

The Ethics of Dieselgate

Luc Bovens – L.Bovens@LSE.ac.uk

The final version can be found in
Midwest Studies in Philosophy 40 (1), September 2016

Citation: Bovens, L. (2016), The Ethics of Dieselgate. *Midwest Stud Philos*, 40: 262–283.
doi:10.1111/misp.12060

<http://onlinelibrary.wiley.com/doi/10.1111/misp.2016.40.issue-1/issuetoc>
<http://onlinelibrary.wiley.com/doi/10.1111/misp.12060/pdf>
<http://onlinelibrary.wiley.com/gate3.library.lse.ac.uk/doi/10.1111/misp.12060/abstract>

1. *The Volkswagen Scandal: Reactions*

VW marketed supposedly “clean” TDI (Turbocharged Direct Injection) diesel-models of the Jetta in 2009 and of the Golf in 2010 in the US market. This was in response to the EPA Tier 2 emission standards. What was challenging for diesel engines in passenger cars were the very strict new standards on NO_x, that is NO (Nitrogen Oxide) and NO₂ (Nitrogen Dioxide). NO_x contributes to smog. VW’s models supposedly did not need SCR (Selective Catalytic Reduction) technology—requiring a urea or AdBlue tank—to cut down on NO_x emissions, but instead relied on the cheaper new LNT (Lean NO_x Trap) technology. However, in reality, the NO_x trap was not doing much. Instead, the cars were installed with software that detected when they were being tested and were programmed so that NO_x emissions would indeed be minimal under test conditions. On the road NO_x emission controls were turned off and emissions were far from complying with Tier 2 standards. In the 2012 TDI Diesel Passat model, VW actually did install SCR technology but to comply with EPA standards the urea tank would have to be refilled often. In order not to inconvenience consumers, they retained the software to manipulate emissions so that fewer urea refills were needed while the cars would still pass emission tests. Through independent testing¹ of NO_x emissions in on-the-road tests it was discovered that something was amiss. VW ultimately admitted to their scheme and the scandal broke in September 2015 when the EPA issued a formal notice of violation.

There has been very little sympathy for VW. *Car and Driver* writes: “From a moral and legal standpoint, the fraud was a colossally bad decision” and calls it a “heinously bad, unethical, and trust-eroding decision that equally battered both its reputation and its market value.”² *Fortune Magazine* places “Dieselgate” in a long row of scandals that have plagued VW and that are symptomatic of the VW culture. They paint a culture of ruthless management in which engineers

¹ Thompson et al., “In-Use Emissions Testing of Light-Duty Diesel Vehicles in the U.S.”

² Robinson, “Caught Black-Handed.”

could not admit defeat and, in the words of a company whistle-blower, resorted to manipulation of the NOx emissions controls as “an act of desperation.”³

But there are a few lone voices that are putting up some kind of defence of VW.

American Spectator published a blog entitled “No More Affordable Diesels—Courtesy of the EPA.” It blames the EPA for setting unreasonable standards which keep affordable diesels off the US market and accuses it of not being democratically accountable and of refusing to work with industry:

The problem is *not* that the diesels are “dirty.” It is that the EPA is out-of-control. This anti-democratic bureaucracy, subject to no vote, accountable to no American citizen, simply decrees standards that must be complied with irrespective of cost — or *benefit*. (...) The people never had a say in this. No one ever empowered EPA to decide that a less-than-1-percent reduction in the overall output of oxides of nitrogen is worth *whatever it costs* to achieve compliance. EPA does not have to consider the economic impact of its *fatwas*. It simply issues *fatwas* — and leaves it up to the targeted industry to comply. (...) European diesel emissions standards are not lax. They are in fact very strict. But they are different from EPA’s loony standards. And it is the cost of complying with both the European and the U.S. standards that is keeping clean, high-efficiency diesels (some of which deliver 60 MPG or more) out of the U.S. market. [New Paragraph] There is no *legitimate* reason for that.⁴

Hans-Werner Sinn, the former president of the Ifo Institute for Economic Research in Munich, accuses the US of protectionism by keeping affordable diesel engines off the market through regulation. The *Handelsblatt* reports:

... Hans-Werner Sinn consider the criticism of VW to be exaggerated. For decades the US has tried “to keep the small and efficient diesel motors for cars from the market by stricter and stricter NOx limits, because they themselves did not control the technology,” Sinn told the *Handelsblatt*. The USA does not care about the “NOx misrepresentation of their own trucks,” according to Sinn. “They have now achieved what they wanted. The diesel motor is once again gone. My sincere congratulations.”⁵

In an interview with the *Südkurier* Sinn says:

“In setting limits, the core issue was to protect the US car industry from competition from abroad. The emission limits were consciously set low in order to keep the

³ Smith and Parloff, “Hoaxwagon.”

⁴ Peters, “No More Affordable Diesels — Courtesy of the EPA.”

⁵ Neuerer, “Ifo-Chef Sinn zur Abgasaffäre.” [My translation]

diesel motor away from their own market. What was at stake was not environmental policy, but commercial policy.”⁶

He compares VW’s actions to “regulatory arbitrage” by investment funds who “program” their portfolios so that they get better credit ratings than they deserve. There is a double standard in that the deception by these investment funds does not get treated in the same way as VW.

