

**Solutions for Clean Electrical  
Generating Plants**

**Lindsay Harlow**

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## **INTRODUCTION**

This report examines the sources of alternative energy and clean energy. It gives a general understanding of where these energy sources come from and how they are used in the average household. It shares details on how the average American household uses energy and gives projections on how the average household is forecasted to use energy.

This report explains the factors that affect energy consumption and the different circumstances that change these factors. It gives insights into how the average household can utilize alternative energy sources to reduce their carbon footprint and emissions of harmful greenhouse gases.

It then explains the research that was undergone to find the most cost-effective solution for the town of Atreides in finding a new renewable source of electrical power for their plant. It explains the most cost-effective power plants and how they can be utilized. It explains the most cost-effective ways to do this and its recommendations for which source to use to do this.

## **BACKGROUND**

### *Where the Energy Use Comes From*

According to the United States Census Bureau, the average number of people in the American household was 3.1 in 2022 (United States Census Bureau, 2023). The average U.S. home needs electricity to provide power for many different reasons. Heating and air conditioning are the two main factors leading to seasonal energy consumption. Water heating, lighting, and refrigeration are things that every household uses year-round. The remaining share of energy use is television, appliances, and other electronics (United States Energy Information Administration, 2023).

### *The Factors That Affect How Much Energy is Used*

Many things can affect how much energy a typical household uses on average. It's geographic location and climate. Homes in the Northeast and Midwest parts of America typically consume more power than those in the South and West regions because they have to run heating for extended periods of the year. The type of home and its construction play a large part in how much energy it uses. For instance, "In 2015, the average household living in a single-family detached home consumed nearly three times more energy than a household living in an apartment building with five or more apartments." (United States Energy Information Administration, 2023).

### *Energy Sources Used Most in Homes*

Retail electricity accounts for 43% of the total residential sector in residential homes. Natural gas accounts for 42%, and Petroleum heating oil, kerosene, and liquefied petroleum gas (LPG) account for 8 % of the residential sector. Renewable energy sources, including geothermal energy, solar energy, and wood fuels, account for only 7% of the residential sector's energy use in 2021. The majority of the uses for these are space heating, water heating, cooking, and in the

case of solar energy for total electricity (United States Energy Information Administration, 2023).

Homes in the United States typically use two or more energy sources, but they are not renewable. However, the number of households with small-scale solar photovoltaic systems has increased in recent years, primarily due to government tax rebate programs. A typical U.S. household now uses more air conditioning, appliances, and consumer electronics than ever, but the average household energy use has declined. The reasons for these include (United States Energy Information Administration, 2023):

- Home improvements
- Population migration to areas with lower heating
- Improved heating and cooling appliances

However, despite declining household energy consumption, the increase in houses has resulted in a relative flatline in energy use.

### *What is Renewable Energy*

Renewable energy comes from sources that are naturally replenished and virtually inexhaustible in duration but limited in the amount of energy that is available per unit of time (United States Energy Information Administration, 2023). The different types of renewable energy are as follows and how much energy consumption they maintain (United States Energy Information Administration, 2023):

- Biomass: 37% quadrillion Btu
- Wood and wood waste: 16% quadrillion Btu
- Municipal solid waste: 3 % quadrillion Btu
- Landfill gas and biogas: 18% quadrillion Btu
- Biofuels: 18% quadrillion Btu
- Hydropower: 18% quadrillion Btu
- Geothermal: 1.6% quadrillion Btu
- Wind: 29% quadrillion Btu
- Solar: 14.2% quadrillion Btu

"In 2022, renewable energy provided about 13%, or 13.18 quadrillion British thermal units (Btu)—1 quadrillion is the number 1 followed by 15 zeros—of total U.S. energy consumption. The electric power sector accounted for about 61% of total U.S. renewable energy consumption in 2022, and about 21% of total U.S. electricity generation was from renewable energy sources" (United States Energy Information Administration, 2023).

According to recent studies, renewable energy can reduce greenhouse gas emissions. It can reduce energy imports and reduce fossil fuel use. According to projections by the Annual Energy Outlook 2023 Reference case, U.S. renewable energy consumption will continue to increase

through 2050 if specific laws and regulations that affect the energy sector remain unchanged—leading us to look for the necessary clean, renewable energy solutions (U.S. Energy Information Administration, 2023).

## **RESEARCH**

The combination of declining capital costs and government subsidies, including IRA initiatives, drive renewable technologies for electricity generation, such as solar and wind. Wind and solar energy are the least costly resources for operating and meeting electricity demand because they have zero fuel costs. Over time, the investment in installing and operating the system increases the advantage of zero-carbon electricity generation. As a result, solar-generated energy is expected to grow in every region. It is expected to grow by about 325% in 2022 to 1019% by 2050 (U.S. Energy Information Administration, April 2023).

## **CONCLUSIONS & RECCOMENDATIONS**

I recommend that the town of Atreides invest in a solar/wind-powered electrical power plant. These plants generate electricity with no associated air pollution emissions. By investing in a hybrid solar/ wind power plant, the town will receive the benefits that both wind and solar can give.

### *Costs*

The cost of an average wind turbine is \$1,300,000 per megawatt. The typical wind turbine runs anywhere from two to three MW in power, costing roughly two to four million dollars. Operation and maintenance are about 45,000 a year (Blewett, 2023).

The cost of an average solar power plant is between \$0.89 and \$1.01 per megawatt. A 1MW solar farm can cost between \$890,000 and \$1.01 million to invest in. The maintenance is around 1 % of the total investment (Coldwell Solar, 2023).

I project that the town will need to invest roughly 2 million dollars to build this combination electrical power plant and that it should see a reduction in the amount of energy used within the next three years.

## References

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