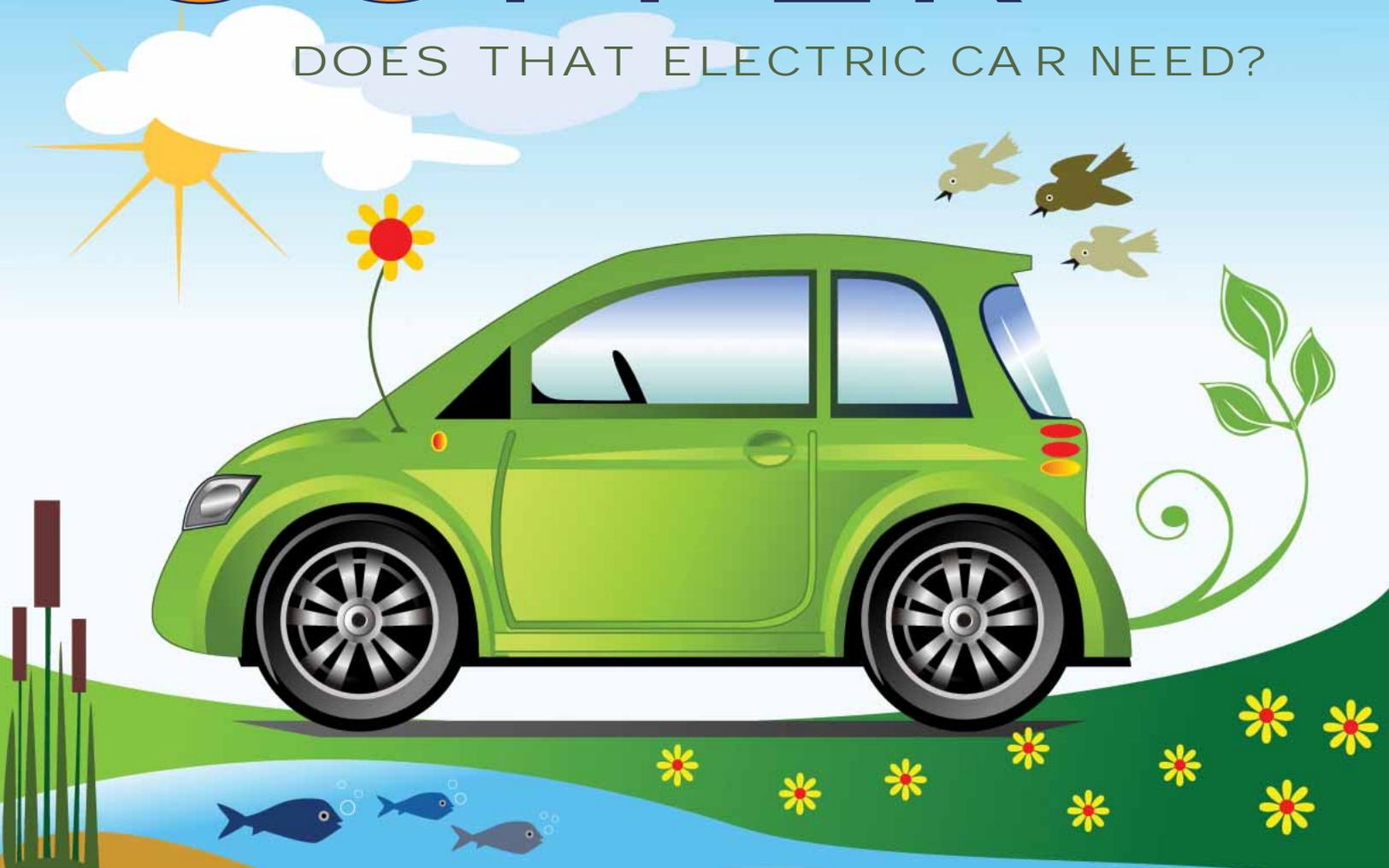


HOW MUCH COPPER

DOES THAT ELECTRIC CAR NEED?



A CHANGING GAME

The U.S. has begun a great transition in the automotive industry. Whether it be to decrease our dependence on foreign oil or lessen our current emission problems, hybrid cars are taking over the roads—one model at a time.

Or maybe we can thank the cost of fuel for that. Gas prices have spiked again. When you show up at the pump and end up paying more than \$3.50 per gallon, the good ol' days when gas cost less than a buck seem surreal. There's widespread

cynicism about how arbitrary the price of gas is and we all know that the big oil companies are making money.

