Energy basket 2050: reducing share of fossil fuels

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This article aims to show how fossil primary energies will continue to play a smaller role in the global energy mix by 2050 compared to renewable energies, despite their progressive decline due to lower demand. This is due to the strategies and policies adopted by countries within the current energy transition aimed at decarbonizing the global energy system by 2050 within the framework of the Paris Agreement. This is because CO2 emissions into the atmosphere from the massive consumption of oil, natural gas, and coal have contributed to global warming.

For (Smil, 2017), energy is part of the planet's history, and from a biophysical perspective, natural processes and human actions are energy transformations. In this sense, civilization has been characterized by the constant search for greater energy flows for the production of food, raw materials, and goods, as well as to promote mobility and access to information. This has entailed improving the population's quality of life, supporting economic growth, and developing new, more complex social, productive, and political arrangements; as well as controlling larger quantities of energy reserves in more concentrated, versatile, and accessible forms, at lower costs, and with greater efficiency in generating heat, light, and movement.

In this sense, (Rifkin, 1989) argued that the current energy transition is related to the reduced future availability of energy for productive use due to entropy. In the process of harnessing energy, it is transformed into pollution that generates a greenhouse effect through atmospheric emissions and global warming. This is the case with fossil fuels (coal, oil, and natural gas), which are nonrenewable natural resources and finite in terms of their reserves and emit carbon dioxide (CO2) when burned. And as entropy deepens, there will be a shift toward a new energy environment with new technology and social, economic, and political institutions, evolving from an industrial age based on nonrenewable resources to an undefined age based on renewable energy.

(Rifkin, 1989) also outlined that the depletion of nonrenewable energy sources has fractured the energy system, and there is not enough time to remedy this energy shortage. Furthermore, since global warming is not neutralized in the short term, its speed can be reduced to create the conditions for adaptation to changes in the economy and climate. In this regard, at the Belaggio Conference (Italy) in 1987, and at the Conference on Atmospheric Change in Toronto (Canada) in 1988, it was pointed out that, in the absence of a quick technological solution, fossil fuel consumption and, consequently, CO2 emissions should be reduced, in addition to implementing efficiency, recycling, and energy conservation programs.

Given these prospects, climate diplomacy actions are being developed, which are materializing at the 21st Conference of the Parties (COP21) through the Paris Agreement of December 12, 2015. According to (United Nations, 2025a), commitments are defined to address the threats of climate change in the context of sustainable development, with the aim of limiting the increase in global temperature to below 2.0°C compared to pre-industrial levels, as well as strengthening efforts to limit this increase to 1.5°C. These actions are expected to achieve maximum GHG emissions, aiming to balance anthropogenic emissions by sources and their absorption through sinks by the second half of the 21st century.

In relation to the above, (Ottesen, Dieter, Bhagat, & Rola, 2023) point out that this energy transition seeks to replace hydrocarbons (oil and natural gas) in favor of low-carbon or carbon-free energy sources, the speed of which will depend on government policies and the achievement of the objectives of the Paris Climate Agreement. Thus, the COP28 declaration raises for the first time the need to gradually abandon fossil fuels within a reasonable timeframe, so that the era of fossil fuels ends with justice and equity according to (United Nations, 2025b). The imperative to limit the increase in global temperature to 1.5 ° C remains, and the capacity of renewable energies must be tripled, as must energy efficiency be doubled by 2030.

(O'Sullivan & Bordoff, 2024) state that the transition to clean energy is at a very early stage with uncertainties and internal paradoxes generating volatility, and in the face of ambitious measures to combat climate change, political leaders fear the deepening of geopolitical problems, and governments fear the risks to energy security, promoting strategies that include fossil fuels and clean alternatives, in addition to avoiding a shift from dependence on imported oil to imported lithium.

Likewise, a poorly designed clean energy policy can lead to higher costs for consumers, economic anxiety, and a risk to energy reliability and the political will to support climate action. Furthermore, grids and the

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electrical system must be prepared to cope with the rise of intermittent energy sources (solar and wind), the closure of fossil fuel and nuclear plants, and the increased demand for electric cars, data centers, and artificial intelligence.

Regarding the evolution of the energy transition (Yergin, Orszag, & Arya, 2025), they observe an increase in energy demand, and that renewable sources are not replacing conventional sources, but rather adding to them to support these increased demands. Furthermore, in the context of the current transition, renewable energies are expected to be transformative or replacement, rather than additive, as previous transitions have been. The challenge is to develop a variety of energies in a multidimensional and complex way, due to the differential pace of technologies and regional priorities, shaped by governments and businesses.

In relation to additive energy transitions throughout the history of humanity, (Ritchie, Rosado, & Rose, 2020) support that primary energies (biomass, coal, oil, natural gas, hydraulic, nuclear, wind, solar, biofuels, thermal and other non-conventional renewables) maintain their validity in the energy basket since 1800, changing their participation as their use focuses on certain market niches according to their calorific capacity and characteristics, which has led to complementarity of sources and substitution between them for specific uses according to technological advances, and implied changes in the processes to illuminate, heat, refrigerate, generate electricity and produce fuels (energy vectors), depending on the energy needs of households, companies, industries, transportation and productive sectors, tending to promote the well-being and economic growth of countries.

