



STUDY GUIDE

ARE ELECTRIC CARS REALLY GREEN?

KEY TERMS: gasoline emission CO2
pollution renewables coal

NOTE-TAKING COLUMN: Complete this section during the video. Include definitions and key terms.

How many pounds of CO2 emission is an electric car rolling off of the production line responsible for creating?

The electricity to run electric cars is derived from which fossil fuel?

By 2020, how many more people are estimated to die every year from the pollution from electric cars than from gasoline-powered cars?

CUE COLUMN: Complete this section after the video.

How do electric cars compare to gasoline-powered cars in terms of both economic and environmental cost?

Why are electric cars far worse for the environment than gasoline-powered cars?

DISCUSSION & REVIEW QUESTIONS:

- Dr. Lomborg begins the video by asking, “Do electric cars really help the environment?” How would you answer his question? Explain.
- Later in the video, we learn that, “The mining of lithium [for an electric car’s battery], for instance, is not a green activity. When an electric car rolls off the production line, it has already been responsible for 30,000 pounds of carbon-dioxide emission. The amount for making a conventional car: just 14,000 pounds.” Why do you think that the mining is not an environmentally friendly activity? Do you think that any mining is necessary to make a gasoline-powered car? Exactly how, do you think, is the electric car responsible for all of that CO2 emission whilst being built? What is using the CO2?
- Dr. Lomborg explains that, “...while it’s true that electric cars don’t run off of gasoline, they do run on electricity, most of which is derived from another fossil fuel – coal. As green venture capitalist Vinod Khosla likes to point out, “Electric cars are coal-powered cars.” Do you think that electric car owners tend to be more ignorant of this fact or more in denial about it? Explain how you arrived at your conclusion. Why do you think that environmentalists tend to not focus on or address this fact?
- Dr. Lomborg shares with us that “...the electric car cuts almost no CO2, costs taxpayers a fortune, and... generates more air pollution than traditional gasoline cars,” and further that, “...while gasoline cars pollute closer to home, coal-fired power actually pollutes more – a lot more... researchers estimate that if the U.S. has 10% more gasoline cars in 2020, 870 more people will die each year from the additional air pollution. If the U.S. has 10% more electric vehicles powered on the average U.S. electricity mix, 1,617 more people will die every year from the extra pollution.” Do you think that most electric car purchasers are aware of this? Why or why not? Do you think that they care? Why or why not? Why do you think that so many people believe and claim that electric cars are good for the environment?
- Considering that the production of electric cars and the electricity they need to run pollutes the environment substantially more than gasoline-powered cars, and considering the fact that for electric car purchasers, “Paying \$7,500 to avoid \$25 in climate damage is a very poor deal, even by government standards. And that doesn’t include the billions more in federal and state grants, loans and tax write offs that go directly to battery and electric-car makers,” why do you think that people, especially environmentally-friendly-minded people, purchase electric cars? Why do you think that the government provides such heavy economic incentives for people to purchase electric cars, and provides economic incentives for electric car makers and battery makers?

EXTEND THE LEARNING:

CASE STUDY: EVs

INSTRUCTIONS: Read the article “Don’t look so smug: Your Tesla might be worse for the environment than a gas car,” then answer the questions that follow.

- What is the ‘dark side’ of lithium ion batteries? What are the negative consequences of cobalt exposure? Pollution from battery production takes place mostly in which country?
- What happens when an EV is powered by electricity generated from fossil fuels, in terms of energy cost? The article states that, “The lithium-ion battery market is expected to grow to \$22.5 billion in the next three years, and potentially double that by the end of the decade.” How does the author predict that ‘big lithium’ will compare to the ‘big oil’ that America has been dependent on in the past?
- After watching the video and reading the article, has your answer to Dr. Lomborg’s question “Do electric cars really help the environment” changed? Why or why not?



QUIZ

ARE ELECTRIC CARS REALLY GREEN?

