

## Guam Territory Energy Profile

### Guam Quick Facts

- Guam has no fossil energy resources and meets nearly all of its energy needs with imported petroleum products. In 2019, about 31% of the petroleum consumed in Guam was motor gasoline, 28% was jet fuel, 24% was diesel fuel, 15% was residual fuel, and propane accounted for 2% of petroleum use.
- Guam's electricity costs, including fuel surcharges to cover petroleum costs, are usually two to three times higher than the average electricity rate for the 50 U.S. states, although Guam's power prices are typically the lowest among the nearby Pacific islands.
- The commercial sector, including hotels, restaurants, and commercial buildings, consumes more than one-third of Guam's electricity. The U.S. military accounts for one-fifth of the Guam's electricity consumption.
- About 120 megawatts of new solar power generating capacity is expected to come online in Guam in 2022, offsetting some of the lost generating capacity at the Cabras power plant.
- In 2019, Guam's legislature updated the island's renewable portfolio standard to require that 50% of electricity sales come from renewables by 2035 and 100% by 2045.

Last Updated: December 17, 2020

### Data

Last Update: December 16, 2021 | Next Update: January 20, 2021

#### Economy

Population and Industry	Guam	United States	Period
Population	0.2 million	328.2 million	2019
Gross Domestic Product	\$ 6 billion	\$ 19,552 billion	2018

#### Prices

Electricity	Guam	United States	Period
Residential	NA	14.19 cents/kWh	Sep-21
Commercial	NA	11.76 cents/kWh	Sep-21
Industrial	NA	7.71 cents/kWh	Sep-21

#### Reserves

Reserves	Guam	United States	Period
Crude Oil	0 billion barrels	42 billion barrels	2019
Natural Gas	0 trillion cu ft	465 trillion cu ft	2020
Recoverable Coal	0 million short tons	252,057 million short tons	2019
Capacity	Guam	United States	Period
Total Electricity Installed Capacity	1 million kW	1,122 million kW	2019

#### Imports & Exports

Total Imports	Guam	United States	Period
Crude Oil Imports	0 thousand barrels/day	7,850 thousand barrels/day	2016
Natural Gas Imports	0 billion cu ft	2,551 billion cu ft	2020
Coal Imports	0 thousand short tons	6,697 thousand short tons	2019
Total Exports	Guam	United States	Period
Crude Oil Exports	0 thousand barrels/day	591 thousand barrels/day	2016

## Imports & Exports

Natural Gas Exports	0 billion cu ft	5,284 billion cu ft	2020
Coal Exports	0 thousand short tons	93,765 thousand short tons	2019

## Supply

Production	Guam	United States	Period
Total Energy	*	96 trillion Btu	2018
Crude Oil, NGPL, and Other Liquids	0 thousand barrels/day	17,936 thousand barrels/day	2020
Natural Gas - Gross	0 billion cu ft	32,915 billion cu ft	2015
Coal	0 thousand short tons	706,307 thousand short tons	2019
Total Utility-Scale Net Electricity Generation	Guam	United States	Period
Total Net Electricity Generation	2 billion kWh	4,163 billion kWh	2019
Petroleum, Natural Gas, and Coal Net Electricity Generation	2 billion kWh	2,582 billion kWh	2019
Total Electricity Generation from Renewable Sources	0 billion kWh	777 billion kWh	2019
» Hydroelectric	0 billion kWh	288 billion kWh	2019
» Other Renewables *		489 billion kWh	2019

## Consumption

by Source	Guam	United States	Period
Total Energy	*	101 trillion Btu	2018
Total Petroleum Products	13 thousand barrels/day	19,958 thousand barrels/day	2017
» Motor Gasoline	1 thousand barrels/day	9,327 thousand barrels/day	2017
» Distillate Fuel	3 thousand barrels/day	3,932 thousand barrels/day	2017
» Liquefied Refinery Gases	0 thousand barrels/day	1,299 thousand barrels/day	2017
» Jet Fuel	2 thousand barrels/day	1,682 thousand barrels/day	2017
» Kerosene	0 thousand barrels/day	5 thousand barrels/day	2017
» Residual Fuel	4 thousand barrels/day	342 thousand barrels/day	2017
» Other Petroleum Products	2 thousand barrels/day	3,371 thousand barrels/day	2017
Natural Gas	0 billion cu ft	30,482 billion cu ft	2020
Coal	0 thousand short tons	588,415 thousand short tons	2019

