



The first age of renewables

WHEN CHARCOAL WAS KING

THE SUSSEX WEALD

How premodern energy shaped Britain—and left lessons for life after

ENTERING SHADOW WOODS, a coppice just outside the town of Haven in West Sussex, England, is like stepping into a medieval fairy-tale. Before the Industrial Revolution, coppicing, a method of harvesting wood on a multi-year cycle by cutting trees back to a stump, helped meet Britain's energy needs. After the tree, usually hazel, hornbeam or oak, is cut, new shoots spring to life. A coppiced tree looks more like a porcupine than the arboreal lollipop of a child's picture book. Shadow Woods was largely abandoned after the second world war and many of the trees are now "overstood", grown beyond the point at which they would be harvested, shading the ground and preventing the growth of any new saplings. But they have kept their shape. From each of the hornbeams as many as half a dozen thin trunks rise from a thick stump, resembling the crown of some pagan god.

Since early humans first kindled firewood until Britain's Industrial Revolution, energy typically came from renewable sources like wind, water and the sun, not from fossil fuels like coal, oil and natural gas. Vertical windmills were used to grind flour in ancient Persia. Chinese water power pulped paper and hammered iron. The Romans combined their aqueducts with complexes of watermills. All of this was renewable.

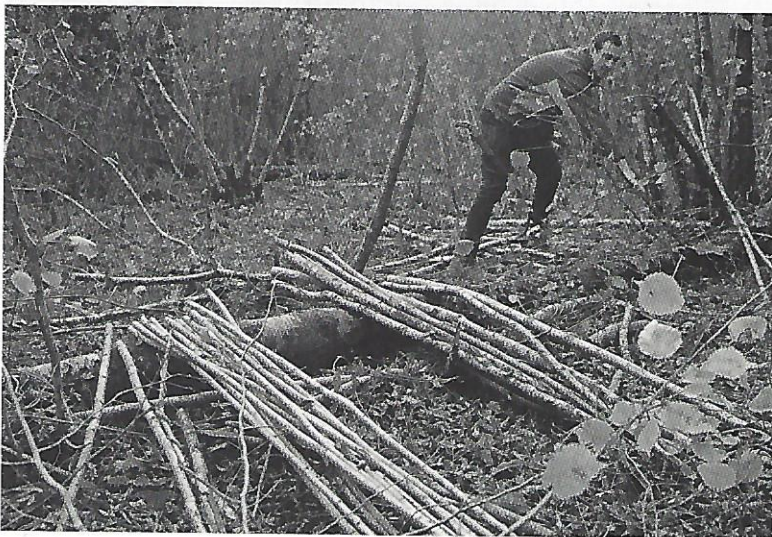
In the case of wood, the practice of coppicing made it much more so. An untended ash tree might last a few centuries. There are probably coppiced ash stumps that have endured in Britain for at least a thousand years since they were first harvested. They are living relics from the first age of renewable energy. »

The pre-industrial world operated on a lot less energy than the modern one. In the 1560s, during the reign of Elizabeth I, Britain's 3.2m people consumed 18 terawatt-hours of energy annually, according to estimates from Paul Warde, a professor of environmental history at the University of Cambridge. That equates to 10.6m barrels of oil, or slightly more than three barrels of oil per person, less than one-twentieth of what a Briton consumes nowadays. Draft animals, such as horses, provided a little under a third of this energy, and human muscle provided slightly under a quarter (solar power fuelled this muscle energy indirectly, by way of photosynthesis in plants, yielding sugar). Less than a sixth of the energy came from coal, water and wind, in that order. The rest—nearly a third of all consumed—came from firewood.

