

Fuel supply and agriculture in post-medieval England

by Paul Warde and Tom Williamson

Abstract

Historians researching the character of fuel supplies in early modern England have largely focused on the relative contributions made by coal and the produce of managed woodland, especially with an eye to quantification. This has been to the neglect of the diversity of regional and local fuel economies, and their relationship with landscape, social structure, and infrastructural changes. This article highlights the wide range of other fuels employed, both domestically and industrially, in this period; examines the factors which shaped the character of local fuel economies, and the chronology with which these were altered and eroded by the spread of coal use; and looks briefly at the implications of this development for farming and land management.

A number of economic and environmental historians have, over the years, suggested that England made the transition from an organic to a fossil-fuel economy long before the conventional 'industrial revolution' of the eighteenth and nineteenth centuries. Nef argued in the 1930s that, by the sixteenth century, as a consequence of a serious shortage of wood caused by industrial expansion and population growth, coal was already becoming the main supplier of thermal energy in the country.¹ Nef's ideas were challenged by Coleman,² and somewhat nuanced by Hatcher,³ but the importance of an 'early' transition to a coal economy – occurring before the end of the seventeenth century, and associated to varying extents with a shortage of alternative fuels – has been restated by a number of economic and environmental historians, including Richard Wilkinson, Tony Wrigley, Brinley Thomas and Paul Warde.⁴ Others, such as George Hammersley, Robert Allen and Oliver Rackham, have disputed the specific scenario of fuel scarcity, pointing to the existence of untapped reserves of woodland where timber rotted where it fell, or the continuing capacity of consumers to supply themselves with wood

¹ J. U. Nef, *The rise of the British coal industry* (1932), pp. 158–76.

² D. C. Coleman, *The economy of England, 1450–1750* (1977), pp. 84–5.

³ J. Hatcher, *The history of the British coal industry, I, Before 1700: Towards the age of coal* (1993), pp. 5–7.

⁴ R. G. Wilkinson, 'The English industrial revolution', in D. Worcester (ed.), *The ends of the Earth: Perspectives on modern environmental history* (1988),

pp. 80–99; B. Thomas, 'Was there an energy crisis in Great Britain in the seventeenth century?', *Explorations in economic history* 23 (1986), pp. 124–52; E. A. Wrigley, *Continuity, chance and change: the character of the industrial revolution in England* (1988); id., *Energy and the English industrial revolution* (2010); P. Warde, *Energy consumption in England and Wales, 1560–2000* (2006), pp. 32–9, 67.

and timber well into the nineteenth century.⁵ Allen has also argued that, while the growth of London stimulated the provision of the cheaper fuel, coal, to the capital, energy in England was not expensive by European standards: the growth in the coal economy was more a consequence of expensive labour encouraging more energy-intensive development, employing the cheapest fuel available, rather than a particular shortage of wood.⁶ Nevertheless, while the precise mechanics and causes of the 'transition' are disputed, the position of coal as the dominant source of thermal energy in England by the late seventeenth century is now widely accepted.

Most contributions to this debate have, we would suggest, been characterized by a confusion of 'national' and 'regional' stories. Nef argued that scarcity was 'common to most parts ... rather than limited to special areas':⁷ and while evidence of readily available supplies of wood in particular areas can be used to refute this statement, this does not in itself tell us anything reliable about the overall 'national' picture. Allen has pointed out that the price trends for fuel in London and other parts of England diverge, although he only provides data on *charcoal* (a fuel involving more processing than firewood, and hence less representative of prices for wood itself) and talks loosely of comparing London data with a price series for charcoal and coal representing 'western Britain', 'the Midlands', and 'non-metropolitan England', somewhat varied designations, without providing any source.⁸ His essential point is, however, unquestionably correct. Different regions of Britain, and of England, clearly had divergent fuel economies, and these underwent varied transitions between the sixteenth and the nineteenth centuries. For some purposes it is, indeed, important to know the date of 'national transition', defined as the point at which coal began to provide more than half of England's thermal energy.⁹ But for many other enquiries, both economic and environmental in character, the date at which different *regions* and areas of the country became primarily coal using is probably more important: a rather different matter.

In this article we, first, emphasize the diversity of organic fuels in pre-industrial England, especially those other than wood, in part because these alternative energy sources have received little attention in debates and calculations concerning the date of a 'national transition'. This neglect is perhaps largely a consequence of the difficulty of assessing the importance of any of these on a *national* scale: historians have understandably been drawn to fuel sources that

⁵ R. C. Allen, 'Was there a timber crisis in early modern Europe?', in S. Cavaciocchi (ed.), *Economia e energia secc. XIII-XVIII* (2003), pp. 469–82; id., *The British industrial revolution in global perspective* (2009), pp. 84–90; O. Rackham, *Trees and woodland in the British landscape* (1976), pp. 87–99; although see also id., *Woodlands* (2006), pp. 131–2; G. Hammersley, 'The charcoal iron industry and its fuel', *EcHR* 26 (1973), pp. 593–613.

⁶ Allen, *British industrial revolution*, pp. 95–7.

⁷ Nef, *Rise of the British coal industry*, p. 161; see the reply by Hatcher, *British coal industry*, p. 32.

⁸ Allen, *British industrial revolution*, pp. 94–5.

⁹ The most detailed, but still very preliminary, attempt at quantifying national fuel supplies is that by

Warde, who estimated that coal became a more important provider of thermal energy than wood around, or a little earlier than, 1620: Warde, *Energy consumption*, p. 67. Hatcher speaks of such a transition definitely happening by around 1700 and perhaps before 1650, Rackham between the mid- and late seventeenth century, and Allen by 1700. Davidson rightly highlights the diversity of local fuel economies while asserting, on the basis of no clear quantitative evidence, that coal only became the main domestic fuel around 1840. Hatcher, *British coal industry*, I, pp. 47, 55; Rackham, *Woodlands*, p. 131; Allen, *British industrial revolution*, p. 96; C. Davidson, *A woman's work is never done: a history of housework in the British Isles, 1650–1950* (1982), pp. 74, 77.

are readily quantifiable, and that tend to relate to larger sources of supply and more extensive markets. Second, we look at some of the factors that shaped the character of local fuel economies, and the chronology with which these were altered and eroded by the spread of coal use throughout England. Last, we examine the agrarian implications of this latter development, suggesting that the use of the countryside for fuel production often placed limits on agricultural production, and that the widespread adoption of coal, especially as a domestic fuel, thus had important implications for the character of farming and the rural environment. The spread of coal use, that is, may help explain a number of significant but neglected changes in the countryside during the period of the classic 'agricultural revolution' of the later eighteenth and nineteenth centuries, and may cast additional light on some better known ones.

I

Past research into England's fuel supplies, and in particular into the chronology of coal adoption, has tended to focus almost entirely upon wood produced from managed, coppiced woodland.¹⁰ Allen, for example, based an estimate of the availability of wood fuel in England largely on a suggestion made by Gregory King in the 1690s that the area of woodland used to supply firewood amounted to 1.5 million acres (rather lower than modern estimates by Collins and Warde).¹¹ Yet it is clear that a significant proportion of the fuel used in many districts did not come from coppiced woods, but comprised a range of materials dug or harvested from commons and other marginal land. William Harrison for example, writing at the end of the sixteenth century, argued that the shortage of wood in the vicinity of London would soon drive the inhabitants of the city to burn 'fenny bote, broom, turf, gall, heath, furze, brakes, whins, ling, dies, hassocks, flags, straw, sedge, reed, rush and also seascale'.¹² Harrison clearly implies that it would be sad indeed if Londoners were to become dependent on such things, but they are offered as realistic possibilities.

Harrison's 'fenny bote', or peat, was a fuel of considerable significance, especially in upland districts, where raised bogs supplied ample reserves of *sphagnum* peat.¹³ It was extensively exploited from medieval times. In the South Pennines, for example, it has been suggested that all the peripheral blanket peats have been significantly affected by extraction, while on Dartmoor 'some areas seem to have had their altitude lowered by cutting'.¹⁴ Indeed, the paucity of ancient woodland in upland districts has in part been explained by the fact that the availability of peat made the enclosure and protection of coppices unnecessary.¹⁵ In the later

¹⁰ One of the few exceptions is a passage discussing the variety of fuels in D. Woodward, 'Straw, bracken and the Wicklow whale: the exploitation of natural resources in England since 1500', *Past & Present* 159 (1998), pp. 48–56.

¹¹ Allen, *British industrial revolution*, p. 96; E. J. T. Collins, 'The wood-fuel economy of eighteenth-century England', in S. Cavaciocchi (ed.), *L'uomo e la Foresta Secc. XIII–XVIII* (1996), p. 1100; Warde, *Energy consumption*, p. 34.

¹² G. Edelen (ed.), *The description of England: the*

classic contemporary account of Tudor social life by William Harrison (1994), p. 281.

¹³ I. R. Rotherham, *Peat and peat cutting* (2011), *passim*.

¹⁴ I. G. Simmons, *The moorlands of England and Wales: an environmental history, 8000 BC–AD 2000* (2003), p. 233; C. P. Rodgers, E. A. Straughton, A. J. L. Winchester, and M. Pieraccini, *Contested common land: environmental governance, past and present* (2011), p. 93.