## Carbon Dioxide Emissions

by Source	Guam	United States	Period
Total Fossil Fuels	2 million metric tons	5,284 million metric tons	2018
Petroleum	2 million metric tons	2,385 million metric tons	2018
Natural Gas	0 million metric tons	1,686 million metric tons	2019
Coal	0 million metric tons	1,076 million metric tons	2019

## Analysis

Last Updated: December 17, 2020

### Overview

Guam, the largest among the thousands of small western Pacific islands that are collectively known as Micronesia, is located in the Pacific Ocean about 5,800 miles west of San Francisco and 1,600 miles east of Manila, Philippines.<sup>1,2</sup> The island has been a U.S. territory since 1898, and it is close to the International Date Line. As a result, it is the first place in the United States to see each new day, which is why Guam is known as the place "Where America's Day Begins."<sup>3</sup> Surrounded by coral reefs, Guam sits on the edge of the Mariana Trench and its Challenger Deep, which lies nearly 7

miles below the surface of the ocean and is the deepest known place on earth. Guam, like the neighboring Mariana Islands, is the top of an undersea mountain, part of a volcanic subsea range stretching northwest toward Japan. At 30 miles long and 4 to 12 miles wide, the territory has nearly three-and-a-half times the land area of Washington, DC.<sup>4,5,6</sup> Guam has a tropical marine climate that is warm and humid with little variation in seasonal temperatures that range between 70oF and 90oF throughout the year. The rainy season runs from May to November and can bring devastating typhoons.<sup>7</sup> Guam recorded one of the world's highest measured wind speeds of 230 miles per hour when Super Typhoon Paka struck the island in 1997.<sup>8</sup>

Guam has a population of about 168,000, plus about 13,000 military personnel and their families.<sup>9,10</sup> Tourism annually brings in about 1.2 million visitors, most of whom are from Japan. Tourism and the U.S. military are the two largest contributors to Guam's economy.<sup>11</sup> U.S. military plans to relocate thousands of personnel from Okinawa, Japan, to Guam starting in 2024 could bring a substantial influx of people to the island.<sup>12,13,14,15</sup> The military accounts for about one-fifth of Guam's energy consumption.<sup>16</sup> Per capita energy consumption on Guam is slightly more than half the average of the 50 U.S. states.<sup>17,18</sup> The island's energy intensity—the amount of energy consumed to produce one dollar of gross domestic product—is about one-eighth lower than the average for the states.<sup>19,20</sup> Guam has no fossil energy resources and meets nearly all of its energy needs—including the fuel for generating most of its electricity—with imported petroleum products.<sup>21,22,23,24</sup> However, Guam is increasing its use of wind and solar resources for electricity generation.<sup>25,26</sup>

*Guam imports petroleum products to meet most of its energy needs.*

## Petroleum

Guam has no crude oil reserves, petroleum production, or refineries.<sup>27,28</sup> All petroleum products are shipped through the island's only port, located at Apra.<sup>29</sup> Most petroleum products are imported from Asian countries.<sup>30</sup> In 2019, about 31% of the petroleum consumed on the island was motor gasoline and 28% was jet fuel. Diesel—used mostly to generate electricity—accounted for about 24%, residual fuel oil's share was 15%, and propane made up the remaining 2% of the island's petroleum consumption.<sup>31,32</sup> In 2012, the Guam government set a goal to reduce petroleum consumption 20% from 2010 levels by 2020.<sup>33</sup> Because ground transportation uses a large portion of the petroleum, Guam wants to increase the efficiency of vehicles on the island, improve traffic flows, reduce vehicle miles traveled, and increase biodiesel use.<sup>34</sup>

*Motor gasoline and jet fuel account for the majority of the petroleum products consumed in Guam.*

## Electricity

Electricity is provided by the Guam Power Authority (GPA), a public corporation overseen by the elected Consolidated Commission on Utilities (CCU) and regulated by the Guam Public Utilities Commission (PUC). GPA owns and manages the island's electric grid, which is made up of about 1,800 miles of transmission and distribution lines. GPA's electricity is generated mainly from burning residual fuel oil and diesel fuel, with renewables accounting for a small share of the island's electricity generation.<sup>35,36</sup>

