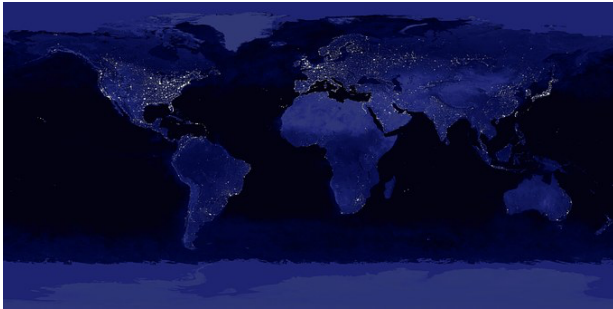


Electric House



Worldwide energy consumption is increasing.

Our Energy Future

Worldwide energy consumption has been steadily increasing for decades and is expected to continue to do so. Between 1973 and 2015, it nearly doubled, and it is projected to increase 28% by 2040. The top consumers are China, the United States, India, Russia, and Japan.

Electricity made up 9.4% of energy use in 1973 and rose to 41% in 2015, with total electricity consumption nearly quadrupling. While most of that electricity usage is industrial in nature, around a quarter of it is residential. We still rely heavily on **fossil fuels** (coal, oil, and natural gas): they made up about 81% of total energy consumption in 2014. **Renewable energy** is, however, on the rise, projected to increase an average of 2.3% per year through 2040.

In 2014, about 35% of total energy use went to the transport industry, mostly for passenger cars. Only around 2% of electricity consumption is used for transportation, but that may be changing. Electric cars are becoming increasingly affordable and common. Technology companies with an eye to the future are trying to combine the rising use of electricity with the increasing desire to go renewable. The biggest of these is **Tesla**, which is rolling out the potential for **energy-neutral homes**, boasting **solar roofs**, **energy-storing batteries**, and **electric cars**.

Solar Roofs

Solar roofs are roofs made from shingles that double as **solar cells**. They alleviate the undesirable aesthetics of a classic, but bulky, solar array without losing much in the way of efficiency. Tesla isn't the first company to put forth solar shingles, a type of **building-integrated photovoltaic (BIPV)**. They first became commercially available in 2005. Widely regarded as a luxury item, they are fast becoming competitive with traditional solar panels. They still aren't financially sensible if you're not already in the market for a new roof, however, and their affordability varies by state. Tesla has begun installations in the U.S. and plans to expand outside the U.S. in 2018.



Solar roofs perform the same function as solar panels on roofs (pictured), but are more aesthetically-pleasing.



Tesla's solar roof tiles include a Tuscan style.

Tesla's solar roof tiles are made of quartz glass, are lightweight, stronger than traditional roof tiles, and come in four different styles. The company claims that they are just as efficient as traditional photovoltaic cells and provide a warranty of the first of infinity or the life of the home. Tesla estimates an average cost of \$21.85 per square foot and offers a calculator on their site to determine individual costs by address.

Placing a 3700-square-foot solar roof on a home in Texas would cost over \$99,000 initially and over 30 years, that cost only decreases to a net of \$41,400 when taking incentives (e.g. tax breaks) and energy savings into account. By contrast, the same size roof in Florida would cost only \$75,900 upfront and *earn* the customer a net of \$9,500 over 30 years.

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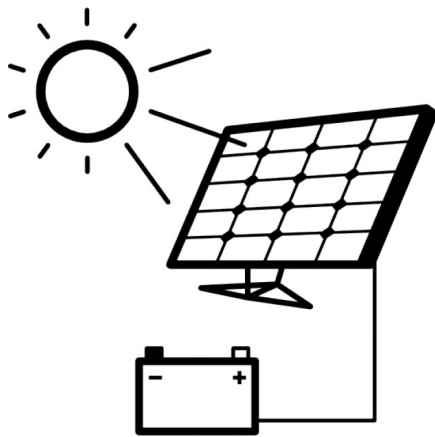


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Dow Chemical, in partnership with the solar company **RGS Energy**, has **Powerhouse Solar Shingles**, a line of silicon solar cells that are integrated into asphalt roofing. While RGS doesn't include a handy calculator on their website, they claim to offer a less expensive option than systems that integrate with tile roofing (e.g. Tesla) and have been priced by news outlets at \$20,000 for installation. They offer a 25-year warranty on the roof and a 10-year warranty on the solar cells. RGS began an initial launch covering

California, Colorado, Massachusetts, and Texas, with plans to expand installations throughout the United States.