Returning to (Yergin, Orszag, & Arya, 2025), they argue that concerns about climate change have generated expectations about a rapid abandonment of fossil fuels, but the global energy system is not capable of carrying out a transition at that pace because it is much more difficult, costly, and complex. Furthermore, much of the thinking about the transition was consolidated during the COVID-19 pandemic, when energy demand and carbon emissions plummeted, generating optimism about the energy system's flexibility and capacity for change.

Therefore, achieving the 2050 goal of net-zero emissions requires a more pragmatic plan, because the transition is not only related to energy, but to the reconfiguration and redesign of the entire global economy. And in the face of the goal of replacing most of the current energy system with a completely different one, it must be kept in mind that throughout history, no energy source has decreased in absolute terms for an extended period. While previous transitions were driven by increased functionality and lower costs, these incentives are lacking in much of the energy system; and technological, political, and geopolitical uncertainty makes it difficult to calculate the costs of achieving net-zero emissions by 2050.

In the process of decarbonizing the energy mix, they argue that natural gas is an available option and a better alternative in terms of emissions compared to coal and traditional biomass (wood). Furthermore, they predict that global oil demand will stabilize in the early 2030s, natural gas consumption will continue to increase well into the 2040s, and liquefied natural gas (LNG) production will increase by 65% by 2040, thus meeting energy security needs in Europe, replacing coal in Asia, and boosting economic growth in the Global South.

Regarding the future of the energy transition, the Secretary General of OPEC, at COP28 in Dubai in 2023, according to (Organization of the Petroleum Exporting Countries (OPEC), 2023), argues that due to the interrelation between emissions reduction and energy security, realistic policies are needed that consider all technologies and energies, including hydrocarbons, aimed at satisfying the growing demand for energy and its universal and affordable access. Furthermore, the purpose of the Paris Agreement is the reduction of emissions, and the capacities, circumstances and development priorities of countries must be considered to spread the benefits of the transition.

Complementing OPEC's vision and in light of the evolving energy transition toward renewable energy, the paper explores the position of several international oil companies, taking into account that the expected decline in demand for oil and natural gas to achieve the net-zero emissions goal will affect their interests and lead them to become more sustainable in their production processes and product portfolios, thus maintaining their status as energy companies. These corporations shape energy markets, influence geopolitical strategies, and generate billions of dollars in revenue. They also control large hydrocarbon reserves, invest in technology, and play a fundamental role in global economic stability.

(ExxonMobil, 2025), it seeks to create sustainable energy solutions to improve the quality of life, as well as continue to meet the growing demand for oil, natural gas, and refined products; likewise, to efficiently produce energy (fuels), chemicals, lubricants, and low-emission technologies with new technologies, reducing greenhouse gas emissions and creating sustainable value for society, as well as strengthening energy security through the expansion of low-cost, highly profitable oil and natural gas operations. Low-carbon solutions include carbon capture and storage (CCS), hydrogen, and biofuels.

(Chevron Corporation, 2025)'s purpose is to provide affordable, reliable, and cleaner energy, based on the premise that energy drives human progress, improves lives, and generates positive changes in society. Therefore, it works to increase production to meet growing demand by offering low-carbon energy solutions, while building the lowest-carbon future energy system using innovative technology. Therefore, it seeks to expand its oil and natural gas business, reduce the carbon intensity of its operations, and develop new businesses in renewable fuels, carbon capture and offsetting, hydrogen, and power generation for emerging technologies.

In the case of (Shell plc, 2025), it defined a strategy to generate more value with fewer emissions, offering safe and reliable products for the present and during the energy transition, aimed at meeting the changing needs of customers. Along with traditional fuels and lubricants, it seeks to offer low-emission energy solutions, such as electric vehicle charging, biofuels, hydrogen, and carbon capture and storage; it also generates and markets energy from renewable sources: wind and solar, and natural gas due to its low emissions; and it enters the carbon credit business, seeking to reduce emissions from oil and natural gas assets, as well as net carbon intensity (NCI).

(BP plc, 2025)'s purpose is to provide energy in the context of energy transition, which will last several decades, due to its ability to operate in increasingly complex energy markets and systems. Its strategy includes investments in biogas, biofuels, and electric vehicle charging, developing innovative partnerships in renewable energy, as well as in hydrogen and carbon capture projects to decarbonize operations. Given the increase in global energy demand, it plans to expand its fossil fuel and low-carbon energy business, seeking to reduce emissions and transform oil, natural gas, and refining operations to boost efficiency.

According to the list of the ten (10) largest oil companies in the world by market capitalization (Energy, Oil & Gas Magazine, 2025), ExxonMobil is second with $ 490 billion USD, Chevron Corporation is third with $ 281 billion USD, Shell is fifth with $ 220 billion USD and BP is ninth with $ 97 billion USD; this ranking is topped by Saudi Aramco, with a capitalization of $ 1.7 trillion USD.

