists and anthropologists concerned with energy demand have used historical examples, these have tended to focus on the making of demand instead of attempts at unmaking demand (Shove 2003, Wilhite 2008). Similarly, energy history has tended to focus on the dominant trends towards increased overall demand (e.g. Fouquet 2008, Nye 1998, Pursell 1999, Feldman 1994, Smil 2003). This literature has often provided sobering lessons for those arguing that increased energy efficiency will lead to reduced demand, with Wilhite (2008) and Smil (2003) explicitly using history to show this. However, the literature has not discussed historical attempts to reduce demand.

⁶ On large scale history, see e.g. Fouquet 2008 and Kander et al 2014. On economic perspectives, see e.g. Scott and Walker 2011. On energy and practice, see e.g. Shove 2003.

solve certain issues, problematizing the success of the tactic. Secondly, this paper discusses how one aspect of the industry's tactics was adopted by the London County Council and the Council's tenants. In doing so, it attempts to tie together the promotion and adoption (or not) of load shifting tactics, using this as a case study of how demand is created.

Why the emphasis on load shifting? Amongst present-day analysts demand management, in the sense of reduction and shifting, is usually assumed to have become important since the oil crisis in the 1970s.⁷ This paper argues that we need to account for a longer history of energy efficiency, demand reduction and load shifting. This was pointed out as early as 1982 by Daniels and Rose, who discussed a number of pre-1970s energy crises in the American context.⁸ In Britain, it is clear that both the gas and electricity industry have long worked to even out demand for their products, by load shifting to increase off-peak loads, often to increase profits.⁹ At least since the 1890s electrical engineers have argued that demand for electricity should be diversified away from lighting by promoting domestic appliances for cooking and heating, to improve the economics of production.¹⁰ Engineers talked of improving the 'load factor', a measure of power output compared to the maximum possible output which gives an indication of the use made of existing generating plant. While today demand management is usually thought to imply demand reduction, in the past it has as often been about increasing demand: load building whilst load shifting. Issues of rebound effects, when energy efficiencies do not lead to the expected reduction in demand, can further complicate the outcome of demand management.¹¹

This article focuses on demand management measures not involving increased prices, not least because the EDA was not directly involved in price setting. It is well known that the electricity supply industry in this period tended to under-charge domestic consumers, who at peak demand (and sometimes more generally) were not paying the full cost of meeting their demand. The debates about actual versus charged costs of supplying domestic demand for space heating have been analysed in depth by Hannah and Chick and are therefore not further analysed in this paper.¹²

This article analyses the dynamics of change in the heating of British homes, analysing the actions of the EDA, the London County Council and tenants: how were attempts at managing demand translated into lived experiences in council housing? It will focus on electric underfloor heating. The EDA saw this as a solution to load problems while the LCC saw it as a cost-efficient way of heating tall blocks but then found tenants failed to use it when paying through quarterly bills. Analysing tenants' practices is important to

⁷ Anderson 1993, Hazas, Friday and Scott 2011, Moezzi and Lutzenhiser 2010, Wilhite et al 2000, Wilhite 2008

⁸ Daniels and Rose 1982

⁹ Goodall 1999, PEP 1939, Clendinning 2004, Hannah 1979

¹⁰ Forty 1986, 183—7. Luckin 1990

¹¹ Smil 2003

¹² Hannah 1979 and 1982 and Chick 1990 and 1998

understand the dynamics of change in heating practices. I begin by showing why the industry was concerned about shifting electricity off-peak.

The making of demand for electric heating

The Second World War and the capacity crisis

Domestic electric heating was identified in the post-war period as a particularly important but difficult to control area of demand that tended to be used most at times of overall peak demand. Its use had increased during the war and in 1946 the British Electrical and Allied Industries Research Association found that around three fifths (61 per cent) of electricity consumers had one or more electric space-heaters, with a total of about 9.5 million appliances.¹³ Overall, between 1939 and 1945 domestic consumption of gas and electricity increased significantly (by 25 per cent and 41 per cent respectively). When the government restricted domestic coal supplies through rationing during the war, some people shifted to gas and electricity, for example for heating, which then required similar amounts of coal for their production.¹⁴

Despite the increased use of electric fires, coal fires still dominated domestic space heating in 1945. Most households then heated only their living room, usually through a coal fire in a grate – three quarters (74 per cent) of working class households heated only one room in February and March 1942.¹⁵ Those who could afford to combined such ‘background heating’ with other heat sources for ‘topping-up’ in other rooms or e.g. during cold evenings in spring or autumn.¹⁶ While most (90 per cent) of households preferred solid-fuel open fires for living-room heating, there was also a ‘strong desire for satisfactory means of bedroom heating’, with electric fires preferred for this.¹⁷ The preference for open fires in living rooms had many reasons, including their promotion of ventilation.¹⁸ While survey respondents recognized that other types of fires were easier, cleaner and less work, there was also felt to be something missing: ‘the most technically perfect provision of other types of heating, cheaper, cleaner, easier to operate from the housewife’s point of view and less polluting of the atmosphere, will fail

¹³ Technical Report Reference K/T125, A large-scale sampling survey of domestic consumers, British Electrical and Allied Industries Research Association: London, 1948, Box 63, ESI collection, ref 1989.338, Museum of Science Industry archive, Manchester (hereafter MOSI), 10 and 16. The figures were based on a sample of 57,500 domestic consumers.

¹⁴ Chick 1998, 117, Hannah 1979, Robertson 1987, 32

¹⁵ Chapman 1945, 120–5

¹⁶ Chapman 1945, PEP 1945

¹⁷ PEP 1945, xxiii

¹⁸ Mosley 2003 and 2007

to satisfy some deep-seated aesthetic demand that is satisfied by the old-fashioned, dirty, smoky coal-fire'.¹⁹

Shortly after World War Two Britain faced a fuel crisis, which in the electricity supply industry was felt as a crisis of supply capacity due to rising demand existing power plants could not meet. Demand for electricity rose sharply in 1945 and 1946 (see Figure 1), especially from domestic consumers during peak hours when these were consuming 25 per cent of all electricity. By the late 1940s about two fifths of domestic electricity sales were estimated to be for space heating.²⁰ The price of domestic electricity had fallen in real terms since before the war.²¹ Electricity was under-priced compared to production costs, especially at peaks. Electric fires were seen as a particularly problematic load, especially when used during winter peak-hours as they often were, with some researchers estimating that domestic consumers only paid one third of the cost of supplying electricity for on-peak space heating. A second reason for the growth in use of electric heaters after the war was the continued rationing of coal. Domestic consumers could switch on an electric heater at will but could not always get as much coal as they wished.²²

In addition, the light engineering industry which had been developed during the war swiftly changed over to civilian manufacturing, e.g. of electrical appliances. Government found it difficult to limit the manufacture or retail of electric fires, which were not sold by the electricity supply industry but by other, harder to control, retailers.²³ Around 200,000 fires per month were produced for the home market in the second quarter of 1946, double that in 1937.²⁴ Furthermore, wages were relatively high and many other goods were rationed, which may have further encouraged consumers to acquire any available electrical appliances.²⁵ Also, local authorities housed people in pre-fabricated bungalows, which were often highly-electric.²⁶

