Energizing change

Energy's pivotal role in the transition to a regenerative economy

2023

In the current context of environmental challenges, finding sustainable solutions for energy generation is critical to the successful transition to a regenerative economy. This transition entails reducing dependence on fossil fuels, which are associated with various environmental, health, and economic issues. Renewable energy technologies are seen as the solution for this shift, offering a viable pathway towards a regenerative economy, as Melanie Beyeler, Senior Portfolio Manager, details in this thought piece.

The transition from fossil fuels to renewables

The power generation sector was responsible for 40% of global CO_2 emissions in 2022[1] mainly due to its reliance on fossil fuels such as coal, oil, and gas. This brings about multiple challenges.

Primarily, fossil fuel usage contributes substantially to environmental degradation. The extraction and burning of these fuels generate pollution and consume a significant amount of energy. Dependence on a few fuel-exporting countries also exposes the sector to potential disruptions due to geopolitical issues or price volatility, thereby raising concerns about energy security. Additionally, the emissions from burning fossil fuels can cause health problems, such as respiratory diseases. Overcoming these challenges necessitates a transition towards more efficient and cleaner energy sources.

Utilising renewable energy in areas like electricity production, transportation and heating for buildings and industries, is key for the decarbonisation of this sector and a successful transition. Even though a complete shift to renewable energy will take time, we have the ability to use several existing technologies right now. These include wind, solar, hydro, and geothermal power.

Accelerating the shift towards these renewables can bolster energy security on a national level, strengthen economic resilience, and create prospects for enhancing societal wellbeing. It's therefore imperative that we expedite this transition.

Primary and secondary energy

Energy exists in various forms, generally classified into two categories: primary and secondary.

Primary energy refers to energy found in nature before any conversion or transformation process. This category includes fossil fuels like coal, oil, and natural gas, as well as renewable sources such as wind, solar, and geothermal energy. For example, coal in the ground or the sun's radiant energy is primary energy. Primary energy sources can be used directly, such as burning coal for heat, or they can be converted into secondary energy forms.

Secondary energy is the result of converting or transforming primary energy sources into more useful forms. The most common example of secondary energy is electricity, which is generated by using primary energy sources. Other secondary energies include gasoline and diesel, which are refined from the primary energy source of crude oil.

The distinction between primary and secondary energy is crucial for understanding the journey of energy from its raw state to its final, usable form. This categorisation helps to evaluate the efficiency of energy conversion processes, assess the environmental impacts of different energy forms, and make informed decisions about energy use and policies.[2]

Renewable and non-renewable energy sources

Energy is derived from a variety of sources, which are classified into two categories: renewable and non-renewable.

Renewable energy refers to energy obtained from limitless sources that naturally replenish over time. This includes energy harnessed from the sun (solar), wind (wind power), flowing water (hydropower), heat from the Earth (geothermal), and plant or animal matter (biomass). Renewable energy sources are sustainable in nature, causing minimal or no greenhouse gas emissions during their operation.

Non-renewable energy, in contrast, originates from sources with finite supplies, primarily fossil fuels like coal, oil, and natural gas. Essentially, these fuels represent concentrated sunshine. Over hundreds of millions of years, the sun produced vast forests, seas full of plankton and plants that sustained billions of animals. The carcasses were gradually compressed into coal, gas and oil. Once used, this process cannot be repeated on a human timescale. Although non-renewable energy has driven industrial development and modern civilization, their extraction and combustion lead to significant environmental issues, including the release of greenhouse gases contributing to global warming.[3]

[1] Source: IEA, 2023a

[2,3] Source Vaclav Smil, Energy Transitions, 2016

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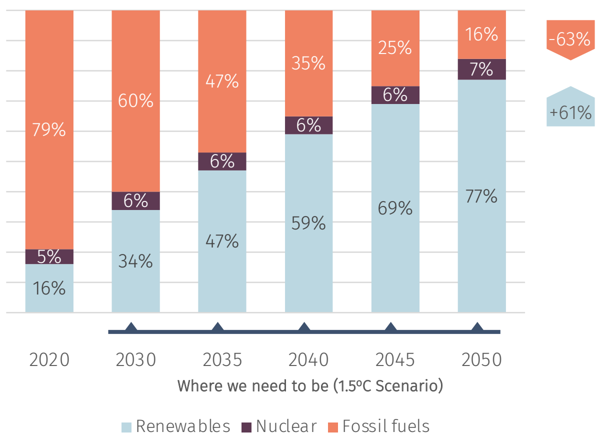
Share of renewables to reach 77% by year 2050[4]

According to the International Renewable Energy Agency's (IRENA) 1.5°C scenario[5], the proportion of renewable energy in the global energy usage needs to jump from 16% in 2020 to a significant 77% by 2050. Despite this large increase, the total energy supply is expected to remain stable due to improvements in energy efficiency and the expansion of renewable sources.