¹⁵ Rackham, *Trees and woodland*, p. 93.

eighteenth century peat was still being removed on such a scale from the upland commons in parts of the North West that it was causing serious damage to the grazing. At Bolton in Westmorland in the early nineteenth century, for example, it was argued that if the common were not enclosed, it would soon be completely ruined by peat extraction.¹⁶ Peat was widely used as a fuel in the seventeenth century not only in remote rural areas but also in a number of northern towns, including York.¹⁷ It was extracted on a commercial scale in the mosses of south-west Lancashire and supplied to Ormskirk and Liverpool in the seventeenth century, in a mixed economy alongside the output of the local coalfields.¹⁸

In the lowlands peat also continued to be a significant fuel source well into the post-medieval period. In 1797 Frederic Eden reported that it was ‘the usual fuel consumed by labourers’ in Lincolnshire, and was more generally used on the Isle of Axholme.¹⁹ Although the drainage of the East Anglian Fens began in the seventeenth century, it was a protracted process, and peat was still being dug on an industrial scale in south Cambridgeshire in the late nineteenth century. The last extensive excavations, at Swaffham, were only closed at the start of the Second World War.²⁰ There were numerous other local sources. In the ‘Broad’s’ district of Norfolk and Suffolk, the kind of deep digging that created the lakes or ‘broads’, which gave the district its name, appears to have come to an end in the fourteenth century, but shallower peat excavation continued everywhere, and seems to have increased in scale in the decades around 1800, following enclosure of the valley fens.²¹ Peat was employed industrially, as well as domestically, usually in the form of peat charcoal. It was used to fire lime kilns and, alongside wood charcoal, for smelting tin and other non-ferrous metals, only finally being replaced by coal in the first half of the eighteenth century, following the development of the reverberatory furnace.²² It was, in short, even in the eighteenth century, a fuel of central importance in many areas of England and Wales.

Many other combustible materials were regularly cut from marginal land but have received little or no attention in calculations of aggregate fuel supplies.²³ Both heathlands, and to a lesser extent moors, grew significant quantities of gorse (or ‘furze’), heather (‘ling’) and other vegetation which was burned as a domestic fuel.²⁴ Such material was especially useful for oven firing but was also employed on a more general basis. In the early seventeenth century, even though coal was becoming ‘normalized’ as a fuel in and around London, Thomas Blenerhasset could comment of Horsford Heath near England’s second city that ‘This heathe is to Norwich and the cuntrye heare as Newcastle coales are to London’.²⁵ Even where trees and woods were

¹⁶ I. Whyte, *Transforming fell and valley: landscape and parliamentary enclosure in north-west England* (2003), p. 33.

¹⁷ Rotherham, *Peat and peat cutting*, p. 25.

¹⁸ J. Langton, *Geographical change and industrial revolution. Coalmining in south-west Lancashire, 1590–1799* (1979), pp. 56–7.

¹⁹ F. M. Eden, *The state of the poor: or, an history of the labouring classes in England from the Conquest to the present period* (1797), p. 566.

²⁰ A. Day, *Fuel from the Fens* (1999), p. vi.

²¹ T. Williamson, *The Norfolk Broads: a landscape*

history (1997), pp. 98–103.

²² M. Palmer and P. Neaverson, *Industry in the landscape, 1700–1900* (1994), pp. 48, 83; Simmons, *Moorlands*, p. 128.

²³ e.g. Warde, *Energy consumption*, p. 21. This is partly because there is currently no obvious way of quantifying their use.

²⁴ C. J. Humphries and E. Haughnessy, *Gorse* (1987).

²⁵ T. Barrett-Lennard, ‘Two hundred years of estate management at Horsford during the 17th and 18th centuries’, *Norfolk Arch.* 20 (1921), p. 120.

abundant, the importance of furze, in particular, is reflected in the strenuous efforts made by manorial courts to control its exploitation. At Bushey in well-wooded Hertfordshire, at no great distance from the capital, an order was passed in October 1600 forbidding the selling of furze cut from the waste to anyone living outside the manor, while in 1707 the Court Baron ruled that ‘every person that cuts furze within the manor between May Day and Michaelmas [i.e., during the summer growing season]’ would be fined 20*d.*²⁶ On the north Norfolk coast at Brancaster and Thornham furze was used as a fuel by both rich and poor, and manor courts attempted to protect supplies and promote re-growth in several by-laws passed during the sixteenth century.²⁷

Gorse was grown not only on common land. There were many areas of private heath, moor and other rough ground where it was cultivated in special enclosures, protected from grazing. Even in 1801 it was said of Sithney in Cornwall that

Here are, it is almost literally true, no trees; consequently a considerable part of every estate is under furze, which would frequently, with proper cultivation, produce whatever the cultivated lands now produce.²⁸

Heather was perhaps even more widely used as a domestic fuel, cut in the form of turves dug to a depth of at least 2.5 cm, which thus included both the vegetation and, more importantly, a portion of matted root material. Crabbe, writing in the late eighteenth century about the east Suffolk heathlands in ‘The Village’, refers to the local heaths as a source of ‘the light turf that warms the neighbouring poor’.²⁹ In the 1760s, Gilbert White, writing about the almost treeless Woolmer Forest near the south coast in Hampshire, noted how ‘such forests and wastes ... are of considerable service to neighbourhoods that verge on them, by furnishing them with peat and turf for their firing’. When the forest was enclosed in 1866, some 961 houses still claimed rights of turbarry.³⁰ At times this material reached wider markets. The Dorset port of Swanage, for example, was one of the main destinations for the turves cut from the Purbeck heaths.³¹ Broom, another characteristic plant of the heathlands, was also widely exploited for fuel and bracken was sometimes burnt on domestic fires, or used as kindling.³² Where other sources of firing were scarce and expensive, even fern could be ‘a very great help to the poore for firing’.³³

Heather, broom and gorse were all used industrially, especially for firing brick kilns. When Blickling Hall in Norfolk was constructed in 1617–21, for example, more than a million bricks were fired in kilns entirely fuelled with gorse and broom faggots brought from the heaths at nearby Cawston and Saxthorpe (although Blickling also appears to have had its own ‘Furze

²⁶ Hertfordshire Archives and Local Studies (hereafter HALS), 6398 and 6442, court rolls for the manor of Bushey.

²⁷ Rodgers *et al.*, *Contested commons*, p. 172.

²⁸ M. Turner (ed.), *Home Office Acreage Returns, HO 67. List and Analysis* (4 vols, List and Index Soc., 189–90, 195–6, 1982–3), I, pp. 33–4.

²⁹ G. Edwards (ed.), *George Crabbe: selected poems* (1991), p. 5.

³⁰ G. White, *The natural history of Selborne* (1789, 1993 edn), p. 29. We are indebted to information on the enclosure award to David Zylberberg.

³¹ Parry, *Heathland*, p. 63.

³² O. Rackham, *History of the countryside* (1986), p. 295.

³³ W. Blith, *The English improver improved* (third edn, 1652), p. 122.

Close', to judge from an estate map of 1729).³⁴ Well into the nineteenth century most of the kilns on the Bedfordshire brickfields were likewise fired using heathland vegetation.³⁵ It has been suggested that the vitrified bricks so common in seventeenth, eighteenth and even some nineteenth-century buildings throughout England, and often used in a decorative fashion, may have been the consequence of using such fuel: 'the high proportion of vitrified headers was probably a consequence of using firing materials, such as heather and gorse, which gave off fumes containing potash'.³⁶ Other industries might also be fuelled with gorse or heather turf, including lime burning, well into the eighteenth century. In short, the extensive common 'wastes' of seventeenth- and eighteenth-century England, and enclosed marginal land of similar character, produced a wide variety of fuels.

The continuing importance of peat, gorse, heather and the rest as fuel, at least for the poorer elements in society, even in the early nineteenth century is evident from the terms of numerous enclosure awards. Sarah Birtles has argued that many commons were, in the course of the eighteenth century, used less for grazing by the main farmers in a parish and more as a fuel source for the poor. In recognition of such customary uses (and presumably to reduce claims on poor relief), parliamentary enclosure commissioners often allotted an area for use as a fuel allotment, to be cut by the poor for gorse, turf or peat, although sometimes rented out from the start to provide coals for them.³⁷ In Norfolk alone no less than 250 parishes had such allotments, some relatively small but others – as at Bridgham or Feltwell – extending over more than 100 hectares.³⁸ In addition, a number of parishes in the same county – as many as 146 as late as 1845 – remained unenclosed, or were only partially enclosed, again mainly to leave sufficient firing for the poor.³⁹ In many other parts of England where extensive areas of heath, moor or fen survived enclosure, traditional fuels continued to be exploited. As late as 1858 a total of six million heather turves were still being cut each year in the New Forest.⁴⁰

In Midland areas, where the pre-enclosure landscape contained fewer heaths and fens, allotments for fuel were less common, although still sporadically made. They were most frequent in forest districts, such as Rockingham, where most enclosure acts made such provision for the poor, a clear recognition of their previous rights to collect fuel from the forests. But a few were also made elsewhere, in the case of Northamptonshire in villages outside the forests at Clipston, Aldwinckle, Harlestone, Wappenham, Wadenhoe, Wollaston, specifically in compensation for the loss to the poor of gorse, thorns and bushes.⁴¹ In upland areas, however, the extent to which peat remained a major source of fuel is clear from the way that enclosures often allocated, to those receiving allotments, a 'moss dale' where they could cut peat: 'these usually show up on award maps as relatively small areas divided into large numbers of narrow rectangular strips'.⁴² Such allotments continued to be made into the

³⁴ Norfolk RO, MC₃/45. Blicking Hall, map of 1729, no catalogue number.

