

# U.S. Energy System

Energy plays a vital role in modern society, enabling systems that meet human needs such as sustenance, shelter, employment, and transportation. In 2020, the U.S. spent \$1 trillion on energy, or 4.8% of Gross Domestic Product (GDP).<sup>1</sup> When spread over the population, annual costs were \$3,039 per person.<sup>1</sup> Environmental impacts associated with the production and consumption of energy include global climate change, acid rain, hazardous air pollution, smog, radioactive waste, and habitat destruction.<sup>2</sup> The nation's heavy reliance on fossil fuels (primarily imported crude oil) poses major concerns for energy security. Potential gains in energy efficiency in all sectors may be offset by increases in consumption, a phenomenon called the rebound effect.<sup>3</sup>

## Patterns of Use

### Demand

- With less than 5% of the world's population, the U.S. consumes almost 17% of the world's energy and accounts for 16% of world GDP. In comparison, the European Union has 6% of the world's population, uses 10.4% of its energy, and accounts for 16% of its GDP, while China has 18% of the world's population, consumes 25% of its energy, and accounts for 18% of its GDP.<sup>6,7</sup>
- Each day, U.S. per capita energy consumption includes 2.5 gallons of oil, 8.86 pounds of coal, and 246 cubic feet of natural gas.<sup>5,6</sup>
- Residential daily consumption of electricity is 12 kilowatt-hours (kWh) per person.<sup>5,6</sup>
- In 2021, total U.S. energy consumption decreased 3.1% from 2019 peak levels.<sup>5</sup>

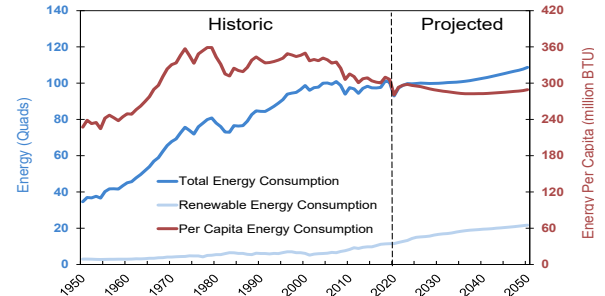
### Supply

- By current DOE estimates, 75% of U.S. energy will come from fossil fuels in 2050, which is widely inconsistent with IPCC carbon reduction goals.<sup>4,8</sup>
- Renewable energy consumption is projected to increase annually at an average rate of 2.1% between 2021 and 2050, compared to 0.4% growth in total energy use. Residential photovoltaics are projected to grow annually by nearly 6%. At these rates, renewables would provide 20% of U.S. energy consumption in 2050, compared to 12.5% today.<sup>4,5</sup>
- In 2021, for the first time since tracking began, the U.S. exported more oil (8.63 million barrels per day) than was imported (8.46 million barrels per day), and is also expected to be a net exporter in 2050.<sup>4,5</sup>
- Canada, Mexico, and Russia are the three largest suppliers of U.S. oil imports.<sup>9</sup> The Persian Gulf region accounted for 8% of U.S. imports in 2021.<sup>9</sup> Oil from OPEC countries was 11.3% of U.S. imports in 2021.<sup>5</sup> The Persian Gulf contains 48% of the world oil reserves, and 16% of world reserves lie in Saudi Arabia.<sup>7</sup>