GPA continues to rebuild and expand its generating assets after an August 2015 explosion and fire at the utility's main Cabras power plant destroyed two of the station's four generating units.<sup>37</sup> GPA lost about one-seventh of its generating capacity, leaving the island with periodic power rationing and localized power outages. GPA asked large hotels, shopping malls, and military facilities to use their own generators when possible, and the power utility leased high-efficiency diesel generators to stabilize its electricity supply.<sup>38,39,40</sup> GPA received approval from regulators to build a new power plant to replace all four of the Cabras generating units, which had a combined generating capacity of 212 megawatts. The new power plant, which will have a generating capacity of 180 megawatts and can run on either ultra-low sulfur diesel fuel or natural gas, is expected to begin operating in 2022. Separately, about 120 megawatts of new solar power generating capacity also expected to come online in 2022, will help offset the loss of the Cabras plant.<sup>41,42,43,44</sup>

*About 120 megawatts of solar power generating capacity in Guam is scheduled to come online in 2022.*

In recent years, Guam's residential electricity costs, including fuel surcharges, were two to three times higher than the average residential electricity rate for the 50 U.S. states, although Guam's residential electricity rates are typically the lowest among the nearby Pacific islands.<sup>45,46</sup> Because Guam's electricity is generated primarily by burning petroleum, GPA imposes a fuel surcharge that can be adjusted every six months to reflect changes in petroleum costs. Guam's electricity rates declined in mid-2020 following a drop in petroleum prices that occurred during the global economic slowdown resulting from the Covid-19 pandemic.<sup>47,48</sup>

GPA surpassed 51,000 electricity customers for the first time in 2017 and was just short of 52,000 customers in late 2019.<sup>49</sup> Tourist hotels, restaurants, and private office buildings accounted for slightly more than one-third of Guam's electricity use in 2019. Residential households accounted for almost one-third of the island's electricity use, the U.S. military accounted for one-fifth, and the Guam government consumed just over one-tenth.<sup>50</sup>

The utility offers net metering and pays its customers for surplus power they generate from small-scale solar, wind, and other renewable generation installations. The surplus power is distributed on the island's grid.<sup>51</sup> The Guam PUC recently approved GPA-sought changes to the net metering program; beginning in 2021 the program's more than 2,000 customers will not be able to roll over their excess net metering credits into the next year or cash out their credits.<sup>52</sup>

Separately, all new net metering systems connected to the grid after June 2020 are required to have energy storage batteries to improve the reliability of electricity supplies.<sup>53</sup>

## Renewable energy

A goal of Guam's economic development strategy is to replace some of its imported petroleum with local renewable energy resources.<sup>54,55</sup> In 2008, Guam's legislature enacted a renewable energy portfolio standard (RPS) to have renewable sources provide 8% of the island's electricity sales by the end of 2020. The renewable goal would increase to 10% of electricity sales by 2025 and to 25% by 2035. In 2019, Guam's legislature updated the standard to require that 50% of electricity sales come from renewables by 2035 and 100% by 2045. Solar, wind, biomass, wave energy, and ocean thermal energy are all recognized as acceptable renewable sources to meet the standard.<sup>56,57,58</sup>

Until recently, little renewable energy was used for electricity generation on the island beyond a small number of solar PV units (used for cell phone towers and remote weather stations), solar thermal units (used for water heating), and a few small wind generators (less than 5 kilowatts capacity) operated by commercial and residential users.<sup>59,60</sup> In 2016, about 6% of Guam's electricity was generated by renewables.<sup>61</sup> In 2015, Guam's first commercial solar PV facility—the 26-megawatt Dandan solar farm with more than 120,000 solar panels—began operating.<sup>62</sup> The facility can generate enough electricity to serve 10,000 homes.<sup>63</sup> In August 2018, GPA signed contracts with two companies to provide a total of 120 megawatts of new solar power generating capacity that is scheduled to come online by 2022. Another 60 megawatts of solar power capacity are planned by 2024.<sup>64,65,66</sup> GPA is also adding battery storage systems to help maintain grid stability as the utility adds more renewable electricity generation.<sup>67,68</sup>