Every sector will rely more heavily on renewable energy. The growing trend of electrification, particularly in sectors like transport and buildings, will necessitate a substantial expansion in renewable electricity. Specifically, by 2050, renewable electricity capacity will need to be twelve times larger than it was in 2020.

As a result, the world must rapidly increase the amount of renewable power capacity it adds each year. From 2023 to 2050, an average of 1,066 gigawatts (GW) of new renewable power capacity will need to be installed globally every year to achieve the 1.5°C scenario.

Figure 1: Required transition in terms of primary energy supply

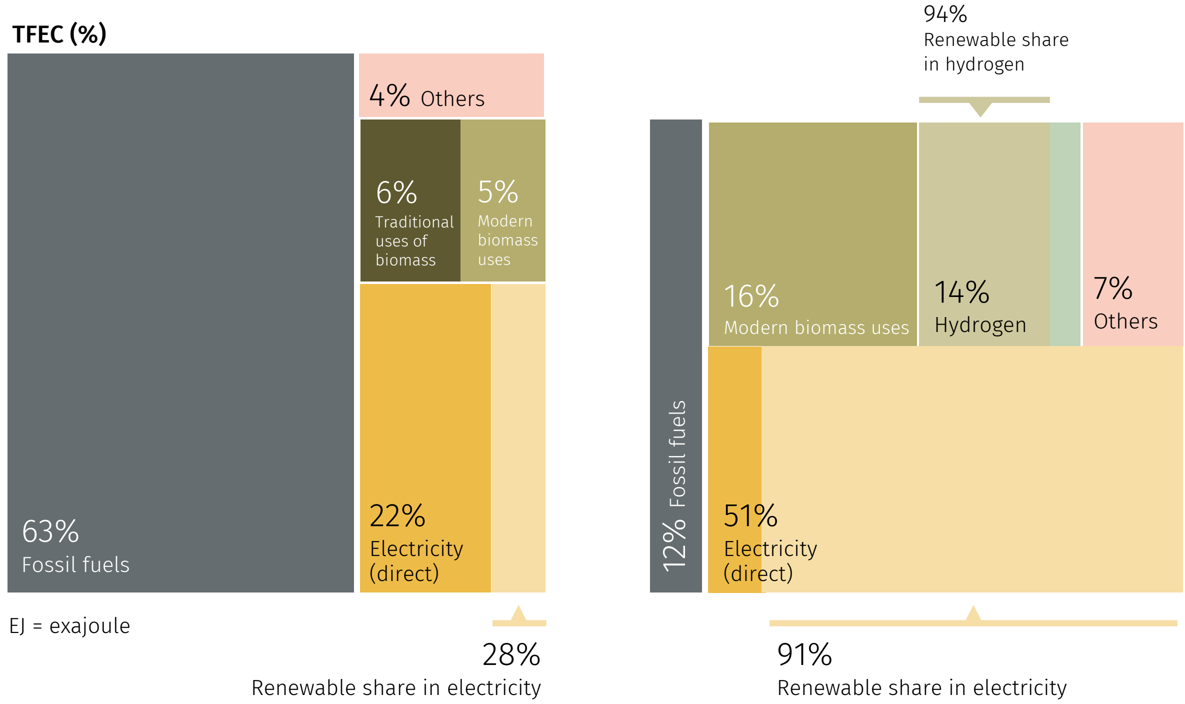


Source: IRENA, World Energy Transitions Outlook 2023

Figure 2: Required transition in terms of energy consumption

2020
Total final energy consumption: 374 EJ

2050 (1.5ºC Scenario)
Total final energy consumption: 353 EJ



Source: IRENA, World Energy Transitions Outlook 2023

[4] Source: IRENA, World Energy Transitions Outlook 2023

[5] The 1.5°C Scenario describes an energy transition pathway aligned with the 1.5°C climate goal to limit global average temperature increase by the end of the present century to 1.5°C, relative to preindustrial levels.

