

# Volkswagen's Emissions Scandal

By GUILBERT GATES, [JACK EWING](#), KARL RUSSELL and DEREK WATKINS UPDATED July 19, 2016

Volkswagen has admitted that 11 million of its vehicles were equipped with software that was used to cheat on emissions tests. The company is now contending with the fallout. [Related Article](#)

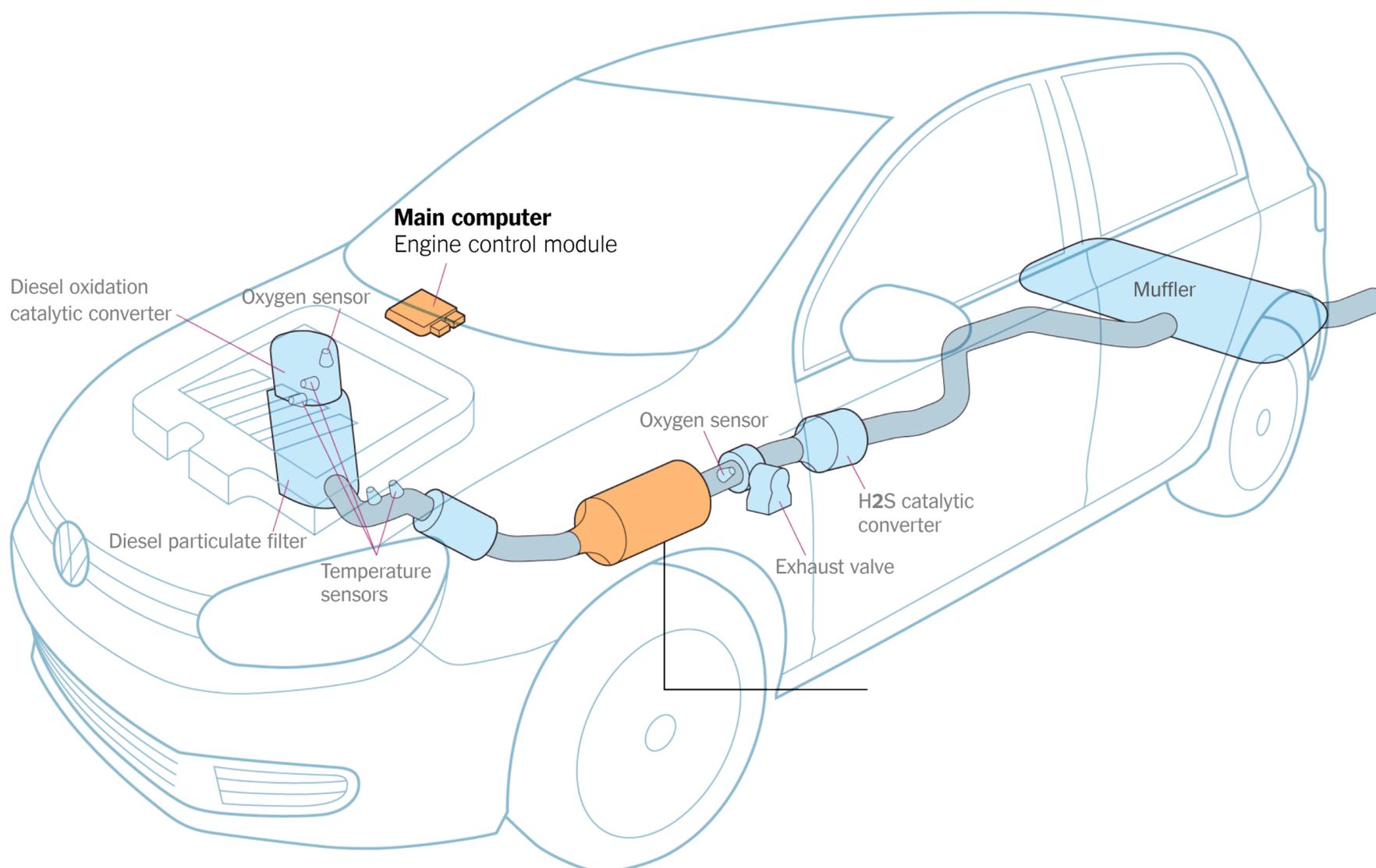
## How Did the System Work?

The software sensed when the car was being tested and then activated equipment that reduced emissions, United States officials said. But the software turned the equipment down during regular driving, increasing emissions far above legal limits, most likely to save fuel or to improve the car's torque and acceleration.

