

Background Paper

CHP and DH to the mid-1990s



Stewart Russell

version 1, November 2010

ISSTI, University of Edinburgh

1	Introduction.....	1
2	Explaining the neglect of CHP and DH	1
3	Local government.....	4
4	Energy providers.....	5
5	Central government	6
	Notes and references.....	7

1 Introduction

- 1.1 This paper attempts to draw lessons from the history of combined heat and power and district heating in the UK up to the mid-1990s.¹
- 1.2 It is a long and mostly sorry history, stretching back to the turn of the twentieth century: of repeated periods of interest in the techniques – especially at times of crisis or reorganisation in the sector – many proposals and plans, but only a few mostly small schemes ever starting.
- 1.3 The conditions in the energy sector and the economy and polity more broadly changed significantly over that period, and obviously conditions now are markedly different even from those in the 1980s. Moreover one of the key arguments here [2.6-2.8] is that the viability of schemes always depended on the precise and at best precarious balance of a wide range of determinants. The same will doubtless apply now, though of course the detail of the obstacles that schemes face and the requirements they must meet will again be very different. Nonetheless, at a general level we can find some useful insights in this history.

2 Explaining the neglect of CHP and DH

- 2.1 There is no simple reason for their neglect and it is futile and misleading to ascribe it to any one cause. CHP and DH were peripheral to and disadvantaged by the increasingly entrenched mainstream developments in the energy sector. They found only a limited role and a precarious existence in very specific circumstances in its interstices – or simply fell in the gaps separating the existing institutions. That they should have been left to such a fate and never established a firm institutional base, itself needs explaining.
- 2.2 A satisfactory account must therefore situate the activity around CHP and DH, including the periodic resurgence of interest in them, in the organisational and technical development of the key institutions – the energy industries and central and local government – and developing relations between them. These characteristics and relations must in turn be linked to the specific character of the British economy and state as it changed over this period.
- 2.3 The extent and strength of state intervention to override the short-term economic logic of the energy sector was at all times crucial in determining the size and shape of the niches that CHP and DH might occupy. But in the continued absence of a powerful organisational base for the options [5.3], and the failure of government and energy suppliers to provide the coordination, stability and long-term planning and economic objectives that large scale CHP/DH needs, it was changes in the pattern of main generation, movements in energy prices and sources, and other effects of the mainstream activities of the key organisations – much more so than any fine-tuning of the regulatory and financial framework of the sector – which continually limited the chances of CHP/DH achieving its full potential in Britain.
- 2.4 Advocates of the technique, frustrated and unable to understand why such an obviously sensible technology was not taken up with enthusiasm, often resorted to accusations of a deliberate plot on the part of the energy industries and related sections of government to suppress it. Central government and the electricity industry generally took the line that they were never opposed to the options, but that the economics was assessed rationally and that if there was little in existence, that was nonetheless the economically optimum level; particular circumstances must have meant that it was unsuitable. While there is a limited sense in which both claims are valid, neither more than scratches the surface of an explanation for the neglect of the options.

- 2.5 To some extent we can depict the exclusion or marginalisation of these technologies as *accidental*: that is, a significantly different outcome at least in the number of schemes could have been realised through relatively minor improvements in conditions [2.6-2.8] and without significant changes to the institutional structure and procedures of the sector. Beyond that however, we must see the exclusion as *systematic*, in the sense that it was characteristic of that sociotechnical formation and could not have been overcome without substantial reform to energy provision and with that some wider aspects of the UK economy, polity and infrastructure.
- 2.6 To understand why proposals failed, or so few schemes were introduced – in rare combinations of circumstances, in spite of general conditions in the sector rather than because of them, and crucially in the absence of an institutional champion at national level [5.3] – we must see how their prospects depended on the intricate detail of the influences on them and the fine balance of a large number of conditions and variables. The fate of any scheme depended on the precise conditions that tipped viability one way or the other, or determined the extent to which it could develop, or shaped in detail its configuration.
- 2.7 In particular,
- escalating costs or other deterioration in their economics often forced plans to be abandoned or scaled down to much more modest ventures, or schemes that did start were curtailed so that their geographical scope was reduced and marginal and outlying – generally lower density – loads were never connected; and
 - the configuration of the heat source was often constrained inappropriately.²
- 2.8 Conversely, where economic viability of a scheme was marginal, the balance could be tipped in its favour by relatively small improvements in financial or regulatory conditions, a few additions to the core loads, or small changes in the way the economics was assessed.
- 2.9 The systematic character of the exclusion of CHP and DH [2.5] was thus expressed through what appeared as contingencies: first in the structuring of the balance of power of the actors so that favourable minor changes were not made, and second and more fundamentally in the setting of constraints such that few schemes did make progress and that the success of these was so critically dependent on these details.
- 2.10 The options were thus marginalised largely through the normal operation of institutions going about their mainstream business, and to that extent unintentionally. Sometimes, however, they were actively opposed because of the challenges which their introduction would have represented to established interests in the sector and more widely, the political demands with which they was associated, and the economic and organisational changes their adoption would have required.
- 2.11 CHP was clearly disadvantaged throughout because of its dual product and the problems of coordination in planning and operation that this presented, and the complexity this introduced into assessing and securing its economics.
- 2.12 DH always competed against individual heating systems. Although in principle DH could have been introduced in open competition with other heating forms – and where consumers have had a choice the price of heat from DH has been pitched to compete with the alternatives – generally DH was only introduced where a collective decision could be made on its installation – that is, where