Key renewables for a successful transition

Solar energy

Solar energy is the most abundant of all energy resources and can even be harnessed in cloudy weather. The two main types of solar power generation are Solar Photovoltaic (PV) and Concentrated Solar Power (CSP).

Solar PV technology directly converts sunlight into electricity. It is a very modular technology. It can be produced in large factories for economic efficiency, and it can also be deployed in very small quantities at a time. This adaptability allows it to be used in diverse settings - from small rooftop systems on homes, to extensive installations for utility-scale power generation.

On the other hand, CSP uses mirrors to concentrate sunlight onto a small area to produce high-temperature heat, which is then used to generate electricity, typically through a steam turbine. Whilst CSP can incorporate thermal storage to provide electricity even when the sun is not shining, a key advantage, the technology is typically more complex and more expensive than PV. As a result, its adoption has been more limited.

Solar power capacity has grown significantly in recent years, and it continues to show an upward trend. Under IRENA’s 1.5°C Scenario, by 2030 the worldwide solar power capacity would be almost eight times what it was in 2020, surpassing 5,400 GW. It’s expected to continue growing to over 18,200 GW by 2050. To accomplish this, annual solar power capacity additions would increase from 191 GW in 2022 to an average of 615 GW per year by 2050. However, the potential for solar power varies significantly across regions due to factors such as the amount of sunlight, available land, and local government support.

Wind energy

Wind energy harnesses the kinetic energy of moving air by using large wind turbines located on land (onshore) or in sea or freshwater (offshore). Both onshore and offshore wind energy technologies have evolved over the last few years to maximize the electricity produced - with taller turbines and larger rotor diameters. Onshore wind is a proven, mature technology with an extensive global supply chain. Offshore wind is expected to grow rapidly in the coming years as deploying turbines at sea takes advantage of stronger winds.

Wind energy has tripled from 2012 to 2022, showing fast growth. According to IRENA’s 1.5°C Scenario, wind power would become one of the biggest sources of electricity globally, with capacity reaching almost 10,300 gigawatts (GW) by 2050. Over the past ten years, 55 GW of wind power was added per year on average, with 75 GW added in 2022. Meanwhile, the overall outlook period would see 335 GW of net average annual wind capacity additions.

Hydropower

Hydropower harnesses the energy of water moving from higher to lower elevations. It can be generated from reservoirs and rivers. Reservoir hydropower plants rely on stored water in a reservoir, while run-of-river hydropower plants harness energy from the available flow of the river. Hydropower currently generates more electricity than all other renewable technologies combined and is expected to remain the world’s largest source of renewable electricity generation into the 2030s.

In order to limit global warming to 1.5°C by 2030, global hydropower capacity would need to grow by almost 21% from the 2020 level, reaching 1,465 GW. By 2050, the installed capacity would double from the 2020 level, surpassing 2,500 GW. The G20 countries would account for 79% of the global hydropower capacity by 2030. Among the different regions, Asian countries have substantial technical potential for hydropower growth.

Bioenergy and geothermal energy

Modern bioenergy refers to the energy produced from organic materials, known as biomass, that have recently been living. This distinguishes it from fossil fuels, which also come from organic material but have been aged over millions of years.

Bioenergy can come from a variety of sources. Some of these sources include agricultural residues, wood, and specially grown energy crops. The biomass can be directly burned to produce heat or can be converted into biogas or biofuels through a variety of processes.

Modern bioenergy is considered a form of renewable energy because the biomass it uses can be regrown, capturing carbon dioxide from the atmosphere in the process. However, its sustainability can vary depending on a number of factors, including the source of the biomass, how it’s grown and harvested, and how the bioenergy is produced and used. For instance, it’s important that biomass is sourced in a way that doesn’t contribute to deforestation, compete with food crops, or harm local ecosystems. Bioenergy is the largest source of renewable

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energy globally, accounting for 55% of renewable energy and over 6% of global energy supply.