³⁵ A. Cox, *Brickmaking: a history and gazetteer* (1979), p.27.

³⁶ *Ibid.*, pp. 28–9.

³⁷ S. Birtles, "'A green space beyond self interest': the evolution of common land in Norfolk, c.750–2003" (unpublished PhD thesis, University of East Anglia,

2003).

³⁸ *Ibid.*, pp. 196, 307–9.

³⁹ *Ibid.*, pp. 304–5.

⁴⁰ Parry, *Heathland*, p. 62.

⁴¹ R. Liddiard, T. Partida and T. Williamson, *Cham-pion: the making and unmaking of Midland landscapes* (2013), p. 152.

⁴² Whyte, *Transforming fell and valley*, p. 76.

middle decades of the nineteenth century, as at Troutbeck in Westmorland in 1840. They were exploited by the farmers, as much as by smallholders and cottagers.⁴³

II

In a world in which peat, gorse, heather and other materials cut or dug from heaths, moors, fens and other rough ground are seldom used as fuel, it is easy to forget the contribution that they made to energy supplies in the past. But other significant sources of fuel have also been largely ignored by historians, for it is clear that much of the fuel wood consumed in England did not in fact come from coppiced woodland at all. A major contribution was made by hedges and farmland trees.

Hedges were the main form of field boundary in lowland England. They needed to be rigorously managed, otherwise they would develop into a line of unconnected shrubs and trees, and this was achieved in two main ways, both of which would of necessity have produced significant quantities of wood, more likely to have been used as fuel than simply burnt *in situ*. The most familiar is perhaps *laying* or *plashing*, which took a number of regional forms but essentially involved hacking back the hedge with a billhook, removing lateral suckers, dead material, many of the main branches, unwanted species and much of the twiggy growth. Some of the principal stems were allowed to remain, cut roughly three quarters of the way through and bent at an angle of 60 degrees or more so that each overlapped its neighbour. In the spring, when growth resumed, a thick, impenetrable wall of vegetation was created.⁴⁴ But laying was never the only method of management, for in many districts hedges were *coppiced*: their constituent shrubs would simply be cut down, at intervals of between ten and twenty years, usually to within a few centimetres of the ground but sometimes at a height of around 0.6–1.0 metre.⁴⁵ Some local traditions recorded in the early nineteenth century, as in Middlesex, combined elements of both practices.⁴⁶

Coppicing produced more fuel wood than laying, but even laying produced very significant quantities, although in both cases much would depend on the kinds of shrubs growing within the hedge, with hawthorn and blackthorn being less useful in this respect than species like ash, oak, elm, hazel, hornbeam and maple. By the end of the eighteenth century, hedges were usually planted solely with hawthorn or blackthorn, or with a combination of these species, and single-species thorn hedges were also recommended by some seventeenth-century agricultural writers, such as John Worlidge.⁴⁷ But as Wendy Johnson demonstrated many years ago, the evidence of numerous other early writers, including Fitzherbert and Norden, as well as the comments of foreign visitors and others, indicate that the planting of mixed hedges was common in the early modern period and continued into the eighteenth century.⁴⁸ Pehr Kalm,

⁴³ Ibid.

⁴⁴ R. and N. Muir, *Hedgerows: their history and wild-life* (1997), pp. 96–104.

⁴⁵ N. Kent, *General view of the agriculture of Norfolk* (1796), p. 182; W. Stevenson, *General view of the agriculture of Lancashire* (1815), p. 212.

⁴⁶ J. Middleton, *General view of the agriculture of the*

County of Middlesex (1813), p. 150.

⁴⁷ J. Worlidge, *Systema Agriculturae; the mystery of husbandry discovered* (1681), p. 101.

⁴⁸ W. Johnson, 'Hedges: a review of some early literature', *Local Historian* 13 (1978), pp. 197–9; J. Fitzherbert, *The Boke of Husbandry* (1533), p. 53; John Norden, *The Surveyor's Dialogue* (1618), p. 201.

a Scandinavian traveller who came to England in 1748, typically noted how, in the Chilterns Hills in Hertfordshire, hedges were planted with a mixture of hawthorn and sloe but that in addition the farmers 'set here and there, either at a certain distance or length from each other, or just as they please, small shoots of willows, beeches, ash, maple, lime, elm, and other leaf-trees'.⁴⁹ A number of studies of the character of hedges surviving in the modern landscape have similarly concluded that mixed-species planting was normal before the eighteenth century.⁵⁰ Landowners planted a range of shrubs partly because it was often hard to source large quantities of hedging thorn but also because, while the latter made a good stock-proof barrier, it had few other practical uses, made indifferent firewood, and was awkward to handle. Useful species might also be added some time *after* hedges had been planted. Arthur Young described in the early nineteenth century how in Hertfordshire the need for firewood had 'induced the farmers to fill the old hedges everywhere with oak, ash, sallow and with all sorts of plants more generally calculated for fuel than fences'.⁵¹

The significance of hedges as a fuel source is frequently referred to in early modern sources. Thomas Tusser typically contrasted the open-field or 'champion' districts of England with the early-enclosed 'woodland' areas, in which 'in every hedge' there was 'plenty of fuel and fruit'.⁵² Advocates of early enclosures often cited the improvements in fuel supply that would result from the planting of hedges; Walter Blith claimed that if more hedges were planted 'No man almost in the nation would be either at want of firing'.⁵³ Even in the late eighteenth and early nineteenth centuries, when single-species planting had become the norm, older hedges were still a major source of fuelwood. William Marshall noted in 1787 how, in north-east Norfolk, the 'old hedges, in general, abound with oak, ash and maple stubs, off which the wood is cut every time the hedge is felled; also with pollards, whose heads are another source of firewood'. The entire supply of wood in the district, he added, 'may be said, with little latitude, to be from hedge-rows'.⁵⁴ The great density of hedges in the sixteenth, seventeenth and eighteenth centuries in many old-enclosed districts in south-eastern England, the West Country, and southern East Anglia may, in part, be explained by their role as a fuel source. A 'Particular of Mr Rodwell's Farm' in the Norfolk parish of Diss, for example, made in 1771, describes 21 fields with an average size of less than three acres.⁵⁵ This was an extreme case: but maps and surveys nevertheless suggest that in all areas hedges formed a dense and intricate web across the landscape.

As the quotation from Marshall indicates, most hedgerows contained pollarded trees. Where farms were rented, especially in areas where there was a high demand for fuel, leases often

⁴⁹ Johnson, 'Hedges', p. 200; P. Kalm, *Kalm's Account of his visit to England on his way to America in 1748*, trans. J. Lucas (1892), p. 108.

⁵⁰ A. Willmott, 'The woody species of hedge with special reference to age in Church Broughton Parish, Derbyshire', *J. Ecology* 68 (1980), pp. 269–86; J. Hall, 'Hedgerows in West Yorkshire: the Hooper method examined', *Yorkshire Arch. J.*, 54 (1982), p. 105; G. Barnes and T. Williamson, *Hedgerow history: ecology, history and landscape character* (2005), pp. 73–96.

⁵¹ A. Young, *General view of the agriculture of*

Hertfordshire (1813), p.49.

⁵² G. Grigson (ed.) *Thomas Tusser's five hundred points of good husbandry* (1984 edn), p. 281.

⁵³ Blith, *English improver improved*, p. 113; M. Reed, 'Pre-parliamentary enclosure in the East Midlands, 1550–1750, and its impact on the landscape', *Landscape Hist.* 3 (1981), pp. 60–8.

⁵⁴ W. Marshall, *The rural economy of Norfolk* (2 vols, 1787), I, p. 96.