individual consumers could not opt for an alternative. Thus DH schemes, or smaller group or block heating schemes, appeared mainly in social housing estates, industrial estates, education campuses, and military, hospital and other public building complexes. Planning and installation of such schemes was also much easier than where multiple heat customers had to be enrolled.

- 2.13 Besides the physical and institutional structure of the energy system into which they had to fit, another crucial focus of an explanation of the treatment of CHP and DH has to be their evaluation – in the broad sense, not just of formal procedures, methods and criteria, but of wider discourses and debates which shaped interpretations of the technologies, their purposes, merits, problems and possibilities, which framed and legitimated decisions on them, or indeed challenged them. Clearly the debates and decisions on CHP and DH, at national level and for individual schemes, did rest heavily on economic methods and criteria, even when their advantages were formulated initially in social and environmental terms. Again however, a comparison of the different periods in their history shows how their economics was shaped by the institutional structure and physical characteristics of the energy sector of the time, and how the forms of evaluation in turn were set by these. Even the economic calculations consistent with the structure of the sector were not the sole determinant of decisions, and we must explain the extent to which narrowly defined economic criteria did dominate; the economics often was – and within the limitations on state intervention at any time in principle always could have been – overridden by political decisions on social, environmental and other grounds, whether strategic or expedient.
- 2.14 The conditions influencing the introduction of CHP and DH also included the level of scepticism or caution in the responsible authorities, so that political support for what could easily be depicted as a peripheral, risky and inessential initiative was also precarious – especially when the schemes came up for repeated reappraisal and approval – and user reactions to existing schemes [2.17].
- 2.15 The arguments for the benefits of group and district heating, of course, remained largely unchanged through the century, though after years of problems and decline its attraction was boosted from the 1980s by environmental concerns, by technical improvements such as prefabricated piping, fully electronic meters and prepayment heat controllers, by a variety of management options such as contract operation, and above all by the availability of new small CHP technologies which themselves showed very promising performance.
- 2.16 At a cultural level, we must also recognise a contribution from the way heat as an energy form was understood and treated: that it was hardly ever an organising concept, focus of attention and therefore object of policy as gas and electricity were. Comfort levels were rarely made explicit as an objective and criterion in energy policy; they only surfaced in discussions of housing conditions and improved living standards, as during postwar reconstruction and planning for new towns. Overall, consideration of heat and how to supply it was thus not institutionalised in the same way, and DH was disadvantaged by the lack of a national agency or even forum concerned specifically with heat [5.3].
- 2.17 No comprehensive evaluation of the technical and economic performance of DH schemes was undertaken and assessments of individual schemes were often not released. There were reports of severe technical problems with some schemes, and when it was assessed, of poor economic performance. There were complaints about the paternalistic mode of operation, lack of consumer control, poor maintenance, and escalating costs to operators and users. In some schemes the envisaged major heat source – usually a new CHP station – did not become

available. Consequently at times DH earned a poor reputation – though this may have been unfair – and in government and engineering circles critics emerged as fervent as its proponents. At most times there were few schemes to use as demonstrations of successful ventures. It is doubtful that most schemes that did operate were ever truly economic. Several were dismantled after a short life, before operators were eventually persuaded to renovate schemes rather than replacing them with individual heating [2.15].

3 Local government

3.1 Local authorities were always central to DH initiatives, in that:

- they often initiated plans – at some times ambitious proposals for city- or suburb-wide schemes;
- where a consortium of interests pursued a scheme, local authorities were key players, even when their involvement was discouraged or constrained;
- in a negative sense, initiatives were seldom taken where local authorities were not motivated or able to do so.

3.2 Local authorities' involvement in DH schemes arose from their role

- as providers of social housing;
- as controllers of major public buildings and other facilities and hence as major energy users;
- as the level of government most concerned with consumption and welfare;
- as the level of government most concerned with local economic development and at certain times with urban reconstruction or expansion.