However, Sinn also holds VW responsible. When asked whether “the VW affair is harmful to the reputation of the economic position of Germany” he responds: “Yes, one should be most ashamed.”⁷

Some voices in the German press are eager to spread the blame. The newspaper *Die Welt* has an opinion piece in which it puts some of the blame on consumers:

... critical self-reflection or even the resolve to draw practical conclusions will also this time be hard to find among consumers. [New paragraph.] The majority of us want heavier and heavier cars with more and more powerful motors. We do not want to accept that it is difficult and even impossible to make this rhyme with stricter and stricter environmental regulations. This insight would be uncomfortable. There is hypocrisy among all parties.⁸

Newsweek reports that VW’s sales are nicely bouncing back after an initial dip. Consumers may say that they are upset by the VW scandal, but it has not turned them away from VW. “Don’t call it consumer loyalty—it’s more a case of consumer cynicism (...) I do like the performance” says a VW Passat owner. What seems to annoy customers the most is that if VW decides to correct the NOx problem with a technological fix, their cars will come back with lower fuel efficiency and worse performance.⁹

Deutsche Umwelthilfe also holds the German government co-responsible for complacency. Jürgen Resch, its federal business manager, says that “the German federal government fights for the right of car manufacturers to pollute the air, thwarts regulations for inspection that were planned by the EU Commission, and refuses official controls of NO₂ even when they exceed limits with 2500 per cent.”¹⁰ *Heise Online* picks up the same theme:

The pattern seems to be that Europe likes to look the other way. Following the DUH [*Deutsche Umwelthilfe*]¹¹ it is precisely the German Government that regularly torpedoes each restriction. Stricter limits on paper should make the voters believe that something is being done. Subsequently these limits are being evaded by

⁶ Domjahn, “Hans-Werner Sinn: Ökonomen Sind Weltverbesserer.” [My translation]

⁷ Ibid. [My translation]

⁸ Exner, “Uns Verbraucher trifft Mitschuld am Abgas-Skandal.” [My translation]

⁹ Goodman, “Volkswagen Is Thriving in the Wake of ‘Dieselgate.’”

¹⁰ “Fahrverbote für Diesel-PKW in Deutschen Städten ab 2016 und Entzug der Typengenehmigung als Folge des Audi/VW-Skandals in den USA.” [My translation]

¹¹ Ibid.

completely unrealistic controls and assessments, in order not to step on the toes of the car lobby.¹²

The German government does so to support the interests of the car industry who have powerful labour unions, but also because CO₂ emissions from diesel are lower and it needs to make its targets in the context of climate change commitments.¹³

There is much blame going around. When mud is being slung in directions other than toward VW, the implication is at times that the *real* culprit is someone else than VW, e.g. the EPA or the US government; at other times the implication is that, sure, VW is blame, but let us not forget that others are also to blame, e.g. the consumer or the German government.

Defending VW in today's climate may seem like defending Jack the Ripper. But let us examine what the best case is that could possibly be made. I will first give a voice to the defence and then let the plaintiff respond. In doing so I hope to sketch a fuller picture of where the moral responsibility should fall.

2. *The Defence*

As signatories to the Kyoto protocol, EU governments committed themselves to battling climate change and reducing GHG emissions. VW has been in the forefront of this by developing diesel technology. Diesel is more fuel-efficient than gasoline and CO₂ emissions are substantially lower per mile travelled in comparable cars.¹⁴ The cost of diesel is that NO_x and particulate emissions are higher, contributing to smog.¹⁵ Are the benefits worth the costs?

Maybe the much discussed trolley can come to our aid. A trolley is hurling down a hill with defective brakes and is bound to run over five people on the track ahead. A bystander can turn the switch so that the trolley will be diverted to a sidetrack but the catch is that it will then run over

¹² Honsel, "Kommentar zu VW." [My translation]

¹³ This is what *Heise Online* intimates in response to the accusations that Opel Diesel exceeds its NO_x limits. See Schäfer, "Kommentar zum Abgas-Skandal."

¹⁴ An advertisement for VW TDI Diesels indicates a 9% reduction in CO₂ emissions for the Passat – see: "TDI: U.S. Market Success.pdf." Graeme Grieve, CEO BMW Group UK, cites a 20% reduction on average due to shift to Diesel, see: "SMMT Puts Record Straight on Diesel Cars with New Nationwide Consumer Campaign." Schipper and Fulton cite 15-18% for comparable petrol and Diesel-engines – see: "Disappointed by Diesel? The Impact of the Shift to Diesels in Europe through 2006."