⁵⁵ Norfolk RO, NRS 12793 3F F8.

laid down detailed stipulations regarding the management of both, normally reserving the 'bolling' or trunk of the pollards to the landlord, restricting the frequency with which hedges and pollards could be cropped and sometimes insisting that pollards should only be cropped when the hedges in which they stood were plashed or otherwise 'new made'. A lease drawn up in 1657 for a farm in Ridge in Hertfordshire thus allowed the tenant 'to lopp all the pollard hasells, maples, sallows, willows, hawthorns & hornebeame trees growing in the severall hedges, fields, dells & hedgrows', provided that he 'lopp and cutt but one tenth part of all the pollards hasells, maples, sallowes, willows, hawthorns & hornbeams every year for and during the last nyne yerres' of the term.⁵⁶ An agreement from 1693 concerning a farm in Aldenham in the same county stipulated that the tenant 'shall not lopp or cutt or cause to be lopped or cut any of the pollards growing upon the premises but when the hedges shall be new made and ditches scoured where the sayd pollards do grow'.⁵⁷

Pollards also grew free-standing in pastures and meadows, while in many districts, including the Chilterns, the Home Counties north of London, and East Anglia, they were often grouped into 'rows', three or four deep, on the margins of pasture fields, or on 'hedge greens', unploughed strips of land on which the ploughteam could turn, and which was mown for hay or used for grazing tethered cattle.⁵⁸ The number of trees growing in fields and hedgerows shown on early maps, (and recorded in surveys), in old-enclosed districts is often astonishing. A farm survey made at Denham in Suffolk in 1651, for example, suggests that there was an average of 38 trees per hectare, while at Thorndon in the same county, another, made in 1742, implies as many as 72 per hectare.⁵⁹ These may have been extreme cases, for the tenant of the latter property complained to his landlord about the density of pollards on the farm, and data from nine surveys examined by Rackham, from farms in Essex, Suffolk and Norfolk made between 1650 and 1771, suggest an average of only c.25 trees per hectare.⁶⁰ On the other hand, a set of detailed maps drawn up as late as the mid-eighteenth century by Henry Keymer for farms in Norfolk, which record every hedgerow tree on the properties surveyed, suggest an average density of around 37 per hectare.⁶¹ As late as 1784 a survey of West End Farm in Wormley in south-east Hertfordshire recorded an incredible 1496 trees scattered through 28 fields covering a mere 38 hectares.⁶² What is even more striking is the proportion of farmland trees that were pollarded, rather than grown for timber. On a farm in Beeston near Mileham in Norfolk, surveyed by Keymer in 1761, there were 413 pollards, but only 104 timber trees: that is, 80 per cent of the trees were pollards.⁶³ Timber surveys from elsewhere suggest very similar ratios, in the 70–80 per cent range: on a farm at Stanfield in the same county in c.1798 there were 192 pollards to 66 timber trees (74 per cent pollards); on a farm at nearby Whissonset, at around the same

⁵⁶ HALS, D/ECd/E14.

⁵⁷ HALS, D/EAm/E3.

⁵⁸ D. Walker, *General view of the agriculture of Hertfordshire* (1795), p. 154; S. Wade Martins and T. Williamson, *Roots of change: farming and the landscape in East Anglia, c.1700–1870* (1999), p. 25; E. Martin and M. Satchell, *Where Most Inclosures Be: East Anglian fields, history, morphology and management* (2008), pp. 343–4.

⁵⁹ J. Theobald, 'Changing landscapes, changing

economies: holdings in woodland High Suffolk, 1600–1840' (unpublished MA dissertation, University of East Anglia 1993); West Suffolk RO, T1/1/6.

⁶⁰ Rackham, *History of the countryside*, pp. 218–21.

⁶¹ Norfolk RO, WIS 138, 166X3; PD 703/45–6. See also G. Barnes and T. Williamson, *Ancient trees in the landscape: Norfolk's arboreal heritage* (2011), pp. 64–82.

⁶² Together with 569 'spars' or immature specimens: HALS, D/EBb/E27.

⁶³ Norfolk RO, WIS 138, 166X3

time, 131 pollards and 59 timber trees (70 per cent pollards) and, a few years earlier, 309 to 133 (again, 70 per cent); while at Thorndon in Suffolk in 1742, 80 per cent pollards.⁶⁴ Occasionally the proportion was even higher: 91 per cent at West End, Wormley, in Hertfordshire in 1784; and apparently reaching 100 per cent on a property at Ickburgh in Norfolk in 1651.⁶⁵

Pollards were not only found on farmland. In many districts they were also a prominent feature of commons, including some heaths.⁶⁶ Sometimes they were present in only small numbers, often located towards the margins, but even in the later eighteenth century some commons still carried substantial quantities, in spite of the fact that wood pastures were, by their nature, inherently unstable environments. Their trees were vulnerable to damage from stock, through the stripping of bark for example, or the compaction of the ground above their root systems. More importantly, once trees died, were blown down or were felled, it was difficult to establish replacements in the face of sustained grazing pressure. It is usually assumed that such problems were more serious on commons than in parks and other private grounds because it was difficult to fence off portions of land to protect new trees (or indeed for any other purpose) as this came into conflict with the rights of commoners to access and exploit the common.⁶⁷ Recent research by Patsy Dallas, however, suggests that management systems existed that allowed or encouraged the replacement of lost trees on common land.⁶⁸ During a legal dispute in the late sixteenth century concerning the commons at Pulham in Norfolk, for example, it was stated that ‘The tenants of the said manor have used to make benefit of the trees growing upon the common near their houses which were planted by themselves and their predecessors’.⁶⁹ A manorial survey of 1579, relating to the parish of Gressenhall in the same county, records that when tenants were admitted to holdings they received one or more ‘plantings’.⁷⁰ A detailed map of the parish surveyed in 1624 shows that ‘plantings’ were areas of scattered trees growing on the various commons, in some cases so dense that the areas in question were effectively wooded. They are associated by name with the owners close to whose homes they were located.⁷¹ Such customs certainly continued in many places into the eighteenth century. Francis Blomefield, in his *Topographic History of the County of Norfolk* of 1739, described how the tenants of his home parish of Fersfield had:

Liberty to cut down timber on their copyholds, without licence and also to plant and cut down all manner of wood and timber on all the commons and wastes against their own lands, by the name of an outrun.⁷²

These customs were not restricted to Norfolk, but have been noted in Hertfordshire and Essex and were probably common elsewhere.⁷³

⁶⁴ Norfolk RO, PD 703/45–6; West Suffolk RO, T1/1/6.

⁶⁵ Norfolk RO, Walsingham XXVI/4, 414X6.

⁶⁶ G. Barnes, P. Dallas, H. Thompson, N. Whyte and T. Williamson, ‘Heathland and wood pasture in Norfolk: ecology and landscape history’, *British Wildlife* 18 (2007), pp. 395–403.

⁶⁷ Rackham, *History of the countryside*, pp. 121–2.

⁶⁸ P. Dallas, ‘Sustainable environments: common wood pastures in Norfolk’, *Landscape Hist.* 31 (2010), pp. 23–36.

⁶⁹ Norfolk RO, NAS II/17.

⁷⁰ Norfolk RO, MR61 241X1.

⁷¹ Norfolk RO, Hayes and Storr 72.

⁷² F. Blomefield, *Topographic history of the county of Norfolk* (11 vols, 1805), I, pp. 95, 739.

⁷³ See, for example, the papers relating to a dispute between Wheathampstead manor and Rothamsted manor over Harpenden Common, 1839–43: HALS, DE/Lw/E16.

Although the tenants usually had the right to crop pollards on commons, this was not always the case, and in south-east Hertfordshire the right to crop was sometimes in the hands of the lord of the manor and could only be enjoyed at a price. In this district the commons carried vast numbers of pollards. When in 1695 the commoners went to law in an abortive attempt to prevent their manorial lord, Sir Henry Monson, from felling the hornbeam pollards growing on Cheshunt Common, it was said that there were 24,000 on 1186 acres: that is, a density of around 50 per hectare.⁷⁴ Estate accounts show that Monson's descendants were still lopping the pollards on nearby Broxbourne Common as late as 1778 on a 12-year rotation. No less than 3809, again probably hornbeams, grew on 60 acres, a density of over 155 per hectare.⁷⁵ The large numbers of pollards on the commons of south-east Hertfordshire may be due to the proximity of London, and the market it provided for fuel, but commons in many other districts retained significant numbers of trees into the later eighteenth or nineteenth centuries, especially in the royal forests.

III

It is important to note the extent of regional variation in the availability of 'traditional' fuels, not least because this will have had an impact on the speed with which coal was adopted by local communities. The local abundance or otherwise of a particular resource was usually in sharp contrast to its national prominence. Some districts thus contained large numbers of hedgerow trees and hedges, others very few; woodland was abundant in some regions but not in others. In lowland England these particular variations to some extent followed the familiar distinction between 'champion' and 'woodland' areas. The former, mainly located in the Midlands and on the principal exposures of chalk in southern and eastern England, were characterized by nucleated villages, which, in the Middle Ages and often into the eighteenth and nineteenth centuries, cultivated extensive open fields. In contrast, in 'woodland' districts, which occupied the western counties of England and most of the South East, including southern East Anglia, open fields either never existed or had largely disappeared at an early date, so that, by the seventeenth century, the majority of farmland lay in hedged closes. The majority of coppiced woodland was also to be found in these kinds of landscape.⁷⁶

However, the distinction between the 'two countrysides', at least by the seventeenth century, should not be too firmly drawn. Some extensive tracts of wood-pasture and woodland survived in the heart of the 'champion' Midlands, and especially in royal forests like Salcey, Rockingham or Bernwood.⁷⁷ Around the nucleated villages there had always been private crofts and other closes, all bounded by hedges, most of which contained pollards, and some trees and hedges also existed away from settlements, especially on parish boundaries: the boundary of East Farndon in Northamptonshire, a parish which was not enclosed until 1780,

⁷⁴ HALS, 10996 A/B.