Geothermal energy utilises the accessible thermal energy from the Earth's interior. Heat is extracted from geothermal reservoirs using wells or other means. It is a renewable source of energy since the heat emanating from the interior is essentially limitless on a human timescale. The use of geothermal energy offers numerous benefits. It's a reliable and consistent source of power since it's not subject to weather variations or seasonal fluctuations like some other renewable sources. It also has a small surface footprint relative to most other power generation sources.

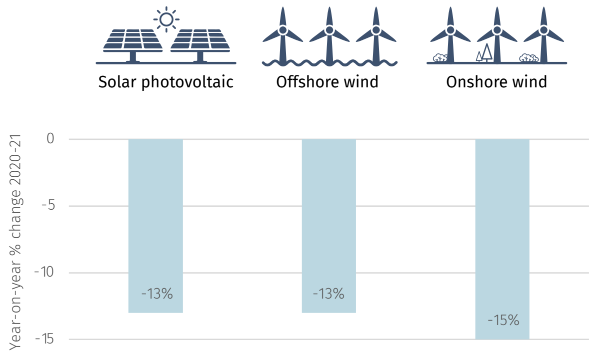
Bioenergy and geothermal energy play a major supporting role in the energy transition of the power sector. They're particularly helpful for providing flexibility in the power system. These energy sources are expected to grow a lot, with five times more capacity by 2030 compared to 2020. Over half of this capacity would be in the G20 countries, both in 2030 and 2050[6].

Costs of renewables have decreased

Since 2010, renewable power sources have become a lot more affordable. The average cost to produce electricity from newly commissioned large-scale solar power projects dropped 88% from 2010 to 2021. The onshore wind power costs declined by 68%, concentrated solar power costs fell 67%, and offshore wind power got 60% cheaper. Just in 2021, the cost of making electricity with solar power fell by 13%, and costs for onshore and offshore wind power dropped by 15% and 13%, respectively. Accordingly, the 12-year period from 2010 to 2021 saw the deployment of 786 GW of renewable energy capacity that was less expensive than even the cheapest fossil fuel-based alternative in the G20.

Starting from 2022, the average cost to produce electricity from solar power and onshore wind has gone up in many countries. This has been especially true for onshore wind, where the increases have been larger than for solar power. The rise in costs is mainly due to issues in the supply chain that started in 2020 and the general commodity price inflation beginning in 2022. These have affected the costs of wind power projects more widely than they did in 2021. However, on a global scale, the impact has been muted. This is because China, which plays a big role in solar power and wind power, has still seen costs decrease.

Figure 3: Change in global weighted average levelised cost of electricity by technology, 2020-2021



Source: IRENA, World Energy Transitions Outlook 2023

Renewable capacity additions accelerate

In 2022, there was a significant increase in the use of renewable energy around the world. In fact, 83% of new power capacity added to the grid was from renewable sources like wind and solar power. In total, 295 GW of renewable power was added globally, which was the most ever added in a year.

What helped this growth was that renewable energy was a good financial choice for many businesses. It also helped that many governments put policies in place that supported renewable energy. But, even with this growth, most of the new renewable power was added in just a few areas. China, the European Union, and the United States alone were responsible for 75% of all new renewable energy capacity.

For 2023, the International Energy Agency predicts that global renewable capacity will experience an unprecedented surge by 107 GW, taking the total to above 440 GW. This significant growth is anticipated in spite of increased interest rates, rising system costs, and ongoing supply chain challenges. Faster solar PV and wind expansion underpins this acceleration due to sustained policy support and enhanced competitiveness. In 2024, the IEA expects the renewable sector to break another record for annual deployment, with solar PV leading the charge, comprising two-thirds of all renewable capacity additions for the year[7].

[6] Sources: https://www.iea.org/energy-system/renewables/
https://www.un.org/en/climatechange/what-is-renewable-energy
https://www.irena.org/Publications/2023/Jun/World-Energy-Transitions-Outlook-2023
[7] Source: https://iea.blob.core.windows.net/assets/63c14514-6833-4cd8-ac53-f9918c2e4cd9/RenewableEnergyMarketUpdate_June2023.pdf