¹⁵ For an instructive comparison, see "Motor Vehicle Emission Controls: Fuel Types." As to particulate matter, we find reports that GDI (Gasoline Direct Injection) engines can have higher particulate matter than Diesel engines without GPFs (Gasoline Particulate Filters). The effectiveness of these filters is under discussion in "Green Car Congress: NRC Canada Team Investigates Effect of Gasoline Particulate Filter on PM from Light-Duty GDI Engine." and earlier posts referred to in this blog.

one person on the sidetrack. There is a widely shared intuition that it is at least permissible if not obligatory for the bystander to turn the switch.¹⁶

Similarly, climate science tells us that CO₂ emissions are a major contributor to anthropogenic climate change and if we do not change course then there is catastrophe ahead of us – millions of future people will be adversely affected in the most tragic ways.^{17,18} During the 2008–12 first commitment period following the Kyoto Protocol 1997, the EU was committed to change course and reduce GHG emissions, including CO₂ emissions. They would not let the global warming trolley wreak the havoc that it is expected to cause under business-as-usual conditions. The EU promoted the sale of diesel passenger cars through various policy instruments and succeeded in changing the composition of its fleet such that a substantial proportion are now diesels.¹⁹ VW's development and promotion of low-cost diesel engines is part of this endeavour.

But changing course is not cost-free. The increase in NO_x and particulates that comes with a switch from petrol engines to diesel engines is costly in present human lives—it affects asthma, respiratory disease and aggravates heart disease. As such it is responsible for an increase in the number of premature deaths of present people.²⁰ But the deaths of present people on the sidetrack are the cost that needs to be incurred if we want to avoid the deaths of many times more future people on the business-as-usual track in front of us.²¹

The US Senate did not ratify the Kyoto protocol and the US has been a laggard in tackling climate change. In particular CO₂ emissions per capita are more than double compared to the EU.²² A substantial contribution to this comes from passenger cars. The US is a car culture and with relatively low taxes on gasoline and relatively lax legislation on fuel efficiency²³, the average miles per gallon of passenger cars is substantially lower than in the EU and the average CO₂ emissions

¹⁶ Foot, "The Problem of Abortion and the Doctrine of the Double Effect" and Thomson, "The Trolley Problem."

¹⁷ World Bank, "Turn down the Heat : Climate Extremes, Regional Impacts, and the Case for Resilience - Full Report."

¹⁸ Stern, *The Economics of Climate Change: The Stern Review*.

¹⁹ E.g. 30% in Germany and the UK and close to 70% in Luxemburg. In many country, a large majority of new purchases are diesels. See tables 4 and 1 in Eurostat, "Passenger Cars in the EU - Statistics Explained."

²⁰ US EPA, "Health | Nitrogen Dioxide | US EPA." and Fuller, "Putting a Price on NO_x Health Impacts."

²¹ DARA, "Climate Vulnerability Monitor: A Guide to the Cold Calculus of a Hot Climate" estimates that 100 million lives will be lost due to climate change by 2030.

²² E.g. World Bank data for the US for 2011 indicate 17 tons equaling 15.4 tonnes per capita in the US whereas Eurostat data indicate 7.5 tonnes in the EU-28. Worldbank, "CO₂ Emissions (metric Tons per Capita)." and Eurostat, "CO₂ emissions per inhabitant in the EU and in developing countries."

²³ See entry 74 in An, Earley, and Green-Weiskel, "Global Overview on Fuel Efficiency And Motor Vehicle Emission Standards: Policy Options and Perspectives for International Cooperation." Note that the US and the EU are striving for similar fuel efficiency targets in 2020-25.

per mile is substantially higher²⁴. If VW could make some inroads in reducing the CO₂ emissions of the US fleet of passenger cars by creating even a relatively small low-cost diesel market²⁵, then it would be doing a good thing in protecting future people from climate change. In the mid-2000s the time was ripe for this, because petrol prices were high and moral concerns among US consumers about CO₂ emissions and climate change were growing.

What about the costs to present people? Proponents of diesel argue that the marginal increase in NOx that is due to increasing the proportion of diesel engines would be minimal. Furthermore, the technology has made great strides to reduce NOx and particulates of diesel cars and sees further improvements on the horizon.²⁶ To push the analogy—there are relatively few people on the sidetrack who will be affected by the excess NOx emissions and particulates due to an increased proportion of diesels in the passenger car market. What makes the case even stronger is that present people are the beneficiaries of present emissions and hence they, rather than future people, should internalise the costs.

So much for the trolley defence. However, it is one thing to justify selling cars that reduce overall CO₂ emissions at the cost of an increase in NOx emissions. But VW has done more than that. It has made deceitful claims about its product in advertisement and has tried to evade being found out by installing a device that defeats testing. Was it permissible to bypass the EPA's NOx emission standards in doing so? Or to put it more bluntly, was it permissible to cheat?

Let us first look at some circumstances under which making deceitful claims and evading detection in the market place would be permissible or at least not outright objectionable.

1. *Culpable Threat*. As the CEO of a weapons factory of the unjust side of an unjust war it would be permissible to sabotage production by making deceitful claims and evading detection. Think of *Schindler's List*. In this case, the deceit is justified partly by the lack of moral standing of the regime affected by the deceit and by the horrendous consequences of a victory by the unjust side in the war.
2. *Unjust Treatment*. Gauthier discusses a case of a slave-holding society in which the slaves agree to a proposal by their masters stipulating that they will not run away and in exchange they will receive better treatment and have their shackles removed. Of course, once the

²⁴ International Council on Clean Transportation, "Global PV Standards Chart Library."

