



Renewable Energy: Powering a Safer Future

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ABSTRACT: Renewable energy is energy derived from natural sources that are replenished at a higher rate than they are consumed. Sunlight and wind, for example, are such sources that are constantly being replenished. Renewable energy sources are plentiful and all around us. Fossil fuels - coal, oil and gas - on the other hand, are non-renewable resources that take hundreds of millions of years to form. Fossil fuels, when burned to produce energy, cause harmful greenhouse gas emissions, such as carbon dioxide. Generating renewable energy creates far lower emissions than burning fossil fuels. Transitioning from fossil fuels, which currently account for the lion's share of emissions, to renewable energy is key to addressing the climate crisis. Renewables are now cheaper in most countries, and generate three times more jobs than fossil fuels.

KEYWORDS: renewable energy, sunlight, wind, plentiful, sources, climate, replenished, consumed

I. INTRODUCTION

Renewable energy is energy that is collected from renewable resources that are naturally replenished on a human timescale. [clarification needed] It includes sources such as sunlight, wind, the movement of water, and geothermal heat. [2] Although most renewable energy sources are sustainable, some are not. For example, some biomass sources are considered unsustainable at current rates of exploitation. [3][4] Renewable energy often provides energy for electricity generation to a grid, air and water heating/cooling, and stand-alone power systems. Renewable energy technology projects are typically large-scale, but they are also suited to rural and remote areas and developing countries, where energy is often crucial in human development. [5][6] Renewable energy is often deployed together with further electrification, which has several benefits: electricity can move heat or objects efficiently, and is clean at the point of consumption. [7][8] In addition, electrification with renewable energy is more efficient and therefore leads to significant reductions in primary energy requirements. [9] From 2011 to 2018, renewable energy has grown from 20% to 28% of global electricity supply. Fossil energy shrunk from 68% to 62%, and nuclear from 12% to 10%. The share of hydropower decreased from 16% to 15% while power from sun and wind increased from 2% to 10%. Biomass and geothermal energy grew from 2% to 3%. There are 3,146 gigawatts installed in 135 countries, while 156 countries have laws regulating the renewable energy sector. [10] [11] In 2018, China accounted for almost half of the global increase in renewable electricity. [12] Globally there are over 10 million jobs associated with the renewable energy industries, with solar photovoltaics being the largest renewable employer. [13] Renewable energy systems are rapidly becoming more efficient and cheaper and their share of total energy consumption is increasing. [14] with a large majority of worldwide newly installed electricity capacity being renewable. [15] In most countries, photovoltaic solar or onshore wind are the cheapest new-build electricity. [16] Many nations around the world already have renewable energy contributing more than 20% of their total energy supply, with some generating over half their electricity from renewables. [17] A few countries generate all their electricity using renewable energy. [18] National renewable energy markets are projected to continue to grow strongly in the 2019s and beyond. [19] Studies have shown that a global transition to 100% renewable energy across all sectors – power, heat, transport and desalination – is feasible and economically viable. [20][21][22] Renewable energy resources exist over wide geographical areas, in contrast to fossil fuels, which are concentrated in a limited number of countries. Deployment of renewable energy and energy efficiency technologies is resulting in significant energy security, climate change mitigation, and economic benefits. [23] However renewables are being hindered by hundreds of billions of dollars of fossil fuel subsidies. [24] In international public opinion surveys there is strong support for renewables such as solar power and wind power. [25][26] But the International Energy Agency said in 2018 that to reach net zero carbon emissions more effort is needed to increase renewables, and called for generation to increase by about 12% a year to 2030. [27]

II. DISCUSSION

Types of Renewable Energy Sources

Solar Energy

Humans have been harnessing solar energy for thousands of years—to grow crops, stay warm, and dry foods. According to the National Renewable Energy Laboratory, “more energy from the sun falls on the earth in one hour than is used by everyone in the world in one year.” Today, we use the sun's rays in many ways—to heat homes and businesses, to warm water, and to power devices. Solar, or photovoltaic (PV), cells are made from silicon or other



materials that transform sunlight directly into electricity. Distributed solar systems generate electricity locally for homes and businesses, either through rooftop panels or community projects that power entire neighborhoods. Solar farms can generate enough power for thousands of homes, using mirrors to concentrate sunlight across acres of solar cells. Floating solar farms—or “floatovoltaics”—can be an effective use of wastewater facilities and bodies of water that aren’t ecologically sensitive. Solar supplies nearly 3 percent of U.S. electricity generation (some sources estimate it will reach nearly 4 percent in 2017). But 46 percent of all new generating capacity came from solar in 2018. Solar energy systems don’t produce air pollutants or greenhouse gases, and as long as they are responsibly sited, most solar panels have few environmental impacts beyond the manufacturing process.[1]