The software was modified to adjust components such as catalytic converters or valves used to recycle some of the exhaust gasses. The components are meant to reduce emissions of nitrogen oxide, a pollutant that can cause [emphysema, bronchitis and other respiratory diseases](#).

## Exhaust system of a Volkswagen Golf

Volkswagen has used two basic types of technology to reduce emissions of nitrogen oxides from diesel engines, by either trapping the pollutants or treating them with urea. The first type is shown here.



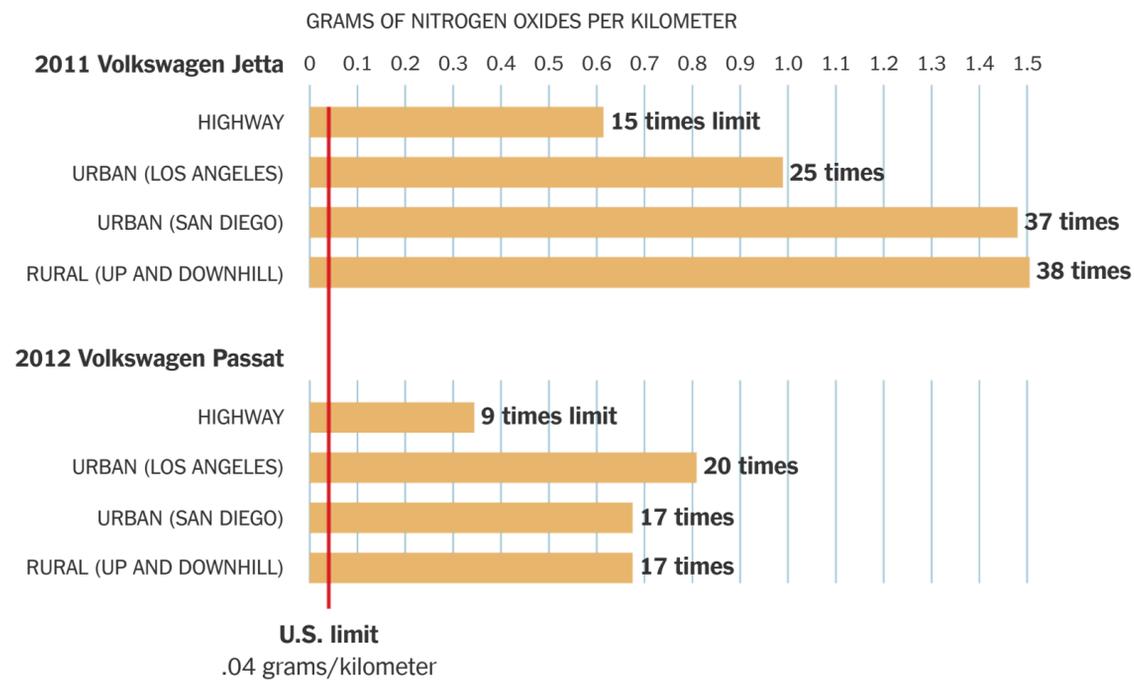
## Nitrogen oxide trap

This system traps nitrogen oxides, reducing toxic emissions. But the engine must regularly use more fuel to allow the trap to work. The car's **computer** could save fuel by allowing more pollutants to pass through the exhaust system. Saving fuel is one potential reason that Volkswagen's software could have been altered to make cars pollute more, according to researchers at the International Council on Clean Transportation.

## The Emissions Tests That Led to the Discovery of VW's Cheating

The on-road testing in May 2014 that led the California Air Resources Board to investigate Volkswagen was conducted by researchers at West Virginia University. They tested emissions from two VW models equipped with the 2-liter turbocharged 4-cylinder diesel engine. The researchers found that when tested on the road some cars emitted almost **40 times** the permitted levels of nitrogen oxides.