¹⁹ Mass-Observation 1943, 137

²⁰ Hannah 1982, 83

²¹ Chick 1990, 111 and 1998, 116—7

²² Hannah 1979 ch9 and 1982, 83, Chick 1990 and 1998

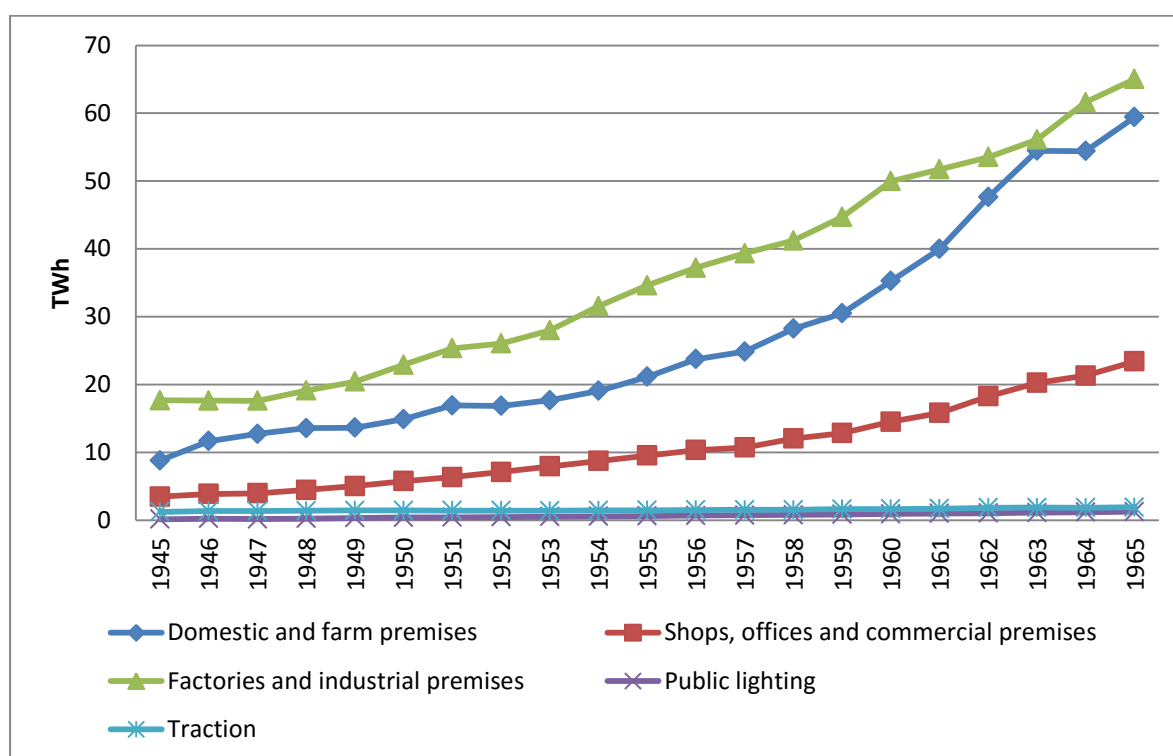
²³ Hannah 1979 ch 9, Chick 1990, 112

²⁴ PEP 1947, 247

²⁵ Chick 1990, 112—3, Chick 1998, 13. According to Chick (1998, 13), in 1946 consumption increased on e.g. hardware and furniture, while it stayed the same on basic items like food, coal and clothing. However, compare Zweiniger-Bargielowska (2002).

²⁶ Chick 1990, 113 and 1998, 121—22. On the other hand, Barty-King (1984, 226) suggests widespread installation of gas-powered refrigerators in some pre-fabs.

Figure 1 Electricity consumption in TWh by different users. Data from DECC 2012.



Simultaneously, the war effort had reduced investment in electricity supply. Plans for extending supply by building new power plants were quickly put in place, but this would take several years. The investment plans initially suffered from a lack of co-ordination and supplies, a common problem for industrial investment at the time.²⁷ Coal was also in short supply, due to reduced output and increased demand (e.g. from existing electricity plants and to make the steel needed for new power plants). During the winter of 1945/46 the government narrowly avoided a coal supply crisis by restricting use. Despite repeated Cabinet discussions about the potential for a fuel crisis in the autumn of 1946, fuel restrictions were not agreed until early January 1947, when electricity cuts were already forcing various manufacturers to stop production.²⁸

The 1947 fuel crisis and its aftermath

At the end of January 1947 an unusually cold and snowy spell hit the country, lasting until the middle of March.²⁹ While electricity demand remained high coal transport became difficult, with electricity cut or reduced to some customers on 82 days – in the most extreme case, 29 January, an estimated 16 per cent of demand could not be met.³⁰ In early February 1947 the government responded by introducing further restrictions on the use of fuel, especially electricity as it was feared the whole supply system could

²⁷ Chick 1990 and 1998 ch6, Hannah 1979 ch 9 and 1982 ch 3, Robertson 1987

²⁸ Robertson 1987, 37–65

²⁹ Robertson 1987, 10–16.

³⁰ Hannah 1979, 314

collapse if it was over-loaded through continued high demand. Domestic consumers were told to not use electricity between nine and 12 am and two and four pm.³¹ The ban was difficult to enforce, as suppliers could not tell what consumers used their electricity for and were unable to cut off electricity to domestic consumers alone. At first people complied and consumption fell by over a quarter (29 per cent in the first week, 28 per cent in the second), but later compliance faltered and by the fourth week the reduction was down to 15 per cent. In the first half of March demand increased further, which was thought to be due to the increased use of electric fires, and by 3 March electricity undertakings were again shedding load.³²

After the immediate crisis ended in April 1947 the government attempted to reduce demand for gas and electricity through a variety of measures. It forbid gas and electric space heating between May and September, leafleted domestic consumers about reducing gas and electricity consumption and doubled the purchase tax on electric appliances from 33 1/3 per cent to 66 2/3 per cent.³³ Purchase tax was increased to 100 per cent on space heaters in 1948, but cookers, seen as off peak appliances, quickly had their purchased tax reduced.³⁴ The government's Fuel and Power Advisory Council had in the spring of 1946 recommended that the main winter space and water heating load should be met by efficient solid fuel stoves with extra top-up heating provided by gas or electric fires. These recommendations were made in its report on Domestic Fuel Policy, known as the Simon Report after its chair.³⁵ The government appears to have listened to those, like the authors of the Simon Report, who argued that solid fuels should form the basis of domestic heating, and kept purchase tax as one of the few things it felt it could do to restrict sales of electric appliances.