Guam has substantial wind potential but also has unique siting issues. The island is seismically active and is in the Pacific's Typhoon Alley, so wind turbines must be engineered to resist both earthquakes and typhoon-force winds. Wind turbine siting must also consider impacts on military facilities, endangered species, and other local environmental concerns. Another challenge is maintaining reliability of the island's small electric grid given the variability of wind power.<sup>69</sup> As a result there is little wind generation in Guam, although wind power remains part of the island's long-term energy plan.<sup>70,71,72</sup> In early 2016, GPA inaugurated a wind pilot project—a single 275-kilowatt turbine in the Cotal region of Yona that can generate enough power for 50 homes.<sup>73</sup>

Guam has limited known geothermal resources, but because the island is in a volcanic region geothermal energy is considered a potential future energy resource.<sup>74</sup> The U.S. military has looked into whether geothermal is a viable energy source for its installations.<sup>75</sup> In late 2016, one company proposed providing up to 10 megawatts of geothermal power generation, but that project was not selected by Guam's electric utility.<sup>76</sup>

## Natural gas

Guam has no natural gas reserves, and does not produce or use natural gas.<sup>77</sup> GPA plans to build a new power plant by 2022 that is capable of burning either ultra-low sulfur diesel fuel or natural gas, if Guam decides to import liquefied natural gas, to generate electricity.<sup>78,79</sup> The new plant will enable the utility to comply with U.S. federal environmental requirements with either fuel.<sup>80,81</sup>

## Coal

Guam has no known coal reserves, and does not produce or use coal.<sup>82,83</sup>

## Endnotes

- <sup>1</sup> Foster, Sophie, and Dirk Anthony Ballendorf, Guam, Encyclopedia Britannica, updated November 11, 2020.
- <sup>2</sup> U.S. Central Intelligence Agency, The World Factbook, Guam, Geography, Location, updated November 9, 2020.
- <sup>3</sup> Guam Economic Development Authority, About Guam, accessed November 12, 2020.
- <sup>4</sup> Foster, Sophie, and Dirk Anthony Ballendorf, Guam, Encyclopedia Britannica, updated November 11, 2020.
- <sup>5</sup> Guampedia, Geography of Guam, accessed November 5, 2020.
- <sup>6</sup> U.S. Census Bureau, Quick Facts, District of Columbia, Geography, Land Area in Square Miles, 2010.
- <sup>7</sup> Foster, Sophie, and Dirk Anthony Ballendorf, Guam, Encyclopedia Britannica, updated November 12, 2020.
- <sup>8</sup> "Tropical cyclone projections: changing climate threats for Pacific island defense installations," Weather, Climate, and Society (Volume 11, Issue 1, January 2019), Climate variability, p. 6.
- <sup>9</sup> U.S. Central Intelligence Agency, The World Factbook, Guam, People and Society, Population, July 2020 estimate.
- <sup>10</sup> Guam Economic Development Authority, Economic Resources, Military, accessed November 12, 2020.
- <sup>11</sup> Guam Economic Development Authority, Economic Resources, Visitor Industry, Military, accessed November 12, 2020.
- <sup>12</sup> Limtiaco, Steve "NAVFAC: Buildup spending, construction, will peak in 2022," Pacific Daily News (February 22, 2018).
- <sup>13</sup> Limtiaco, Steve, "Guam, Okinawa governors discuss U.S. Marines relocation," Pacific Daily News (August 30, 2019).
- <sup>14</sup> Staff Reports, "Marine Corps activates Camp Blaz in Dededo, first new Marine Corps base since 1952," Pacific Daily News (October 1, 2020).
- <sup>15</sup> Guam Economic Development Authority, Economic Resources, Military, accessed November 13, 2020.
- <sup>16</sup> Baring-Gould, Ian, et al., Guam Initial Technical Assessment Report, National Renewable Energy Laboratory, NREL/TP-7A40-50580 (April 2011), p. 2.
- <sup>17</sup> U.S. Energy Information Administration (EIA), International Energy Statistics, Guam, Energy indicators in Guam,

*In 2019, Guam updated its Renewable Portfolio Standard to have 50% of its electricity sales generated by renewables by 2035.*

Energy consumption per capita, 2017.