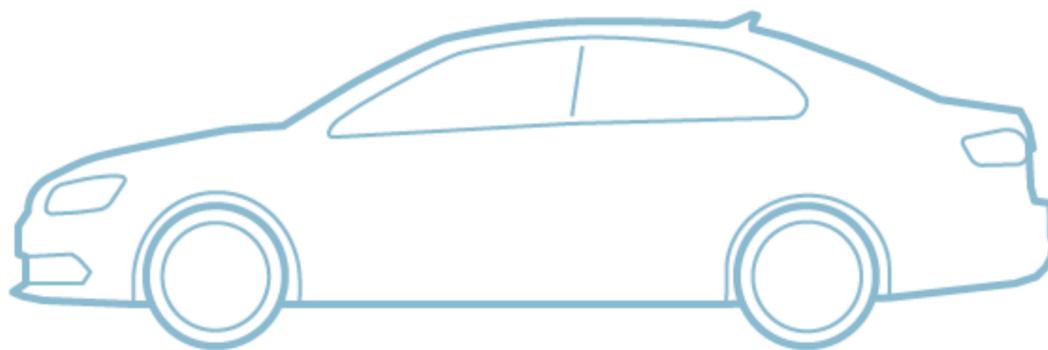
### Average emissions of nitrogen oxides in on-road testing



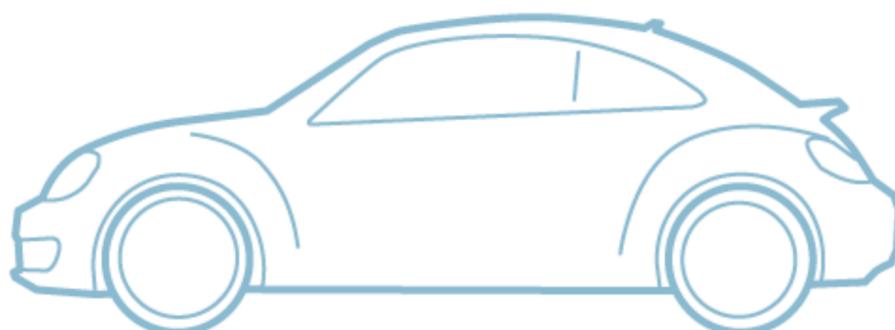
Source: Arvind Thiruvengadam, Center for Alternative Fuels, Engines and Emissions at West Virginia University

### Which Cars Are Affected?

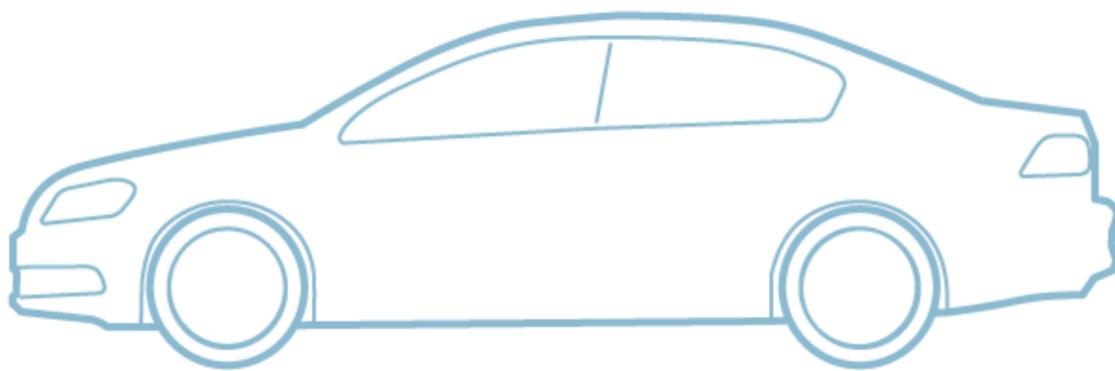
The Environmental Protection Agency said in September that it would order Volkswagen to recall seven of its American car models with affected engines, which amount to nearly 600,000 vehicles. Volkswagen has not released a list of international models, which make up the majority of the 11 million affected vehicles, that have engines with the software in question.



