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Renewable energy is critical to combatting climate change and global warming. The use of clean energy and renewable energy resources--such as solar, wind and hydropower--originates in early human history; how the world has harnessed power from these resources to meet its energy needs has evolved over time. Here"s a quick look at how different forms of renewable power generation evolved to diversify the global energy sector and the world"s energy supply.

Efforts to harness the power of the sun date back to ancient times, when Greeks and Romans used burning mirrors--concave mirrors that concentrate the sun"s rays--to light torches. The world"s first known solar collector, a device that collects solar radiation, was invented in 1767 and later used to cook food. Then, the late 1800s saw the advent of the first commercial solar water heater and the first solar cell, an apparatus that could convert light into electricity.

According to the United Nations" Intergovernmental Panel on Climate Change, the 1950s marked the modern age of solar research with the formation of the International Solar Energy Society and more research and development into solar energy by multiple industries. By the early 1960s solar thermal energy (the concentration of sunlight to create heat) was widely used to provide hot water to homes in Israel while solar cells, also known as solar photovoltaic cells, became more efficient. The energy crisis and spiking oil prices of the 1970s propelled solar energy development even further, as more countries invested in solar technology as an alternative energy source to fossil fuels.1

Since the 1990s, continued innovation in energy production and government energy policies, such as tax incentives, have spurred the growth of the solar energy industry and solar energy use. Construction began on large-scale solar power plants, including solar thermal plants, and there was an expansion of distributed solar electricity--electricity generation at residential and business locations through rooftop-mounted solar panels. Solar power also became a source of energy for electric vehicles, with drivers charging their cars through their own home rooftop systems and at solar-powered public charging stations. In 2022, solar photovoltaic generation reached nearly 1300 terawatt hours of electricity, up a record 26% from the year before.2

Demand for solar energy is driven in part by companies seeking to transition to renewable energy sources to meet their ESG goals. For some, solar energy production has become an in-house operation; companies like GPT Group, a diversified property group listed on the Australian Securities Exchange (ASX), have installed on-site solar photovoltaic arrays. To track the results of such efforts, including energy efficiency and emissions reductions, GPT Group deploys an SaaS tool that consolidates enterprise ESG data for analysis and reporting.

Humans have long used wind energy for mechanical purposes. Simple windmills in China were used to pump water and vertical axis windmills were used to grind grain in the Middle East by 200 BC. The Middle East

also became home to windmill-powered food production by the 11th century. Later, in Europe, the Dutch adapted windmills for various industrial uses, including making paper and draining lakes. And, in the 19th century, settlers in the Americas used windmills to pump water for agriculture.3

Eventually the use of wind energy shifted from its mechanical applications to electricity generation. Electrical engineer James Blyth is credited with building the world"s first wind turbine in his backyard in Scotland in 1887, while fellow wind energy innovators Charles Brush and Poul la Cour followed up with turbines of their own in Ohio and Denmark, respectively, before the close of the 19th century. Blyth later built a second wind turbine to power a local asylum, Brush used his to power his mansion, and la Cour leveraged wind power to light a school.4

It took decades, however, for wind power generation to achieve commercial-scale viability. As with solar power, the energy crises of the 1970s heightened interest in wind power. Denmark emerged as an early leader in commercial wind power as Danish government policies supported the development of the country"s wind power industry. Then utility-scale wind farms were installed in California in the 1980s, followed by wind farms in Germany and Spain in the 1990s.

Today wind turbines around the world produce more than 2,100 terawatt hours (TWh) of electricity a year. While most turbines are located on land, offshore wind farms have played an increasing role in global electricity generation in recent years, accounting for 18% of wind capacity growth in 2022.5

As the prefix "hydro" suggests, hydropower is the energy derived from water--specifically, the flow of water. As with wind energy, humans have long taken advantage of the mechanical applications of hydropower. The ancient Greeks, for example, used hydropower to turn water wheels that ground wheat into flour.6

The use of hydropower to generate electricity, however, didn"t become commonplace until much later. Innovation in water turbine technology took place throughout the 1800s, including the invention of the Francis turbine by British-American engineer James Francis, which remains widely used today. By the late 1800s, such innovation culminated in hydroelectric projects ranging from one that powered a single lamp in a home in England in 1878 to, four years later, a full-fledged hydroelectric power station with 12.5 kW capacity that served two paper mills and one residence.6, 7

Countries around the world soon became home to hydropower projects, from Australia to Canada. After World War II, hydropower development accelerated further, with state-owned projects in Europe, North America, Japan and the former Soviet Union. Today, the two largest hydroelectric projects in the world are dams in South America and China: The 14,000 megawatt Itaipu Dam, at the Paran? River on the border of Brazil and Paraguay, and 22,500 megawatt Three Gorges Dam, along China"s Yangtze River.

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