⁷⁵ HALS, D/EBb/E26.

⁷⁶ B. K. Roberts and S. Wrathmell, *Region and place: a study of English rural settlement* (2002), p. 24.

⁷⁷ R. C. Thomas, 'Traditional woodland management

in relation to nature conservation', in J. Broad and R. Hoyle (eds), *Bernwood: the life and afterlife of a forest* (1997), pp. 108–25; P. A. J. Pettit, *The royal forests of Northamptonshire: a study in their economy, 1558–1714* (1968).

was marked by a hedge in 1684, even though adjacent townships still remained open.⁷⁸ Hedges sometimes surrounded one or more of the open fields, as at Upper Boddington or Crick in the same county;⁷⁹ the meadows, as at Weston and Weedon;⁸⁰ and both consolidated and dispersed demesne land, as at Farthinghoe and Gretton.⁸¹ Early maps often show short or discontinuous fragments of hedge within the open fields, of uncertain origins, but often in considerable numbers, as at Murcott or Wollaston.⁸² They also indicate that the hedges within the fields contained trees, while trees could also be found free-standing on commons in some numbers.⁸³ Moreover, much early enclosure of the open fields took place in champion districts: even within the archetypical champion county of Northamptonshire, around half the townships had been fully enclosed before the first parliamentary enclosure act was passed in 1732, and most others had experienced some degree of partial, piecemeal enclosure.⁸⁴ Many of the hedges planted when such enclosures were made contained a mixture of woody shrubs as well as pollarded trees.

Other fuel sources in the seventeenth and early eighteenth centuries similarly exhibited distributions which were not only very uneven but also very complex, hard, if not impossible, to map on a national scale with any degree of confidence. Heaths for example, supplying gorse and heather, occupied poor, infertile soils overlying porous and acid sands and gravels. Charting their distribution is difficult, not least because late eighteenth-century county maps, while they frequently label such areas as 'heath', often describe them more neutrally as 'common'. In addition, vast areas of heathland were eradicated entirely during the period of the agricultural revolution, often before the earliest maps were surveyed. Many of these lost areas were associated with relatively small patches of sand and gravel, often unnoticed on modern geology maps or even destroyed entirely by the very process of 'improvement' itself, as in the case of the thin bands of sand, overlying chalk, which gave rise to the so-called 'chalk heaths'.⁸⁵

The actual amount of fuel produced by the various kinds of 'waste' in any district is also difficult to calculate, even where their extent is known, because it depended not only on their extent but also on how they were managed. In some districts vegetation cut from marginal land had important alternative uses, as animal bedding or thatching, or as raw materials in the manufacture of potash, potentially reducing the quantity available for burning. More importantly, the amount of fuel produced by such rough land was determined by the intensity of agricultural exploitation – by the extent to which the ground in question was used for grazing – for where this was intense, gorse and broom could not grow into the large, woody plants suitable for firewood. John Norden, writing in 1618, described the gorse in the West Country, which grew 'very high, and the stalke great, whereof the people make faggots'. He continued:

⁷⁸ D. Hall, *The open fields of Northamptonshire* (1995), p. 264.

⁷⁹ *Ibid.*, p. 234; Northamptonshire RO, Map 3133.

⁸⁰ BL, Add Ms 78141A; Northamptonshire RO, Map 4341.

⁸¹ Hall, *Open Fields*, p. 264; Northamptonshire RO, Enclosure Plan 17.

⁸² BL, Add, Ms 78141A; Northamptonshire RO, Map

4447.

⁸³ As at Weekley, Quinton, Easton on the Hill, Castor and Ailsworth, and Wollaston, Northamptonshire RO, maps 1349, 2895, 60p/504, and 4447.

⁸⁴ D. Hall, 'Enclosure in Northamptonshire', *Northamptonshire Past and Present* 9 (1988), pp. 351–68.

⁸⁵ Barnes *et al.*, 'Heathland and wood pasture in Norfolk', pp. 395–7.

And this kind of Furse groweth also upon the Sea coast of *Suffolke*: but that the people make not the use of them, as in *Devonshire* and *Cornwalle*, for they suffer their sheep and cattell to browse and crop them when they be young, and so they grow too scrubbed and lowe tufts, seldome to that perfection that they might be.⁸⁶

In the case of lowland fens the amount of fuel extracted was similarly often limited by the conflicting demands of agriculture. Most such land was common land, and manorial courts evidently restricted, in some circumstances, the extent of peat extraction because it would of necessity reduce the amount of grazing available to commoners: it took decades for the ponds to 'terrestrialize', and even when they finally did so the grazing was usually dominated by reeds and other vegetation unpalatable to stock. At Martham in Norfolk, as early as 1404, two men were prosecuted for digging peat from part of the common which should have been left for hay; in 1509 an order was made forbidding the extraction of peat from all the commons in the parish, with the exception of Cess Heath and part of South Fen.⁸⁷

Similar issues relate to the amount of fuel produced by hedges, for these varied significantly not only in number but also character. Most hedges for example were probably no more than two metres in width but in some districts they could be more like linear woods. James Parnell thus described in 1769 how in Hertfordshire

the oak and elm hedgerows appear rather the work of nature than plantations generally extending 30 or 40 feet broad growing irregularly in these stripes and giving the fields the air of being reclaim'd from a general tract of woodland.⁸⁸

Such variations presumably arose from the extent to which farmers put a premium on the production of fuel over that of food, for hedges of the kind described by Parnell not only took up large amounts of productive land but also cast shade over the adjoining fields. A further consideration may have been the character of the local farming economy, with livestock producers perhaps less bothered by such matters than arable farmers – tall hedges might inhibit grass growth to some extent, but would themselves have provided some sustenance (as well as shelter) for sheep and cattle. Similar calculations must have structured the density of pollarded trees on farmland, and perhaps on commons. We should also note that the amount of fuel produced by managed woodland, but also to some extent by pollards and hedges, must have depended to some extent on how far wood was needed for other purposes in the local economy.

The intensity with which the countryside in any district was exploited for fuel may to some extent have been dependent on population density: the kind of fuel sources with which we are concerned will presumably have been exploited to a lesser extent in areas where few people actually lived. This issue is rendered complex, however, by the fact that the more marginal sources of firing were disproportionately used by the poorer elements in society, and questions of local social structure, and of the character and extent of common rights, might thus affect the extent of their use. Comments by contemporaries need to be read in this light. Timothy Nourse, writing at the end of the seventeenth century, thought that the cutting of fuel from

⁸⁶ Norden, *Surveyor's Dialogue*, p. 235.

⁸⁷ Williamson, *Norfolk Broads*, p. 83.

⁸⁸ LSE, Misc 38/3, fo. 8.

hedgerows was no longer worth the cost of labour, and one was better off planting quicksets. But this is the view of the yeoman farmer, not the smaller husbandman or cottager.⁸⁹

The most direct way to assess the scale and character of local fuel demand, and to discover how this changed during the course of the seventeenth and eighteenth centuries, should be through the direct records left behind by households and industry. Unfortunately, while much data of this kind exists, it is skewed towards particular groups (especially institutions, wealthier households with accounts, and recipients of poor relief). Secondary estimates of demand vary widely: Alberry has noted that in the eighteenth century it was believed that a cottager and his family would need between 25 and 50 tons of fuel wood per annum, equivalent to around 40 to 80 cubic metres, an improbably large amount to be consumed on any scale.⁹⁰ Rather more modestly, we can infer from Timothy Nourse's estimates on London's fuel supply that its half million inhabitants in 40,000 houses with some 360,000 chimneys, would consume 400,000 loads of firewood per annum, an amount equivalent to about a load per person, or a little less than 1.5 cubic metres of solid wood, although Nourse noted a nobleman's house might consume 40 loads.⁹¹ Nourse's estimate falls more in the range of estimates for other European countries but is no more than a figure he found plausible, and in any case tells us little about the character of fuel mix and local consumption across broad swathes of the country.⁹²

Longitudinal price series for fuels remain surprisingly rare and the literature has generally drawn on a limited number of institutional prices, often from diverse places. Given what we have noted about the localized nature of fuel markets, providing fuels of very diverse quality, these can tell us relatively little beyond the most general trends, although they do indicate huge regional diversity; especially in coal prices, which were ten times higher in Hitchin (Herts.) than in Derby in the 1690s, for example.⁹³ Despite the compilation of price series by authors such as Thorold-Rodgers or Beveridge, or the careful tracing of pithead coal prices in Lancashire by John Langton, we still await a systematic and comparative study of fuel price.⁹⁴

Much about the nature of local fuel economies in the early modern period thus remains unclear, and would repay further research. But there is no doubt that, at a local and even regional level, traditional fuels must have made a considerable contribution to energy supplies in the seventeenth and eighteenth centuries. Turbaries and wood-pastures in particular must have produced very large quantities of fuel; and even where only bracken, scrub, gorse and heather were available, they were often present in significant quantities. There were probably around 33,000 square kilometres of moor, marsh, fen and other 'waste' in seventeenth-century England, out of a total land area of 130,000 square kilometres. It is, however, very uncertain

⁸⁹ T. Nourse, *Campania Foelix* (sec. edn, 1706), p. 28.