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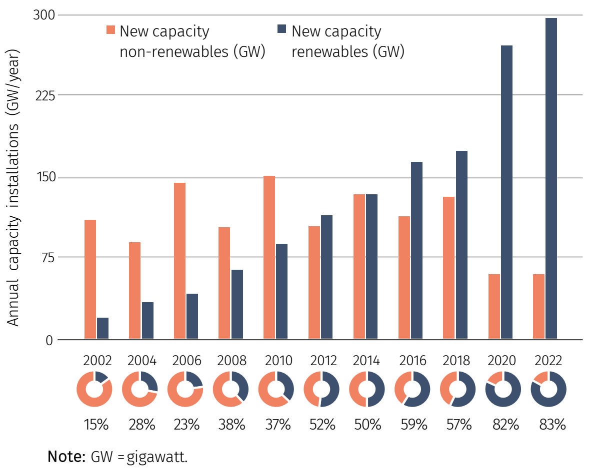
Figure 4: Annual power capacity expansion, 2002-2022



Source: IRENA, World Energy Transitions Outlook 2023

Over USD 100 trillion of energy investments by 2050

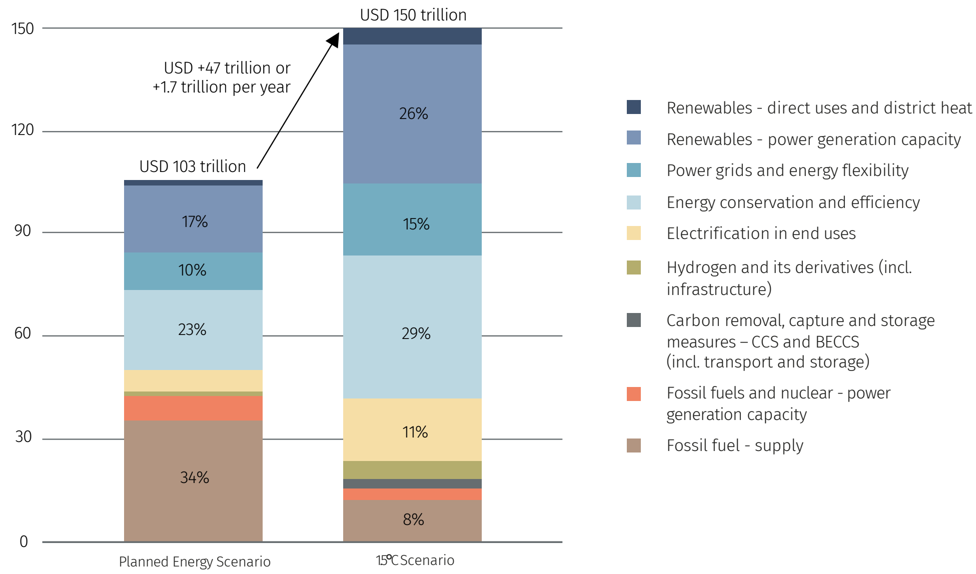
The Planned Energy Scenario by IRENA[8] foresees cumulative sector-wide investments amounting to USD 103 trillion from 2023 to 2050. Approximately 60% of this projected capital is intended for transition technologies - predominantly renewables, efficiency enhancements, electrification, hydrogen, and carbon sequestration. However, a significant 40% of the envisaged investment still targets fossil fuels. Investment in energy should spearhead the transition while circumventing the risk of stranded assets.

To keep the 1.5°C target within reach, both scale-up and re-allocation of investment in transition technologies are needed. Compared with the Planned Energy Scenario, the 1.5°C Scenario requires additional capital expenditure of USD 47 trillion, culminating in a total of USD 150 trillion. This scenario also entails the re-allocation of approximately USD 26 trillion, presently aimed at coal and oil-based fossil fuel technologies, towards transition technologies and infrastructure by 2050.

The path to a powerful future

In conclusion, the power generation sector holds an unparalleled significance in the transition to a regenerative economy. However, this transition requires strategic foresight and assertive action. The reduction of CO_2 emissions necessitates a move away from fossil fuels and towards renewable energy technologies. These technologies, including wind, solar, hydro, and geothermal power, are not only viable, but they are imperative to maintain global warming below 1.5°C and for a successful transition to a regenerative economy.

Figure 5: Global investment by technological avenue, 2030-2050



Source: IRENA, World Energy Transitions Outlook 2023

[8] The Planned Energy Scenario provides a perspective on energy system developments based on governments' energy plans and other planned targets and policies in place at the time of analysis, with a focus on G20 countries.

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