²⁵ The US market of diesel is only 3% of the market for passenger cars, whereas it is over 50% in the EU. There are various reasons for this, but a major factor is lower fuel taxes in the US. See Lussenhop, "Why Do American Car Buyers Shy Away from Diesel?"

²⁶ In March 2015 the Society of Motor Manufacturers and Traders (SMMT) launched a campaign to defend Diesel Engines. They set up a web site www.dieselfacts.co.uk to defend diesel. The website was taken down, but an archive version can be found at Web Archive: "Diesel - The Facts | SMMT". The site claims that NOx due to passenger cars is only 14% of total emissions (while NOx due to electricity generation is 30%) and it would take 42 million diesel cars that are within Euro 6 norms on the road to create the same amount of NOx as one large coal-power plant. *The Guardian* published a critical article—see Mathiesen, "Have Diesel Cars Been Unfairly Demonised for Air Pollution?"

shackles are off, the slaves have no compunction about running away.²⁷ In *Genesis* 34 the prince of a neighbouring tribe captures Dinah, daughter of Jacob and Leah, and rapes her. When he asks permission to keep her in marriage, Jacob's sons respond that they can only do so if all men in the tribe agree to be circumcised. The neighbouring tribe agrees and while they are recovering from surgery, the Hebrews attack, rescue Dinah and sack the city.²⁸ The trickery and deceitful agreements by the slaves or the Hebrews seem fully justified. What justified them is that they themselves were facing unjust treatment.

3. *Securing Buy-In*. Within a context of deliberative democracy, it is important for policy makers to consult and have buy-in from stakeholders. If they do not have buy-in, stakeholders will fail to respect legislation which may involve forms of deceit and evasion. This may be justified in some circumstances precisely because it forces policy-makers to engage in consultation.
4. *Context-Relative Morality*. In academic advising, I tell my PhD students that it is permissible to sign on the dotted line for a temporary job (e.g. a postdoc) starting six months hence and to renege when they are offered a permanent job in the meantime, but that it is not permissible to accept a *permanent* job and renege when one is offered a *better* permanent job. Not all will agree, but this is how I am reading current practice. This is not to say that 'everyone is doing it' is a good enough a defence. But determining what constitutes deceit as a normative category can only be done internal to a practice.
5. *Enforcement-Relative Morality*. Tax advisers are reputed to say that what is legal is what the IRS (Internal Revenue Service) cannot catch you on. Glaucon notoriously defends this position in the discussion of the *Ring of Gyges* in Plato's *Republic* and Socrates rightly takes issue with it.²⁹ But there is a position in the neighbourhood that is defensible, viz. a policy maker should put in place the right incentive and disincentive structure, including proper oversight, especially if the business environment lacks social capital. If they fail to do so, then the rules of what constitutes permissible moral practice will shift as discussed under point 4.

Did VW face circumstances that fit any of these categories and might such an appeal make them less blameworthy or even absolve VW? Let us look at each category in turn. Again, I will try to make the best case for the defence and turn to a critical assessment in the next section.

Threat aversion. The threat of climate change is looming and the US is a major violator. Bracketing the Gulf states and a few small-country outliers, the US had the highest CO₂ emissions per capita in 2011.³⁰ Throughout the mid-2000s the US were acting unconcerned. We have to wait until 2009 before the EPA even declares CO₂ to be a pollutant following the 2007 Supreme Court decision *Massachusetts v. EPA*, which overruled the EPA's position that it had no authority to regulate GHGs. The *New York Times* comments: "The United States has come under fierce international criticism for trailing other industrialized nations in regulating emissions of carbon dioxide and other pollutants tied to global warming. (...) Agency [i.e. EPA] scientists were virtually unanimous

²⁷ Gauthier, *Morals by Agreement*. Pp. 190–1.

²⁸ Genesis 34.

²⁹ Plato, *The Republic - Book 2*.

³⁰ World Bank, "CO₂ Emissions (metric Tons per Capita)."

in determining that those gases caused such harm, but top Bush administration officials suppressed their work and took no action.”³¹

Given the threat of climate change and given the US’s loss of moral authority in matters of climate change in the international arena throughout the Bush administration, one might argue that bringing the business strategy of promoting low-cost diesel to the US, which had been trialled successfully throughout the world in the fight against global warming, should be applauded, even if it required an ill-fated attempt to bypass EPA regulations.

Unjust treatment. The EPA is not conducting *environmental* policy in setting NOx emissions standards unreasonably low, out of line with other OECD countries, and without the requisite scientific evidence to back up that NOx emissions need to be set so low in order to avert damage to public health. Rather, it is conducting an objectionable form of *trade* policy. It engages in protectionism to keep the competition of low-cost diesel motors out of the US market and to promote the hybrids and electric cars in which US car manufacturers do have greater representation.³²

This is the line of defence of Sinn when he cynically congratulates the US for winning the trade war by successfully blocking entrance to foreign low-cost diesel passenger cars. If we place VW’s attempt to bypass EPA legislation in the context of averting underhanded protectionism then, one might argue, we can hardly blame VW for trying to circumvent ill-grounded EPA restrictions on NOx.