In November 1950, because of lower coal production and increased demand for electricity, another fuel crisis hit. Measures were again introduced by the government, for example to increase the recruitment of miners while attempting to reduce demand for electricity.³⁶ After this the supply situation gradually became more sustainable, though there were continued material shortages and intermittent restrictions on investment in the electricity industry, e.g. during the Korean War (1950-53).³⁷

Continued rise in demand and concerns about heating and load factors

By 1953 the capacity crisis had, it appeared, been solved and electricity supply began to be less restricted. However, space heating continued to be viewed as a problem for the electricity supply industry: even though purchases of electric fires were not explicitly

³¹ Robertson 1987, 17—18

³² *ibid*, 108—128

³³ *ibid*, 136—8 and 169—71. For an explanation of the 1947 rises, explaining it as a reaction to the fuel crisis and high consumption of electricity especially for heating, see Dalton's speech in June 1947 (HC Deb 17 Jun. 1947 vol 438 cc1843—69, http://hansard.millbanksystems.com/commons/1947/jun/17/third-schedule-purchase-tax-intermediate#S5CV0438P0_19470617_HOC_341)

³⁴ Corley 1966, 45—6

³⁵ Ministry of Fuel and Power 1946, ii

³⁶ Robertson 1987, 176—9

³⁷ Hannah 1982, Chick 1998

promoted by them, especially for on-peak use, appliances were still easy and cheap to buy. Electricity also remained priced at below cost. The majority view in the electricity supply industry remained that increased prices were unlikely to shift demand for heating away from the peak. When coal supplies improved in the mid-1950s the peak electric space heating load decreased, though industry researchers still identified uneconomically high peak loads during cold weather (Hannah 1982: 89-90). Load-shifting off-peak was promoted, as it would reduce running costs and the need for investment in in electricity supply plants.³⁸

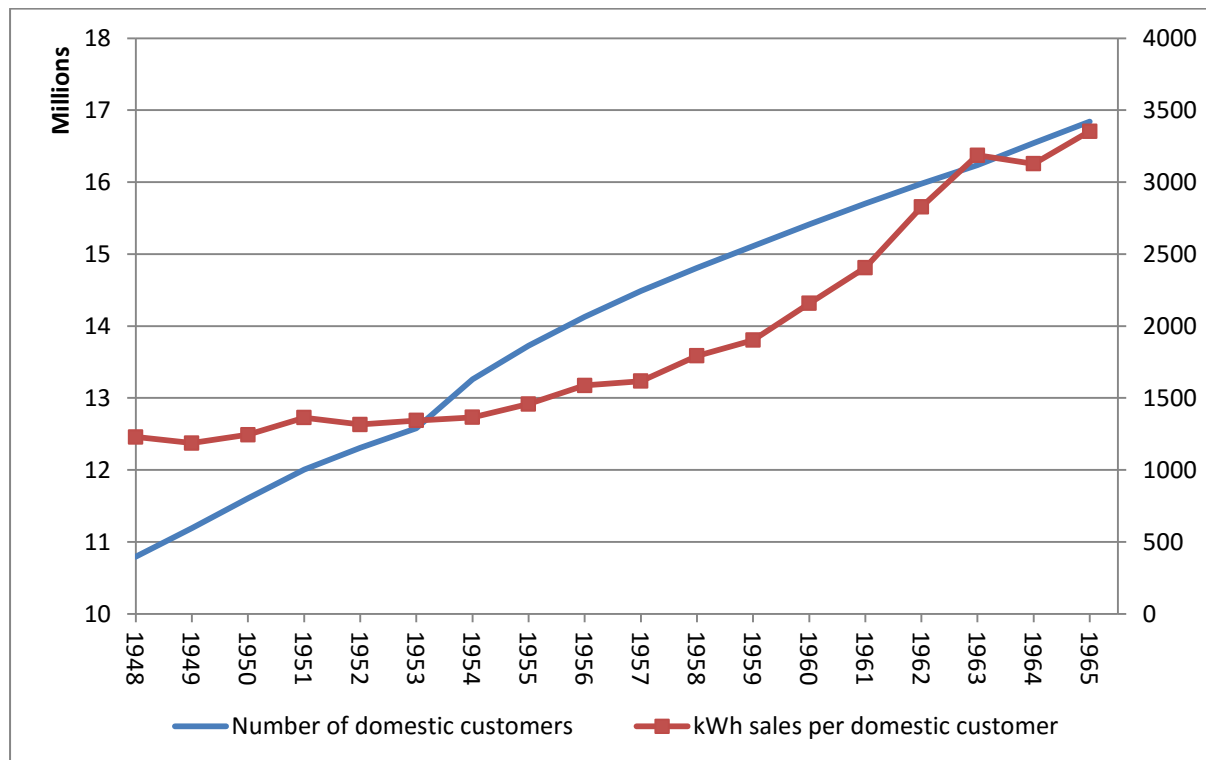
Total domestic demand for electricity accelerated in the 1950s (Figure 1 above). Between 1957 and 1962 domestic electricity sales almost doubled, which the Area Boards had not expected. The industry's surprise came in the use per customer: this remained fairly static until the mid 1950s before rising in the second half of the 1950s (Figure 2 below). A quarter of the growth in the sale of electricity in the 1950s came from newly-connected homes, a quarter from increased use of existing appliances and half from newly-purchased appliances.³⁹ The increased demand was due to the decreased real price of electricity (by 11 per cent) and, especially, reduced real prices for electric apparatus. Consumers were spending more on appliances than on electricity. At the same time incomes were rising, more married women were working (leading to demand for labour-saving appliances and the purchasing power to acquire them), and there was a boom in hire-purchase. Ownership of appliances went up, e.g. refrigerator ownership increased from 11 per cent in 1957 to 28 per cent in 1962, while consumers were becoming less frugal in their use of energy services.⁴⁰

³⁸ Hannah 1982, 81—82

³⁹ Hannah 1982, 80

⁴⁰ *Ibid*, 210—11

Figure 2 The number of domestic consumers in millions (left axis) and the sales per domestic consumer in kWh (right axis). Data from DUKES various dates.



As part of this increase, the electric domestic heating load grew rapidly between 1957 and 1962 – estimates range from doubling to quadrupling.⁴¹ It is unclear how the increase was split between on and off peak. Hannah argues the increase was due to several factors: reductions in all-day heating needs (usually using solid fuel) as more married women went out to work, increased number of rooms heated, increased living standards, increased prices of gas and smoke-less fuel and that coal fires were made illegal in smoke control zones after the 1956 Clean Air Act.⁴²

The 1956 Act, which followed on a severe fog in London in 1952, allowed Councils to set up smoke control areas, in which smoke producing fireplaces had to be replaced with either smoke-less solid fuel appliances or e.g. gas or electric appliances.⁴³ A grant was available for this, but not until 1964 did electric or gas heating systems qualify for the grant. Until then smokeless solid fuels heating systems only qualified for the grant. While smoke abatement efforts and legislation was part of the shift towards electric heating, in many cases people shifted to smoke-less appliances before Smoke Control Zones were introduced in their area (especially in the South). On the other hand, many

⁴¹ *ibid*, 211—212, n.1

⁴² Hannah 1982, 211—2. For further discussion on the links between rising living standards and rising consumerism, see e.g. Madigan and Munro (1991), Forty (1986) and Whilhite and Lutzenheiser (1999).