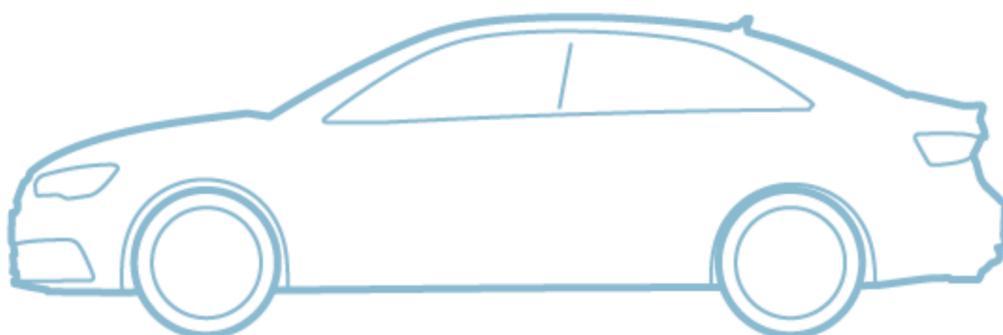
VOLKSWAGEN  
**Jetta**  
2009 to 2015



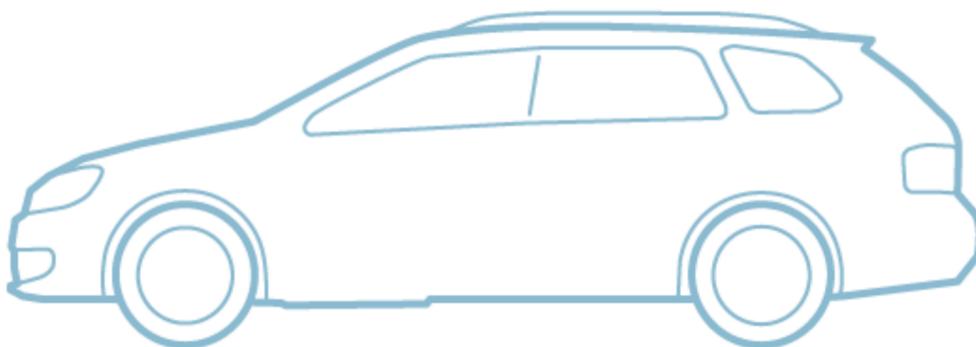
VOLKSWAGEN  
**Beetle and Beetle Convertible**  
2012 to 2015