Securing Buy-In. The EU Environment Directorate-General’s mode of operation is to work with business to explore costs and benefits of proposals for environmental regulations and to determine which route is most technologically and financially feasible, given the objectives at hand.

For example, in the wake of the VW crisis, the EU is transitioning, within the context of the Euro 6 legislation, to the WLTC/P (World Harmonised Light Test Cycle and Procedures), a more realistic laboratory test, and the RDE (Real Driving Emissions) test, an on-the-road test. However, many Euro 6 diesel cars, who were designed to pass the earlier NEDC (New European Drive Cycle) test, are expected to fail these tests as matters currently stand. Car manufacturers were consulted about what transition period they would need to be able comply. An amendment to Euro 6 came out in April 2016 to the effect that until 2020, there is a “conformity factor” of 2.1, that is, their NOx emissions can be up to 2.1 times the Euro 6 limits in RDE testing.³³

But the EPA did not listen to the concerns of German car manufacturers, who were then forced to resort to a political route to get their concerns across. In 2010 Angela Merkel appealed to Mary Nichols, the California Air Resources Board (CARB) Director, saying that the tough emission

³¹ Broder, “E.P.A. Clears Way for Greenhouse Gas Rules.”

³² US News Best Cars, “Best Hybrid and Electric Cars Rankings.”

³³ See entry (10) of European Commission, “EUR-Lex - 32016R0646.”

rules were hurting German car manufacturers. There was absolutely no sympathy for this kind of political interference with environmental regulations in the US.³⁴

From a business point of view, compliance with the Tier 2 legislation with NOx was tough for VW in their low-cost models. The US Golf and Jetta TDI Diesel market in 2007 was a very small percentage of their total Golf and Jetta sales. The platforms of these cars made it very difficult to retrofit a urea tank for SCR technology and it would be costly to make an ageing product conform to legislation in a jurisdiction that was only a small share of its market. VW needed more time for a technological fix and was hoping to be able to do that before stricter NOx standards would go into effect with the Euro 6 regulations in 2014.³⁵ Consultation could have resolved this problem.

American Spectator colourfully complains about the EPA's lack of consultation by calling its regulations *fatwas*. The implication is that, just as we would not chide Salmon Rushdie for cleverly evading his would-be assassins, we should, the argument goes, not blame VW either for evading EPA NOx limits when there was a complete absence of consultation.

Context-Relative and Enforcement-Relative Morality. In the world of business and advertising it is well-known that sailing close to the wind is the norm and that posted performance measures only hold under very strict conditions, should be taken with a grain of salt, or are outright lies. We find this especially in fuel efficiency postings.^{36, 37}

But what is happening with NOx readings?

The International Council of Clean Transportation (ICCT) brought out a study of NOx emissions in 10 diesels in real-world driving conditions and they found some models to be satisfactory, but also some serious laggards.³⁸ The UK Department for Transport tested 37 Euro 5 and Euro 6 diesel models. There was not a single one that passed real-world testing and average emissions were five times the set standards for the models.³⁹ The German Transportation Ministry tested 55 diesel motors and found questionable emission controls in 22 cases.⁴⁰ How did this come about?

In the EU 2007 legislation on the type-approval of motor vehicles with respect to emissions there is the following clause under Manufacturers' Obligations:

Art 5. 1. The manufacturer shall equip vehicles so that the components likely to affect emissions are designed, constructed and assembled so as to enable the vehicle, in normal use, to comply with this Regulation and its implementing measures.

³⁴ Geiger, "Merkel Complained in 2010 About California Emissions Rules."

³⁵ Robinson, "Caught Black-Handed."

³⁶ Blanco, "Mitsubishi Admits It Lied about MPG Ratings for All Vehicles in Japan."

³⁷ Joseph, "Suzuki Latest to Admit to Falsifying Fuel Economy Tests."

³⁸ Yang et al., "NOx Control Technologies for Euro 6 Diesel Passenger Cars."

³⁹ Walker and Ruddick, "Diesel Cars' Emissions Far Higher on Road than in Lab, Tests Show."

⁴⁰ Online, "Verkehrsminister Dobrindt Ordnet Rückrufaktion an."

2. The use of defeat devices that reduce the effectiveness of emission control systems shall be prohibited. The prohibition shall not apply where:
 - (a) the need for the device is justified in terms of protecting the engine against damage or accident and for safe operation of the vehicle;⁴¹

Article 5.2.a permits the use of a “defeat device” to protect the engine in extreme ambient temperatures or when the car is put under stress. Manufacturers specify a temperature window under which the emission controls are operative. Outside this window the controls are off, allegedly to protect the engine. But these windows are taken very broadly—Opel turns off emission controls below 62.6°F⁴² and Daimler below 50°F.⁴³ This means that their diesels can pollute a good part of the year in mild climates. It is questionable whether an argument can be made that the engine is really in need of protection for these temperatures. If no such argument can be made, then it would violate the legislation, but of course there is room for interpretation.