⁴³ Whitehead 2009, 142—8

other areas, especially coal-producing areas in the North, had still not introduced smoke control zones in 1964.⁴⁴

According to industry research, ownership of domestic ‘unrestricted’ electric heating appliances, i.e. potentially on-peak heaters, rose from 60.5 per cent in 1955, 66 per cent in 1961 and 69 per cent in 1963.⁴⁵ However, these relatively low figures were and are contested by others. Hannah, for example, states that in the early 1960s more than three million electric fires were being sold annually.⁴⁶ In addition, existing appliances were being used more. Even a somewhat conservative industry report admitted that ‘over the period 1955 to 1961 space heating consumption doubled although space heating installed load only increased by half, thus pointing to a change in habits in use.’⁴⁷ At winter peaks, between 17 and 17.30, domestic demand was estimated at almost half (47 to 49 per cent) of total demand and unrestricted domestic space-heating one-fifth (18 per cent).⁴⁸

Social, economic and policy issues, together with changed levels of desired comfort, meant that heating practices and the resulting electricity demand were changing in complex and unpredicted ways in the late 1950s and, again, becoming a concern for the industry. This fed into more general concerns about the industry’s load factor, said to be too low, and the industry’s pricing structure. Such criticisms were raised by researchers within the industry, as well as by outsiders, for example during Parliamentary debates on the Electricity (Borrowing Powers) Bill in 1959.⁴⁹ In the late 1950s there were also increasing calls for the electricity supply industry to earn a higher rate of return.⁵⁰ Despite the increasing critiques throughout the 1950s those in the industry who thought price increases would not change demand continued to win out: domestic charges remained low, with the industry instead concentrating on increasing off-peak demand, especially by promoting appliances. In this context the EDA’s campaigns to shift domestic demand off-peak, especially those promoting off-peak heating appliances through advertising, appear to in part be a response to these concerns about the industry’s load factor.

⁴⁴ Scarrow 1972. See also Kessel 2006, ch 5

⁴⁵ Report on the space heating load in relation to the supply system in England and Wales, The Electricity Council, Research and Technical Planning Committee, Working party on the characteristics of the space heating load, VI—5, Feb. 1964, MOSI Box 377. Ownership of other electrical appliances had risen much faster, for example washing machine ownership grew three-fold, from 17.5% in 1955 to 50.2% in 1963, and of refrigerators four-fold, from 8.1% in 1955 to 33% in 1963.

⁴⁶ Hannah 1982, 211—2. See also Hannah 1979.

⁴⁷ Report on the space heating load in relation to the supply system in England and Wales, The Electricity Council, Research and Technical Planning Committee, Working party on the characteristics of the space heating load, X—3, Feb. 1964, MOSI Box 377

⁴⁸ *Ibid.*, VIII—20

⁴⁹ See e.g. HC Deb 17 Feb. 1959 vol 600 cc229—73, Clause 1.—(Extension of borrowing powers.), http://hansard.millbanksystems.com/commons/1959/feb/17/clause-1—extension-of-borrowing-powers#S5CV0600P0_19590217_HOC_414 and Supplement to the Report on the Space-Heating Load, by P. Schiller, Commercial and Development Department, Electricity Council, 18.6.58, Box 397 on load development 58, MOSI

⁵⁰ Hannah 1982, 202—7

Heating practices and technologies continued to change in this period. In 1964 about a tenth (11 per cent) of households had central heating, but only 11 per cent of these used electricity, while nearly three fifths (58 per cent) of central heating systems used solid fuel.⁵¹ However, a high proportion of households - probably more than 70 per cent - now owned electric fires. As before, electric fires were usually used to provide 'top-up' heating in bedrooms and in living rooms during spring and autumn evenings and cold spells. Electric heating was still 'relatively more popular with well-to-do homes'.⁵² Starting with a supply-side perspective and continuing with the views of landlords and tenants, I will now analyse the dynamics of change: how were industry concerns about load factors and peak electric heating translated into advertising, and how was this promotion received?

The Electricity Development Association's attempts at load-shifting

In the late 1950s one of the ways the electricity supply industry attempted to load-shift was through the promotion of off-peak electric heating, particularly underfloor heating. This promotion was managed by the Electricity Development Association (EDA), which had earlier attempted to reduce demand by advertising against peak use of electric fires. This article analyses the EDA's attempts at demand management, highlighting the tension between the organisation's desire to both promote electricity and shift demand off-peak. The EDA's attempts at managing demand for domestic heating are interesting as the organisation's main interest was to increase, not decrease, the use of electricity, a position not unlike that of most large electricity utilities today.

The EDA was set up and financed by the electricity supply industry to develop common sales and advertising material under the Electricity Act of 1919. It was heavily involved in promoting domestic demand for electricity in the period between the two World Wars, when domestic electricity use in Britain rose sharply, from less than a tenth (8 per cent) of the total electricity used in 1920 to just over a quarter (27 per cent) in 1939.⁵³ This increase came despite relatively high prices, lack of supply to houses and wiring within them, and fear of electricity. Electricity was widely seen as a 'colourless, odourless, invisible, dangerous and expensive form of energy'.⁵⁴ One of the EDA's goals after its establishment was to overcome the fear of electricity. It used an image of modernity to promote domestic use of electricity, with slogans such as 'To Electricity belongs the Present and the Future', 'Science's Greatest Gift to the World - Electricity', and 'For Health's Sake - Use Electricity'.⁵⁵ It targeted middle class women, with only limited attention to working class needs in the interwar period.⁵⁶ The EDA's inter-war

⁵¹ Woolf 1967, 89

⁵² The 8% of homes that were AB class owned 18% of electric heating capacity whereas the 33% DE households owned 20%. Report on the space heating load in relation to the supply system in England and Wales, The Electricity Council, Research and Technical Planning Committee, Working party on the characteristics of the space heating load, VI—9, Feb. 1964, Box 377, MOSI

⁵³ Forty 1986, 188

⁵⁴ *ibid*, 200

⁵⁵ *ibid*, 188—193

⁵⁶ Luckin ch 2

work can be portrayed as a combination of electrical millenarianism with a general awareness within the wider industry that it was desirable to increase off-peak loads to increase profits.

After the Second World War and nationalisation of the Electricity industry, the EDA's work in its headquarter continued, though its local offices were taken over by the Electricity Area Boards.⁵⁷ Initially after the war the organisation returned to promoting all types of domestic electricity use.⁵⁸ However, in October 1946 the electricity supply industry warned the government of coal shortages as power cuts were introduced.⁵⁹ In response to these concerns EDA changed its advertising policy away from 'urg[ing] the unrestricted use of electricity' towards 'appeals for economy, particularly during peak periods'.⁶⁰ In practice, the change of policy meant a switch from advertisements urging readers to visit their local Electricity Showroom to find out about electricity and put their name down for appliances such as cookers, under the slogan 'Electricity? Wonderful thing!'.⁶¹ From November, the EDA instead ran a campaign with the slogan 'Use electricity at off-peak periods and help to avoid cuts', explaining when peak times were and why supply was low, urging consumers to 'time-ration' their electricity.⁶²

However, the industry still felt electric heating should be part of long term plans. The EDA and other supply industry actors protested loudly against the recommendations to favour solid fuel for domestic heating made in the Simon Report of the Fuel and Power Advisory Council.⁶³ While the EDA had changed its short-term advertising policy because of the supply shortages, the industry's long-term policy clearly still emphasised and defended increased electricity consumption for heating.

Throughout the 1940s and the 1950s the electricity supply industry did not increase prices to reduce demand, despite researchers within the industry as well as some within the Civil Service and some politician repeatedly arguing for it. The industry claimed peak electric heating had low price elasticity of demand and so would be unresponsive to price changes.⁶⁴ The EDA continued to respond the recurrent capacity issues in an ambivalent way. It continued its work promoting the 'idea' of electricity, as it put it, though it claimed to do so in a way that would not raise undesirable demand at the time. For example, in 1951 it claimed its advertisements were 'designed to promote greater economy and efficiency in the use of electricity without creating additional demand'.⁶⁵

⁵⁷ Hannah 1982, 77

⁵⁸ EDA 1945 and 1946, 9

⁵⁹ Robertson 1987, 59

⁶⁰ EDA 1946, 9

⁶¹ See e.g. The Times 3 May 1946, 3 and The Times Oct. 18 1946, 3

⁶² See e.g. The Times 20 Nov. 1946, 3; 3 Jan 1947, 3 and 5 Feb. 1947, 3.

