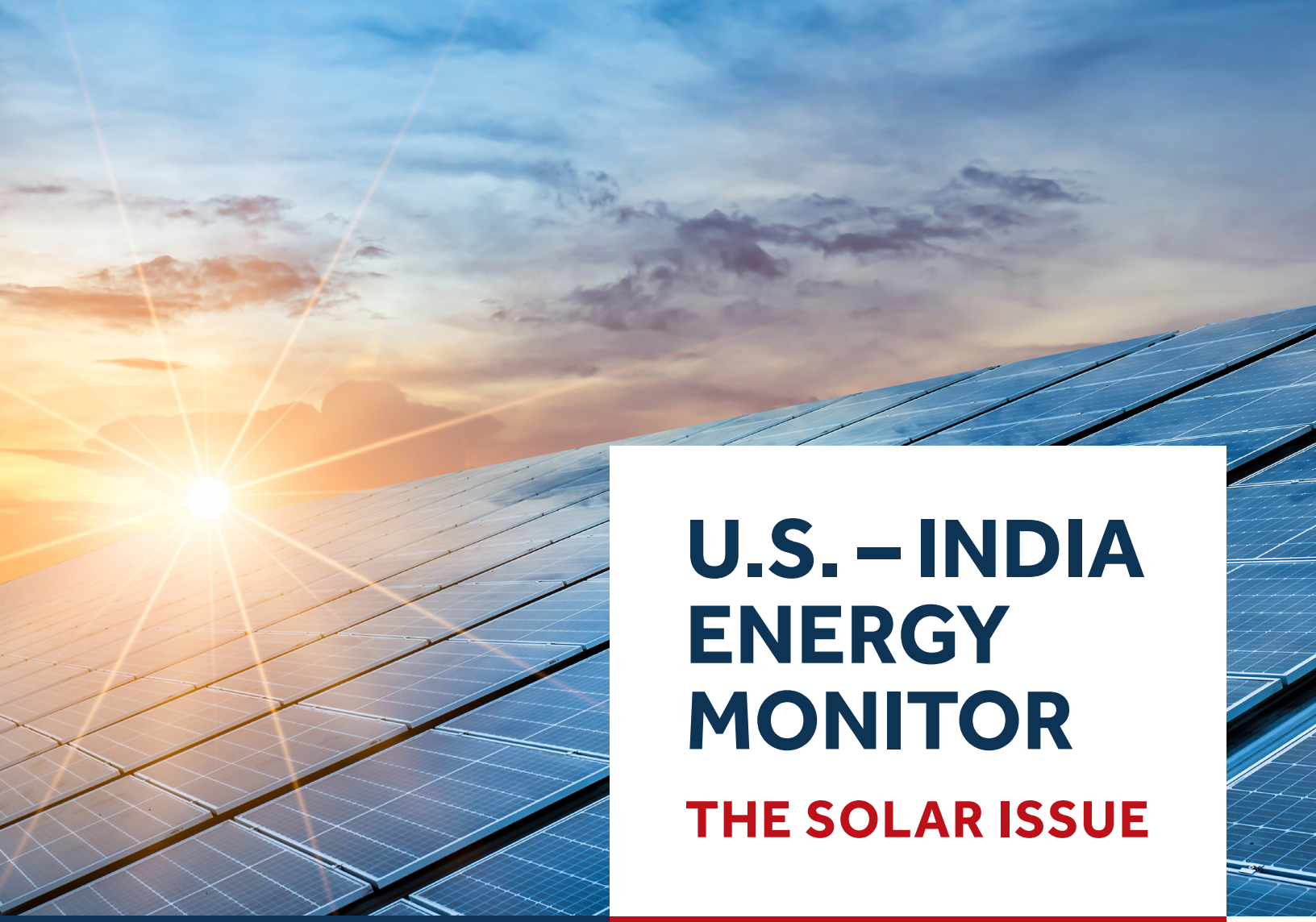

U.S. – INDIA ENERGY MONITOR

THE SOLAR ISSUE

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Compiled by
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ORF AMERICA

Higher Global Energy Prices

The global energy crisis is persisting, driven by the confluence of economic recovery and ensuing energy demand increases, more extreme weather, increased heating and cooling needs, and a limited supply of gas and coal. As a result, consumers face rising gas and electricity prices.[1] In turn, energy transitions have come under increasing scrutiny as prices and volatility increase, with views diverging on whether energy transitions need to be accelerated to reduce reliance on fossil fuels or whether fossil fuel production needs to increase to reduce volatility and ensure affordability.

