



Efficient energy supply

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This is true only for "thermal generation" of electricity, which includes coal, natural gas, and nuclear power. Renewables like wind, solar, and hydroelectricity don't need to convert heat into motion, so they don't lose energy.

The problem of major energy losses also bedevils internal combustion engines. In a gasoline-powered vehicle, around 80% of the energy in the gas tank never reaches the wheels. (For details, see an earlier post comparing the efficiency of electric vehicles and internal combustion engines.)

Fossil-fueled power plants are more efficient than a car's engine, but they still grapple with the same obstacle. In both cases, converting energy from one form to another leaves only a fraction of the original energy left over to accomplish the intended task.

Through the ages, the most common way to make electricity has been through thermal generation, with the process beginning by generating heat. That heat is then used to boil water and make steam, which spins a turbine that generates an electric current. The fuel source can be coal, natural gas, or nuclear fission, but the process is similar - and very inefficient. The majority of the energy that goes into a thermal power plant is vented off as waste heat. Additional minor losses come from the energy used to operate the power plant itself.

In contemporary thermal power plants, 56% to 67% of the energy that goes into them is lost in conversion. But the impacts of mining, processing, greenhouse gas emissions, particulates, and other forms of pollution are levied on the full amount of fuel consumed at the upstream end of the process, not just on the minority that eventually reaches your outlets. The same is true for the price tag, of course, which is all the more noticeable as the cost of natural gas is increasing.

The efficiency of power plants is measured by their heat rate, which is the BTUs of energy required to generate one kWh of electricity. This simple math compares the total amount of energy entering the power plant with the amount of electricity that leaves the plant and heads out onto the grid.

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The Energy Information Administration lists the heat rate for different types of power plants, and the average operating efficiencies of thermal power plants in the U.S. in 2020 were:

What about the efficiency of renewables? A wind turbine is around 35 to 47% efficient. But wait, isn't that the



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same low efficiency as coal and gas power plants? Well, yes...and no.

Comparing renewable energy with fossil fuels isn't an apples-to-apples comparison, because renewables don't use fuel.

A coal plant with 32% efficiency still burns 100% of its coal. The impact of burning coal is based on how much coal is burned, not how much electricity is generated at the end of the process. But a wind turbine that converts 32% of the passing breeze into electricity isn't consuming anything.

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