And this pattern is being stretched further and further. Fiat is currently being accused of turning the emission controls on for about 22 minutes after starting the motor because the German emission test takes precisely 20 minutes.⁴⁴ Renault turned emission controls on between 62.6°F and 95°F because emission testing is typically conducted in ambient temperatures of 68°F and 86°F.

VW was doing something that is more sophisticated and efficient, but also slightly more devious. Cars do require software to recognise that they are being tested. They change into “test mode” in which the settings of the car are adapted on safety grounds. VW tapped into this information and turned emissions on *only* when the car was in test mode. Or in other words, the defeat device turned emissions controls off in on-the-road mode.⁴⁵

There is a class action suit in the US against Daimler who is being accused of using the same kind of defeat device as VW in its Mercedes-Benz diesels, based on Dutch research.^{46,47} And this will certainly not be the end of diesel’s troubles.

The business environment is one in which emissions tests are being conducted under restrictive and unrealistic conditions and in which the oversight is minimal. *Ars Technica* provides a history of how manufacturers have always tried to stretch the conditions under which defeat devices are permitted to kick in.⁴⁸ In addition, there is the allegation that EU legislation is keen to give manufacturers loopholes on diesel because it permits governments to make their CO₂ targets. Diesel manufacturers have made extensive use of this lax regime. The objective is to pass the test

⁴¹ Regulation No 715/2007 of the European Parliament and of the Council.

⁴² “Verkehrsminister Dobrindt Ordnet Rückrufaktion an.”

⁴³ Dörner and Murphy, “EPA Scrutinizing Daimler Diesel Emissions After Suit.”

⁴⁴ Blanco, “Fiat Diesels Might Also Cheat Emissions Tests.”

⁴⁵ “Renault Recalls Captur Diesels to Fix Emissions Glitch.”

⁴⁶ Dörner and Murphy, “EPA Scrutinizing Daimler Diesel Emissions After Suit.”

⁴⁷ Blanco, “Mercedes-Benz Diesels Use Cheat Device, Claims Lawsuit.”

⁴⁸ Geuss, “Volkswagen’s Emissions Cheating Scandal Has a Long, Complicated History.”

and at the same time turn off emissions control under a wide range of conditions in order to increase performance and fuel efficiency.

The problem is systemic. Just as educators in the public school system are instructed to teach to the tests even if these tests do not capture whether students have gained any real-world knowledge, engineers are instructed to design cars that will pass the test even though these tests do not measure real-world emissions. With meaningless tests, educators and car manufacturers will exploit loopholes and stretch them if they can get away with it. In addition, there are many reasons why the guardians of these tests might want to look the other way. Are individual educators and manufacturers to blame for this? There are moral reasons to work for social change at the level of the education system or the emissions testing system—but, one might argue, it would be wrong to do so by scapegoating *particular* educators or car manufacturers.

3. *The Plaintiff's Rejoinder*

I will now give a voice to the plaintiff and discuss the strength of the rejoinders.

a. *The Trolley Defence.*

For the analogy with the trolley problem to hold water, it should be the case that the future people saved on grounds of CO₂ reductions by the shift toward diesel outweighs the number of present people lost due to the increase in particulates and NO_x. In other words, trolley defences only work if there are fewer people on the sidetrack than on the track ahead.⁴⁹

There are three studies that estimate the excess early deaths due to VW's non-compliance with NO_x standards during 2009-15 in the US.^{50,51,52} The question they are asking is: Had VW's NO_x emissions conformed to EPA standards, how many fewer expected early deaths would there have been? Barrett et al., Holland et al. and Oldenkamp et al. report numbers ranging from 45 to 60 fewer early deaths. Holland et al. monetise the losses from the expected early deaths—46 in their calculations—at \$430 million.

Only Holland et al. tries to make a comparison with the benefits from reduced CO₂ emissions. They use the following counterfactual. The EPA estimated the fuel efficiency of the VW models. At low NO_x emissions, that is, when the emission controls are on, the fuel efficiency is worse than when they are not on and since the emission controls were only operative in test mode, the EPA

⁴⁹ This is assuming a zero discount rate. With a positive discount rate, there have to be *substantially* fewer people on the side track.

⁵⁰ Oldenkamp, van Zelm, and Huijbregts, "Valuing the Human Health Damage Caused by the Fraud of Volkswagen."

⁵¹ Holland et al., "Damages and Expected Deaths Due to Excess NO_x Emissions from 2009 to 2015 Volkswagen Diesel Vehicles."

⁵² Barrett et al., "Impact of the Volkswagen Emissions Control Defeat Device on US Public Health."

estimated the fuel efficiency to be lower than what it actually is on the road. Indeed VW drivers used to boast that they beat EPA fuel efficiency ratings.⁵³ Holland et al. ask: If the VW diesel vehicles had always run with NOx emission controls on, then they would have had the fuel efficiency that the EPA estimated and CO₂ emissions would have been greater. On the basis of this they estimate the gain that was achieved in reduced CO₂ by having the emission controls turned off and they then use standard SCC (Social Cost of Carbon) figures to quantify this gain, yielding a figure of \$25.6 million.