In November, the United States, India, the United Kingdom, China, Japan, and South Korea agreed to release strategic petroleum reserves to dampen the damages caused by skyrocketing energy prices, the highest in seven years. The United States and India will release 50 million and five million barrels of strategic reserves, respectively.[2]

COP 26

The U.N. Climate Change Conference - COP 26 - was held in Glasgow from October 31 to November 12, 2021. The conference saw participation from nearly 200 countries, resulting in the Glasgow Climate Pact. The pact includes commitments to strengthen resilience against climate change, limit greenhouse gas emissions, and provide the required climate finance to achieve these targets.[3] The United States and India charted their own stories at COP 26 and, in doing so, have highlighted further areas for bilateral cooperation.

India made headlines by announcing a net-zero greenhouse gas emissions target by 2070, one of five commitments announced by Prime Minister Narendra Modi. This announcement is significant because India was one of the last major economies to set a target to end greenhouse gas emissions.[4] Arguing India has emitted per capita and cumulatively less than wealthy, developed economies, India emphasized near-term

India announced five significant commitments at COP 26:

1. Increase non-fossil fuel energy capacity to 500 GW by 2030.
2. Meet 50% of energy requirements through renewable energy by 2030.
3. Reduce total emissions by one billion metric tons by 2030.
4. Reduce carbon intensity of the economy by more than 45% by 2030.
5. Achieve net-zero emissions by 2070.

tangible actions to reduce emissions instead of far-off targets.[5] The 2070 target is ambitious and provides a platform for further investment and cooperation between India and the U.S.

The United States announced several initiatives at COP 26 in support of its 2050 net-zero greenhouse emissions target and commitment to reduce emissions by 50% of 2005 levels by 2030.[6] The U.S. and China, the world's largest emitters, released a joint statement to reaffirm commitments to implement the Paris Climate Accords.[7] Multilaterally, joint U.S. efforts include the Global Methane Pledge, which will reduce methane emissions by 30% by 2030.[8] Methane is a greenhouse gas more potent than carbon dioxide and the primary component of natural gas. The U.S. launched the First Movers Coalition, a coalition of 25 of the world's largest companies will focus on hard-to-abate industrial sectors like steel and aviation.[9] Other U.S. commitments focused on fossil fuel infrastructure, including announcements to end fossil fuel projects abroad starting in 2022[10] and working with South Africa to reduce its reliance on coal.[11] Lastly, the U.S. entered commitments on climate adaptation, to better equip countries to face a warmer world. These include President's Emergency Plan for Adaptation and Resilience (PREPARE) to support developing countries,[12] the Global Forest Finance Pledge for forest-related finance,[13] and Agriculture Innovation Mission for Climate to support climate-smart agriculture and food systems.[14]

Domestic Developments

India temporarily averted the coal crisis that was gripping the country in October 2021.[15] Increasing energy demand, seasonal demand peaks, and severe coal shortages led to widespread blackouts, especially in North India.[16] The Government of India has supported coal production increases. State-owned enterprises like Coal India have boosted production to secure a coal stock of 70 million tons, expected to last until March 2022.[17]

In the United States, President Biden signed the Bipartisan Infrastructure Deal (BID) into law with eight key pillars, including public transit, electric vehicle infrastructure, clean energy transmission, and legacy pollution. With climate change in mind, BID aims to improve resilience, slash consumer costs, and increase U.S. competitiveness.[18] The House of Representatives passed the Build Back Better framework to create a 21st-century clean energy economy.[19] The framework is unlikely to pass the Senate as Senator Joseph Manchin (D-WV) has expressed his reservations due to the framework's potential impact on inflation.[20]

The amount of sunlight that strikes the earth's surface in an hour and a half is enough to handle the entire world's energy consumption for a full year.[21]

