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Energy

Energy: A Brief History

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Over time, the source from which we get our energy has changed. Until the mid-19th century, most energy came from traditional biomass - burning wood, crop waste, or charcoal. With the Industrial Revolution came the rise of peat, coal and, later, oil and gas. Hydropower gained momentum at the turn of the 20th century. China is the leader in hydropower globally, generating four times more than Canada and Brazil, ranked second and third.

Then, from the 1960s, more countries embarked on using nuclear power. Today, the United States, France, and China have the largest installed nuclear power capacity. Renewable energy sources, solar and wind, only emerged in the 1980s, now driven by the imperatives to curb global warming and climate change.

Among the three sources of fossil fuels, coal has the largest carbon emissions. Natural gas produces lower carbon emissions and air pollution than coal and oil but releases methane (a potent greenhouse gas) and other non-CO_2 pollutants. In 2021, natural gas production accounted for 40 million tons of methane emissions, roughly equivalent to the methane emissions generated by the entire oil industry. As outlined by the International Energy Agency (IEA), coal contributed almost 44% of global carbon emissions from fuel combustion in 2021, closely following oil at 32% and natural gas at 22%.

In its 'Renewables 2023' report, the IEA states that 507 gigawatts (GW) of renewable energy capacity was installed globally in 2022, increasing the installed base to about 3 600 GW, with solar photovoltaic (PV) accounting for three-quarters of worldwide additions.

In 2023, China extended its position as a global renewables frontrunner by surpassing the collective 2022 solar PV installations of the rest of the world. Furthermore, there was a notable increase of 66% in China's wind power additions from 2022 to 2023. As a result, China is likely to achieve its 2030 target for wind and solar PV installations in 2024, six years ahead of schedule.

According to the IEA[1], a powerful alignment of costs, climate and energy security goals plus industrial strategies such as the 2022 US Inflation Reduction Act means that clean energy investment is now rising much faster than investments in fossil fuels.[2] Investment in global exploration and production (upstream oil and gas investment) has slowed but steadily declined for several years. Russia's invasion of Ukraine temporarily increased oil and gas demand as European countries scrambled for alternative sources from Russia, but prices have subsequently stabilised.

Many challenges remain. The use of solid fuels (biomass, coal and charcoal) as a household energy source, is still common for more than 3 billion people globally. However, it has declined with more citizens accessing electricity to cook, heat and cool. Many of these households are in Africa, such as Ethiopia, the DR Congo, Tanzania, Nigeria and Mozambique, where most citizens in rural areas continue to use traditional biomass for cooking and heating. Solid fuel use, particularly indoors, is associated with increased mortality[3] from pneumonia and other acute lower respiratory diseases among children, as well as increased mortality from chronic obstructive pulmonary disease, cerebrovascular and ischaemic heart diseases, and lung cancer among adults. Because solid fuels generate household air pollution, it is associated with more than 2 million deaths in 2019.

In contrast, in more advanced economies, biomass is used at household, municipal, and industrial levels to produce energy as part of a transition to renewables, illustrating energy's evolution and technology's role in the modern world. In tomorrow's economy, biomass, solar and wind offer the prospects of energy independence at the household level and possibly the development of a circular economy where households, businesses and communities generate their energy, food and water as part of their waste and garbage management processes.

Biomass is typically produced and consumed near the end-user, likely within the same country, village or community. Coal, oil, gas, hydrogen and electricity can be transported between countries by rail, road or sea, gridlines or pipelines, meaning that these sources and types of energy that are mined or produced in one country can satisfy demand in another. The result is a complex system in which energy sources are connected and transported across national boundaries either in unrefined or final form. Production in one country feeds demand in another.

At a sufficient scale, fossil fuel, hydrogen and electricity producers can exert significant influence. For example, for several decades towards the end of the 20th century, large energy producers, mostly in the Middle East, established a cartel, the Organization of the Petroleum Exporting Countries (OPEC), that effectively controlled petroleum prices globally. OPEC market dominance was subsequently disrupted, particularly by large-scale oil and gas fracking in the US, to the extent that, together with an increase in energy efficiency and renewable energy, the US has emerged as the largest oil and gas producer globally. It became almost energy-independent, even preparing to export large amounts of natural gas to others. Today, China, too, is actively pursuing energy self-sufficiency but has yet to satisfy domestic demand from own national resources and has replaced the US as the largest market for oil and gas with sources from the Middle East.

Using a common yardstick to measure energy production, in this instance BBOE, only about 4.8% of the global energy production came from 'other renewables', mainly sun and wind (equivalent to 4.6 BBOE) in 2023. The share from oil was at 31%, gas at 27%, coal at 29%, and the remainder from nuclear (5.4%) and hydro (2.9%). The share of oil, coal, and gas production, the three components of fossil energy in the global energy mix, has remained above 80% for the last two decades and is declining slowly, with global peak coal production possibly occurring in 2023.

Endnotes

1. IEA, World Energy Investment 2023, p 12
2. The IEA World Energy Investment 2023, 2023 saw a total of US$2.8 trillion invested in energy. US$1 trillion was spent on fossil fuels and US$1.7 trillion on clean energy, nuclear power, grids, storage, low-emission fuels, efficiency improvements, and end-use renewables and electrification. Still, that means that slightly over US$1 trillion is going to unabated fossil fuel supply (meaning without interventions that substantially reduce the amount of greenhouse gas emitted during the lifecycle) and power, of which 15% is to coal and the rest to oil and gas.
3. WHO

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Dr Jakkie Cilliers is the ISS's founder and former executive director. He currently serves as chair of the ISS Board of Trustees and head of the African Futures and Innovation (AFI) programme at the Pretoria oce of the Institute. His 2017 best-seller Fate of the Nation addresses South Africa's futures from political, economic and social perspectives. His three most recent books, Africa First! Igniting a Growth Revolution (March 2020), The Future of Africa: Challenges and Opportunities (April 2021), and Africa Tomorrow: Pathways to Prosperity (June 2022) take a rigorous look at the continent as a whole.

Ms Alize le Roux joined the AFI in May 2021 as a senior researcher. Before joining the ISS, she worked as a principal geo-informatics researcher at the CSIR, supporting various local and national policy- and decision-makers with long-term planning support. Alize has 14 years of experience in spatial data analysis, disaster risk reduction and urban and regional modelling. She has a master's degree in geographical sciences from the University of Utrecht, specialising in multi-hazard risk assessments and spatial decision support systems.

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