⁹⁰ A. Alberry, 'Woodland management in Hampshire, 900 to 1815', *Rural Hist.* 22 (2011), p. 164.

⁹¹ This is based on a cart 'load' being just under a ton of wood. Nourse, *Campania Foelix*, pp. 351–2.

⁹² The forthcoming PhD thesis of David Zylberberg on Hampshire and the West Riding of Yorkshire will be a very welcome step towards building up a more precise and thorough regional picture. For an exemplary study of medieval supply, although with little evidence on

consumption levels, see J. Galloway, D. Keene and M. Murphy, 'Fuelling the city: production and distribution of firewood and fuel in London's region, 1290–1400', *ECHR* 49 (1996), pp. 447–72. On European comparisons, see P. Warde, 'Fear of wood shortage and the reality of the woodlands in Europe, c.1450–1850', *History Workshop J.* 62 (2006), pp. 28–57.

⁹³ Figures from Houghton, cited in Hatcher, *British coal industry*, I, p. 52.

⁹⁴ The authors hope to conduct such a study.

how much difference all this makes to current estimates about precisely when the nation as a whole made the transition to a coal-burning economy. In addition to the problems we have outlined above, much uncertainty surrounds the amount of thermal energy produced by these fuels. Pollarded trees for example were clearly a key resource; but even where we know their density, we have little real information about the volume of wood that pollards actually produced. Arthur Standish, in the 1610s, reckoned that after two decades a tree could produce at least 6*d.*-worth of lop every eighth year but, like other estimates, much must have depended on species, soil, drainage and proximity to other trees.⁹⁵ The contribution made by peat, gorse, heather, broom, bracken, sedge and other materials cut from commons and other rough ground is particularly hard to estimate, not least because the calorific value of such materials has been little researched. This said, if the thermal energy produced by this range of fuel sources could be effectively estimated, then the date of national ‘transition’ (usually calculated, as we have noted, on a comparison of recorded coal production with estimates of the amount of fuel produced by managed woods) might need to be adjusted, perhaps to a significant degree.⁹⁶ But far more important was the impact of the spread of coal use at a regional level, on localized fuel economies, and thus on the landscape and environment.

IV

In the absence of detailed studies of local fuel economies, it is difficult to chart this development except in the broadest terms. Coal was unquestionably in widespread use as a domestic as well as an industrial fuel across much of northern England and in parts of the Midlands by the middle of the seventeenth century, but assessing the rate of its wider adoption is made complex by the tendency – already noted – for fuel use to be not only geographically but also socially differentiated. In Herefordshire in 1805 it was believed that ‘Coal is in general use as fuel as by as many of the inhabitants as can afford the purchase of it’, at prices for Forest of Dean coal brought by ship and wagon that hint at a generally high cost of fuel in these parts.⁹⁷ In 1791, according to a government survey, coal was the most important fuel in Devon in the ‘houses of creditable people, but the poor burn no coals, and very little wood, on account of the expense ... most of their fuel is turf or peat.’ But the same source makes it clear that most areas of the country were at least partly coal-using. Only in Durham, Yorkshire, Nottinghamshire, Staffordshire, Lancashire, Cheshire and the Welsh counties of Carmarthenshire and Flint was it reported that coal played little part in the local economy.⁹⁸

That this general diffusion of coal use amongst the wealthier elements of rural society mainly occurred in the middle and later decades of the eighteenth century, rather than earlier,

⁹⁵ A. Standish, *The commons complaint* (1611), pp. 6–7; id., *New directions of experience* (1616), p. 14.

⁹⁶ Merely as an illustration of the parameters involved, if we estimate that the total energy provided by ‘traditional’ fuels was twice as high as current estimates, which are based on the supply of firewood alone, this would move the date of ‘transition’ from the 1620s to the late 1660s.

⁹⁷ J. M. Ducumb, *General view of the agriculture of the county of Hereford* (1805), p. 141.

⁹⁸ *Journals of the House of Commons*, 47, 1792, 13 Feb. 1792, pp. 328–30. See also the reporting of turf and peat used extensively in Cumbria, mid-Wales and Barkham in Berkshire in D. Davies, *The case of labourers in husbandry stated and considered in three parts* (1795), *passim*.

is suggested by the character of vernacular buildings, the houses occupied by the 'middling sort'. In the middle of the sixteenth century open halls went out of fashion and open hearths were gradually replaced by large 'inglenook' fireplaces, set in massive stacks that occupied a significant proportion of a house's ground area.⁹⁹ Yet this change does not reflect the rapid expansion of coal use in Elizabethan England. A chimney-stack of this kind, in Smith's words, represented 'a very large cover placed over an open hearth, the heat from which was never intended to be so great as to affect the structure above it'.¹⁰⁰ Such stacks usually battered inwards markedly, in order to increase the draught. These characteristics, and in particular the width of the fireplaces themselves, indicate that vernacular houses in the sixteenth and seventeenth centuries were largely designed for burning wood and similar organic fuels: coal does not burn well in these circumstances, as anyone who has tried will appreciate. The shift to hearths and stacks more suited to burning coal, and the resulting changes in the design of houses, appear to have occurred at different rates in different areas. In Hertfordshire, near London, Smith has noted that in the late seventeenth century stacks began to be constructed that rose vertically on all four sides, quite possibly indicating a shift to the burning of coal although perhaps mixed with charcoal or other organic fuel, for fireplaces were still wide.¹⁰¹ More significant was the decline of the large axial stack, which was under way in larger farmhouses in some areas by the end of the seventeenth century: smaller fireplaces, equipped with small vertical flues, facilitated the construction of the kind of 'double pile' farmhouse typical of the eighteenth century, often with internal stacks.¹⁰² But the development was a gradual one. In North Yorkshire the 'rounded fireplace arch and timber hoods' characteristic of the area's vernacular architecture were only slowly replaced, in the course of the eighteenth century, by smaller stone-framed fireplaces. Even in the West Midlands it was only 'towards the end of the eighteenth century' that 'square, double-pile houses began to replace earlier elongated plans'.¹⁰³ The character of hearths and fireplaces certainly deserve more rigorous investigation, perhaps using the evidence of inventories, in which references to 'iron chimneys' and 'grates' may provide an indication of the spread of coal use.¹⁰⁴ But the evidence of surviving vernacular buildings certainly suggests that coal did not become a common domestic fuel in rural areas, away from coalfields, in the seventeenth century, still less in the sixteenth, but only from the middle decades of the eighteenth.

Thereafter the adoption of coal must have been rapid. As we have noted, when commons were enclosed, areas were often allocated to the poor as fuel allotments. But right from the start many, at least in the less remote rural districts, were being rented out by the committees that controlled them, and the proceeds used to buy coal for the indigent; and the proportion so managed increased rapidly with the passing decades. In Norfolk, for example, 55 per cent of

⁹⁹ E. Mercer, *English vernacular houses: a study of traditional farmhouses and cottages* (1975), pp. 50–71.

¹⁰⁰ J. T. Smith, *English houses, 1200–1800: the Hertfordshire evidence* (1992), p. 186.

¹⁰¹ *Ibid.*

¹⁰² Mercer, *English Vernacular Houses*, pp. 72–3.

¹⁰³ B. Harrison and B. Hutton, *Vernacular Houses in North Yorkshire and Cleveland* (1994), p. 186; D. Hooke,

England's Landscape: the West Midlands (2006), p. 157.

¹⁰⁴ K. Wrightson, *Ralph Taylor's summer. A scrivener, his city, and the plague* (2011), pp. 117, 131, 186. For an example of a grate specifically for coal near Bury St. Edmund's in 1603, see Hatcher, *British coal industry*, I, p. 416. See also the discussion in M. Spufford, 'Chimneys, wood and coal', in P. S. Barnwell and M. Airs (eds), *Houses and the Hearth Tax* (2006), pp. 22–32.

allotment land was already, by 1833, used in this way; by 1845, 60 per cent; by 1883, 81 per cent; and by 1896, 92 per cent.¹⁰⁵ The cutting of peat on most surviving commons in the county also appears to have come to an end in the middle decades of the nineteenth century: extraction from Whitwell Low Common in the same county ceased in the 1870s because ‘the houses and fireplaces of the commoners are unusable for the burning of turf’.¹⁰⁶

The substitution of coal for local fuels in the course of the eighteenth and early nineteenth centuries was the consequence of two related developments. As population rose rapidly after 1750 it made more economic sense, in many circumstances, to use land formerly employed to produce fuel to grow food. Rising food prices may thus have served to increase the cost of local fuels, especially wood, relative to that of coal. This is because traditional fuels competed for space with cropped land: the rise in the value of crops would therefore raise the rental value of areas like managed woods, and thus the cost of the fuel cut from them. As Rock Church expressed it in his *Old Thrift Newly Revived* of 1612, the price of coppice wood in any region was determined by ‘the value and vent for wheat is in that place where it groweth’. If the price of grain went up, so must the price of wood, even if demand for wood remained unchanged.¹⁰⁷ But substitution of local fuels by coal would not have been possible on any scale if the latter had not become more freely available, and the crucial factor here was unquestionably the progressive improvements in transport that occurred in the middle and later decades of the century. There would be little point in using any fuel if the expense of bringing it from its source came close to or exceeded the value that was derived from burning it (both of which might vary according to the season when it was supplied and consumed). Given the energy obtained from food and fodder was always more expensive from that provided by fuel, this reduced the marketable range of coal even further, although coal, with its higher energy density (i.e. joules per weight or volume), clearly could bear the costs of transportation better than any of its competitors.¹⁰⁸ Most places in England and Wales lie at some distance from ready supplies of coal, and so the nature of transport systems was clearly of crucial importance in deciding the distribution of its use. Even if, in national terms, coal was outstripping other sources of fuel by 1700, at this date some three-quarters came from mines in Shropshire, Staffordshire, Yorkshire and the North East of England.¹⁰⁹ Its use must have been highly concentrated, with only the north-eastern ports allowing for a large coastal trade.