The Sussex Weald, where Shadow Woods is located, once provided a substantial portion of London's energy budget. For your correspondent, trimming coppiced hazel poles with a billhook, muscle energy feels more like a price that must be paid than a budget that can be spent. "Everything to do with coppicing is simple if you're not frightened of failing," advises Clive Cobie, a coppicer who lives in a self-built wooden cabin in Shadow Woods. An enthusiast for the natural world and an evangelist about the power of mycelium, part of a fungus, to rejuvenate the soil and store carbon, Mr Cobie taught himself the near-forgotten techniques of premodern forest management. Hazel can be harvested for firewood every seven to nine years; hornbeam, used as the feedstock for charcoal-burning, was on a 20-year cycle. As the tree's stump remains anchored into its root system—and the wood-wide network of mycelium—it should regrow more rapidly than a freshly planted sapling.

For all the modern-day appeal of sustainability, the first age of renewable energy was not some agrarian Arcadia. Scarcity, or the fear of it, shaped life and the terrain. The dependence on solar power rooted the economy in the seasons, and in the land to be cultivated. The land, in turn, had to be used for either food or fuel, not both. Hedges, which formed the boundary between one field and the next, could be used for firewood, and were planted with oaks, hazels and hornbeams for coppicing. Mostly, though, in times when

The Weald supplied much of the energy for premodern London



people wanted more farmland, that meant giving up fuel. By the time of the Domesday Book, a survey of the holdings carried out in 1086, after the Norman conquest, farmers had cleared much of Britain's woodland for farmland. Just 15% of the country was covered in woodland, and this would fall by more than half over the next three centuries until the Black Death killed millions and eased pressure on the land.

The Sussex Weald was not torn up for crops. It was little use for farming. The soil in the High Weald, the uplands, sits on sandstone—it is hardly more fertile than gravel. The Low Weald is clay. The area remained thickly forested in the 16th century, making it, for premodern Britain, the Saudi Arabia of forest energy.

BIG STICK ENERGY

With copious reserves of ironstone as well, the Weald became the centre of the Tudor and Stuart iron industry. The Romans had smelted iron there. At the peak the Weald had around 180 ironworks, making iron for London and eventually armaments for the Royal Navy. The cannons the navy used at the Battle of Trafalgar, during the Napoleonic wars, were smelted there.

Smelting iron used a vast amount of forest energy, in the form of charcoal from wood. The energy- and land-needs were massive. Some 30kg of wood would yield enough charcoal to smelt a kilogram of iron. A Wealden ironworks would probably have needed around 2,000 hectares of wood, covering the equivalent of 5,000 football pitches, to sustain its operations.

From the vantage point of the 21st century, coal's rise and the end of the first renewable era might seem inevitable. Using fossil fuels built up within Earth broke through the "photosynthetic constraint" placed on energy by what could grow on its surface. Energy budgets surged and living standards began their first sustained rise. Yet coal was not a new discovery. It had been known about for millennia and largely rejected as an inferior, choking, fuel source compared with wood. It was confined to limited uses in blacksmithing and the making of salt and lime, for mortar and spreading on fields (to improve crop production).

For economic historians the puzzle is why coal took over when it did and why it did so in one corner of western Europe. Explanations fall into two camps: one stresses the scarcity of renewable energy; the other focuses on innovation and shifting patterns of demand.

Britain's renewable economy was, perhaps, testing its limits by the 16th century as fossil fuels began their inexorable rise. Politicians of the time fretted about wood shortages: in 1581 a statute prevented any ironworks fuelled by charcoal (and thus wood) from being set up within 22 miles of London. Yet politicians worrying about shortages, then as now, are not proof of true scarcity. Prices for firewood in London, already a trading entrepot, were rising as the city's population expanded but this was caused by rising demand rather than shortages. Anton Howes, an economic historian, notes charcoal-burners were able quickly to find new woods to expand to as demand grew. Britain imported firewood from Norway and the Baltic, which combined lower population densities with even more forests. Mr Howes writes that backers of the 1581 law were worried mostly about maintaining a domestic supply of old-growth timber—the sort substantial enough for

▶ shipbuilding, not wood for kindling and charcoal. The wood age did not end because they ran out of wood.

The beginning of the end of the first era of renewables was the advent of coal in the English home. Mr Howes notes that coal could be delivered to many places easily, by sea and river. Wooded land near water, where coal was plentifully available, began to be churned up to be used more profitably for crops. Cheap coal began to win out in nearby cities.