A United States-based building material company called **CertainTeed** produces two lines of solar shingles bearing the name Apollo. Both come with a 25-year warranty. Their **Apollo II** solar shingle system uses monocrystalline silicon solar cells and integrates with asphalt roofing (which the company also manufactures). CertainTeed boasts 60 watts of energy per shingle, shingle weight comparable to traditional asphalt, and high durability



and wind resistance for the Apollo II system. Their **Apollo Tile II** solar shingle system uses the same type of solar cells but integrates with concrete tile roofing. The tile system provides 60 watts of energy per tile, is lightweight (lighter than traditional concrete tiles), and just as durable and wind-resistant as the Apollo II system. CertainTeed doesn't include price estimates on their website but interested parties can request an estimate after inputting some information.

Energy Storage Batteries

Companies such as Tesla, RGS, Mercedes-Benz, Nissan, and IKEA have developed home energy storage batteries to capture excess energy generated by solar cells for use during a power outage or when the sun goes down.

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Tesla further manufactures a higher-capacity version of the Powerwall for utility companies called a **Powerpack**. A megawatt Powerpack battery can provide power for 750 homes for four hours. Some California and Hawaii utility companies have already begun using them.

RGS's **Sonnen home battery** integrates with its solar roof system in much the same way as Tesla's Powerwall. It offers less efficiency, restoring power 30 seconds after a power outage and only providing between 3 (6 kW battery) and 7 (16 kW battery) hours of power, depending on how many things are drawing energy.

Mercedes-Benz produces a residential battery that is an upscaled version of the battery used in their electric cars. The largest of their batteries (20 kWh) stores enough energy to power a home for about 18 hours, more than Tesla's Powerwall. Like Tesla, multiple batteries can be used together, but Mercedes-Benz maxes out at four rather than ten. It starts at \$5,000 (including installation) for a small system (2.5 kWh) up to \$13,000 for the largest system.

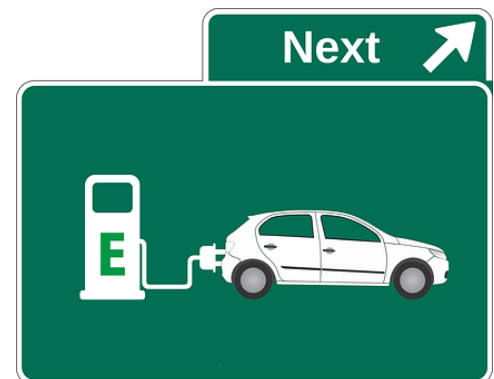
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Electric Vehicles

Personal electric vehicles are on the rise. Not only are they considered more environmentally-friendly than gas/petrol-powered cars, but they are much cheaper to run. To keep an electric car going for one year can cost



Range anxiety is a problem for electric car drivers.

less than running a central air conditioner for a year. Unfortunately, public charging stations are lagging behind the market. As of March 2018, there were about 18,000 public charging stations across the United States, including in Alaska, Hawaii, and Puerto Rico. Contrast that with about 120,000 gas stations. Some towns are over 200 miles from the nearest public charging station. While the **range** (distance the car can travel on a full charge) of newer electric vehicles is rising, older models are still on the road and the longer-range models aren't affordable for everyone wishing to go electric. Not to mention the time it takes to charge an electric vehicle.