⁶³ Domestic Fuel Policy, EDA Bulletin number 132 Jan 1947, 6—7, in Box 506, MOSI 1989.338. Ministry of Fuel and Power 1946, ii

⁶⁴ Chick 1990 and 1998, Hannah 1979 and 1982

⁶⁵ EDA 1951, 7

Promotion of off-peak appliances

However, as soon as the capacity crisis seemed to have been resolved by 1953, the EDA again began promoting the use of electricity directly. Domestic electricity was promoted in the national press, using the logo 'Electricity a power of good'.⁶⁶ The EDA reported growth in the demand for electric appliances and electricity with '(a)n increasingly favourable attitude towards electricity throughout the country' and in the press.⁶⁷ While the EDA's claims that it tried to restrict demand generally in the early 1950s ring somewhat hollow, its long-term commitment to shifting load off-peak seems more solid. Throughout the 1950s the EDA, and the rest of the electricity supply industry, continued to promote electricity and certain electrical appliances, in particular attempting to increase off-peak demand.⁶⁸ It promoted electric cookers, water heaters, refrigerators and washing machines, arguing that these were off-peak loads.⁶⁹

The organisation recognised that electric space heating was causing problems with the load-factor. It responded by promoting domestic off-peak storage heating, especially under-floor heating. Initially these efforts concentrated on architects, builders and planners, with EDA supplying advice to those involved in local authority housing schemes in 1954.⁷⁰ The EDA also lobbied government to promote off-peak storage heating by reducing purchase tax.⁷¹ Later the EDA also began promoting under floor storage heating direct to domestic consumers by providing information, producing a brochure titled 'Cheaper Heat from Off-Peak Power' in 1957.⁷² The title indicates an important aspect of its promotion of off-peak heating: the introduction of cheaper off-peak tariffs by the Area Boards to support this development.⁷³ The electricity supply industry appears to have preferred to shape demand via price discounts rather than restrain it via price increases. The EDA also paid more and more attention internally to off-peak heating, identifying barriers to off-peak domestic space heating and attempting to remove these. For example, it established a committee on space heating, which ranged from technical issues about the consumption of electricity by underfloor heating to concerns about mortgages for houses without flues.⁷⁴

The EDA was keen to portray its interest in off-peak electric heating as shared by those outside the electricity supply industry. In 1959 the EDA reported that electric heating and off-peak floor warming were especially noticed by the press, that the Ministry of Works included electric floor warming in its programmes of lectures, and that the Heating and Ventilating Research Association had established a sub-committee to

⁶⁶ EDA 1953, 23

⁶⁷ *ibid*, 6

⁶⁸ Hannah 1982, 81—82

⁶⁹ EDA 1954, EDA 1958, 9

⁷⁰ EDA 1954:15

⁷¹ EDA 1954: 8 & 15, EDA 1958:13

⁷² EDA 1957, 10—11

⁷³ Hannah 1982

⁷⁴ EDA 1958, 13, EDA 1959, 13

research off-peak heating. EDA also claimed that architects continued to be interested, as were government committees on housing standards.⁷⁵

It seems the industry wished to shift people to off-peak electrical heating for economical and technical reasons, not environmental. While some advertising material mentioned that electric heating systems were smoke-less, for example in a 1961 leaflet which mentions that storage heating complied with the Clean Air Act, this tended to be part of more general appeals to cleanliness: "Absolute cleanliness: Storage heating is absolutely clean; there is no smoke to cause smog and soot; no fumes, no dust; no ashes; no fuel stove; and no difficulty in complying with the Clean Air Act."⁷⁶ Most of EDA's press adverts for electric under floor heating and storage heating mentioned its cleanliness but without mentioning smoke-abatement – the concern was as much about in-house cleanliness. For the EDA taking part in Clean Air Exhibitions and producing leaflets on complying with the Act was part of the organisation's sales tactics. This is made quite clear in 1958: "Perhaps the most outstanding features of the year was the fresh scope afforded by the establishment of Smoke Control Areas under the Clean Air Act, for pressing home the part which electricity can play in clearing the air of smokes and fumes."⁷⁷

From the EDA's point of view, by 1959 under floor heating appeared to be taking off. The EDA argued that measures favouring it, including reduced purchase tax, had led to strong growth in the demand for off-peak heating apparatus and directly linked that to improved load factor: 'One of the newest applications of electricity, and one which showed the greatest rate of growth, was off-peak electric floor warming, the popularity of which was manifest in almost every type of building, with resultant benefits in the improvement of load factor'.⁷⁸ In the next sections we will discuss how the system was taken up by one major housebuilder and its tenants, illustrating how the EDA's promotions were received elsewhere.

⁷⁵ EDA 1959, 11 and 29

⁷⁶ Leaflet on storage heating, 1961, in Box 443, MOSI 1989.338

⁷⁷ EDA 1958

⁷⁸ EDA 1959, 8



Figure 3. EDA Brochure promoting underfloor heating, with notes on the distribution of the leaflet within LCC in the top left corner, including to the Assistant Director of Housing. EDA leaflet 'How to enjoy your new home more with Electric Floor Warming', GLC/HG/HHM/10/L247 Part 1, Under floor heating, LMA . Copyright: MOSI (Museum of Science & Industry, Manchester).

The LCC and underfloor heating

To explore the details of the adoption and experiences of underfloor heating it is necessary to take a case study approach, with London County Council (LCC) chosen because of the richness of archival material. After the Second World War the LCC began a major housing program. Between 1945 and June 1949 provided 32,500 homes. 12,000 permanent homes were under construction, another 3,330 were out to tender and 64,000 were being planned.⁷⁹

Most of the LCC's houses and low blocks of flats adopted the type and standard of heating suggested in the Simon report, which the EDA and other electricity actors argued against. This meant that these dwellings had an 'efficient' solid fuel heating system that could burn smokeless fuels. The fire was designed to be 'topped-up' with gas or electric fires. Hot water was provided through a back-boiler, usually complemented by an electric immersion heater or gas water heater for when the fire was not in use, for example in summer.⁸⁰ This policy was confirmed in 1961, as surveys of tenants with such systems showed they still used the fires and liked them, in particular because the back-boiler provided hot water seemingly for free. One survey showed that 90% of tenants in flats with open fires with back-boilers used the fire daily in winter. Over three quarters (77%) of these tenants liked the open fire, with the most common reasons for liking it being that it also heated water, was 'cheerful' and provided good warmth.⁸¹

The policy finally changed in early 1963, when the Housing Committee decided that in the future only about ten per cent of all new dwellings should use solid fuel appliances with back-boilers, now of a type that could heat two radiators as recommended by the Parker Morris Committee. This committee recommended higher heating standards and whole-house heating and it seems to have been an important trigger in the changing policy at LCC. Different types of warm air systems were the options preferred by LCC. Councillors favoured higher standards of temperature, following the Parker Morris standard, and increased flexibility and reduced work for tenants, whereas officers were concerned about the affordability of these higher heating standards for tenants.⁸² In the end, forced warm air heating, either directly heated by individual gas units or indirectly heated by hot water from a central boiler house, was recommended as offering flexibility, convenience and higher heating standards.⁸³