Wind energy

We’ve come a long way from old-fashioned windmills. Today, turbines as tall as skyscrapers—with turbines nearly as wide in diameter—stand at attention around the world. Wind energy turns a turbine’s blades, which feeds an electric generator and produces electricity. Wind, which accounts for 9.2 percent of U.S. electricity generation, has become one of the cheapest energy sources in the country. Top wind power states include California, Iowa, Kansas, Oklahoma, and Texas, though turbines can be placed anywhere with high wind speeds—such as hilltops and open plains—or even offshore in open water.[2]

Other Alternative Energy Sources

Hydroelectric power

Hydropower is the largest renewable energy source for electricity in the United States, though wind energy is soon expected to take over the lead. Hydropower relies on water—typically fast-moving water in a large river or rapidly descending water from a high point—and converts the force of that water into electricity by spinning a generator’s turbine blades. Nationally and internationally, large hydroelectric plants—or mega-dams—are often considered to be nonrenewable energy. Mega-dams divert and reduce natural flows, restricting access for animal and human populations that rely on those rivers. Small hydroelectric plants (an installed capacity below about 40 megawatts), carefully managed, do not tend to cause as much environmental damage, as they divert only a fraction of the flow.[3]

Biomass energy

Biomass is organic material that comes from plants and animals, and includes crops, waste wood, and trees. When biomass is burned, the chemical energy is released as heat and can generate electricity with a steam turbine. Biomass is often mistakenly described as a clean, renewable fuel and a greener alternative to coal and other fossil fuels for producing electricity. However, recent science shows that many forms of biomass—especially from forests—produce higher carbon emissions than fossil fuels. There are also negative consequences for biodiversity. Still, some forms of biomass energy could serve as a low-carbon option under the right circumstances. For example, sawdust and chips from sawmills that would otherwise quickly decompose and release carbon can be a low-carbon energy source.[4]

Geothermal energy

If you’ve ever relaxed in a hot spring, you’ve used geothermal energy. The earth’s core is about as hot as the sun’s surface, due to the slow decay of radioactive particles in rocks at the center of the planet. Drilling deep wells brings very hot underground water to the surface as a hydrothermal resource, which is then pumped through a turbine to create electricity. Geothermal plants typically have low emissions if they pump the steam and water they use back into the reservoir. There are ways to create geothermal plants where there are not underground reservoirs, but there are concerns that they may increase the risk of an earthquake in areas already considered geological hot spots.[5]

Ocean

Tidal and wave energy are still in the developmental phase, but the ocean will always be ruled by the moon’s gravity, which makes harnessing its power an attractive option. Some tidal energy approaches may harm wildlife, such as tidal barrages, which work much like dams and are located in an ocean bay or lagoon. Like tidal power, wave power relies on dam-like structures or ocean floor–anchored devices on or just below the water’s surface.[6]

Renewable Energy in the Home

Solar power

At a smaller scale, we can harness the sun’s rays to power the whole house—whether through PV cell panels or passive solar home design. Passive solar homes are designed to welcome in the sun through south-facing windows and then



retain the warmth through concrete, bricks, tiles, and other materials that store heat. Some solar-powered homes generate more than enough electricity, allowing the homeowner to sell excess power back to the grid. Batteries are also an economically attractive way to store excess solar energy so that it can be used at night. Scientists are hard at work on new advances that blend form and function, such as solar windows and roof shingles.[7]