Contemporaries agreed on the crucial importance of water transport in structuring the use of coal. William Harrison, writing in the 1570s, noted how coal use was just beginning

¹⁰⁵ Birtles, “Green space beyond self interest”, p. 205.

¹⁰⁶ *Ibid.*, p. 206. Bird, describing the use of East Ruston ‘Common’ (really a poors’ allotment) in east Norfolk in 1909, similarly noted that the cutting of flags, peat and furze for firing had ceased ‘since the old larger brick ovens and open chimneys have entirely disappeared’, replaced, presumably, by grates and ranges designed for coal: M. C. H. Bird, ‘The rural economy, sport, and natural history of East Ruston Common’, *Trans. Norfolk and Norwich Naturalists Soc.* 8 (1909), p. 638.

¹⁰⁷ R. Church, *An old thrift revived* (1612), p. 29.

¹⁰⁸ Langton, *Geographical change, passim*; *Journals of the House of Commons*, 47, 1792, p. 314. On transport costs see also Hatcher, *British coal industry*, I, pp. 13–14, 39.

¹⁰⁹ Calculated from Hatcher, *British coal industry*, I, p. 68. The proportion is much the same if we take instead the possible minima Hatcher provides for output. The North East produced up 1.3 m. tons, Shropshire 230,000, Staffordshire 150,000, and Yorkshire 150,000 out of a total of 2.3 m. tons.

to spread ‘from the forge into the kitchen and hall, as may appear already in most cities and towns *that lie about the coast*, where they have little other fuel except it be turf or hassock’ [our italics].¹¹⁰ This importance of water transport was still being emphasized by Pehr Kalm in 1748, who observed that coal could be found in London, and was widely burned in villages within a 14-mile radius, but, ‘in places to which they had not any flowing water to carry boats loaded with coals’, the population continued to burn wood – mainly from ‘trees they had cut down in repairing hedges’ – or ‘fuel of some other kind, as bracken, furze etc’. The effects of ‘the improvement of roads, and the navigable canals’ in Lancashire have been meticulously documented by Jack Langton, and indeed similar improvements elsewhere are widely recognized.¹¹¹ Of particular importance was the massive extension of the canal network following the completion of the Bridgewater canal (designed to serve the coal mines at Worsley) in 1761, ‘the movement reaching a crescendo in the “mania” of 1789–93’.¹¹² The canal mania was directly paralleled by the expansion in the numbers of turnpike trusts, which was likewise most rapid in the period between 1750 and 1850. But in some districts, remote from navigable waterways, it was only the spread of railways that sounded the death knell for traditional kinds of fuel. Coal only began to be used on the Bedfordshire brickfields, for example, following the arrival of the local rail lines between 1838 and 1872: it was only from around 1845 that the Duke of Bedford’s Crawley Kiln was fired with coal. The Duke’s steward, Thomas Bennett, recalled in 1869 how ‘Furze used to be grown for a demand for brickmaking, but this fell off some years ago’.¹¹³

V

The spread of coal use throughout England had many important ramifications, but one of these was that the countryside was now principally used for the production of crops and livestock, and was no longer also regarded as a major source of fuel. There was one obvious exception to this: fuel cut from woodland continued to be economically important well into the nineteenth century. It is true that in the eighteenth century landowners began to establish, on a significant scale, plantations which lacked a coppiced understorey, and which were composed only of timber trees;¹¹⁴ and in some districts a decline in the economic importance of wood, as opposed to timber, is also indicated by the increasing density of standard trees in coppiced woods. It has been calculated that in Norfolk, for example, this rose from around 7 to around 20 per acre (c.17 to 50 per hectare) between the fifteenth century and the nineteenth, with most of the increase probably occurring in the latter part of this period.¹¹⁵ By the 1830s, when the tithe files were produced, the density of timber was such that the growth of the understorey beneath was being suppressed, as for example at Fulmondeston in the same county, where the commissioners noted that the coppice would be ‘much better if timber was thinned’.¹¹⁶ But against this we should also note that the new forms of woodland were not intended to supply

¹¹⁰ Edelen (ed.), *Description of England*, p. 281.

¹¹¹ Kalm, *Kalm’s account of his visit to England*, pp. 137–8.

¹¹² N. Cossons, *The BP Book of Industrial Archaeology* (1987), p. 256.

¹¹³ Cox, *Brickmaking*, p. 44.

¹¹⁴ Rackham, *Woodlands*, pp. 430–57.

¹¹⁵ G. Barnes, ‘Woodland in Norfolk: a landscape history’ (unpublished PhD thesis, University of East Anglia, 2003), pp. 214–5; 226–8; 294–307.

only timber. Plantations were usually very densely planted in order to suppress weed growth, and thus needed to be repeatedly thinned, the young extracted material being referred to in estate accounts, like that cut from traditional coppices, as ‘poles’. William Marshall was able to describe how the great plantation belt around the park at Holkham in Norfolk comprised ‘480 acres of different kinds of plant, two thirds of which are meant to be thinned *and cut down for underwood*, so as to leave the oak, Spanish chestnut, and beech, only as timber’ [our italics].¹¹⁷ More importantly, in many districts not only were existing areas of coppice managed intensively into the nineteenth centuries but – as in parts of Hampshire – entirely new ones were established by major landowners at the expense of wood pastures.¹¹⁸ Indeed, some historians have characterized the late eighteenth and early nineteenth century as the heyday of coppicing.¹¹⁹ All this said, where coppicing remained buoyant, or even increased in local importance, much of the wood produced was often used for purposes other than fuel; and where it was employed as fuel this was often for specific, limited industrial uses. In east Hertfordshire, for example, hornbeam from the local woods was still being employed to fuel malting kilns as late as the 1960s, one observer describing the coppice poles in ‘immense stacks like haystacks’ beside the works.¹²⁰

While coppicing thus remained economically important until the late nineteenth century – and still accounted for some 19 per cent of English woodland as late as 1949¹²¹ – other forms of traditional fuel production went into sustained decline from the later eighteenth century, and the implications of this development deserve more attention than they have received in the past from agricultural and landscape historians. The steady decline in pollarding is particularly noteworthy. Opposition to pollarding had existed from the seventeenth century but this was in large measure because the practice was associated with common rights and with damage to timber trees on tenanted land. ‘[A]s late as the mid-eighteenth century, pollarding was being written about in a positive manner by one of the most influential agricultural writers’, William Ellis. In the second half of the century, however, ‘the critique of pollarding gained greater force’, in large part because of the ‘rise in the use of coal to replace firewood as a fuel in country districts’.¹²² As William Marshall put it: ‘We declare ourselves enemies to Pollards; they are unsightly; they encumber and destroy the Hedge they stand in ... and occupy spaces which might, in general, be better filled by timber trees; and, at present, it seems to be the prevailing fashion to clear them away.’¹²³ By the middle of the nineteenth century most farmland trees were probably standards, rather than pollards, a dramatic reversal of the situation a century earlier.

More important, perhaps, is the way in which the middle and later decades of the eighteenth century saw a decisive shift, as already argued, towards the planting of single-

¹¹⁶ TNA, IR 29/5937.

¹¹⁷ Kent, *Norfolk*, p. 90.

¹¹⁸ Alberry, ‘Woodland management in Hampshire’, *passim*.

¹¹⁹ E. J. T. Collins, ‘The coppice and underwood trade’, in G. E. Mingay (ed.) *The agrarian history of England and Wales, VI, 1750–1850* (1989), pp. 484–501.

¹²⁰ W. Branch Johnson, *The industrial archaeology of Hertfordshire* (1977), p. 33.

¹²¹ Forestry Commission, *Thirtieth annual report of the Forestry Commissioners for the year ending September 30 1949* (1949), p. 45.

¹²² S. Petit and C. Watkins, ‘Pollarding trees; changing attitudes to a traditional land management practice in Britain, 1600–1900’, *Rural Hist.* 14 (2003), pp. 164, 168.