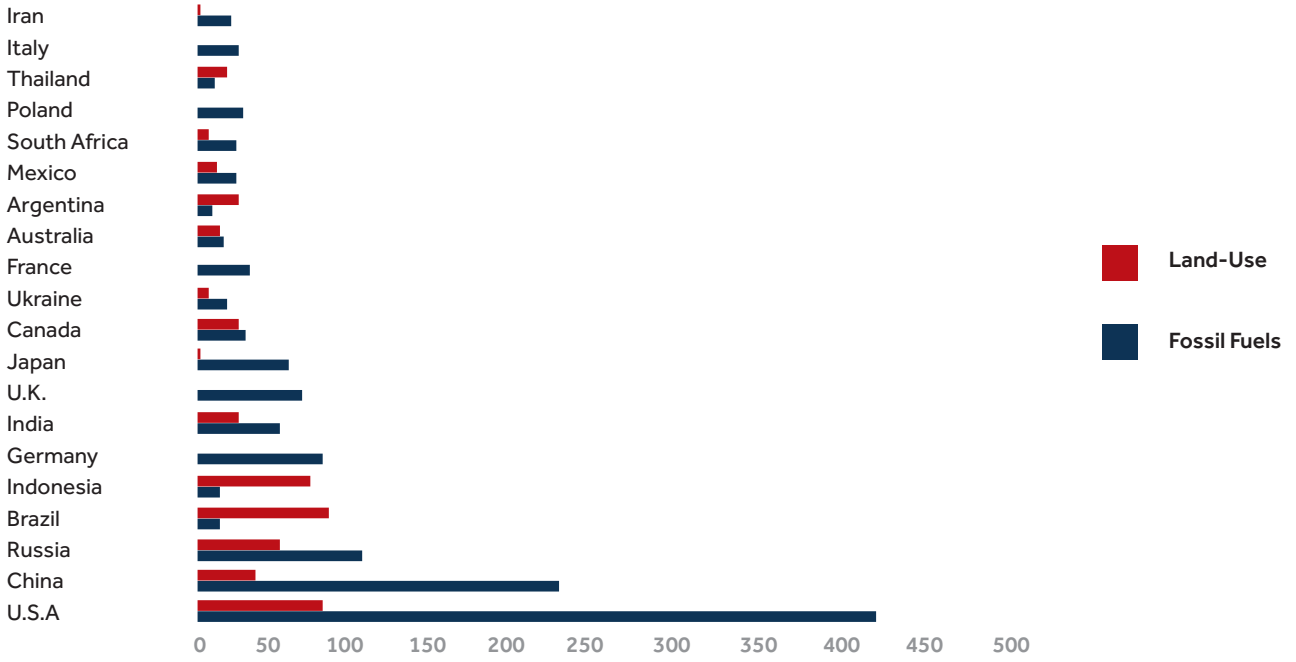
Effective climate change mitigation will require drastic reductions in greenhouse gas emissions and enhanced climate sinks such as forests and oceans.[22] As of 2020, we have collectively emitted an estimated 2,500 billion tons of carbon dioxide (CO_2), the primary greenhouse gas, into the atmosphere. This is 86% of our "carbon budget," the cumulative amount of carbon dioxide in the atmosphere to stay below an average 1.5 °C of global warming, a target of global climate agreements.[23]

While high-income countries have been able to exploit carbon to drive growth, emerging and developing countries face growth and development prospects in a decarbonizing world. Cumulative emissions are highly skewed between countries, as a small group of countries have spent a disproportionate share of the carbon budget over time. For example, the United States and China account for the greatest cumulative emissions since 1850 (Figure 1).[24]

Contributions to greenhouse gas emissions today continue to be highly skewed, with a small group of countries accounting for the greatest annual emissions. The four countries with the highest emissions include China, the United States, India, and Russia.[25] However, on a per-capita basis, the United States

Figure 1

Countries with largest Cumulative Emissions between 1850-2021



Source: Evans, S. Analysis: Which countries are historically responsible for climate change? https://www.carbonbrief.org/analysis-which-countries-are-historically-responsible-for-climate-change