⁷⁹ LCC 1949, 7

⁸⁰ Ibid, LCC 1956, LCC 1960

⁸¹ Report (12/4/61) by the Chief Engineer, the Architect to the Council and the Director of Housing, "Housing Estates - Use of Fires by Tenants", Housing Development and Management Sub-Committee, GLC_HG_HHM_10_L055 Part 2 Development & construction Heating & Hot water services 1945-, LMA

⁸² Housing estates- heating of low blocks, Order 27 Feb 1963; Note to Mr Fishlock 28 Feb 1963; Joint report 12 Feb 1963; Notes of Housing Committee Meeting 27 Feb 1963, GLC_HG_HHM_03_A224 Heating, 1962-65, LMA

⁸³ The standard was 65-67 degrees F in the living room and kitchen, 55 degrees F in the rest of the dwelling when outside temperature was 30 degrees F. Information Notes, London County Council

In tall blocks of flats, with more than six storeys, the situation was different from the start. In such blocks solid fuel fires required too many flues and other heating systems were required. The number of flues was a critical factor: some blocks of maisonettes (flats over two storeys) could use solid fuel fires even though the block had 10 storeys, as only five of those storeys had fireplaces, with bedrooms instead equipped for gas or electric fires. Tall blocks of flats were not built until the mid-1950s by the LCC, but by then government funding and land constraints favoured such blocks. Initially these blocks had central heating and hot water from a central boiler on the ground floor. The cost of this kind of heating system was quoted as an important factor in deciding whether to build a tall block or some other form of dwelling.⁸⁴ In addition, these systems produced a set temperature of 65F and all tenants incurred a set charge, which meant that costs and temperatures were out of the control of tenants, and the LCC's Housing Committee were keen to find systems whereby tenants could choose a lower standard if they desired.⁸⁵

In 1957 the LCC's Housing Committee decided, on the recommendation of officers, that electric floor warming would be used instead of the originally planned central boiler heating system in most of the tall blocks then being planned. The shift was in part triggered by the London Electricity Board beginning to offer a more economic off-peak rate, so as to avoid increasing peak loads for heating.⁸⁶ The capital cost would also be lower and the system was under tenant control. In addition, direct gas fired air heaters were used in two blocks, Camden Road (St Pancras) and Locton Street (Stepney) as an experiment. Further experiments with gas warm air space heating and floor level boilers for central heating were agreed in June 1960.⁸⁷

The policy of heating most tall blocks through underfloor heating, topped-up with electric fires, was continued until 1963. Then officers recommended a shift in policy towards warm air recirculating units, with the air heated by gas or oil-fired rooftop boilers. However, floor warming would continue to be used in already planned or contracted blocks. The 1963 change in policy was made because of low tenant satisfaction with electric underfloor heating, while changes in capital costs made other systems more affordable and technical change allowed tenant control. Finally, the Parker Morris committee had recommended a higher standard of heating than the

Architect's department, "Heating, Housing in Low Blocks", 17 Jul(?) 1963, GLC_HG_HHM_03_A224 (1) Heating, 1962-65, LMA

⁸⁴ LCC 1956, Flats, point block (first unnumbered page of section), and Maisonettes

⁸⁵ Joint report (24.6.63) by the Chief Engineer, the Architect and the Director of Housing, "Heating of Tall Blocks", Housing Committee, Housing and Town Planning Joint Development Sub-Committee, GLC_HG_HHM_03_A224 (1) Heating, 1962-65, LMA

⁸⁶ Chief Engineer to Vice Chairman, Housing Committee, "Electric Floor Warming", 28 Nov 1957, GLC_ME_D_01_029 Electric Floor Heating, LMA

⁸⁷ Joint report (24.6.63) by the Chief Engineer, the Architect and the Director of Housing, "Heating of Tall Blocks", Housing Committee, Housing and Town Planning Joint Development Sub-Committee, GLC_HG_HHM_03_A224 (1) Heating, 1962-65, LMA

underfloor system provided.⁸⁸ As for houses and low blocks, forced warm air heating was seen as flexible yet capable of meeting higher standards.⁸⁹ Underneath these policy changes lie continued investigations into tenant's satisfaction and practices in relationship to the electric underfloor heating.

Table 1 lists the number of dwellings in tall blocks built by 1963 with different heating systems, illustrating the variety of systems tried by the LCC⁹⁰

| Main system | Total number of dwellings |
|---|---------------------------|
| Oil-fired or solid fuel low pressure hot water central heating with boiler house at or below ground level: Radiators or natural convectors in dwellings | 2674 |
| As above: warm air recirculating units in the dwelling | 517 |
| Oil-fired low pressure hot water central heating with boiler house at roof level with warm air recirculating units in the dwelling | 1062 |
| Electric floor warming | 4683 |
| Electrically heated recirculated warm air convector units | 84 |
| Gas radiant convector units | 191 |
| Direct gas fired warm air recirculating units | 593 |

LCC tenants and underfloor heating

The LCC's investigations into underfloor heating allow us an unusual look into the adoption of electric floor heating. What did tenants think about it and how did they use it? What led to the adoption or rejection of the system? Like other studies have found, what the planners planned is not necessarily how the inhabitants inhabited the space.⁹¹

The first of LCC's tenants that moved into flats with underfloor heating in Osterley house on Lansbury Estate (in Poplar) also entered into a payment arrangement that will have been new for many. Instead of buying solid fuel or paying for gas or electricity through a slot meter, which was common at this time, they paid upon the receipt of a quarterly bill. While many tried the heating, most stopped using it, claiming they felt it was expensive and did not produce enough heat. Of the forty tenants interviewed in 1962 from the first block, twenty nine (72 ½%) did not use the heating and had either

⁸⁸ Joint report (24.6.63) by the Chief Engineer, the Architect and the Director of Housing, "Heating of Tall Blocks", Housing Committee, Housing and Town Planning Joint Development Sub-Committee, GLC_HG_HHM_03_A224 (1) Heating, 1962-65, LMA

⁸⁹ GLC_HG_HHM_03_A224 (1) Heating, 1962-65, Information Notes, London County Council Architect's department, "Heating, Housing in Tall Blocks", 5 Nov 1963

⁹⁰ Joint report (24.6.63) by the Chief Engineer, the Architect and the Director of Housing, "Heating of Tall Blocks", Housing Committee, Housing and Town Planning Joint Development Sub-Committee, GLC_HG_HHM_03_A224 (1) Heating, 1962-65, LMA

⁹¹ Llewellyn 2004

removed the fuses (twenty four) or set the thermostat at the lowest point of 45 degrees F. The Council found that many tenants' use of the heating system decreased dramatically after receipt of their first electricity bill. Once the system got a reputation for being expensive many new tenants in neighbouring blocks hardly tried it. Instead tenants used the in-built electric panel fire, often combined with own-purchased electric fires or oil heaters. Other local authorities where tenants paid direct to the Electricity Board had had similarly negative responses to electric underfloor heating.⁹²

