

# The advantages and disadvantages of renewable energy

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New developments in renewable energy are making headlines and inspiring hope in communities worldwide, from a remote Arctic village working to harness solar and wind power under challenging conditions to a U.S. Air Force base planning an advanced, utility-scale geothermal power system.

As much of the world grapples with mitigating the effects of climate change and global warming, innovation and advancements in renewable energy have emerged as a bright spot. Solar energy, wind energy, hydropower, geothermal energy and biomass energy generation is better for the planet than the burning of fossil fuels including oil, natural gas and coal.

But for all of the advantages of renewable energy, its development and use has disadvantages, too. Let's take a look at both.

## The multiple (and sometimes surprising) advantages of renewable energy

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The advantages of renewable energy power sources are wide-ranging, and some are more obvious than others.

### Inexhaustible supply

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One of the main benefits of renewable energy sources like the sun, wind and water is that they will never run out. In contrast, non-renewable resources are not only finite, but cost more as their availability declines and require more extreme extraction methods with greater environmental impacts.

## **Carbon-free energy generation**

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The goal of the clean energy transition is decarbonization. Carbon dioxide emissions reached 11.2 gigatonnes (Gt) in 2022 from oil alone, whereas renewable energy generation emits little to no carbon emissions to power homes, cars and businesses.

## **A cleaner, healthier environment**

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The burning of fossil fuels, like coal, releases airborne pollutants such as nitrogen oxide and sulfur dioxide, while the mining of these resources can result in water pollution and damage animal habitats. Using renewable energy in place of fossil fuels can reduce these pollutants and help mitigate risks to human health and natural environments.

## **Energy independence**

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Renewable energy provides for stronger energy security by opening up new opportunities for domestic energy production, thereby reducing reliance on foreign-sourced energy supply. For example, since Russia's invasion of Ukraine, European countries have sought to reduce their imports of Russian oil and gas. In 2023, domestic renewable energy production in Europe rose to account for a record 44% of the EU's electricity mix while imports from Russia declined, helping build a more stable, resilient power grid.

## **Less maintenance**

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For certain types of renewable energy sources, the maintenance and maintenance costs of their infrastructure are minimal. Solar photovoltaic systems, for example, generally don't have moving parts and can last 25 years or more with little maintenance. Hydroelectric power plants typically have low operating costs and require little maintenance as well, with long-lasting equipment that can remain in operation for decades.

## **Affordable energy**

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When it comes to costs, renewable energy sources once compared unfavorably to fossil fuels. But as fossil fuel prices rise renewable energy has emerged as an affordable alternative energy option. An estimated 96% of new utility-scale solar and wind power projects had lower generation costs than new coal and natural gas plants. As more renewable energy resources are integrated into power grids, businesses are also implementing energy management programs to optimize energy usage and reduce overall energy costs.

## Job creation

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While both clean energy and fossil fuel industries have seen job growth in recent years, growth has been markedly faster in the former. As a result, clean energy roles now account for more than half of the 67 million jobs in the global energy sector. Such growth is fueling demand for additional workers and retraining for existing fossil fuel workers to transition to the renewable energy industry.

## Hurdles to a clean transition: the disadvantages to renewable energy

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For all the celebrated benefits of renewable energy, the sector has some downsides as well. Understanding the disadvantages of renewable energy can help organizations better plan its deployment. Here are some of the cons of renewable energy projects today:

### High upfront costs

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Shifting to renewable energy technologies saves money in the long run but component costs and initial costs for set-up can be expensive. For example, small businesses can expect to pay USD 100,000 or more for commercial solar installations, depending on their energy needs. However, legislation for incentives, tax credits and various rebates can help offset these costs.

### Location and landmass requirements

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Most renewable energy power generation is location dependent—solar farms require unobstructed sunlight, hydropower requires water movement, wind farms require open spaces and traditional geothermal power requires proximity to sources of hot water. In many cases, renewable energy systems require a lot of space—more than traditional power stations. Research conducted by the ICF Climate Center found that large-scale renewable energy installations require 10 times more land than coal- and natural gas-fired power plants.

### Production volatility

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Renewable electricity generation is vulnerable to weather conditions: solar power is susceptible to cloudy days, hydropower to droughts and wind power to calm days. As such, guaranteeing the amount of energy produced at any given time is a challenge. To help companies adapt to this volatility, solutions like the IBM Environmental Intelligence Suite use sensors, geospatial data, advanced analytics, machine learning, artificial intelligence (AI) and weather data to generate day-ahead wind and solar forecasts.

### Storage requirements

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Due to the intermittent nature of renewable power, batteries are required to collect energy during peak production periods for distribution in a controlled, consistent manner during periods of low- to non-production. Energy storage systems to support utility-scale applications are costly but technology is being developed to support more affordable long-term storage.

## **Supply chain limitations**

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Supply chain hurdles are hindering the installation of renewable energy projects. According to a report by McKinsey, project developers face three main challenges: access to raw materials and rare earth metals amid a projected shortage; access to the talent and machinery necessary; and little supplier diversification for critical components. For example, in the case of polysilicon, a material used in solar panels, 79% of global capacity is concentrated in China, making the solar PV industry vulnerable to disruptions in that country.

## **Carbon footprint and waste**

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Although solar and wind power emit no harmful emissions during power generation, the manufacturing, installation and transportation of renewable energy equipment does often produce greenhouse gas emissions. Additionally, waste products are created during asset production process and disposal, with wind turbine blades and solar panels taking up space in landfills.

## **Optimizing renewable energy sourcing**

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Businesses in the renewable energy industry or interested in sourcing renewable power can proactively monitor renewable energy trends with the right tools. The IBM Environmental Intelligence Suite uses historical energy generation data, weather data and more to generate high-accuracy energy forecasts for wind and solar assets to inform key decision-making at the enterprise level.