Agricultural fields may be impacted by either direct flooding or the depletion of river and fertilizing sediment that flows downstream. Nevertheless, hydroelectric dams may also provide advantages to communities by enhancing flood management, providing consistent availability to agricultural water, and facilitating recreational water activities. The improper management of geothermal process fluids may have negative effects on communities because to disagreeable odors caused by H_2S and contamination with baron, radon, and arsenic. Hydroelectric fluids may undergo processing inside a fully enclosed system and then be reinjected, so alleviating these issues.

Table 4. Assessment of the social effect using qualitative methods

Technology	**Impact**	**Magnitude**
Geothermal	Noise Oduor Seismic activity Pollution	Minor Minor Minor Minor-major
Wind	Visual Bird strike Noise	Minor `` ``
Photovoltaic	Visual Toxins	Minor Minor-major
Hydro	River Damage Repositioning Farming	Minor-major `` ``

Ranking

Based on the chosen indicators of sustainability, each technology was assigned a ranking from 1 to 4 basing on the related signal, as shown in **Fig 6**. A ranking of 1 indicates that the technology performed the best for that particular criterion. When values could be measured, the arange and verage were analyzed simultaneously, since there was often substantial overlie between the figures. The qualitative assessment focused on effect categories that could not be measured, including availability and restrictions, as well as societal implications. Hydro was selected as the minimum constrained option owing to its capacity to offer base load energy, operational flexibility, and the abundance of appropriate locations worldwide. The wind was regarded as the second most favorable due to comparable factors.

Geothermal energy is rather constrained on a global scale, since there are fewer appropriate areas available. Solar energy is regarded as the most constrained due to the inability to sufficiently store extra electricity generated during daylight hours for use during nights and overcast days [30]. Wind energy was shown to have the least adverse societal repercussions when considering its benign character. Solar energy ranked second due to its effective manufacturing management and meticulous site selection, which help minimize any possible adverse effects. Geothermal ranked third as a result of heightened seismic activity and the possibility for contamination. The hydroelectric power industry had the most significant influence, mainly because of the extensive displacement of both human and animal populations caused by dam flooding.

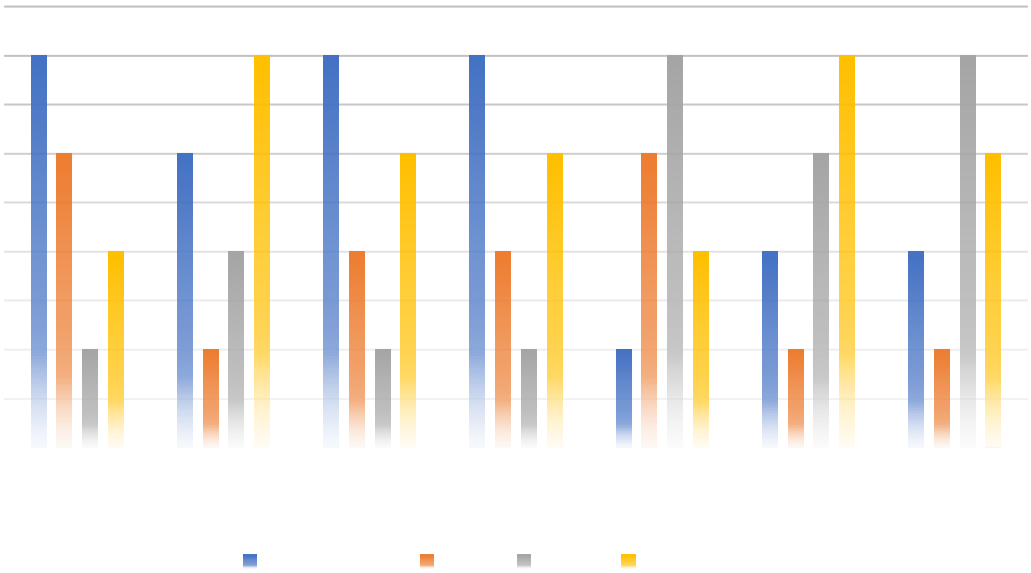

Fig 6. Sustainability Rankings

According to the rating shown in **Fig 6**, wind power is the major energy source that is sustainable, with hydropower being the second most sustainable. Geothermal was determined to have the minimum ranking among the four non-combustion technologies of renewable energy. It is fundamental to remember that the ranking was based on worldwide international circumstances, yet each technology may be greatly influenced by regional factors. Depending on the specific geographical region, some sustainability indicators may have more significance compared to others.

IV. CONCLUSIONS

The Earth's ecosystem has the potential to provide significant amounts of renewable energy that might surpass current levels of energy use. The availability of abundant resources and advanced technology for harnessing renewable energy raises the issue of future progress, depending on the economic and political viability in contrast to other sources of energy. The competitiveness of sources of renewable energy is strongly dependent on technical innovation, since it directly affects their performance and affordability. Various organizations forecast an increasing predominance of sustainable energy in the 21stcentury, with important assistances from wind, solar, biomass, and hydropowersources. There is now a diverse range of technologies available or in progress that provide affordable, dependable, and environmentally friendly energy options. However, there is a significant disparity in the level of advancement and competition among these technologies.

The objective of clean energy solutions is to enhance sustainability by maximizing efficiency, optimizing resource use, boosting cost-effectiveness, lowering environmental harm, strengthening energy security, and improving design and analytical capabilities. When formulating sustainable solutions, it is crucial to consider factors like ecosystem sustainability, abundance, safety, local availability, dependability, and cost-effectiveness. Efforts have been made to develop methods and guidelines for assessing sustainability in a universally recognized and measurable manner. Various measures have been created to evaluate sustainable development in the energy sector. The cost of electricity generation varies significantly across different energy production systems. Renewable energy sources, namely offshore wind farms, are being used for transmitting electricity over long distances, as opposed to non-renewable sources. Over the years, the price of photovoltaics has decreased, making wind energy the most cost-effective option with the lowest carbon dioxide equivalent emissions.

Greenhouse gas emissions are associated with many technologies, with photovoltaics and wind turbines mostly contributing to emissions via energy consumption throughout the production process. The composition of grid mixes varies according on geographical location, so regions with colder temperatures and smaller biomass amounts exhibit fewer emissions per kilowatt-hour. Renewable energy sources have limitations in generating continuous power, mostly owing to challenges in storage and the intermittent nature of its supply. Hydropower has remarkable availability, dependability, and flexibility, making it a dependable energy source for both peak load and base load requirements. Geothermal power is constrained by geographical requirements, despite providing a continuous power supply. The energy production efficiency of photovoltaics and geothermal electricity varies, whereas the efficiency of wind power relies on the quality of wind resources. Photovoltaics and wind production have comparable land use characteristics;however, their hydrological footprints vary. The measurement of water use is a crucial factor in determining sustainability, since large-scale hydroelectric power facilities need significant amounts of water for cooling purposes.

The creation of energy has both advantageous and deleterious consequences on civilization. Renewable energy sources have the capacity to provide power in areas where it would otherwise be unattainable. However, the production of solar cells requires the use of hazardous substances. Public resistance to wind power has arisen due to aesthetic concerns and the possibility of bird collisions. The use of hydropower is a subject of contention, and insufficient management of geothermal process fluids may have detrimental effects on the surrounding populace. Wind power is the most sustainable kind of energy, with hydropower and geothermal energy being the next most sustainable options. However, the rating may be subject to regional factors in view of global events.

Data Availability

No data was used to support this study.

Conflicts of Interests

The author(s) declare(s) that they have no conflicts of interest.

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Competing Interests

There are no competing interests.

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