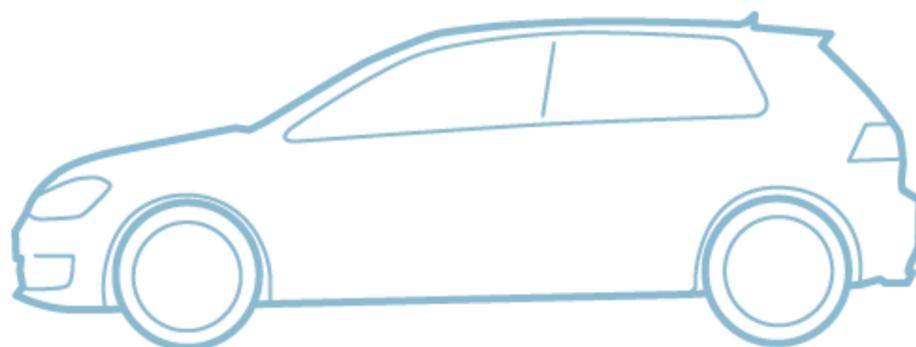
VOLKSWAGEN  
**Passat**  
2012 to 2015



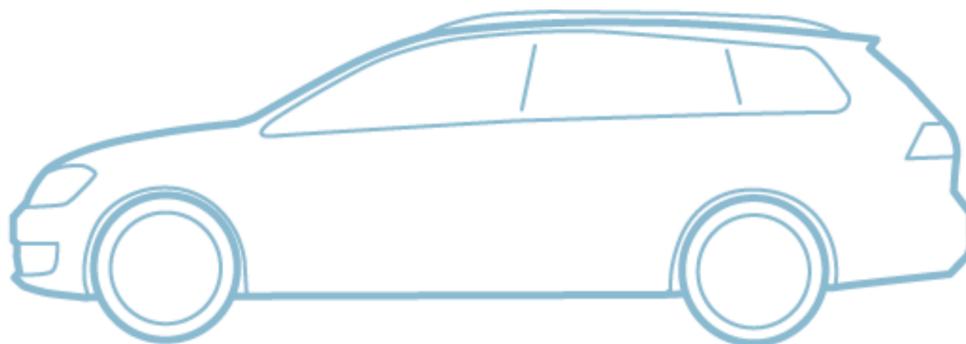
AUDI  
**A3**  
2010 to 2015



VOLKSWAGEN  
**Jetta SportWagen**  
2009 to 2014

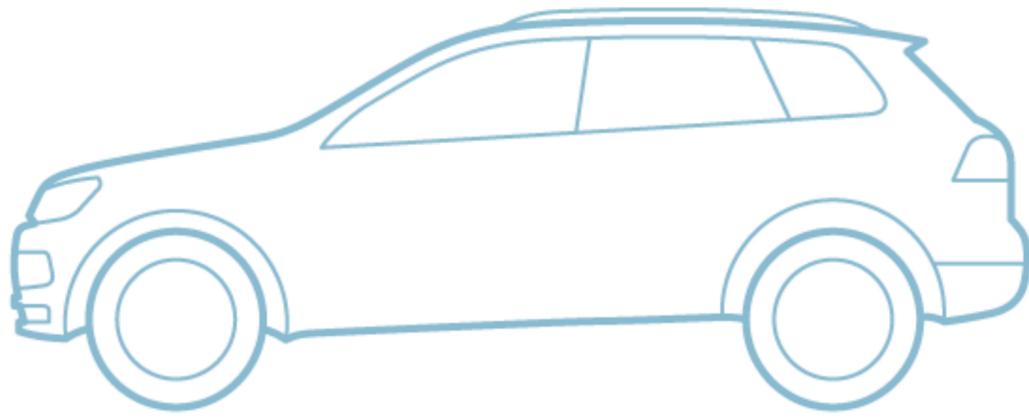


VOLKSWAGEN  
**Golf**  
2010 to 2015

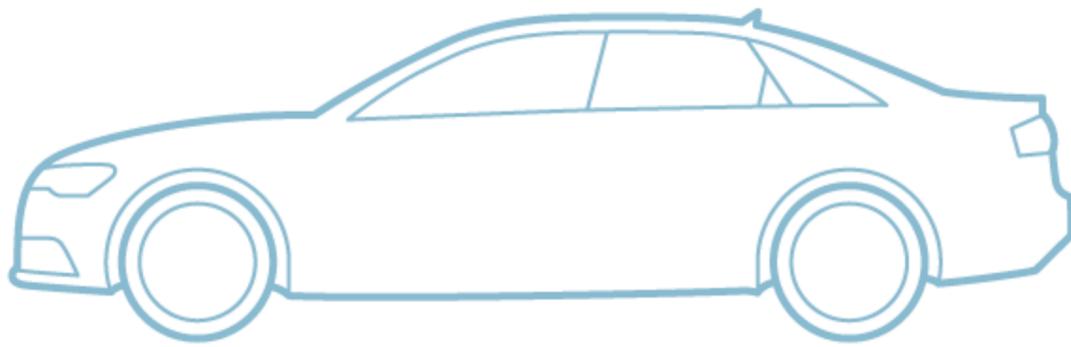


VOLKSWAGEN  
**Golf SportWagen**  
2015

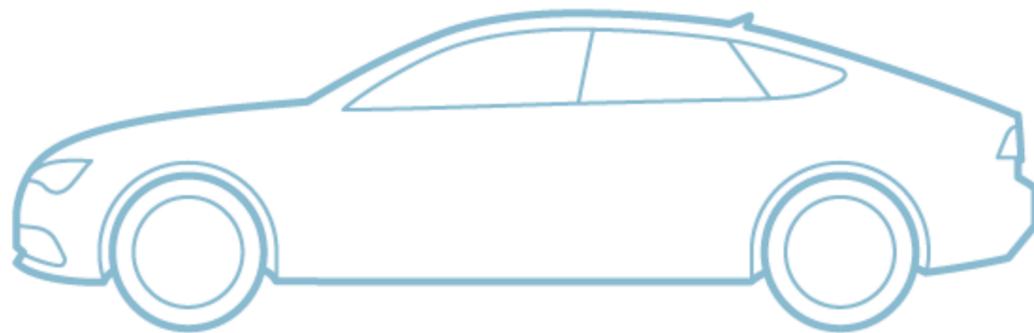
about 10,000 cars sold in the United States since the 2014 model year. But, in meetings with the E.P.A. on Nov. 19 and 20, the company admitted that all model years since 2009 with its 3-liter diesel engines contained the software as well. The latest disclosure covers an additional 75,000 vehicles.