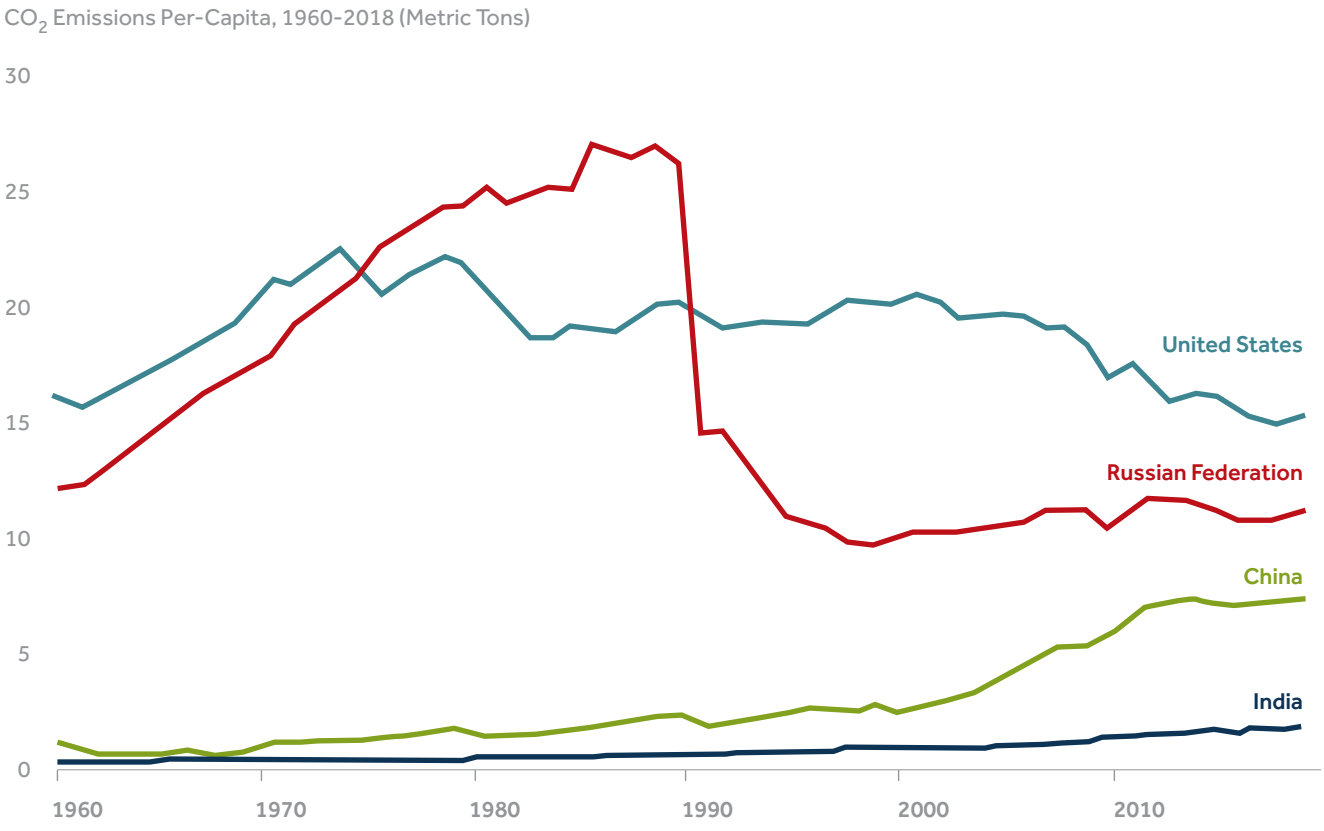
outpaces all other countries. Per capita, CO_2 emissions are 15 times higher in the United States than in India (Figure 2).

Consequently, India occupies a unique position among developing countries and high emitting countries: how to meet growing energy demand and lift hundreds of millions out of poverty in a climate-constrained world.

Lower emission alternatives must be deployed, and India's energy future will shape the global fight against climate change. Renewable energy sources present an alternative to significantly reduce emissions. This monitor focuses on the solar opportunities for India and the United States, a promising area of growth.

> *"Emerging and developing countries face growth and development prospects in a decarbonizing world."*

Figure 2



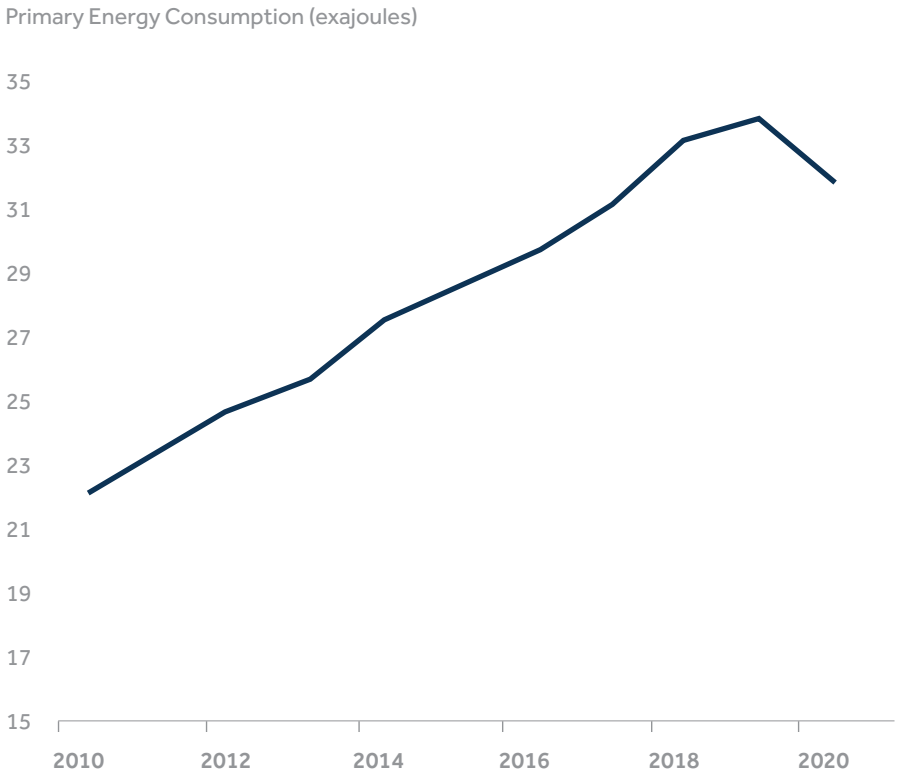
Source: World Bank. CO_2 emissions (metric tons per capita). https://data.worldbank.org/indicator/EN.ATM.CO2E.PC?locations=US-CN-IN-RU