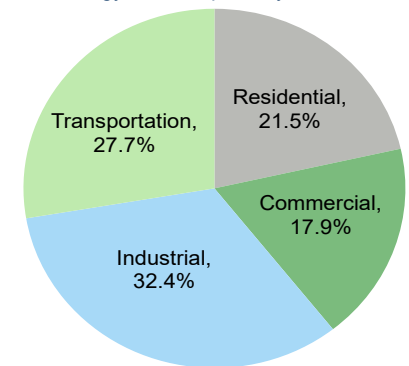
## Life Cycle Impacts

- Air emissions from the combustion of fossil fuels are the primary environmental impact of the U.S. energy system. Such emissions include carbon dioxide (CO<sub>2</sub>), nitrogen oxides, sulfur dioxide, volatile organic compounds, particulate matter, and mercury.
- Methane leakage from the oil and natural gas supply chain (fracking wells, pipelines, etc.) is estimated to be 13 million metric tons (MMT) per year, equivalent to 2.3% of U.S. annual gross natural gas production. With a global warming potential of 28, this methane leakage is equivalent to 364 MMT of CO<sub>2</sub>, or 6.1% of total U.S. CO<sub>2</sub>e emissions in 2020.<sup>10,11</sup>
- U.S. greenhouse gas (GHG) emissions in 2020 were 7.3% less than 1990 values. 73% of total U.S. GHG emissions came from burning fossil fuels in 2020.<sup>10</sup>
- Other energy sources also have environmental implications. For example, issues associated with nuclear power generation include radioactive waste and a high energy requirement to build the plants and mine uranium; large hydroelectric power plants cause habitat degradation and fish kills; and wind turbines alter landscapes in ways some find unappealing and can increase bird and bat mortality.<sup>12</sup>

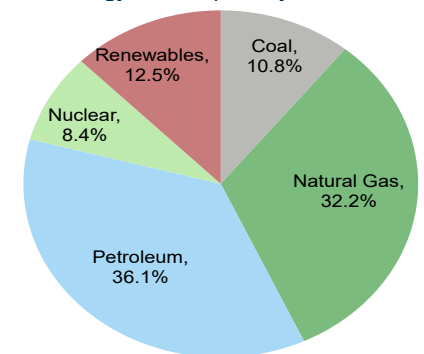
U.S. Energy Consumption: Historic and Projected Values<sup>4,5</sup>



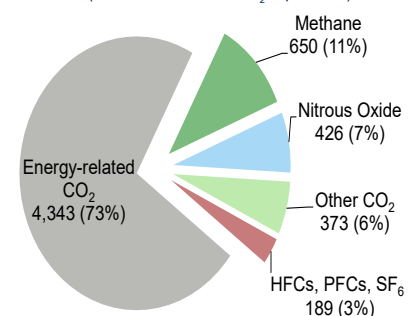
U.S. Energy Consumption by Sector, 2021<sup>5</sup>



U.S. Energy Consumption by Source, 2021<sup>5</sup>



U.S. GHG Emissions, 2020<sup>10</sup>  
(Million Metric Tons CO<sub>2</sub> Equivalent)



# Solutions and Sustainable Alternatives

## Consume Less

- Reducing energy consumption not only brings environmental benefits, but also can result in cost savings for individuals, businesses, and government agencies.
- Living in smaller dwellings, living closer to work, and utilizing public transportation are examples of ways to reduce energy use. See CSS factsheets on personal transportation and residential buildings for additional ways to trim energy consumption.

## Increase Efficiency

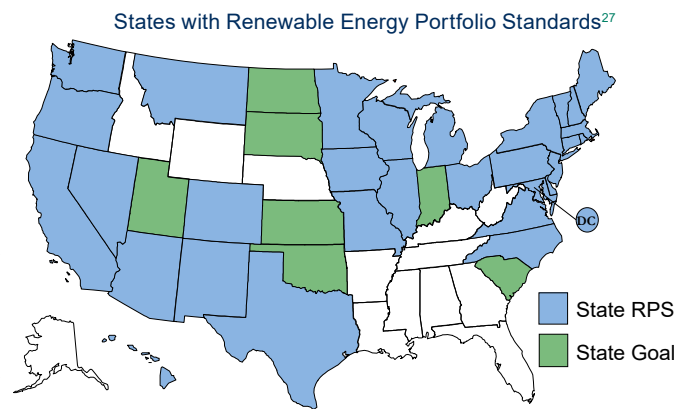
- An aggressive commitment to energy efficiency could reduce U.S. carbon emissions by 57% (2,500 MMT) by 2050.<sup>13</sup>
- Additional information on energy efficiency can be found at the following organizations' websites:
  - General: U.S. DOE Energy Efficiency and Renewable Energy, <http://energy.gov/eere/office-energy-efficiency-renewable-energy>
  - Residential & Commercial: U.S. EPA Energy Star, <https://www.energystar.gov/>
  - Transportation: U.S. DOE and EPA Fuel Economy Guide, <https://www.fueleconomy.gov/>
  - Industrial: U.S. EPA Energy Star, [https://www.energystar.gov/buildings/facility-owners-and-managers/industrial-plants/industrial\\_resources](https://www.energystar.gov/buildings/facility-owners-and-managers/industrial-plants/industrial_resources)