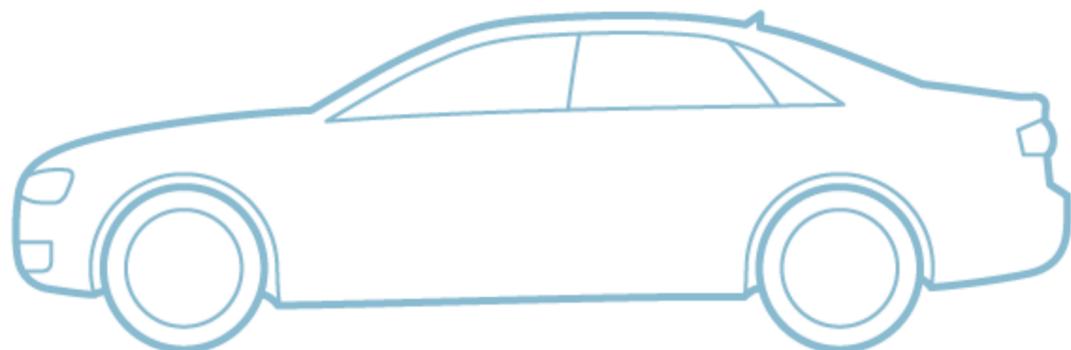
VOLKSWAGEN  
**Touareg**  
2009 to 2016



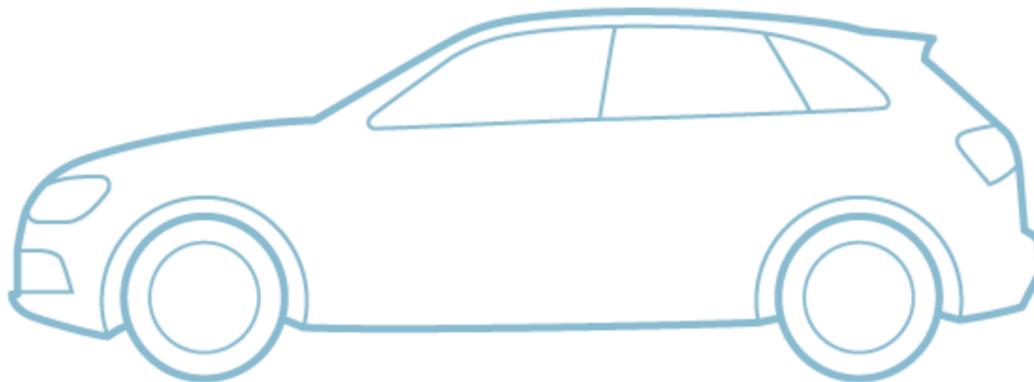
AUDI  
**A6 Quattro**  
2014 to 2016



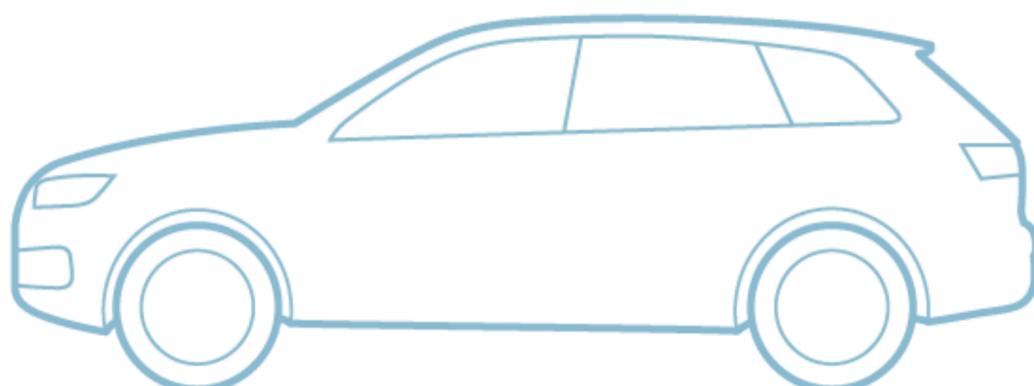
AUDI  
**A7 Quattro**  
2014 to 2016



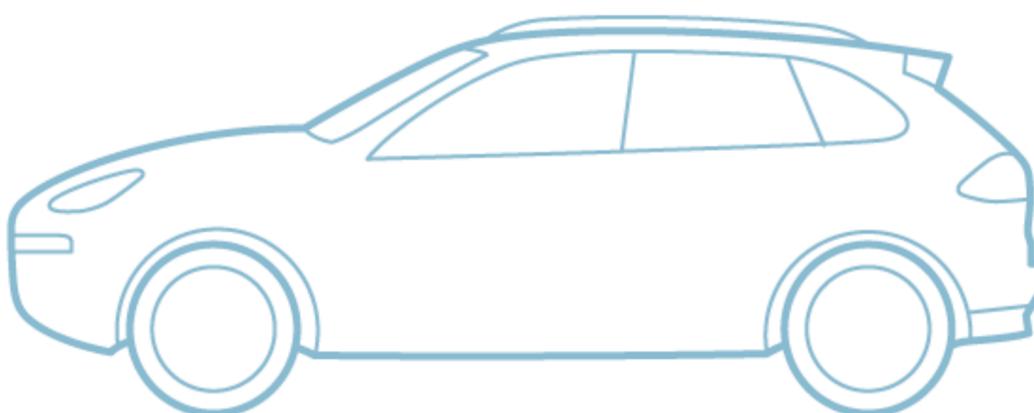
AUDI  
**A8 and A8L**  
2014 to 2016



AUDI  
**Q5**  
2014 to 2016



AUDI  
**Q7**  
2009 to 2016



PORSCHE  
**Cayenne**  
2013 to 2016

Illustrations by Guilbert Gates | Source: Environmental Protection Agency

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### When Will the Cars Get Fixed?