THE STATE OF SOLAR IN INDIA

Despite meeting 80% of its current energy demand with coal, oil, and solid biomass, India is looking to solar to meet growing energy demand (Figure 3), which may increase by 25-30% by 2030 due to population growth, rising incomes, urbanization, and industrialization.[26]

India is establishing itself as a global leader in solar. In 2015, India and France launched the International Solar Alliance (ISA), a member-driven platform

Figure 3

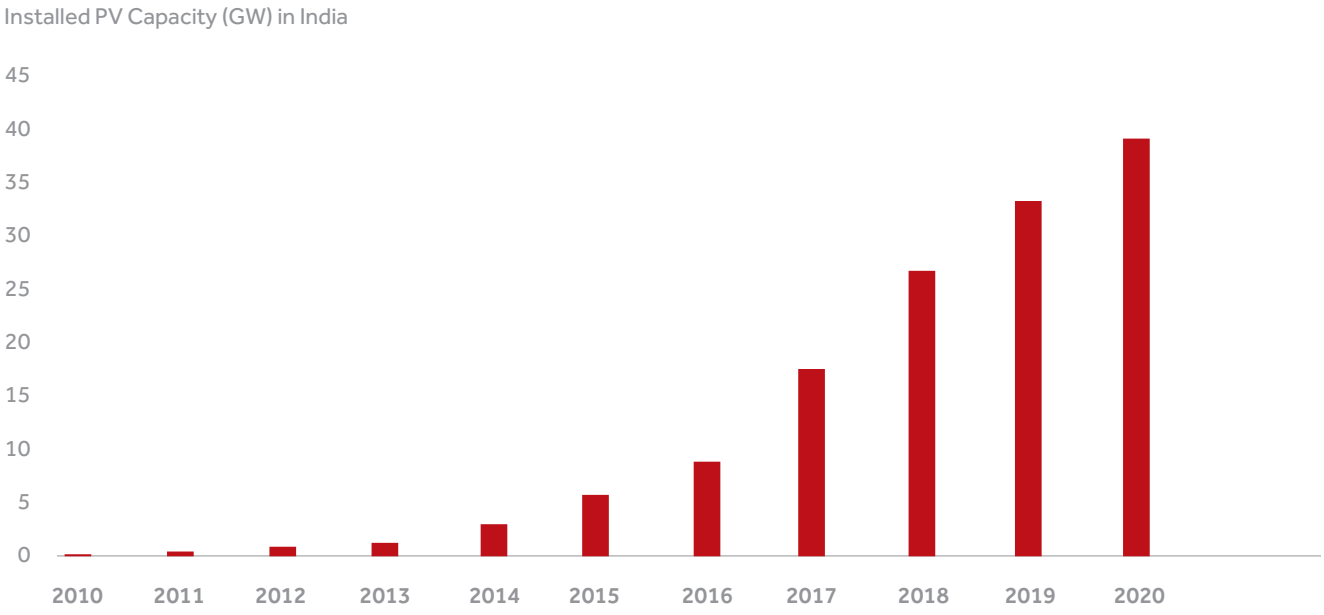


Source: Primary energy consumption in India from 1998 to 2020. https://www.statista.com/statistics/265582/primary-energy-consumption-in-india/

whose mission is to deploy solar as a means of increasing energy access, energy security, and energy transitions.[27] Today, more than 100 countries are signatory to the ISA Framework Agreement, and 80 countries, including the United States are members.