Hoekman objects to Holland et al.'s methodology in general, but one specific objection is that Holland et al. did not take into account that there is a trade-off between NOx and particulate matter in diesel engines.⁵⁴ If the NOx had been lower, then the emissions of particulate matter would have been higher, which has its own health costs. Holland et al. come back and calculate the gains due to reduced particulate matter to be \$38 million.⁵⁵

So the gains from having inadequate NOx emission control are \$25.6 million plus \$38 million and the costs are \$430 million, in their calculations. Hence the costs massively outweigh the gains. Or, here is another way to put it: For the benefit of reduced CO₂ emissions to equal the costs of NOx, say Holland et al., proper NOx emission controls would need to reduce fuel efficiency to 14.4 miles per gallon—which is unrealistically low.

This does not seem to be the right counterfactual though. If VW had abided by EPA regulations, it would simply not have been able to open up the market for low-cost diesels in the US. They might have decided not to enter with their diesel models of Golf, Jetta and Passat, or they may have sold them at a higher premium and very few people would have bought them at this higher price. Hence the proper counterfactual is: What would the cost of carbon have been if all (or most) of the current VW low-cost diesel drivers would have been driving the petrol-engine cars that they would have chosen had VW's low-cost diesel not been available?

I have not done the calculations for this counterfactual. And there are more complicating factors. Much will depend on how we actually set the cost of carbon. In a recent Stanford study US government estimates of \$37 per ton were increased to \$220 per ton which puts extra weight on the scale favouring diesel.^{56,57} On the other hand, Schipper and Fulton argue that the introduction of diesel in the fleet of eight European countries through 2006 may not have brought about a reduction in CO₂ emissions at all, because diesels tend to be larger and because of the rebound effect, that is, people will simply drive more with cheaper diesel-fuel at more miles per gallon.

⁵³ Voelcker, "Volkswagen Jetta TDI: Much More Mileage Than EPA Admits?"

⁵⁴ Hoekman, "Comment on 'Damages and Expected Deaths Due to Excess NOx Emissions from 2009 to 2015 Volkswagen Diesel Vehicles.'"

⁵⁵ Holland et al., "Response to Comment on 'Damages and Expected Deaths due to Excess NOx Emissions from 2009–2015 Volkswagen Diesel Vehicles.'"

⁵⁶ Than, "Estimated Social Cost of Climate Change Not Accurate, Stanford Scientists Say."

⁵⁷ Moore and Diaz, "Temperature Impacts on Economic Growth Warrant Stringent Mitigation Policy."

VW's smaller diesel models neutralise the former argument, but the rebound effect of the fuel efficiency remains. This puts extra weight on the scale opposing diesel.⁵⁸

However, suppose that we follow Holland et al. and conclude that the benefits of the reduction in CO₂ emissions from making a shift to diesel do not offset the cost of the increase in NO_x emissions. Then VW is turning the trolley from one future person on the track ahead to five present people on the sidetrack rather than vice versa, for which there would clearly be no licence. It would be interesting to compare the social cost to present people due to a shift to diesel with other CO₂ mitigation initiatives.

b. Uncertainty

Estimates come with extremely wide confidence intervals. For example Barrett et al.'s estimate of 59 early deaths comes with a 95% confidence interval ranging from 9.7 to 150.⁵⁹ The actual health effects from NO_x emissions from diesel engines are much contested.⁶⁰ Hoekman questions the results of Barrett et al. and of Holland et al. and he concludes: "It is probable that if a rigorous uncertainty analysis were performed here, the estimated number of excess statistical deaths could not be distinguished from zero."⁶¹

If the scientific evidence of the health costs of NO_x to present people due to a shift in the fleet from petrol to diesel is contested, then the benefits to future people of the reduction of CO₂ emissions are even more controversial. Assessing such benefits rests on the science of determining the social cost of carbon and setting discount rates, which are both notoriously contested issues.^{62,63,64,65,66}

There are various objective functions in setting policies over risky prospects. When the outcomes in the prospects involve either life or death, we can distinguish between the objective of minimising the expected loss of life and the objective of minimising the probability that nobody (or few people) die.⁶⁷ To illustrate this, in Luke 15:3-7, the shepherd leaves 99 sheep in the wilderness to find the one sheep that is lost. Doing so may well increase the expected loss of sheep (since the wolf is

⁵⁸ Schipper and Fulton, "Disappointed by Diesel?"

⁵⁹ Barrett et al., "Impact of the Volkswagen Emissions Control Defeat Device on US Public Health."

⁶⁰ Mathiesen, "Have Diesel Cars Been Unfairly Demonised for Air Pollution?"

⁶¹ Hoekman, "Comment on 'Damages and Expected Deaths Due to Excess NO_x Emissions from 2009 to 2015 Volkswagen Diesel Vehicles.'"

⁶² US EPA, "Social Cost of Carbon."

⁶³ Than, "Estimated Social Cost of Climate Change Not Accurate, Stanford Scientists Say."

⁶⁴ Moore and Diaz, "Temperature Impacts on Economic Growth Warrant Stringent Mitigation Policy."

⁶⁵ Wagner and Weitzman: "Climate Shock: The Economics Consequences of a Hotter Planet."

⁶⁶ "Frequently Asked Questions – The Cost of Carbon Pollution."