Some local authorities – usually Labour metropolitan councils – supported or acted as a focus for campaigns after nationalisation to bring more control over energy provision back to a local level. This role often figured in the articulation of more general alternative energy strategies. Because of the potential energy savings and other social benefits associated with them, DH and CHP were usually prominent in these visions, and the generic argument for city-wide schemes, their feasibility and their long-term economic viability, was established by the 1980s.

3.3 In their attempts to introduce DH, local authorities often faced

- severe financial constraints and close financial control by central government;
- limits to their planning powers;
- legal constraints on their productive activities;
- arduous processes for securing approval and finance;
- more stringent controls over the financial operation of schemes than applied to the major energy providers – ostensibly to prevent subsidy across local authority activities, and in effect forcing them to apply strictly commercial terms of appraisal instead of allowing them to pursue the public objectives that had inspired their involvement in DH; and
- at times attempts by central government to reduce the scope and scale of their responsibilities.

From the time of nationalisation of the energy industries – up to which point municipal enterprises had comprised a large part of the sector – their involvement in energy provision largely ceased and their related expertise and interest declined

rapidly. All these limits affected to differing extents at different times the ability and inclination of local authorities to pursue DH.

4 Energy providers

- 4.1 CHP and DH were always at best a peripheral or secondary activity for the major organisations in the energy sector. Few of the municipal or private energy enterprises before nationalisation undertook schemes or showed interest in them. With the exception of the coal and oil industries for a brief period in the 1960s when particular conditions of competition in the domestic heating market encouraged them to try offering heat service packages, the nationalised energy industries regarded bulk heat supply as incidental or irrelevant to their main activities. They either neglected CHP and DH or at times were dismissive or hostile towards them.
- 4.2 The nationalised electricity industry never took a leading role and did little actively to implement CHP, despite adequate powers, a nominal duty and occasional pressure from central government to do so. It certainly never entertained the idea of designing the future electricity system with CHP as an integral part rather than as an adjunct. The industry mostly only responded to proposals brought to it, and then reacted cautiously and conservatively, with little enthusiasm or commitment. It was reluctant to get involved in joint ventures, and tried after early bad experiences to avoid incurring any costs or long-term commitments as a heat supplier or in its purchase of electricity from independent CHP plant, and to displace as much of the cost and risk onto other parties.³ As a secondary activity, CHP was often subjected to more stringent financial appraisal than mainstream investment. All these features of its treatment of CHP contrast markedly with that of mainstream generation projects. Because its approach was largely reactive, the industry appeared indifferent to CHP much of the time, but it did react sharply to the idea when it became associated with basic criticisms or opposition to its main programmes.
- 4.3 Times of major reorganisation in the sector – particularly around nationalisation and privatisation, when despite the obvious differences there were striking parallels in the way CHP and DH struggled to get established – allowed arguments for the options to be aired and alliances to be built around the idea. There was a fluid phase in which possibilities existed for significant introduction. In different ways however they got caught up in issues over which the new terms of operation and governance of the sector, and the positions and objectives of the new players, were being contested and worked out. With their requirements for coordination and longer-term planning and investment, CHP and DH lost out in the assertion of short-term objectives, and in the programme and priorities in generation that emerged. These were also periods – far from coincidentally – in which government [5.1] ultimately retreated from active energy policies and divested itself of the controls and expertise it would have needed to intervene effectively in the sector.
- 4.4 Though obviously the institutional terrain onto which CHP would have to fit after 1990 changed dramatically with the disaggregation, privatisation and liberalisation of the electricity industry, no clear pattern emerged in the first few years of their effect on the technology. A variety of CHP schemes of a range of sizes, for industrial process heat and for DH, did proceed and many more were proposed, but it was not clear how significant this influx would be, nor whether it would be sustained. Proponents of the changes argued that removing the entrenched and technologically monolithic generation monopoly, access to electricity markets, and an influx of new thinking on technologies, would intrinsically favour a diversity of generation sources. Some specific disadvantages

in the initial market system, particularly for smaller CHP operators, were removed. Sceptics however pointed to new conditions that threatened to exclude CHP – the removal of any national planning or coordination of generation, the incumbents' new plans for power station building, the absence of direct incentives for demand-side measures, reductions in electricity prices to users that might have installed their own generation plant, new but arguably more daunting obstacles to connecting such plant to the grid, and poor rewards for the electricity fed in – and to other dramatic and probably counterproductive changes in the sector that came at the same time as its restructuring, coincidentally or otherwise.⁴ The influences on the prospects of the technology probably became more complex and unpredictable than ever, especially as the structure and regulation of the industry and markets were not established definitively at the time of privatisation but continued to evolve significantly. To the extent that CHP did show an upturn in the early 1990s, in all forms but particularly in large industrial installations and in package mini-cogeneration units, it could not be argued convincingly that this came about because of the form of the restructured sector, but still rather in most respects in spite of it; in many ways the fundamental problems were reinforced and exacerbated, it still had to fit as best it could into a system that has not been designed to suit it, and there were no evident incentives or commitment towards energy efficiency built into the new arrangements. Much of the progress in energy efficiency in the early 1990s continued to be made by politically imposed modifications of the operation of energy markets, and much of the installation of CHP was still due to the action of campaigners in identifying and ameliorating obstacles in the market and regulatory regime, and the persistence and skill of project proponents in finding ways of working within the technical, financial and political constraints.