(Aramco, 2025), considering the forecast for global population growth and the need for more energy to meet this growing demand, envisions that all energy sources will be needed; and because alternative energies will not be able to meet future demand despite their advances, hydrocarbons will be essential during the transition to a low-emission global economy. However, the company has a responsibility to help achieve a net-zero emissions economy by providing reliable, affordable, and more sustainable energy, utilizing the potential of technology to reduce emissions, also, to continue expanding and diversifying the energy product portfolio, and managing the extensive hydrocarbon reserves, optimizing production to increase their long-term value.

In this context, (O'Sullivan & Bordoff, 2024) argue that the transition must continue its ambitious implementation because carbon emissions continue to increase and the threat of climate change must be mitigated through decarbonization. Additionally, the transition should not be considered a means to solve global problems, nor to an end, i.e., achieving net-zero emissions by mid-century according to the 2015 Paris Agreement. As the energy system is intertwined with geopolitics, its transformation is an opportunity to address climate change, reduce inequalities, diversify and strengthen supply chains, create export markets for US companies, and reduce dependence on China. In this way, climate and geopolitical objectives are combined by replacing the fuel sources that drive the entire global economy and increasing the energy supply to ensure more prosperous lives.

Regarding the projected share of primary energy for 2050, Table A.1b: World energy supply from the (International Energy Agency, 2025, pág. 302), was taken as a reference, corresponding to the Announced Pledges scenario, through which it is visualized that renewable energies will have a share of 53% (solar: 19%, wind: 10%, hydraulic: 4% and modern bioenergy: 15%), fossil energies (oil: 16%, natural gas: 14% and

				Announced Pledges (EJ)				Shares (%)		
	2010	2022	2023	2030	2035	2040	2050	2023	2030	2050
Total energy supply	536	629	642	641	624	620	635	100	100	100
Renewables	43	74	78	140	197	251	336	12	22	53
Solar	1	6	8	31	55	81	120	1	5	19
Wind	1	8	8	21	34	46	66	1	3	10
Hydro	12	16	15	18	20	22	25	2	3	4
Modern solid bioenergy	23	34	36	48	56	64	73	6	7	11
Modern liquid bioenergy	2	4	5	10	12	14	14	1	2	2
Modern gaseous bioenergy	1	1	1	4	6	8	12	0	1	2
Traditional use of biomass	21	19	19	6	5	3	2	3	1	0
Nuclear	30	29	30	39	49	59	69	5	6	11
Natural gas	115	144	145	138	121	106	86	23	22	14
Unabated	109	136	137	128	108	90	65	21	20	10
With CCUS	0	1	1	2	5	7	13	0	0	2
Oil	173	187	192	178	156	133	100	30	28	16
Non-energy use	26	30	31	34	35	35	34	5	5	5
Coal	153	172	175	138	95	66	40	27	22	6
Unabated	151	169	172	134	87	56	28	27	21	4
With CCUS	-	0	0	0	4	6	10	0	0	2

Fuente: (International Energy Agency, 2025, pág. 302)

coal: 6%) 36% and nuclear energy 11%. Regarding a 12% share of renewable energies in the energy basket in 2023, fossil energies with 80% (oil: 30%, natural gas: 23% and coal: 27%) and nuclear energy with 5%.

In this way, it can be seen how hydrocarbons and other sources will remain relevant until 2050, varying their share depending on their use due to the evolving energy transition toward renewable sources. Among the assumptions, it is identified that carbon capture, utilization, and storage (CCUS) technologies will be used in the production and consumption of natural gas and coal, oil will not be used as a fuel, and nuclear energy is experiencing a new boom.

However, the Stated Policies Scenario (STEPS) in Table A.1a: World energy supply, (International Energy Agency, 2025, pág. 296) shows that fossil fuels will contribute 58%, renewables 33% and nuclear energy 7%. However, the Net Zero Emissions by 2050 (NZE) scenario in Table A.1c: World energy supply, (International Energy Agency, 2025, pág. 308) shows that fossil fuels will contribute 15%, renewables 71% and nuclear energy 14%.

Finally, as this article has shown, renewable energies are not meeting the growing global energy demand due to population growth. Therefore, fuels will continue to play a fundamental role in the global energy mix in the medium term, as energy analysts and international oil companies have stated. In this context, the vision of a 2050 energy mix without fossil fuels is not possible because it is not envisioned under the conditions of technological development and the pace of growth of renewable energies.

Additionally, the history of the energy mix over the last two (2) centuries shows that no source has been replaced, except in specific sectors, leading to the continued existence of all of them since their emergence. All this, even though an energy transition characterized by the replacement of fossil fuels with renewables is expected, contrary to the cumulative processes of previous transitions, in which all primary energy sources meet the needs, supporting energy security, national interests, and promoting the well-being of the population and the economic growth of countries.

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