- <sup>18</sup> U.S. EIA, State Energy Data System, Table C14, Total Energy Consumption Estimates per Capita by End-Use Sector, Ranked by State, 2018.
- <sup>19</sup> U.S. EIA, International Energy Statistics, Guam, Energy indicators in Guam, Energy consumption per GDP, 2017.
- <sup>20</sup> U.S. EIA, Table C10, Total Energy Consumption Estimates, Real Gross Domestic Product (GDP), Energy Consumption Estimates per Real Dollar of GDP, Ranked by State, 2018.
- <sup>21</sup> U.S. EIA, International Energy Statistics, Guam, 2017 primary energy data in quadrillion Btu, Coal, Dry natural gas, Petroleum & other liquids.
- <sup>22</sup> U.S. Central Intelligence Agency, The World Factbook, Guam, Energy, Electricity-from fossil fuels, Refined petroleum products-imports, 2017.
- <sup>23</sup> U.S. EIA, International Energy Statistics, Guam, Electricity, Generation (billion kWh), 2018.
- <sup>24</sup> U.S. Central Intelligence Agency, The World Factbook, Guam, Economy, Imports-Commodities, 2017.
- <sup>25</sup> Guam Consolidated Commission on Utilities, Resolution on Updated Integrated Resource Plan (May 24, 2016).
- <sup>26</sup> U.S. Central Intelligence Agency, The World Factbook, Guam, Energy, Electricity-from other renewable sources.
- <sup>27</sup> U.S. EIA, Guam Profile Data, Reserves, 2019, and Supply, 2020.
- <sup>28</sup> U.S. EIA, Number and Capacity of Petroleum Refineries, Guam, as of January 1, 2020.
- <sup>29</sup> Port of Guam, About US, About PAG, accessed November 16, 2020.
- <sup>30</sup> U.S. Central Intelligence Agency, The World Factbook, Guam, Economy, Imports-Commodities and Imports-Partners, 2017.
- <sup>31</sup> Guam Energy Office, Fuel and Power Data Compilation, 2019 Fuel Sales by Petroleum Companies.
- <sup>32</sup> U.S. Central Intelligence Agency, The World Factbook, Guam, Energy, Electricity from fossil fuels, 2017 estimate.
- <sup>33</sup> Conrad, Misty Dawn, and Sean Esterly, Guam Strategic Energy Plan (July 2013), p. i.
- <sup>34</sup> Johnson, Caley, Guam Transportation Petroleum-Use Reduction Plan, National Renewable Energy Laboratory, NREL/TP-7A30-57191 (April 2013), Executive Summary, p iii, 1.
- <sup>35</sup> Guam Power Authority, 2019 Annual Report, p. 3.
- <sup>36</sup> Guam Power Authority, About, Fact Sheet, accessed November 17, 2020.
- <sup>37</sup> Borja, John, "Guam Power Authority on Long Road to Renewables," Pacific Daily News (May 14, 2017).
- <sup>38</sup> Daleno, Gaynor Dumat-ol, "Power Supply Vulnerable; More Outages Possible," Pacific Daily News (April 14, 2016).
- <sup>39</sup> Daleno, Gaynor Dumat-ol, "PUC to GPA: Cut Cost," Pacific Daily News (October 30, 2015).
- <sup>40</sup> Daleno, Gaynor Dumat-ol, "Rented Power Plant to Go on Line Soon," Pacific Daily News (December 20, 2015).
- <sup>41</sup> Guam Power Authority, GPA 180: New Power Plant Project, accessed November 17, 2020.
- <sup>42</sup> Guam Power Authority, 2019 Annual Report, Attachment: Guam Power Authority, Financial Statements, Additional Information, and Independent Auditor's Report, Years Ended September 30, 2019, and 2019, New Generation, p. 2.
- <sup>43</sup> Lintiaco, Steve, "GPA: Four companies bid on new power plant," Pacific Daily News (April 17, 2019).
- <sup>44</sup> Lintiaco, Steve, "GPA environmental deal would shut Cabras plant, displace dozens of workers," Pacific Daily News (November 12, 2019).
- <sup>45</sup> Guam Power Authority, 2019 Annual Report, Residential Rate Comparison, p. 8.
- <sup>46</sup> U.S. EIA, Electric Power Monthly (February 2020, 2019, 2018), Table 5.6.B.
- <sup>47</sup> O'Connor, John, "Price of power to decrease starting June 1," The Guam Daily Post (May 30, 2020).
- <sup>48</sup> Guam Power Authority, Rates, Rate Schedules, Levelized Energy Adjustment Clause as of February 1, 2019, GPA-Docket 20-12, Determinations, May 28, 2020.
- <sup>49</sup> Guam Power Authority, 2019 Annual Report, Attachment: Guam Power Authority, Financial Statements, Additional Information and Independent Auditors' Report, Years Ended September 30, 2019 and 2018, Operating Revenues, p. 5.
- <sup>50</sup> Guam Power Authority, 2019 Annual Report, Attachment: Guam Power Authority, Financial Statements, Additional Information and Independent Auditors' Report, Years Ended September 30, 2019 and 2018, Annual Electric Sales in kWh, p. 63.
- <sup>51</sup> DSIRE, NC Clean Energy Technology Center, Guam-Net Metering (updated February 12, 2016).
- <sup>52</sup> O'Connor, John, "Rollover policy ending for net-metering credits," The Guam Daily Post (June 1, 2020).
- <sup>53</sup> O'Connor, John, "CCU approves battery requirement for solar-powered homes," The Guam Daily Post (February 27, 2020).
- <sup>54</sup> Guam Economic Development Authority, Guam Comprehensive Economic Development Strategy (2011), p. 36, 37.
- <sup>55</sup> Conrad, Misty Dawn, and J. Erik Ness, Guam Energy Action Plan (July 2013), p. 1.
- <sup>56</sup> DSIRE, NC Clean Energy Technology Center, Guam-Renewable Energy Portfolio Goal (updated May 6, 2015).
- <sup>57</sup> National Conference of State Legislatures, State Renewable Portfolio Standards and Goals, Guam, Enabling Statute or Order: Guam Public Law §29-62, updated April 17, 2020.
- <sup>58</sup> Cruz, Philip, "A vision of Guam future: Embarking on 100% green energy patch by 2045," Pacific Island Times (January 12, 2020).
- <sup>59</sup> U.S. EIA, International Energy Statistics, Total Renewable Electricity Net Generation, Guam, 2007-16.
- <sup>60</sup> Baring-Gould, Ian, et al., Guam Initial Technical Assessment Report, National Renewable Energy Laboratory, NREL/TP-7A40-50580 (April 2011), p. 18.
- <sup>61</sup> Cruz, Philip, "A vision of Guam future: Embarking on 100% green energy patch by 2045," Pacific Island Times (January 12, 2020).
- <sup>62</sup> "NRG Renew Completes Guam's First On-Island Solar Facility," The Weekly Junction (October 12, 2015).
- <sup>63</sup> Guam Power Authority, 2015 Annual Report, p. 20.
- <sup>64</sup> Kenning, Tom "Guam Power Authority signs PPAs for 120MW for solar projects," PVTech (August 24, 2018).
- <sup>65</sup> Guam Power Authority, 2019 Annual Report, p. 2.
- <sup>66</sup> Guam Power Authority, 2019 Annual Report, Attachment: Guam Power Authority, Financial Statements, Additional Information and Independent Auditors' Report, Years Ended September 30, 2019 and 2018, Future Capital Activities, p.