## Increase Renewables

- Installed wind capacity in the U.S. grew 16% in 2020, expanding to over 121 GW.<sup>14,15</sup> If 224 GW of wind capacity were installed by 2030, an amount determined feasible by the U.S. DOE, wind would satisfy 20% of projected electricity demand.<sup>16</sup>
- Solar photovoltaic modules covering 0.6% of the land in the U.S. could supply all of the nation's electricity.<sup>17</sup>

## Encourage Supportive Public Policy

- The U.S. currently produces 14% of the world's energy-related CO<sub>2</sub> emissions. U.S. emissions are projected to decrease by 5.8% by 2035 from current levels.<sup>4,18</sup> The Climate Action Now Act, passed by the House in May 2019, would require an annual plan to ensure the United States meets its stated goals under the Paris Agreement of reducing greenhouse gas emissions by 26-28% by 2025.<sup>19</sup> The Act has not yet been brought to a vote in the Senate.<sup>20</sup> In comparison, the United Kingdom passed into law a goal of having net-zero greenhouse gas emissions by 2050.<sup>21</sup>
- In 2012, new auto manufacturing standards for model years 2017-2025 were set, raising corporate average fuel economy (CAFE) standards to 54.5 miles per gallon for new light-duty vehicles in 2025.<sup>22</sup> In 2020, the Safer Affordable Fuel-Efficient (SAFE) Vehicle Rule revised the CAFE standards down to an annual fuel efficiency improvement of 1.5% until 2030, equal to an average fleet-wide target of 40.5 mpg.<sup>23</sup> The original CAFE rule was projected to save 4 billion gallons of fuel, between \$326 and \$451 billion, and cut CO<sub>2</sub> emissions by 2,000 MMT. The SAFE rule will result in 867-923 MMT more CO<sub>2</sub> emissions than CAFE.<sup>22,23</sup> In 2021, NHTSA assessed the Safe I Rule and has proposed repealing the rule in favor of establishing regulations that align with the Energy Policy and Conservation Act (EPCA).<sup>24</sup>
- The growth of biomass, geothermal, and wind was spurred by a 2.5¢/kWh Federal Production Tax Credit (PTC), as well as state Renewable Portfolio Standards (RPS) that require a certain percentage of electricity be derived from renewable sources. The PTC for wind would have originally expired December 31, 2020.<sup>25</sup> In 2020, the PTC was extended to allow wind projects started in 2020 or 2021 a PTC at 1.5¢/kWh for 10 years of electricity output.<sup>26</sup> Thirty-three states, the District of Columbia, and three U.S. territories had renewable portfolio standards or goals in place as of August 2021.<sup>28</sup>
- A federal tax credit of up to \$7,500 is available for electric and plug-in hybrid electric vehicles purchased after January 1, 2010.<sup>29</sup>
- Homeowners can receive tax credits for up to 26% of purchase and installation costs for renewable energy additions to new and existing houses until 2023. Eligible renewable technologies include geothermal heat pumps, solar water heaters and PV panels, small wind turbines, and residential fuel cells.<sup>30</sup>



**kWh** = kilowatt hour. One kWh is the amount of energy required to light a 100 watt light bulb for 10 hours.

**Btu** = British Thermal Unit. One Btu is the amount of energy required to raise the temperature of a pound of water by 1° Fahrenheit.

**Quad** = quadrillion (10<sup>15</sup>) Btu. One Quad is equivalent to the annual energy consumption of ten million U.S. households.

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