In other words, the carefully designed off-peak heating system was rejected in favour of on-peak electric heating, with tenants considering the latter cheaper. There were also other reasons for rejecting the provided system: tenants complained of lack of heat, with some feeling the flat did not get warm until bed time. A few thought carpets "would render the floor warming useless" and one had stopped as she thought she lost heat to the flat below not using the system.⁹³

Because of the low usage, LCC decided to experiment with a new way of charging. Tenants in later blocks of flats were charged a set charge each week, collected with the rent. If they did not use the entire charge on heating it was given as a credit towards general electric usage (e.g. lighting or cooking), so it was still possible to economise.⁹⁴ However, LCC found that much fewer did. With this charging system, usage remained within what the Council and the Electricity Board thought were acceptable levels. To deal with the unfamiliarity of the system a leaflet with information had been prepared for tenants. Those provided with more information yet paying through a monthly bill used the system more than the very first tenants, but still consumed only half the electricity for underfloor heating than those paying by instalment. To get tenants to take full advantage of off-peak tariffs but also giving tenant control over heating, LCC's Officers recommended that all tenants with underfloor heating pay for it through instalments, and this was implemented.⁹⁵

However, while using the system more, tenants in these later blocks also complained about it. In one of the blocks where tenants paid by instalments, Rowley Garden, thirty eight tenants were interviewed in 1962. Twenty seven said they liked the system because of the warmth and convenience compared to solid fuel fires. Ten disliked the system, but many more, twenty two, criticised it for a lack of warmth, and some disliked the times it came on. Many liked the type of heat, especially that it was warm first thing in the morning and that it provided good background heat – one person dressed in the living room. However, almost half using the heating felt the hall and the kitchen were not warm enough and 16 people felt there was a general lack of heat, with the living-

⁹² Joint report by Chief Engineer and Director of Housing, 22 Sep 1960, "Electric Underfloor Warming", Housing Development and Management Sub-Committee, GLC_ME_D_01_029 Electric Floor Heating, LMA

⁹³ 1962/3 Survey on Electric Floor Warming, GLC/HG/HHM/10/L247 Part 1, Under floor heating, LMA

⁹⁴ Joint report by Chief Engineer and Director of Housing, 22 Sep 1960, "Electric Underfloor Warming", Housing Development and Management Sub-Committee, GLC_ME_D_01_029 Electric Floor Heating, LMA

⁹⁵ Joint report by Chief Engineer and Director of Housing, 27 Jun 1962, "Electric Underfloor Warming", Housing (Development and Management) Sub-Committee, GLC_ME_D_01_029 Electric Floor Heating, LMA

room not reaching the 'desired temperature'. During very cold weather all supplemented the floor heating with the fitted panel fire, and 82% of users (23) supplemented with some form of additional heating even during "normal" winter weather. When using the background floor heating and the top-up panel fire eight said they still did not find the living room warm enough for sitting during very cold weather, despite most of these having the floor-warming thermostat set at 75 degrees. Half the sample (including those who did not use the system) felt the floor warming was not worth the cost, but 45% thought it was worth the cost.⁹⁶

Later in the 1960s tenants in some blocks signed petitions against the system, with tenants continuing to find the system expensive for the level of heat it provided. One problem was a perception amongst tenants that the system was central heating and not just background heating. The expected standard of heating seems to have been increasing, and when presented with a system that heated most of the flat it was considered that it should provide central heating standards instead of the designed background standard.⁹⁷ Tenants were still complaining about underfloor heating being too cold and expensive, as well as "the creation of a dry or stuffy atmosphere" in the late 1960s.⁹⁸

Dynamics of changing heating habits involved moving into a new flat, experimenting with the provided heating system either themselves or through hearing about other's experiences, followed by adoption, partial adoption or whole-sale rejection. If it felt like the system was included in the rent and paid for 'anyway' this led to higher adoption, whereas lack of information and paying by monthly bills led to almost uniform rejection of the system. However, this was as much about perception of bills, not straightforward economics (as tenants would get a rebate if not using the system).

Continued change

Various factors were involved in the 1963 change in LCC policy away from underfloor heating, but key was the dissatisfaction amongst tenants with the system and the relatively low use made of it. The EDA continued to promote underfloor heating, but gradually moved its emphasis to another off-peak technology: storage block heaters, also known as night-storage heaters. These were the next big thing for the EDA. From September 1962 they were promoted through the 'Unit-Plan', through which domestic block storage heaters could be bought for £60 each in combination with a lower off-peak tariff.⁹⁹ Apparently the EDA's whole-page advertisement resulted in so much interest that insufficient heaters and manpower to install the units were available, and the advertising was curtailed.¹⁰⁰ Off-peak storage heaters were given another kind of

⁹⁶ 1962/3 Survey on Electric Floor Warming, GLC/HG/HHM/10/L247 Part 1, Under floor heating, LMA

⁹⁷ Kirby to Allerton 22 Mar 1962; and Underfloor Heating – Edinburgh House GLC/HG/HHM/10/L247 Part 1, Under floor heating, LMA

⁹⁸ Joyce Fairman, 'Heating Survey', 1970, GLC_HG_HHM_1 Surveys of seaside bungalows and central heating, LMA

⁹⁹ EDA 1962, 12

¹⁰⁰ *ibid*, 10–13

boost during the next winter, 1962-3, when a sustained period of unusually cold weather led to day time power cuts, but as off-peak heating continued to work relatively well it apparently received positive press.¹⁰¹ According to Hannah the Unit-plan helped the industry to sell electricity for space heating economically, while retaining more desirable domestic loads.¹⁰²

The financial attitudes of the industry also began shifting in the early 1960s, with the senior men in the industry increasingly seeing price rises and load-restrictions as necessary. In 1961 the Treasury forced the electricity supply industry to implement changed financial targets.¹⁰³ These made the choices regarding new pricing structures more clearly visible, although many in the industry still resisted change. After power supply disruptions during the cold winter 1962/3, the government reduced purchase tax on block storage heaters in 1963.¹⁰⁴ The cold winters of 1961/2 and 1962/3 also represented a crunch-point in debates about pricing to control demand, as high demand had led to power cuts and reductions in frequency and voltage. Following this, the Ministry of Fuel and Power increased investment in the distribution system while the Electricity Council Chairman increased load and utilisation research, which suggested consumers should help pay for the increases in supply their demands required. From 1962 higher domestic price rises were slowly imposed. In the longer run, Hannah argues that the combination of promoting off-peak storage heating and gradually increasing domestic charges to something more closely related to costs led to the on-peak unrestricted space heating load remaining at the 1964 level or below through the rest of the 1960s, while off-peak heating grew. The load factor of the system also increased, from below 50 per cent in the early 1960s to over 55 per cent in the 1970s.¹⁰⁵

The increase in use of off-peak electric heating was in part an outcome of decisions taken within the industry, including by the EDA, to respond to the inherent tensions between their desire to increase overall demand while reducing peak demand. The industry actors' specific response was deliberate promotion, especially of off-peak heating, and price changes, for example, the introduction of lower night time rates. However, for such actions to work they had to be adopted by house-builders installing the necessary infrastructure and appliances, and residents of that housing choosing to use the supplied system and signing up to the off-peak rates. Some factors in that adoption was the introduction of the Parker Morris standard in council housing which mandated central heating, the slow implementation of the Clean Air Act necessitating the use of smokeless fuels and the conversion to natural gas which both reduced the price of gas and reduced availability of coke, a by-product of town gas production. However, while smoke abatement was used by the EDA as part of its promotions,

¹⁰¹ EDA 1963, 8

¹⁰² Hannah 1982, 213—6

¹⁰³ *ibid*, 202—13

¹⁰⁴ EDA 1963, 12 and Load Factor Development, DMN, 11 Jun. 1958, Commercial and Development Department, Electricity Council, Box 397 on load development 58, page 4, MOSI

¹⁰⁵ Hannah 1982, 281—2

environmental concerns were not the organisation's reason for these promotions. Nor was smoke abatement the reason behind the LCC's adoption of electric underfloor heating, who chose the system for technical and economic reasons. Equally, smoke abatement as such was not a frequent concern amongst LCC's tenants, though in-house cleanliness and general lack of dirt was appreciated.