NEW SOLUTIONS PROVIDING NEW CHOICES

To solve the problems with conventional gas engines, new choices in engines are increasingly present on the roads. Gas-electric hybrids have become more common, but electric cars also show promise. Ads feature electric charging stations for cars that look like futuristic parking meters. Implicit

in these ads is the idea that these electric charging stations are coming to your neighborhood soon. Some states already have them. California has between 401 and 500 of them. Washington, Oregon, Texas, Florida, Illinois, Connecticut and Florida have between 21 and 50. Although some states don't have any electric charging stations, a large part of the country has ten or fewer per state.

Ten stations for an entire state is not a lot, but anyone who has electricity

available at home can plug in a car and recharge it. That's called level 1, and it uses a standard 120 V outlet with three prongs. Level 2 electric charging, which uses 240 V, is available at charging stations. Level 3 is still being developed, but the voltage is higher and the recharge time promises to be as short as 15 minutes.

Something even more promising than batteries is being developed for electric cars: a fuel cell. Like a battery-powered electric car, one with a fuel cell doesn't have emissions and is twice as efficient as a traditional engine. It makes electricity by combining hydrogen and oxygen electrochemically. Fuel cells are flexible; you can operate them with hydrogen-rich fuels such as gas, natural gas, methanol, or ethanol, but you can also use pure hydrogen.

Projections indicate that the number of electric or gas-electric hybrid cars on the road is going to increase. Some estimates, in fact, say you can plan on seeing a billion of these cars by 2025.

COPPER MINING AND RECYCLING

All of this is good news for the copper mining and recycling industries. Conventional cars have an average of 55 pounds worth of copper alloys and copper in them. For electric cars and electric hybrid cars, which rely on electricity as the main source of energy, the number is higher. For example, an electric Ford Ranger has about two times as much copper in the wire harness and connectors as a conventional Ford Ranger harness. Each car has between 12 and 25 pounds of copper magnet wiring.

For cars that use AC induction motors instead of DC, an inverter (with eight to ten pounds worth of copper and copper alloys) powers the conversion between the DC batteries and the AC motor. Additionally, some electric systems replace hydraulic ones throughout the car. Power steering, brake systems,

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heating, and air conditioners are increasingly being designed around electrical-based technology. New copper radiators are stronger, lighter, and smaller than ever before. They don't use lead, and it is easier and cleaner to produce them.

The amount of copper required to build one of these cars has increased. Bob Weed, vice president of original equipment manufacturing for the Copper Development Association (CDA), says that where conventional cars have between 50 and 55 pounds of copper in them, electric cars have between 150 and 180 pounds. An electric car powered with a fuel cell uses 70% to 100% more copper than a conventional engine.

THE NEED FOR RECYCLED COPPER

Industry experts have always appreciated copper:

- Copper is strong, resists corrosion, and has superior thermal conductivity.
- 100% of copper can be recycled, making it one of the world's most-recycled metals.
- Manufacturing and refining copper consumes a very low amount of energy.

As the demand for copper increases, making copper mining one of the most important industries in the U.S., there

may be so much demand that the copper mining industry will be hard put to keep up. Fortunately, copper mining and recycling are complementary businesses, and copper recycling is a mature industry.

In the past, at least 12 million cars have been scrapped every year. The total amount of copper scrap per year from radiators is almost 10% of the annual copper scrap. As the number of cars and the amount of copper in those cars increases, the amount of recycled copper is also going to increase.

SMART BUSINESS, SMART ENVIRONMENTALISM

The U.S. copper produced in 2007 was worth \$8.8 billion, but business can only get better. Conservative estimates tell us there will be large numbers of electric cars by 2025. (Bob Weed says that by 2015, 10% of the new cars sold in the U.S. will use some kind of electric motor.) Electric charging stations also use a significant amount of copper.

Copper is also an important material environmentally, whether it is being used in the car manufacturing industry or other green industries such as solar energy production. Electric cars are the closest thing we have to a car that doesn't pollute because they don't create exhaust pollution. And imagine a world without exhaust pollution.

Copper mining can make that picture into reality. ✨

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COMPREHENSION QUESTIONS

1. Why are gas-electric hybrids and electric cars becoming more popular with consumers?
2. How many electric charging stations does California have?
3. At a station that offers level 2 electric charging, how many volts do customers get when charging their cars?
4. How many electric or gas-electric hybrid cars could there be on the roads by 2025?
5. How many pounds of copper and copper alloys are in conventional cars?
6. How many pounds of copper do electric cars have?
7. How much copper can be recycled?
8. How many cars are scrapped every year?