Volkswagen has [agreed to pay almost \\$15 billion to settle claims](#) in the United States, and it must buy back or fix affected vehicles by December 2018.

As part of the settlement, more than \$10 billion has been set aside to buy back the roughly 475,000 Volkswagens and Audi A3 models that have 2-liter engines. The Federal Trade Commission said consumers could expect to get roughly \$12,500 for an older-model Jetta to as much as \$44,000 for a 2014 Audi.

Volkswagen has yet to agree on what to do with its remaining diesel vehicles in the United States, which all have 3-liter engines.

In Europe, the company said [it would install a small tubular part](#) into some of its engines to help them come into line with clean-air standards there. The part, which is about the size of the cardboard inside a roll of paper towels, doesn't lower emissions enough to comply with American standards.

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### What Is at Stake for the Company?

Volkswagen has set aside 16.2 billion euros, or about \$17.9 billion, for costs related to the scandal. But the American settlement with the government and car owners will consume a big chunk of that money.

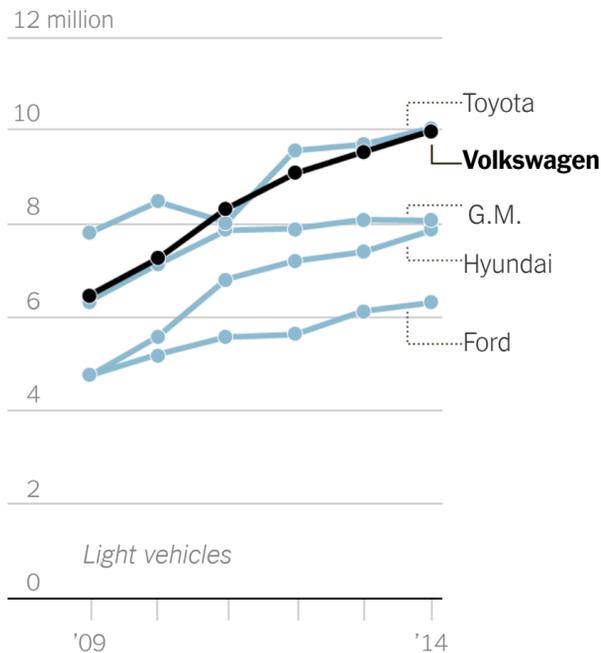
The company has recently [recorded losses](#), and internally it has shaken up its leadership. Its [chief executive, Martin Winterkorn](#), as well as [the head of its American operations](#) have

stepped down, and the company [suspended several high-ranking executives](#).

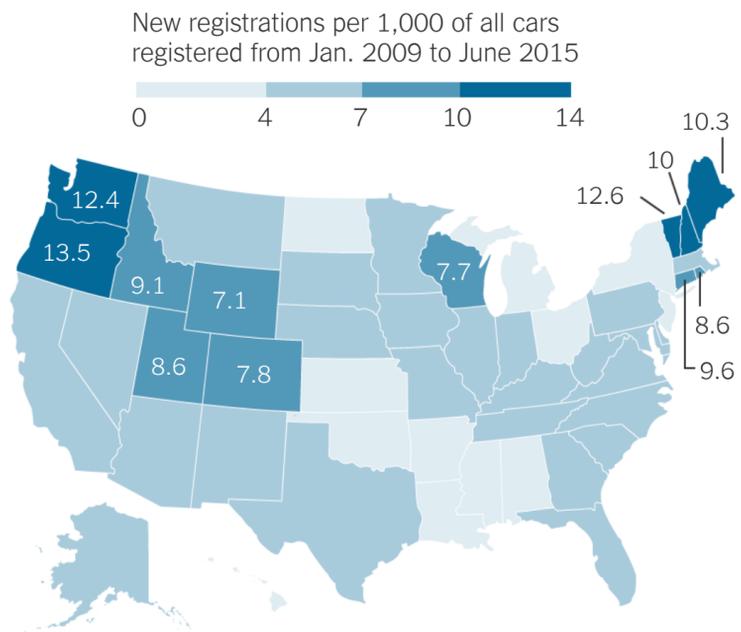
The company continues to face legal challenges, including civil and criminal investigations in the United States, Germany and other countries, as well as potential fines on top of the compensation VW has already agreed to pay as part of the American settlement.