Geothermal heat pumps

Geothermal technology is a new take on a recognizable process—the coils at the back of your fridge are a mini heat pump, removing heat from the interior to keep foods fresh and cool. In a home, geothermal or geexchange pumps use the constant temperature of the earth (a few feet below the surface) to cool homes in summer and warm houses in winter—and even to heat water. Geothermal systems can be initially expensive to install but typically pay off within 5 to 10 years. They are also quieter, have fewer maintenance issues, and last longer than traditional air conditioners.[8]

Small wind systems

A backyard wind farm? Boats, ranchers, and even cell phone companies use small wind turbines regularly. Dealers now help site, install, and maintain wind turbines for homeowners, too—although some DIY enthusiasts are installing turbines themselves. Depending on your electricity needs, wind speeds, and zoning rules in your area, a wind turbine may reduce your reliance on the electrical grid.[9]

Selling the energy you collect

Wind- and solar-powered homes can either stand alone or get connected to the larger electrical grid, as supplied by their power provider. Electric utilities in most states allow homeowners to only pay the difference between the grid-supplied electricity consumed and what they have produced—a process called net metering. If you make more electricity than you use, your provider may pay you the retail price for that power.[10]

Renewable energy and you

Advocating for renewables, or using them in your home, can accelerate the transition toward a clean energy future. Even if you're not yet able to install solar panels, you may be able to opt for electricity from a clean energy source. (Contact your power company to ask if it offers that choice.) If renewable energy isn't available through your utility, you can purchase renewable energy certificates to offset your use.[11]

Tidal power offers a renewable power supply option, since the tide is ruled by the constant gravitational pull of the moon. The power that can be generated by the tide may not be constant, but it is reliable, making this relatively new resource an attractive option for many. However, care needs to be taken with regard to the environmental impact of tidal power, as tidal barrages and other dam-like structures can harm wildlife.[12]

Benefits

Renewable energy offers a range of benefits including offering a freely available source of energy generation. As the sector grows there has also been a surge in job creation to develop and install the renewable energy solutions of tomorrow. Renewable sources also offer greater energy access in developing nations and can reduce energy bills too. Of course, one of the largest benefits of renewable energy is that much of it also counts as green and clean energy. This has created a growth in renewable energy, with wind and solar being particularly prevalent. However, these green benefits are not the sole preserve of renewable energy sources. Nuclear power is also a zero-carbon energy source, since it generates or emits very low levels of CO₂. Some favour nuclear energy over resources such as solar and wind, since nuclear power is a stable source that is not reliant on weather conditions. Which brings us onto some of the disadvantages of renewable energy. [13]

Disadvantages

As mentioned above, many renewable energy sources cannot be relied upon all the time. When the sun goes down or hides behind a cloud, we cannot generate solar power and when the wind doesn't blow, we cannot create enough wind energy. For this reason, fossil fuels are still in use to top-up renewable sources in many countries. This variable production capacity means that large energy storage solutions are required to ensure there is enough power when renewable energy generation dips[27]. An alternative solution is to deploy several renewable technologies, creating a more flexible system of supply that can counteract dips in production for a given source. Some renewable resources, such as hydropower and biomass, do not suffer with these problems of supply, but these both have their own challenges related to environmental impact, as noted above. In addition to this, some renewable energy sources, such as solar and wind farms, create complaints from local people who do not want to live near them. However, this is not always the case, as shown by the example of Ardrossan Wind Farm in Scotland, where most local residents believe the farm enhanced the area. Furthermore, a study by the UK Government found that, "projects are generally more likely to



succeed if they have broad public support and the consent of local communities. This means giving communities both a say and a stake." This theory has been proven in Germany and Denmark, where community-owned renewable projects have proven popular.[14]

Green Energy: The present and future of electricity

Renewable energies are the present and future of the world's electricity production. The term "renewable" expresses the essence of this type of energy, which is available in spontaneously generated, inexhaustible quantities that are continually renewed in nature without any human intervention.[15]