- 8.
- <sup>67</sup> Guam Power Authority, 2019 Annual Report, High System Reliability, p. 10.
- <sup>68</sup> "Largest Solar+Storage Lithium Battery to be Built of Pacific Island of Guam," Energy Storage Journal (October 17, 2019).
- <sup>69</sup> Baring-Gould, Ian, et al., Guam Initial Technical Assessment Report, National Renewable Energy Laboratory, NREL/TP-7A40-50580 (April 2011), p. 30, 31.
- <sup>70</sup> U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy, WINDEXchange, Wind Energy in Guam, accessed November 19, 2020.
- <sup>71</sup> Guam Power Authority, Integrated Resource Plan, FY 2013 (February 22, 2013), p. 7-2.
- <sup>72</sup> Guam Consolidated Commission on Utilities, Resolution on Updated Integrated Resource Plan (May 24, 2016), p. 1.
- <sup>73</sup> Losinio, Louella, "Cotal wind turbine back in operation," The Guam Daily Post (January 17, 2019).
- <sup>74</sup> Guam Power Authority, Integrated Resource Plan, FY 2013 (February 22, 2013), p. 7-3.
- <sup>75</sup> Canes, Michael, "The Use of Geothermal Energy in U.S. Military Operations: Challenges and Potential," United States Association for Energy Economics, accessed November 19, 2020.
- <sup>76</sup> O'Connor, John, "GPA: Solar, geothermal energy on the table," The Guam Daily Post (November 25, 2016).
- <sup>77</sup> U.S. EIA, International Energy Statistics, Guam, Natural gas reserves (tcf), 2020, Dry natural gas production (bcf), 2019, Dry natural gas consumption (bcf), 2019.
- <sup>78</sup> Guam Power Authority, 2019 Annual Report, Attachment: Guam Power Authority, Financial Statements, Additional Information and Independent Auditors' Report, Years Ended September 30, 2019 and 2018, Future Borrowing, p. 9.
- <sup>79</sup> O'Connor, John, "GPA, KEPCO sign power plant agreement," The Guam Daily Post (November 6, 2019).
- <sup>80</sup> Guam Consolidated Commission on Utilities, Resolution on Updated Integrated Resource Plan (May 24, 2016).
- <sup>81</sup> Daily Post Staff, "Justice Department files GPA settlement; agency must pay \$400K," The Guam Daily Post (February 10, 2020).
- <sup>82</sup> U.S. EIA, International Energy Statistics, Guam, Coal and coke, Production, Consumption, 2019.
- <sup>83</sup> U.S. EIA, International Energy Statistics, Guam, Coal and coke, Coal reserves, 2017.