1. Electric cars run on electricity alone and don't burn any gasoline at all.
 - a. True
 - b. False

2. In the U.S., what is energy often produced by?
 - a. coal
 - b. natural gas
 - c. wind
 - d. solar

3. Green venture capitalist Vinod Khosla likes to point out, "Electric cars are _____ cars."
 - a. economical
 - b. superior
 - c. electric-powered
 - d. coal-powered

4. Roughly, how much is the entire climate benefit of an electric car?
 - a. \$35
 - b. \$350
 - c. \$3,500
 - d. \$35,000

5. Which of the following is true of electric cars?
 - a. They cut almost no CO₂.
 - b. They cost taxpayers a fortune.
 - c. They generate more air pollution than traditional gasoline cars.
 - d. All of the above.



QUIZ - ANSWER KEY

ARE ELECTRIC CARS REALLY GREEN?

1. Electric cars run on electricity alone and don't burn any gasoline at all.

- a. True
- b. False

2. In the U.S., what is energy often produced by?

- a. coal
- b. natural gas
- c. wind
- d. solar

3. Green venture capitalist Vinod Khosla likes to point out, "Electric cars are _____ cars."

- a. economical
- b. superior
- c. electric-powered
- d. coal-powered

4. Roughly, how much is the entire climate benefit of an electric car?

- a. \$35
- b. \$350
- c. \$3,500
- d. \$35,000

5. Which of the following is true of electric cars?

- a. They cut almost no CO₂.
- b. They cost taxpayers a fortune.
- c. They generate more air pollution than traditional gasoline cars.
- d. All of the above.

<http://www.digitaltrends.com/cars/hold-smugness-tesla-might-just-worse-environment-know/>

[Road Rave - By Peter Braun](#)

Don't look so smug: Your Tesla might be worse for the environment than a gas car

By [Peter Braun](#) — November 14, 2013



This car is supposed to be great for the environment, but is it? The answer might surprise you.

On a recent drive from Portland, Oregon to Seattle, I stopped for gas near one of Tesla's new Supercharger quick-charge stations. While my car was filling with liquefied dinosaurs, I happened to overhear two Tesla owners chatting while they topped off with electrons. They were clearly preening to one another about their [cars](#), brimming over with smugness. And, at least in theory, they had every reason to be.

Electric cars, and for that matter hybrids, have been marketed in no small part on the good karma you accrue for owning one. "Buy an electric car and save the world!" But just how smug should those Tesla and other EV drivers be? I wanted to find out. And the answers just may take Tesla, Volt and Leaf owners down a notch.

In the last year, a number of important studies tracking the environmental cost of EVs, and particularly lithium-ion batteries, have come out. What these studies have shown is that the environmental gap between internal combustion and electric power is not as wide as we want it to be, and that, regardless of carbon footprint, the process of making lithium-ion batteries leaves a lot to be desired.

Where did that battery come from?

Carl Sagan is famed for saying, “We live in a society exquisitely dependent on science and technology, in which hardly anyone knows about science and technology.” He could have been talking directly about lithium-ion batteries. Chances are you are sitting within three feet of something that uses lithium-ion technology, heck you are probably reading these words *thanks* to lithium-ion batteries. Yet, not that many people really understand what goes into them.

So how do they work? Like any battery, lithium-ions work by creating a flow of current (electrons) between a positively charged (missing electrons) cathode and a negatively charged anode (extra electrons), through a conductive electrolyte. Lithium makes a great battery because it is both very conductive, making it a good electrolyte, allows for extremely high electrical potential. And of course, because this electrochemical reaction is reversible, the batteries are readily rechargeable.



As great as lithium is for batteries, it has a dark side as well: The stuff is downright nasty. Lithium is flammable and highly reactive, [as anyone who has seen photos of burning a Tesla can attest](#), but that’s the least of our worries. The [EPA has linked](#) the use of extremely powerful solvents in the creation of lithium electrolytes and cathodes to everything from cancer to neurological problems. Specifically, the cobalt used in the creation of the most energy dense lithium-ion batteries is poisonous and extremely carcinogenic. Pulmonary, neurological, and respiratory problems have all been connected to cobalt exposure.

A good rule of thumb is that any industrial process that makes liberal use of the word ‘slurry’ is not good for pandas, or for that matter people. And, boy, does slurry come up a lot in the battery-making process.

Other combinations of lithium are not as bad, but none is exactly good. The lithium-iron phosphate used in lower energy density batteries is better in terms of its carcinogenic effect, but might be worse in terms of the impact on the biosphere.

Is it getting hot in here?