India set a 175 GW renewable capacity target by 2022 in 2015, 100 GW (100,000 MW) of which is solar.[28] India's total renewable energy capacity in 2019 stood at 96 GW (96,000 MW).[29] Today, the installed capacity for solar stands at 50.3 GW (50,300 MW)[30], with the highest capacity additions in 2021 (Figure 4).[31] Overall, India ranks fifth in the world in installed solar capacity, following China, the United States, Japan, and Germany.[32] Solar forms about 4% of total electricity generation in India.[33] While the country is on track to miss its 2022 solar

Figure 4



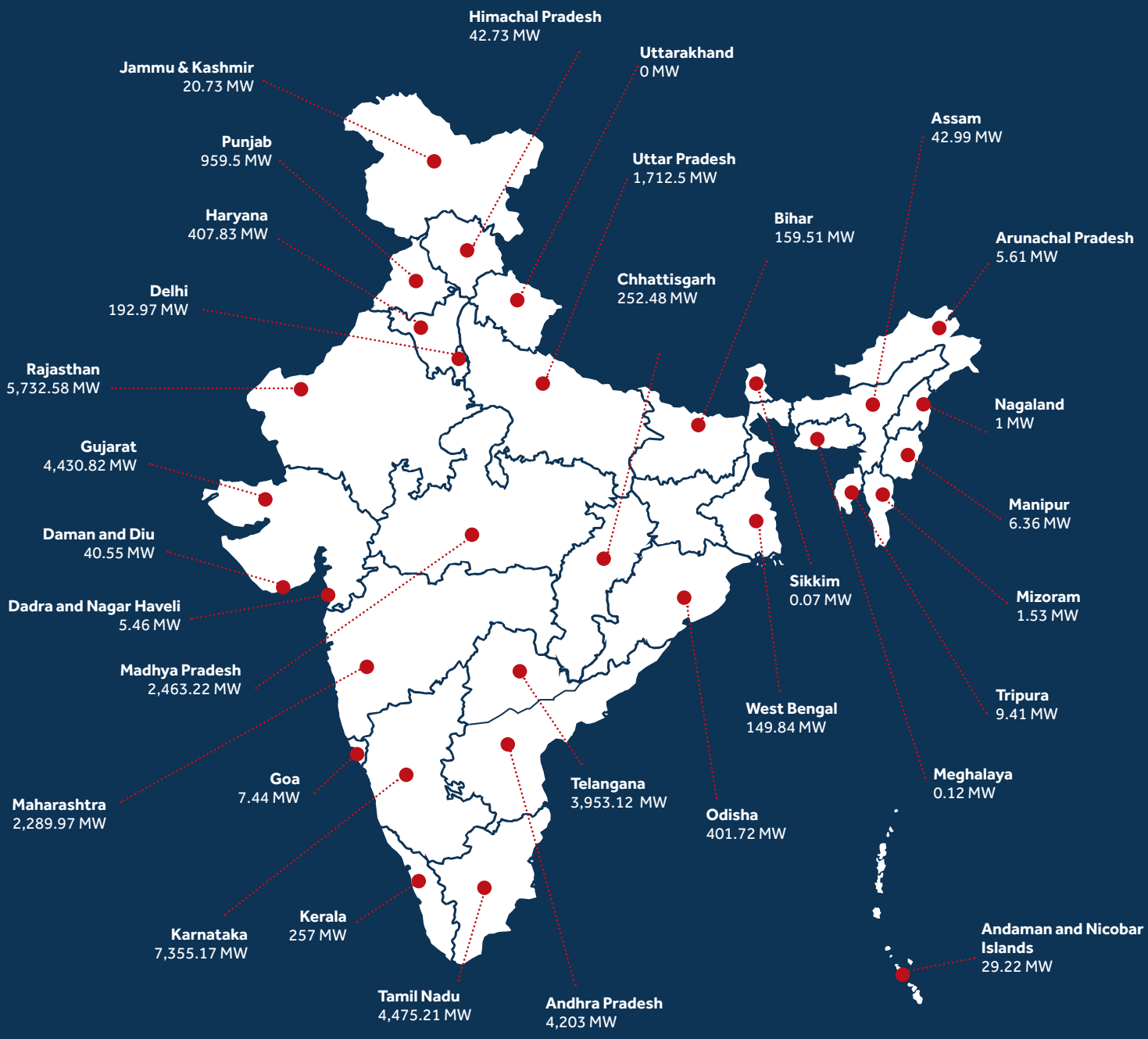
Source: B.P., Statistical Review of World Energy 2021, p. 58.

target, solar will nonetheless form a substantial portion of its 2030 500 GW renewable energy target.[34] As a federal country like the United States, states in India guide much of the deployment of solar capacity.

States in India leading deployment include Tamil Nadu, Karnataka, Gujarat, Rajasthan, Andhra Pradesh, Maharashtra, Madhya Pradesh, Telangana, Punjab, and Kerala (Figure 5).[35]

Figure 5

Installed Solar Capacity by State in India



Source: Ministry of New and Renewable Energy, Government of India. https://mnre.gov.in/solar/current-status/

THE SOLAR OPPORTUNITY IN INDIA

India has a solar potential of 748 GW.[36] Consequently, there is ample opportunity from current levels to grow solar in India's energy mix, as the costs for setting up solar photovoltaic panels in India have dropped by 80% between 2010 to 2018.[37] In addition to decreasing costs, solar offers India opportunities for greater job creation and energy security. However, challenges in diversifying solar supply chains and deployment of rooftop solar remain.