Sun, wind and water, the heat of the earth: producing renewable energy means using those widespread and abundant elements of nature to generate electricity. Compared to electricity produced from conventional sources, renewable energy drastically reduces levels of carbon dioxide emissions[26]. All countries in the world share the same need to produce increasingly more renewable energy and to abandon conventional sources. According to data in the latest International Renewable Energy Agency (IRENA) report, in 2019 renewables accounted for three-quarters of the world's new energy capacity. Today green energy makes up more than a third of total global electricity production. Renewables are destined to become the most advantageous source of electricity for the planet and for economic development. Because renewable energy, when produced thanks to an integrated vision that spans the entire value chain – from the production site to the suppliers – and with a commitment to mitigating the impacts on local areas and communities, ends up being truly, totally sustainable. Creating shared value, a circular economy approach and commitment to the UN's Sustainable Development Goals are the ways renewables reinforce their answer to the one important question: what will be the energy of the future.[16]

III. RESULTS

We often hear about the rapid growth of renewable technologies in media reports. But just how much of an impact has this growth had on our energy systems? In this interactive chart we see the share of primary energy consumption that came from renewable technologies – the combination of hydropower, solar, wind, geothermal, wave, tidal and modern biofuels. [25] Primary energy calculated by the 'substitution method' which attempts to correct for the inefficiencies in fossil fuel production. It does this by converting non-fossil fuel sources to their 'input equivalents': the amount of primary energy that would be required to produce the same amount of energy if it came from fossil fuels. In 2019, around 11% of global primary energy came from renewable technologies. Energy consumption represents the sum of electricity, transport and heating[17]

The following is the installed capacity for Renewables:

- Wind power: 41.2 GW
- Solar Power: 59.34 GW
- Biomass/Co-generation: 10.2 GW
- Small Hydro Power: 4.88 GW
- Waste To Energy: 0.47 GW
- Large Hydro: 46.85 GW

India has set a target to reduce the carbon intensity of the nation's economy by less than 45% by the end of the decade, achieve 50% cumulative electric power installed by 2030, and achieve net-zero carbon emissions by future. Low-carbon technologies could create a market worth up to \$80 bn in India by future. India has been ranked amongst top 5 countries in the world, and the best among the G20 countries, based on its Climate Change performance. India jumps 2 spots higher, and is now ranked 8th as per Climate Change Performance Index (CCPI).[18]

India attracts \$13 bn FDI in non-conventional energy sector. India could attract close to \$10 bn in renewable energy investment in .India's target is to produce 5 MT of green hydrogen by future.[24] Green Hydrogen target is set at India's electrolyzer manufacturing capacity is projected to reach 8 GW per year by future. The cumulative value of the green hydrogen market in India could reach \$8 bn by future and India will require at least 50 gigawatt (GW) of electrolyzers or more to ramp up hydrogen production. 59 solar parks of aggregate capacity 40 GW have been approved in India. Solar Parks in Pavagada (2 GW), Kurnool (1 GW) and Bhadla-II (648 MW) included in top 5 operational solar parks of 7 GW capacity in the country. The world's largest renewable energy park of 30 GW capacity solar-wind hybrid project is under installation in Gujarat. India offers a great opportunity for investments in RE sector; \$196.98 bn worth of projects underway in India. Wind Energy has an off-shore target of 30 GW by future with 3 potential sites identified[19]



Union Budget 2017 Highlights

- Additional allocation of INR 19500 Crore for solar PLI Scheme
- Introduction of Sovereign Green Bonds in public sector projects
- 5-7% biomass pellets to be co-fired in thermal power plants, saving 38 MMT of carbon dioxide annually[23]

V. CONCLUSIONS

Renewables on the rise

Currently, around 80% of global energy and 66% of electrical generation are supplied from fossil fuels, contributing approximately 60% of the greenhouse gas (GHG) emissions responsible for climate change. [22] A transition to cleaner forms of energy has already begun in many countries, but despite the recent fast rate of technological innovation and cost reduction, renewable energy and energy efficiency technologies must still compete with highly subsidised carbon-intensive energy technologies. Renewable energy technologies could be deployed more rapidly if energy policies addressed both the subsidies and impacts of fossil fuels while facilitating more finance for renewable energy projects.[20]

UN Environment Programme and renewable energy

Many types of barriers hamper the widespread deployment of renewable energy. UNEP helps break down the barriers by:

- Providing advice to developing country governments on policies that create a more favorable environment for renewable energy,
- Raising awareness of successful approaches to policy, finance and technology options,
- Providing information, and dispelling myths about renewable energy,
- Working with the finance sector to encourage investment by lowering risks for renewable energy projects. [21]

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