Clearly then, EVs and plug-in hybrids have environmental costs. What effects however, do lithium-ion batteries have on John Q. Polar Bear? Well, [a recent study from Norway](#) looked at the global-warming potential of the complete lifecycle of EVs, from mining to recycling. Previous studies hadn’t accounted for

the energy-intensive process of building EVs, and missed the point: They're not that much better than gasoline cars.

The best outcome for EVs was a 24-percent improvement in global-warming potential over the average gas powered car, and between 10 percent and 14 percent over diesel. These numbers are nothing to sneeze at, but they change radically depending on the source of electricity that EVs are powered on.

EVs that depend on coal for their electricity are actually 17 percent to 27 percent worse than diesel or gas engines.

The above numbers rely on the European power mix, which more heavily favors nuclear, hydroelectric, and renewable sources of energy than other parts of the world.

The global warming potential for EVs that rely on natural gas – generally considered to be the cleanest fossil fuel – show an improvement of only 12 percent over gasoline, and break even with diesel.

Most alarming, EVs that depend on coal for their electricity are actually 17 percent to 27 percent *worse* than diesel or gas engines. That is especially bad for the United States, because we derive close to 45 percent of our electricity from coal. In states like Texas, Pennsylvania, and Ohio, that number is much closer to 100 percent. That's right folks; for residents of some of the most populous states, buying an EV is not only toxic, it's warming the planet more than its gas-powered counterparts.

With cars that supposedly generate “zero tailpipe emissions,” how are these pollution numbers even possible? The simple answer is that as well as being messy to produce; battery production requires a tremendous amount of electricity. The initial production of the vehicle and the batteries together make up something like 40 percent of the total carbon footprint of an EV – nearly double that of an equivalent gasoline-powered vehicle.



The high initial carbon footprint of an EV can be offset when the car is powered by environmentally friendly energy sources like hydroelectric or wind. Unfortunately, when that same EV is powered by

electricity generated from fossil fuels, the initial energy cost of EV production can't be overcome and outweighs gasoline and diesel-powered vehicles.

Previous studies evaluating EVs have overlooked the high energy cost of production, and have focused on the fact that even coal-fired power generation is technically more efficient than internal combustion. But with a carbon footprint from production something like twice that of an ordinary car, an EV needs to be more than "a little" more efficient to make up for all the carbon it generated before it even rolled off the assembly line.

“No war for oil! Err, lithium!”

There are also some geopolitical concerns surrounding the switch from gasoline-powered vehicles to EVs, too. One of the selling points of EVs is that they allow us end our dependence on foreign oil and big oil companies. In fact, however, we might just be trading “big oil” in for “big lithium.”

Your Tesla may look sleek and clean on the outside, but you owe it to everyone to know the real cost.

The lithium-ion battery market is expected to [grow to \\$22.5 billion in the next three years](#), and potentially double that by the end of the decade. That's small compared to the market for oil, but that will continue to change if more people buy electrified cars and trucks.

As for getting rid of our dependence on foreign material, well ... lithium isn't quite rare, but deposits worth mining are. And, unfortunately for the United States and Europe, the big lithium deposits are in countries like Bolivia, China, and – drum roll please – Afghanistan. None of those countries has a sterling environmental track record.

Given the very real concerns about pollution from battery production, most of which takes place in China, this starts to matter a great deal. Especially when there is so much pressure to keep the prices of batteries down.

Conclusions

So what to make of all this?

Some of you have probably concluded that I hate EVs and don't think anyone should buy them. That's not the case. I believe electric vehicles – in one form or another – are likely the future of personal transportation.

But beneath their squeaky clean marketing, EVs are not a panacea, a solution or remedy for all environmental woes. As with any new technology, EVs bring an immense set of new problems; problems we should understand before we become irreversibly tied to the new technology.

Here's what I suggest: If you are interested in an EV, you should know where your electricity comes from before you sign on the dotted line. If you live in a state with a high dependence on coal, an EV may not be the eco-friendly choice for you.

Ultimately, we can't let EV-derived smugness get in the way of a real and serious conversation that needs to be had surrounding global warming and the effect energy consumption has on our planet.

Your Tesla may look sleek and clean on the outside, but you owe it to everyone to know the real cost.