Conclusion

In 1964, Lawrence Wright described household heating practices, emphasising the difference between such practices and those portrayed in advertisements, such as those by the EDA: 'The advertisers' pictures of happy—nay, laughing families, basking idly in inexpensive warmth from invisible sources, while meals cook themselves, do not yet give a true overall image of British home life. In the average small house, a great part of the woman's work is still performed in cold rooms, with occasional spells in a hot kitchen that make her more sensitive to cold. Most of us still muddle along, shovelling coals, riddling and tipping out ashes, having flues swept, begging shillings for meters and carrying cans of paraffin... We admit the need for cleaner, more efficient, labour-saving methods. But if we send for catalogues and estimates, we soon find that no good modern heating system is cheap to install [or run]'.¹⁰⁶ This quote emphasises the tensions and variability in heating practices in this period, as LCC's surveys did.

Between 1945 and 1964 demand for electric heating continued to increase, though some of this demand was shifted off-peak with the introduction of under floor heating and storage heaters. While something, perhaps advertising against electric fires but more likely appliance pricing or blackouts, seems to have slowed down the rate of increase in overall domestic electricity demand between ca 1947 and the mid-1950s (see Figures 1 and 2), this effect was limited in time.

From the mid-1950s onward energy practices changed rapidly and, to the industry, unexpectedly. The low price of electricity (under-priced compared to the cost of production, especially at peak), coal rationing and the later anti-smog campaigns and the Clean Air Act, may have especially stimulated demand for various forms of electric heating. Equally, increased household incomes, changes in regulations about home heating, consumers' desire for increased temperatures in their homes and for 'modern' appliances, together with the EDA's and others' promotional activities, including the development of new technologies such as domestic storage heaters, were contributory factors. Decisions by house builders such as LCC, taken for technological and economic reasons, also favoured the increased use of electric heating in the tall blocks of flats that were then promoted by central government. As tenants in these flats did not use off-peak heating as much as had been hoped, instead choosing to use direct electric fires, promotion of underfloor heating paradoxically led to increased peak demand for electricity. The increase varied between areas and especially with the method of

¹⁰⁶ Wright 1964, 199

payment, with those paying through bills using much less than those paying by instalment.

Despite demand management, including some successful shifting towards off-peak, electricity consumption kept increasing. Shifting demand off-peak in fact seems to be a continuous activity for the electricity supply industry, undertaken since the late nineteenth century. The limited success of this work can, in part, be explained by attending to intermediary actors, such as LCC, and to end users. Indeed, we need to take such a wider view to really understand why under floor heating did not lead to the load shifting that EDA had hoped for.

This paper has shown that some of today's concerns, such as shifting demand off peak, have a long history. While history can show such continuities, it can also point out differences in approach and context (for example how the power cuts and the capacity crisis influenced the industry's actions).¹⁰⁷ Historical work can also show policy makers that large change is possible, though it often takes considerable time.¹⁰⁸ In addition, policy makers' view of energy policy is often limited, and historians may be able to widen the view of policy makers by emphasising the political nature of energy policy, infrastructures and technology.¹⁰⁹

Demand management is one area in which historians could potentially widen the view of current policy makers, pointing out that even when demand management has been attempted and to some extent been achieved, overall demand has continued to rise. Demand management and energy efficiency are often promoted as having the potential to lead to substantially reduced energy use, and thus reduced carbon emissions, though clear evidence for this has been difficult to establish.¹¹⁰ An example of a current demand management strategy is the introduction of smart energy monitors and meters in the UK, to be completed by 2020, which are meant to enable the development of a smart grid and to make energy use visible to consumers. However, research into the response to smart monitors questions whether they will reduce consumption in the long term.¹¹¹ Some have used historical examples to question if increased energy efficiency will lead to reduced demand in a context of generally rising demand.¹¹² This paper argues similarly, adding that this has been the case even when demand management has been explicitly attempted, as by the EDA in this period.

Demand reduction and demand shifting activities were undertaken by the electricity supply industry well before the oil crises in the 1970s. Earlier crises, as in post-war Britain, have led to similar responses, but once the immediate supply shortages were remedied demand continued its steady rise. Historical work can therefore set

¹⁰⁷ Tosh 2008

¹⁰⁸ See also Fouquet 2008, Nye 1998, Pursell 1999, Feldman 1994, Smil 2003

¹⁰⁹ Sabin 2010

¹¹⁰ Lopes et al (2012) and Moezzi and Lutzenhiser (2010).

¹¹¹ Hargreaves et al 2012

¹¹² Wilhite 2008 and Smil 2003

contemporary attempts at demand management within its longer-term context of increasing energy usage, continuously re-shaped by a complex of socio-technical and cultural influences, as well as by infrastructures and institutions. This indicates, as other work has done, that demand management (e.g. attempts at demand shifting and reduction through smart grids and meters) on its own is unlikely to be enough to produce significant long term reductions in energy use, certainly on the scale needed to meet carbon reduction targets. There are many other good reasons for demand management activities, such as reducing fuel poverty and decreasing costs both for the industry and for domestic consumers, but it seems likely that more radical solutions are also needed to mitigate climate change. Historical analyses, such as this study, as well as social and behavioural research, point to the complexity of domestic energy using behaviours and practices. This research suggests that such practices will need to be better understood by policy makers to reduce the environmental impacts of electricity use.¹¹³

¹¹³ See also Shove 2010

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Archival material:

The Times Digital Archive 1785—2007 was used to view EDA advertisements from the following dates: 3 May 1946: 3, 18 Oct. 1946: 3, 20 Nov. 1946: 3, 3 Jan. 1947: 3, 5 Feb. 1947:3, 27 Jun. 1949: 2, 2 and 8 Aug. 1949:7, 7 Oct. 1949: 3 and 2 Dec. 1949: 3.

MOSI: Archival material related to the EDA and the electricity supply industry, referenced in footnotes in the text, is held in the electricity supply industry (ESI) collection (ref 1989.338) in the MOSI (Museum of Science Industry) archive in Manchester. In addition, the following printed material is also held in that collection:

EDA, Annual Reports, 1947—1956, in Box 461, MOSI, 1989.338.

EDA, Annual Reports, 1946 and 1957—1964, in Box 477, MOSI, 1989.338.

EDA Bulletin number 132 Jan. 1947, number 135 Apr. 1947 and number 136 May 1947
in Box 506, MOSI, 1989.338.

LMA: Archival material related to LCC and its tenants is held by the London
Metropolitan Archive (LMA).