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As long as people tend to use their electric vehicles for commuting, there should be little concern about range and charging time. However, when using electric vehicles for road trips, **range anxiety** (worry about finding a charging station before the car battery runs out of power) becomes a problem. Not only that, but spending over an hour filling up at each stop can make a big difference to travel time and generate long lines at the plug.



The range of Tesla's Model S is 335 miles.

A few current and planned products and services have the potential to alleviate these problems. As mentioned, newer vehicles have greater ranges than previous models. In 2011, the median range for an electric vehicle was 73 miles. By 2018, that number had risen to 114. Tesla's Model S has a



Tesla's supercharger can add 300 miles in 75 minutes.

maximum range of 335 miles on a single charge. The Tesla Model 3, their more affordable option, has a 220-mile range, General Motors' Bolt has a range of 238 miles, and Hyundai's Kona (to be released in late 2018) will have a range of 250 miles.

A handful of companies are planning worldwide and nationwide charging networks. Tesla has developed a **supercharger** that can add 300 miles of driving time with 75 minutes of charging. In 2018, there are over 1,200 supercharger stations in operation worldwide, with many more preparing to open. However, such stations only charge Tesla vehicles. What about the rest of the electric vehicles on the road? As part of Volkswagen's punishment for falsifying emissions data, the company is investing billions of dollars in the United States on electric vehicles. Part of that money is earmarked for fast charging stations. Unlike Tesla, they aren't allowed to give preference to their own vehicles, so such charging stations could be universally used. Combining the plans from VW, Tesla, and smaller companies, the U.S. is projected to add hundreds of fast charging stations by 2020. Unfortunately, not all vehicles can handle the power of fast charging stations. Fast-charger-compatible vehicles are likely to enter the market in 2019.



Some places offer curbside charging.

Outside the U.S., some countries have installed **curbside charging stations**. 43% of British homeowners don't have off-street parking, so charging in the home isn't as common as in the U.S. With a coming ban on new petrol and diesel vehicles in the United Kingdom, easy access to charging stations is going to become necessary. Some suggestions include **lamppost charging**, **inductive charging** (touch charging from a pad or the road itself, much like newer cellular phones), **battery swapping stations**, and

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If people continue to charge primarily at home overnight, however, it is unlikely that countries will need as many electric vehicle charging stations as gas stations. This is especially true as technology companies continue to improve electric vehicle range. In 2017, Samsung introduced a battery pack capable of running a vehicle for between 372 and 435 miles.



The home of the future?

The Electric House

So, what does the future look like? Will we all have solar-powered homes with energy storage arrays and electric vehicles? Tesla certainly seems to think so. In 2017, they took their vision of the future on the road, attaching a tiny house on wheels to their Model X SUV and driving all over Australia to advertise. The tiny house included their solar roof and a Powerwall. By making their

charging stations proprietary, Tesla is aiming to funnel consumers into using their products alone. However, with so many other options out there, it's more likely that our future homes will contain some conglomeration of technology. Tesla will have its brand-loyal consumers, but it's unlikely that other companies will be left behind. In fact, the ultra-fast chargers being installed across Europe are faster than Tesla's superchargers and available to a wider variety of cars.

There's also the future of self-driving cars to consider. Might they overtake the electric car's progress, making personal vehicles obsolete? Only time will tell.

Reading Comprehension Questions:

1. By how much is global energy consumption expected to increase between now and 2040?
2. Between 1973 and 2015, by how much did electricity consumption increase worldwide?
3. What
4. Is Tesla's
5. What is net metering and how is it good for people with solar panels/solar roofs?
6. Besides
7. What are home energy storage batteries?
8. What
9. What is the impact of Powerwall installation in the Texas and Florida home examples?
10. What
11. What is range anxiety?
12. Which
13. What is
14. What is the fastest charger listed above, how fast is it, and where is it located?
15. What is the main concern about the increases in electric vehicles on the road?

Extension Questions

16. Do you think
17. In your opinion,
18. Create

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