¹²³ William Marshall, *Planting and rural ornament* (1796), pp. 100–01.

species thorn hedges. The practice of multi-species planting seems to have declined to such an extent that the authors of the various *General Views*, produced in the decades around 1800, regularly contrasted 'recent' and 'old' hedges in terms of the types of shrubs they contained. The Rev. St John Priest, for example, in the *General view of the agriculture of the county of Buckinghamshire* of 1813 noted that the hedges of that county 'are of two sorts, old and new. The old fences consist chiefly of a mixture of ash, willow, and hazel, with some whitethorn ... The new fences consist of whitethorn'.¹²⁴ John Boys, writing about Kent, noted the difference between 'old hedges, such as nature has formed', and the newer 'quickset hedges raised from the berries of the white thorn';¹²⁵ while in Cheshire the contrast was between the new enclosures, of 'white, or haw-thorn', and the 'ancient fences', consisting of 'hasle, alder, white or black-thorn, witch-elm, holly, dogwood, birch &c &c'.¹²⁶ Max Hooper believed that the present distinction between species-poor hedges of eighteenth- and nineteenth-century date, and older species-rich ones, was simply due to the fact that diversity increased with age (so that hedges can be roughly 'dated' by counting the numbers of different woody species they contain).¹²⁷ The testimony of these writers, and others, suggests that it primarily reflects a change in planting practice, with an increasing tendency to plant with thorn alone because hedges were becoming valued simply as stock-proof barriers, rather than functioning also as sources of fuel and, perhaps, fruit. Arthur Young commented at the start of the nineteenth century that a neatly trimmed hawthorn hedge was 'a mere luxury and ornament, and has nothing profitable to recommend it'. He added, significantly: 'Hedges thus cease to be the collieries of a country'.¹²⁸

Many agricultural historians continue to place the 'new rotations', featuring clover and turnips or other root crops, at the centre of the eighteenth- and early nineteenth-century 'agricultural revolution'.¹²⁹ The enhanced supplies of nitrogen and other chemicals necessary for crop growth which resulted from increased stocking levels raised yields and thus, together with the expansion of the cultivated acreage, provided sufficient grain to feed the rapidly expanding (and increasingly urbanized) population in the period after 1750. As all historians of the period are aware, however, other developments were also important in raising productivity, and it is arguable that many of these were directly or indirectly related to the onset of large-scale industrialization. Increases in soil fertility would have produced weeds as much as crops, and turnips were only beneficial if sufficient labour was available to weed them. Large inputs of labour were also required for the various schemes of reclamation, enclosure, marling and under-drainage adopted in the later eighteenth and early nineteenth centuries. It is therefore probably significant that the industrialization of the north and west of England led

¹²⁴ Rev. St John Priest, *General view of the agriculture of the county of Buckinghamshire* (1813), p. 123.

¹²⁵ J. Boys, *General view of the agriculture of the county of Kent* (1813), p. 61.

¹²⁶ H. Holland, *General view of the agriculture of Cheshire* (1813), p. 121.

¹²⁷ Pollard *et al.*, *Hedges*, pp. 84–5.

¹²⁸ Young, *Hertfordshire*, p. 52.

¹²⁹ The central importance of the enhancement of soil nitrogen, emphasized in the 1980s by G. P. H. Chorley

in 'The agricultural revolution in northern Europe, 1750–1880: Nitrogen, legumes and crop production', *EcHR* 34 (1981), pp. 71–93; and in the 1990s by J. Sheil, 'Soil fertility in the pre-fertiliser era', in B. Campbell and M. Overton (eds), *Land, labour and livestock* (1991), pp. 51–77 has recently been restated forcibly by Robert Allen, 'The Nitrogen hypothesis and the English agricultural revolution: a biological analysis', *JEcHist* 68 (2008), pp. 182–210.

to a measure of de-industrialization across large parts of the populous south and east, lowering real wages in some of the key areas of arable production.¹³⁰ The progressive improvements in transport outlined above may also have had an impact on levels of overall food production, for they allowed the cultivation of cereals to be concentrated in those areas best suited by climate and soils to arable farming: the period between 1750 and 1850 saw a significant reorganization of England's agrarian geography, with the emergence of the modern division between a largely pastoral west and largely arable east.¹³¹

The substitution of coal for local fuel supplies is arguably another part of this complex jigsaw of interdependence between industrialization and agrarian change, for many of the 'improvements' considered important by contemporaries were directly associated with the declining value of traditional fuels. The enclosure of commons and the reclamation of marginal land were thus frequently associated with the destruction, on a massive scale, of supplies of gorse, heather and broom on heaths and – through drainage – of peat on the remaining fens and mosses. Although, as we have noted, a proportion of such enclosed ground was sometimes set aside as a fuel allotment, the vast majority was converted to new uses, usually as arable or improved pasture. The enclosure of commons also led, in some districts, to the removal of untold thousands of pollards, as for example when the Midland forests like Rockingham were enclosed and largely turned over to farmland or plantations. The northern section of the 2000-acre Northaw Common in Hertfordshire still had thousands of pollards growing on it when enclosed by an Act of 1803; the work of division was continuing when the Ordnance Survey draft 2-inch map was made, the surveyor writing the words 'clearing for enclosure' across its area, indicating clearly enough its expected fate. Of course, historians have often concentrated on the supposed agrarian benefits arising from the enclosure of 'wastes'. But major increases in the arable area, and in yields per acre, also came from changes in the landscape of districts which had long been enclosed, especially the key cereal-growing areas in the Home Counties and southern East Anglia. These involved the wholesale removal of pollards from field boundaries, the widespread replacement of mixed-species hedges with ones composed solely with hawthorn, the destruction of innumerable copses and spinneys, and a significant degree of hedge removal and field amalgamation. Small, oddly-shaped fields were inconvenient for ploughing, tall hedges and hedgerow pollards shaded out crops and robbed the soil of nutrients, while wide outgrown hedges and groves harboured vermin and took up large areas of potentially productive land. Where successive maps of a farm or parish exist in such areas, significant amounts of 'rationalization' are usually apparent: the rector of Rayne in Essex typically observed in his tithe accounts of the 1780s how on one local farm 'the fields were over-run with wood', but 'since Mr Rolfe has purchased them, he has improved them by grubbing up the hedgerows and laying the fields together'.¹³² A few landowners, such as George Hall at Weston Colville in Cambridgeshire in 1825, planned (and largely

¹³⁰ T. Williamson, *The transformation of rural England: Farming and the landscape, 1700–1870* (2003), pp. 168–70.

¹³¹ *Ibid.*, pp. 158–63; the change is clear when the maps of early modern farming regions prepared by E. Ker-

ridge, *The agricultural revolution* (1967), or Joan Thirsk, *England's agricultural regions and agrarian history, 1500–1750* (1987), are compared with those of nineteenth-century farming regions presented by writers like James Caird, *English agriculture in 1851–2* (1850).

carried out) reorganizations of ancient field patterns, which were so extensive that the areas in question today resemble, with their ruler-straight hawthorn hedges, landscapes created by parliamentary enclosure.¹³³

It is noteworthy that the 1791 government enquiry into the state of the nation's timber supplies included the question:

Whether the growth of oak timber in hedge rows is generally encouraged, or whether the grubbing up of hedge rows for the enlarging of fields, and improving arable ground, is become common in those Counties?¹³⁴

The answers received suggest that in arable districts hedge removal was 'frequent', 'becoming common', or the 'general practice'. One respondent from Suffolk commented that 'Underwood, particularly blackthorn bushes in hedge rows that spread two or three rods wide, is the true nursery of oak timber, but such rows are a dead loss and nuisance in a well cultivated country'.¹³⁵ Farming diaries from the period, where these exist, likewise indicate the extent of landscape 'tidying' which went on in many old-enclosed districts. That kept by Randall Burroughes of Wymondham on the Norfolk claylands in the 1790s makes frequent references to the removal, realignment or replanting of hedges, work usually carried out in the winter: 'the frost continued very severe so much so that ... the men employed in throwing down old hedgerows found the greatest difficulty in penetrating the ground with pick axes'.¹³⁶ When not so employed they were, perhaps needless to say, usually busy taking down pollards. In 1801 one observer of the Essex countryside was able to declare: 'what immense quantities of timber have fallen before the axe and mattock to make way for corn'. The comment could have been of many old-enclosed areas of southern and eastern England.

VI

There is an understandable tendency amongst historians to discuss major economic and environmental developments and transitions in national rather than in regional or local terms. Whatever the pace of national transition, for many purposes a more critical matter was the regional and local character of the spread of coal use beyond coal fields and major urban centres, so that coal became the main provider of thermal energy in each *district* of England and Wales. This development, in association with other circumstances, allowed quite substantial areas of land to be freed up for food production, and permitted a significant intensification of agriculture on others, producing a number of significant changes in the fabric of the rural landscape. These were in one sense local and regional developments, but they had major national implications, in both environmental and economic terms, which remain to be explored.

¹³² Essex RO, D/P 126/3/2.

¹³³ Cambridgeshire RO, 124/P83a.

¹³⁴ *Journals of the House of Commons*, 47, 1792, pp. 318–9.

¹³⁵ *Ibid*, p. 343.

¹³⁶ S. Wade Martins and T. Williamson (eds), *The farming journal of Randall Burroughes, (1794–99)* (Norfolk Rec. Ser. 58, 1995), p. 29.