> *"Lower emission alternatives must be rapidly deployed, and India's energy future will shape the global fight against climate change."*

The growth of the solar industry in India is an opportunity for domestic job creation. The cumulative workforce in the wind and solar energy sectors is 111,400 as noted by the Council on Energy, Environment, and Water (CEEW), with solar accounting for around 86,000 workers. With burgeoning solar ambitions, India could create an additional three million jobs in the solar industry over the next ten years.[38]

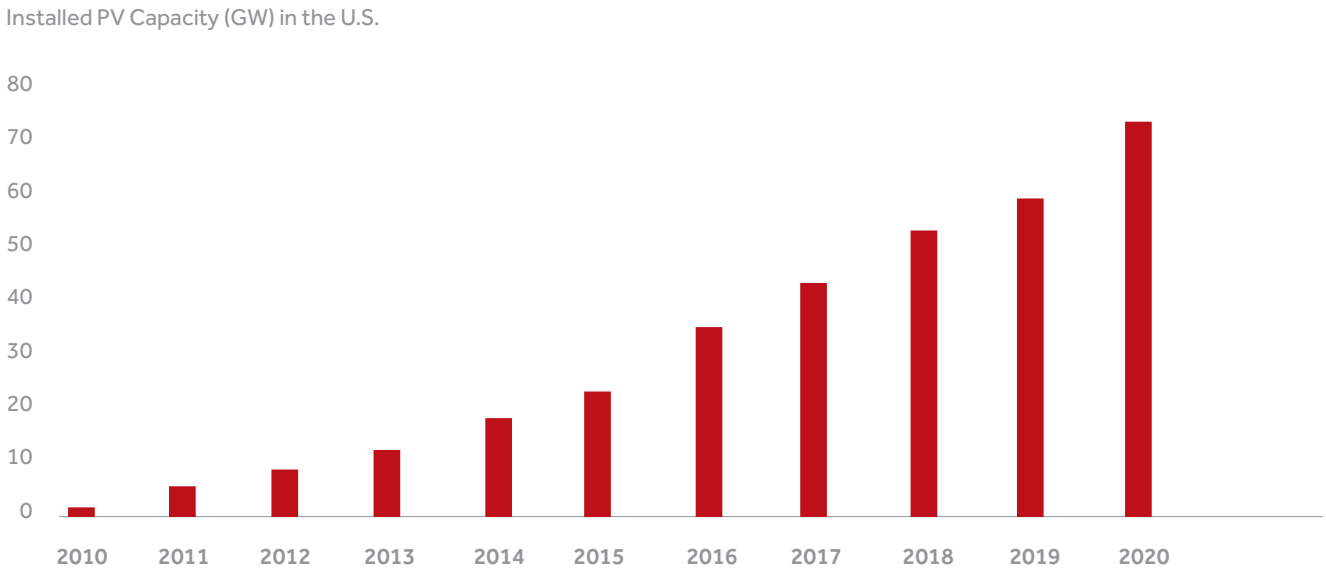
Solar also provides an opportunity for India to increase energy security by reducing its high dependence on energy imports. For example, India imports approximately three-quarters of its oil now. When coupled with electrification, domestic solar energy could displace these imports in the future.[39]

However, a key challenge is to diversify solar supply chains. India imports 86% of its solar photovoltaic modules from China, with the remaining coming from other parts of Asia.[40] To support solar manufacturing development, in April 2021, the Government announced Production-Linked Incentive schemes (PLIs) for solar photovoltaic components. These financial incentives combine tax rebates, tariff reductions and easier land acquisition policies to encourage domestic solar manufacturing. The Government of India also announced that it will introduce a custom duty on imported solar cells and modules of 40% and 25%, respectively in April 2022.[41]

Lackluster deployment of rooftop solar means India will miss its 2022 100 GW solar target. Lack of financing, disincentives for consumer adoption, disinterest by electricity distribution companies, and policies to favor domestic sourcing of solar systems have been impediments for growth in this sector.[42]

Solar capacity in the United States has increased from just 0.34 GW in 2008 to 97.2 GW today and generates 3% of electricity.[43] The United States ranks second in the world after China in installed solar capacity, and it has been on the rise over the last decade (Figure 6).[44] Estimates suggest power generated from solar could increase to 5% in 2022, and by 2030, 20% of electricity in the United States under current policies.[45] The Biden-Harris administration estimates the United States will need 1000 GW of solar power by 2035 to meet goals for a 95% emission-free U.S. electricity grid.[46]

Figure 6



Source: B.P., Statistical Review of World Energy 2021, p. 58.