- 4.5 CHP and DH also suffered through its entire history from an increasingly indifferent or hostile view among engineering professions as their specialisations and technological paradigms strengthened,⁵ as divisions became entrenched, and as they increasingly aligned their interests to those of major employing organisations divided by energy chain. There was a corresponding decline through the century in the number and influence of general engineers more interested in technologies operating across those divisions, and heating engineering companies remained mostly small scale – though some of these continued to lobby for the techniques with limited success through advisory bodies at local and national levels.

5 Central government

- 5.1 Government ministries responsible for energy, housing and planning only ever offered weak support for CHP and DH, and sent ambiguous or pessimistic signals on them to energy providers, local authorities and potential investors, even during periods of reorganisation in the energy sector and major reconstruction in urban areas. At times central government actively if covertly discouraged the proliferation of schemes. Its weak and fluctuating stance affected not just the national initiatives, insofar as they existed, but individual schemes as they were developed. Ironically, in the period of the greatest uptake of DH in the 1960s and 1970s, its spread resulted from a coincidence of the opportunity provided by a new wave of public housing construction and of shifts in the competitive domestic energy market; it had almost nothing to do with the primary concerns of energy policy at the time, and central government involvement was limited to minor tinkering with the legal and financial framework and making a few helpful noises.⁶

- 5.2 The only time the national potential of CHP/DH was assessed – in terms of public costs and benefits, and with a generally favourable outcome – was in the late 1970s.
- 5.3 CHP and DH were thus always disadvantaged by the absence of a national agency responsible for heat supply in general⁷ or DH in particular, able to support its introduction among the energy producers, which were
- strongly separated,
 - organised to compete in heat markets,
 - able to dominate government policy and action in the sector,
 - always keen to define their goals in commercial terms and avoid social obligations, and
 - subject only to weak sporadic attempts at political coordination on common or overlapping issues like fuel conservation.

Note and references

- 1 This paper is based on a major study and can be elaborated in most directions to any level of detail. The study divides the history of CHP and DH in Britain into five periods: up to 1940; the 40s and 50s; the 60s to the mid 70s; the mid 70s to 1990; and 1990 onwards. Though some activity and individual projects crossed the boundaries, the phases are reasonably distinct in that the character of the activity, and conditions in the energy sector, were markedly different in each.
- S Russell, *The Political Shaping of Energy Technology: Combined Heat and Power in Britain* (PhD thesis, Aston University, 1986); S Russell, 'Writing Energy History: Explaining the Neglect of CHP/DH in Britain', *British Journal for the History of Science* 26(1), Mar 1993, 33-54; S Russell, 'Combined Heat and Power in Britain', in *The Combined Generation of Heat and Power in Great Britain and the Netherlands* (Stockholm: Närings- och teknikutvecklingsverket (Swedish National Board for Industrial and Technical Development), report R 1994:29; S Russell, 'At the Margin: British Electricity Generation after Nationalisation and Privatisation, and the Fortunes of Combined Heat and Power', paper to SHOT '96, conference of the Society for the History of Technology, London, Aug 1996.
- 2 Configuring a scheme to avoid as many problems as possible does not lead to an optimal result in technical terms, for its economics, or for sizing (and heat/power ratio) in relation to on-site loads, let alone for the contribution CHP can make to total generation capacity and hence energy savings and environmental benefits.
- 3 Occasionally the regional electricity distributors, before and after privatisation, did consider CHP as a defensive move against competition from CHP installations in commercial or public buildings.
- 4 Notably the progressive severing of the obligation on the industry to buy British coal, the suspension of nuclear power generation, the deregulation of gas markets, and the rising awareness of global warming and initiatives to reduce CO₂ as well as other emissions.
- 5 Particularly in the exclusive focus of power engineers on condensing operation, economies of scale through centralisation and larger turbines, and the improvement of electrical efficiency.
- 6 This activity, and the more limited DH installation that continued into the 1980s, was also almost entirely unconnected with any push for CHP, though some proposals entertained eventual connection to CHP as a remote possibility.
- 7 A National Heat Board was proposed by the Marshall Committee on CHP/DH in 1979, but was immediately rejected by the incoming conservative government.