The early years of the Industrial Revolution relied on traditional sources to provide power for agricultural use, for machinery in factories and for transport. With the development of a viable steam engine, steam power rapidly replaced horse, wind and water power.

**Horse power**

The oldest form of power available to humans was their own physical muscle power. Horses, donkeys and oxen had been used as beasts of burden since ancient times, and were still commonly used in the eighteenth century. Long-distance travel was usually carried out on horseback or in a horse-drawn cart or carriage. Poor people who did not own a horse tended not to travel more than a day’s walk from their homes.
Carts drawn by teams of oxen were used to transport goods over long distances, and teams of oxen had been used for centuries to plough the fields.

**Horses in agriculture and mining**

With the coming of the agricultural and industrial changes of the eighteenth and nineteenth centuries, there was a continuing reliance on horses as a source of power. For example, the horse-powered threshing machine was used to separate grain from the stalks and husks of the wheat plant (see **Source 1**). This machine was invented in 1784 by a Scotsman, Andrew Meikle. Small ponies, known as pit ponies, were used to haul carts full of coal in underground coalmines. Canal boats or barges used to move goods were hauled along by horses walking along tow-paths on the canal bank (see **Source 2**).

**Water power**

Water power had been used in England since ancient Roman times. A water wheel with blades or buckets around its rim would be driven by flowing water, usually from a swiftly flowing stream or river (see **Source 3**). The power generated by the turning water wheel was used to mill grain into flour. Early sawmills used water wheels to power large circular saws. Many of the first textile mills in England were powered by water, with the force of the water sufficient to drive machines in multi-storey factory buildings.

**Wind power**

Like water power, wind power had been used in England for centuries. The wind had been used to drive ships since ancient times, and sailing ships were the standard form of sea transport for several hundred years until the mid nineteenth century. Windmills were introduced to England in the twelfth century. They were used primarily for milling grain to make flour, and later to drive pumps to drain surplus water from marshlands.
Steam power

One of the most significant advances of the Industrial Revolution was the development of steam power. While the potential of using steam to provide power had been known for centuries, the first practical steam engine was the ‘atmospheric engine’ developed by Thomas Newcomen in 1712 (see Source 6). This machine used steam to drive a piston, which powered a large horizontal beam. The Newcomen atmospheric engine was used primarily to pump surplus water out of underground mines, particularly coalmines.

Steam power in coalmines

The Newcomen engine was a huge step forward because it allowed underground coalmines to be sunk to greater depths. Removing excess water had always been one of the barriers to deep-pit mining, and so had restricted the amount and quality of coal that could be extracted (see spread 2.6). The coalmining industry really took off from the mid-eighteenth century. As the Industrial Revolution gathered pace, coal would prove to be a very important fuel.
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EXPLANATION AND COMMUNICATION

1. Identify and explain two examples of the use of animals as a source of power that continued even after the agricultural and industrial changes of the eighteenth century.

2. Referring to Sources 3 and 4, explain how water was used to drive factory machines.

3. Explain the contribution to the Industrial Revolution of Newcomen’s steam engine.

ANALYSIS AND USE OF SOURCES

4. While it worked well for the milling of grain (see Source 5), why might wind power have been unsuitable for driving machinery in factories?

5. What does Source 4 tell us about the limitations of water as a means of driving factory machines?

6. Compare Sources 6 and 7, and explain how Watt’s improvements to the steam engine would have increased the usefulness of steam as a source of power.

7. What does Source 8 tell us about the main form of power in Manchester, England, in the mid-nineteenth century?

PERSPECTIVES AND INTERPRETATIONS

8. Many historians claim that the Industrial Revolution did not really take off until steam power was widely used. Identify and explain three major contributions that steam power would have made to the Industrial Revolution.

James Watt’s steam engine

The next big step forward was James Watt’s steam engine, developed about 1769. Watt produced an engine that had a separate compartment for cooling the steam back to water, after it had been used to drive a piston. Instead of driving a large beam, Watt’s steam engine powered a large flywheel, so it could provide the same type of continuous power that had previously been possible only with a water wheel. This meant the steam engine sold by Watt and his partner, Matthew Boulton, could be used to power many different types of machinery (see Source 7).

As we shall see later in this chapter, the development of the steam engine was to be a pivotal event in the Industrial Revolution. Steam engines were able to power larger and larger machines, which in turn led to bigger factories. Their successful use in coal mines saw coal replace wood as the major fuel source. Steam was to revolutionise both land and sea transport in the nineteenth century as railways and steam-driven ships came into use.

Did you know?

James Watt developed the idea of ‘horsepower’ as a unit of measurement of power. His original calculations compared the power of a steam engine with the work done by horses in providing power to drive machines. The term is still used today to measure the output of many different types of engines. The ‘watt’, as a unit of energy, was named after him.