Solar capacity varies substantially by state, with some states taking the lead. California, Texas, North Carolina, Florida, and Arizona lead the country's capacity.[47] In 2021, Texas and California led the installation of additional solar capacity. Texas added 1.5 GW of capacity, followed by California with 0.6 GW.[48]

Despite losing solar market share, the United States has seen cost declines in solar, and solar provides the country opportunities to create jobs. However, challenges from supply chain, trade, and deployment remain.

The U.S. dominated 95% of the solar market in the late 1970s, though its market share dropped to around 55% by the mid-1980s due to heavy competition from Japanese, Chinese, and South Korean firms.[49] In fact, since 2004, the U.S. proportion of globally manufactured photovoltaic cells declined from 13% to less than one percent.[50] However, in the last ten years the average cost of setting up solar P.V. panels dropped by 70%.[51] The decline in costs has driven growth in the industry. The average cost for a residential solar system declined from around $40,000 in 2010 to $20,000 in 2021.[52] Similarly, the utility cost of solar is now competitive with other forms of energy.[53]

In addition, the U.S. solar industry employs more than 250,000 people.[54] In addition, the Solar Futures Study report released by the Department of Energy shows that solar can power 40% of the U.S. electricity needs by 2035 and employ as many as 1.5 million people.[55]

To reduce imports from China and spur domestic manufacturing, successive U.S. administrations have imposed tariffs on solar cells and modules. The Obama administration imposed tariffs on imports from China in 2012 and 2015.[56] The Trump administration followed with similar tariffs on China at 30% in 2018.[57] Imports of components have shifted away from China to countries such as Malaysia, South Korea, Vietnam, Thailand, and Mexico.[58]

Other efforts to support the solar industry in the U.S. include investment tax credits (ITCs), which provide tax rebates to companies for qualified investments. The credit for solar was 30% in 2019, 26% in 2020, and 22% in 2021.[59] Beginning in 2022, solar energy will have a permanent 10% ITC.[60]

Solar in the United States nonetheless faces challenges including rising material costs from supply chain disruptions and rising costs from trade barriers. In 2022, the U.S. solar industry is projected to grow less than 25% than previously projected.[61] These recent challenges are addition to ongoing challenges from deployment such as barriers in permitting and financing.[62]

Solar provides similar opportunities and challenges to both the United States and India. With solar's potential for job creation, clean energy transitions, and energy security, the United States and India recognize how both can learn from each other's stories and work together to enhance clean energy transition in their own countries and around the world. This is already happening as the U.S. has become the 101st member to join the India-led International Solar Alliance.[63] The U.S. Development Finance Corporation (DFC) announced that it would be lending $500 million for a solar panel manufacturing plant in India. This may support efforts to create more solar manufacturing capacity outside of China, which dominates the industry.[64]

Table 2: India Energy Consumption by Source, 2020

Fossil Fuels — 76%

Petroleum **25%**

Natural Gas **6%**

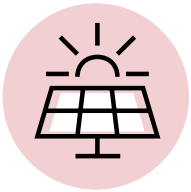
Coal **45%**

Non-Fossil Fuels — 24%

Nuclear **1%**

Solar + Wind **1%**

Biomass **20%**



Hydro **2%**

Source: International Energy Agency. https://www.iea.org/countries/india

Table 1: U.S. Energy Consumption by Source, 2020

Fossil Fuels — 81%

Petroleum **35%**

Natural Gas **35%**

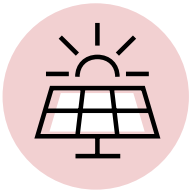
Coal **11%**

Non-Fossil Fuels — 19%

Nuclear **11%**

Solar + Wind **3%**

Biomass **5%**



Hydro **1%**

Source: International Energy Agency. https://www.iea.org/countries/united-states

U.S. – INDIA ENERGY TRADE

Table 3: By Exporting Country 2021 (value in USD Millions)

Source	United States	India
Fossil Fuels	12,227	3,476
Renewables	267	566
Battery Supply Chain	232	136
Thermal Power	87	158
Electricity Infrastructure	46	129
Civil Nuclear	0.40	–
Total	12,861	4,465

Source: U.S. Energy Trade Dashboard. U.S. International Trade Administration. https://www.trade.gov/data-visualization/us-energy-trade-dashboard

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