Thus began a "domestic revolution", in the phrase of Ruth Goodman, a historian. Coal was quickly adopted, and then adapted to. Wood smoke could find its way out of the crannies of wattle-and-daub houses and small openings of thatched roofs but coal smoke could not. Houses were rebuilt with chimneys to whip away the noxious gases. The "Great Rebuilding" of London in the 17th century, aided by the Great Fire in 1666, turned a wood-powered city into a coal-fired one. Houses changed from being open-plan structures built around a central communal hearth, Ms Goodman notes, to individual rooms with fireplaces built into walls. Tapestries, which would collect coal dust, were dispensed with. Women began to devote more hours to cleaning soot from walls, surfaces and dishes (and less time on outdoor chores like going to the market or ploughing fields). Britain's medieval cuisine, cooked over the low and stable heat of wood, was replaced with boiled vegetables and baked meat, easier to manage with the hotter and more variable flame of coal. Britain's reputation for cookery has never recovered.

The renewable era survived longer outside the home, and shaped the Weald in enduring ways. Littered throughout the Weald are lakes and ponds which provide a scenic stop-off for hikers and day-trippers. These "hammer ponds" are not natural features but were made for iron works. Rivers that flow through the Weald's deep valleys, "ghylls" in the local dialect, were stopped up to build a head of water behind a dam. When the dam was lowered the water would rush out and turn a wheel which would, in turn, blow bellows helping to superheat blast furnaces.

POWER TO THE PEOPLE

In England the first age of hydropower met its downfall because it was not located where people were. Remote valleys struggled to attract workers and were easily paralysed by strikes; mill owners had to provide schools, shops and churches to lure workers to these valleys. Manchester, rather than Lancashire, became Cottonopolis not because it had better access to energy but because it had better access to labour, according to Andreas Malm, a Swedish historian.

Pre-industrial peoples did not have a notion of "energy" as a fungible, movable thing. It was the invention of the steam engine, in which chemical energy swiftly became heat and then motion, that led engineers and scientists to conceptualise energy as a fundamental, conserved quantity that can take different forms. Energy has since become understood as a commodity that can be transformed, stored, moved about and made useful in new and surprising ways.

Such insights would have been of no use to medieval peasants, who mostly consumed energy when and where nature provided it (wood being an exception). But this knowledge ensures the second age of renew-

→ *Clive Cobie, a modern-day coppicer*



able energy will not be like the first. The challenges of intermittency are being overcome with storage technology. The immobility of renewable sources can be ameliorated by electricity grids. An incipient second domestic revolution is transforming some homes with solar panels on the roofs, induction hobs in the kitchen and a battery pack in the attic.

It will, like previous transitions, transform more than just the energy economies use. The spread of coal changed Britain's landscape as well as its cities. Without their economic value as a producer of fuel the forests were either turned into timber plantations or dug up to become pasture. The mixed-wood hedgerows were ripped out to be replaced with hawthorn, worse as a source of firewood but far better as a barrier to wandering livestock. Coppicers of today are hobbyists who "coppice for nature", mimicking the behaviour of long-extinct megafauna from when the trees evolved. Cutting trees down to the stumps allows light to reach the forest floor and creates new ecological niches.

On September 30th 2024, the day before the start of the traditional coppicing season, Ratcliffe-on-Soar, Britain's final remaining coal-fired power station, closed alongside the coal-fired blast furnace at Port Talbot, a steel town in south Wales. A half-millennium-long interlude in Britain's energy history came to an end. That day wind provided 43.1% of Britain's electricity, biomass 6.0%, solar 1.4% and the little hydropower the country has 0.5%. No smoke billowed from the chimneys that punctuate London's skylines. Its fireplaces have become "attractive period details" to tempt homeowners, like the Sussex Weald's hammer ponds and coppices. Power stations on the southern bank of the Thames have already been turned into art galleries and luxury flats. A new energy economy is once again growing, from the stump of the old. ●

Among its many sins, coal made British food awful