## Other Resources

### Energy-Related Regions and Organizations

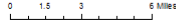
- Petroleum Administration for Defense District (PADD): 7

### Other Websites

- Guam Energy Office
- Guam Public Utilities Commission
- Guam Power Authority
- Guam Consolidated Commission on Utilities
- Guam Energy Office, Weatherization Assistance Program
- Guam Environmental Protection Agency
- Guam Bureau of Statistics and Plans
- Guam Economic Development Authority
- Guam Power Authority
- Port of Guam
- University of Guam, Pacific Islands Climate Adaptation Science Center
- U. S. Department of the Interior, Office of Insular Affairs, Guam
- Alternative Fuels Data Center, Federal and State Laws and Incentives
- NC Clean Energy Technology Center, Database of State Incentives for Renewables and Efficiency (DSIRE)
- National Association of Regulatory Utility Commissioners (NARUC)
- National Association of State Energy Officials (NASEO)
- National Conference of State Legislatures (NCSL), Energy
- National Renewable Energy Laboratory (NREL), Geospatial Data Science Data and Tools
- U.S. Geological Survey (USGS), Publications
- U.S. Bureau of Ocean Energy Management
- U.S. Department of Health and Human Services, Administration for Children and Families, Office of Community Services, Low Income Home Energy Assistance Program (LIHEAP)



Grey Base: National Geographic, Esri, DeLorme, NAVTEQ, UNEP-WCMC, USGS,



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| ■ Mask                      | ⚡ Natural Gas Power Plant         | 🌬️ Wind Power Plant            |
| ▲ Surface Coal Mine         | ☢️ Nuclear Power Plant            | 🌳 Wood Power Plant             |
| ⚙️ Underground Coal Mine    | ● Other Power Plant               | 🏭 Petroleum Refinery           |
| 🌱 Biomass Power Plant       | ⚙️ Other Fossil Gases Power Plant | 🛡️ Strategic Petroleum Reserve |
| ⚙️ Coal Power Plant         | 🛢️ Petroleum Power Plant          | 🚢 Petroleum Port               |
| 🌋 Geothermal Power Plant    | ⚙️ Pumped Storage Power Plant     | 🚢 LNG Import/Export Terminal   |
| ⚡ Hydroelectric Power Plant | ☀️ Solar Power Plant              |                                |

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