One big risk to the carmaker is in Europe. The United States deal focuses on nearly 500,000 Volkswagen vehicles, but the carmaker admitted to installing the cheating device on more than 11 million cars worldwide, with 8.5 million in Europe.

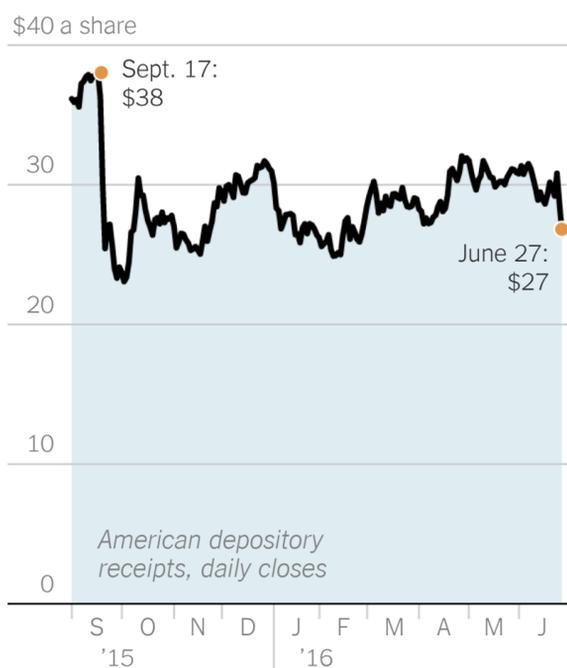
### Worldwide annual car sales



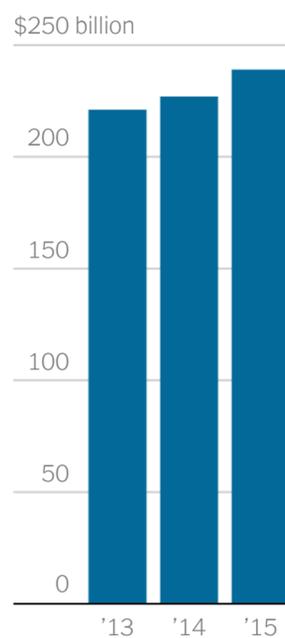
### Diesel Volkswagens in the United States



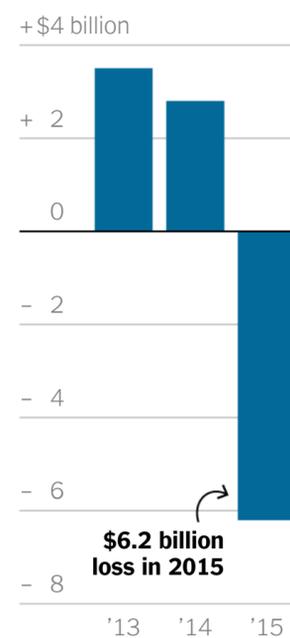
### Volkswagen stock price



### Revenue



### Net income



Sources: Euromonitor International/JATO Dynamics; Reuters; Kelley Blue Book

## Who Knew About the Deception, and When?

The 78-year-old company's unusual culture — [confident, cutthroat and insular](#) — has come under scrutiny as potentially enabling Volkswagen's lawbreaking behavior.

Signs of irregularities in Volkswagen cars [were first discovered in 2014](#) by a nonprofit group, the International Council on Clean Transportation. But [the decision by employees to cheat](#) on emissions tests was made more than a decade ago, after they realized they could not meet United States clean-air standards legally.

In the subsequent years, several high-ranking company officials are believed to have been briefed about the so-called defeat devices, though the extent of who knew remains unclear. Mr. Winterkorn, the former chief executive, [was given a memo about emissions irregularities](#) in 2014, though the company continued to install defeat devices in its cars until last year.

On June 20, German prosecutors said [Mr. Winterkorn was under investigation](#) for market manipulation because he had waited too long to disclose that the company faced an inquiry over the emissions scandal. On July 19, [a civil complaint from the New York attorney general](#) connected the current chief executive, Matthias Müller, to the scandal. For the first time, the investigation has reached the top echelon of Volkswagen's management.