⁶⁷ Bovens and Fleurbaey, "Evaluating Life or Death Prospects."

roaming in the wilderness and may come for the 99), but it is the only chance the shepherd has to save *all* the sheep (since the one lost sheep is bound to perish unless the shepherd finds it.)⁶⁸

A similar distinction may hold with respect to the introduction of diesel. Suppose that it were the case that, given the threat of climate change and the probabilities as we see them now, the objective of minimising the expected present and future harms requires that we diligently meet CO₂ reduction targets. Also suppose that increasing the proportion of diesel for our transportation needs is an effective means of achieving this. However, given the current state of technology, a shift to diesel will cause harm to present people due to elevated NOx levels.

But is this the correct objective? An alternative objective is to reduce the chance of causing any harm, or, more realistically, of causing substantial harm. To do so we take care of present people first, that is, we make sure that they are not harmed by elevated NOx emissions. The consequence may be that we don't meet our targets for CO₂ reduction today. But for harm to future people, we trust that we will come up with a solution. There is currently optimism about green technology, particularly with the advances in renewables. On this trajectory, we will not need to sacrifice present people and we are hopeful that future technological developments will permit us to minimise harm to future people as well.

In addition, diesel is just a short-term fix. It may permit us to meet targets in the short-term, but it offers at most a 20% reduction in CO₂ emissions. Hybrids and electric vehicles may not currently provide any gains or may even be costlier in CO₂ emissions, considering that a large portion of our electricity still comes from coal plants. However, with an eye to the future, it is good to invest in this technology at the same time as investing in technology for renewable energy.

The EU and the US follow a different path in dealing with the uncertainty of harm to present and future people. The US minimises the chance of doing substantial harm. It sets the strictest NOx standards to protect present people, discourages sales of diesel and encourages hybrids and electric vehicles, being confident that they will find a technological fix to reduce CO₂ through renewables to protect future people. The EU minimises expected harm. It aims to protect future people by sticking to CO₂ reduction targets. To do so, they stimulated diesel sales and still do so to a certain extent, while monitoring the harm to present people by negotiating with industry and other stakeholders⁶⁹ on attainable limits assessed through more realistic testing.

c. A Third Track?

The trolley problem presents the situation as if VW had only two choices, viz. to harm present people by emitting inadmissible amounts of NOx or to harm future people by not tapping into the CO₂ reductions that diesel offers relative to petrol engines. Certainly, one might say, VW could have found some alternative track that would have avoided both evils.

⁶⁸ Luke 15: 3-7.

⁶⁹ The ICCT report "Real-World Exhaust Emissions from Modern Diesel Cars" was instrumental in this regard.

Maybe there was an alternative track, but it is not obvious what it would have been.

VW could have refrained from opening up a low-cost diesel market in the US. This is what Mazda and Honda are doing – they have low-cost diesels, but not for the US market.⁷⁰ But this is not a sidetrack—it’s letting business-as-usual in the US run its course.

Or they could have redesigned the platform of the Golf and the Jetta to fit a urea tank. But costs would have been passed onto the consumer and the models would not have been a low-cost diesel models anymore.

Or they could have brought out a low-cost diesel with lower fuel efficiency or with decreased performance. But who would have wanted them? Elizabeth Cabraser who is leading the US class action suits against VW says that US drivers of small diesel cars are a small but choosy minority. They have been doing their homework to find a “sweet spot between high mileage, performance, and environmental responsibility ... They were highly invested in these vehicles.”⁷¹ Indeed, if you raise the price, then their environmental responsibility evaporates and they shift back to petrol engines.

In short, there may have been other ways that VW could have increased the proportion of diesel engines to reduce the CO₂ footprint from transportation in the US. But given consumer preferences and the state of the technology at the time, it is not clear what could have been done.

d. Ill Intentions

But VW certainly was not aiming to safeguard the interests of future generations by reducing CO₂ emissions through changing the proportion of diesels in the US fleet. They did not care about helping the middle class find affordable environmental solutions for their transportation needs. They are not an army of angelic do-gooders, of bleeding hearts for future generations, even though they portray themselves as such in their advertisement.

Of course they are not. They just saw an opportunity to promote diesel engines and to capture a corner of the US market by capitalising on the threat of climate change. The same holds true in any industry—no less in renewable energy companies than in car manufacturing. It is government who should have their eye on the common good and lay out incentive structures so that profit-maximising businesses will come to contribute to the common good by acting within these incentive structures.

Nonetheless, there is some ground to question the moral credentials of the culture in VW. Though we should not expect moral motivations from business, VW’s actions surrounding the whole affair do raise some eyebrows. First, there are reports about a corporate culture that is so cut throat and hierarchical that its engineers resort to cheating, being afraid to admit defeat.⁷² Second, there is the irony that VW exploited its green credentials as a marketing tool. When a firm boasts its green

⁷⁰ Peters, “No More Affordable Diesels — Courtesy of the EPA.”

⁷¹ Smith and Parloff, “Hoaxwagon.”

⁷² Ibid.

credentials we do hold it to a somewhat higher standard—we do not expect it to be sailing too close to the wind or to be forthrightly cheating when it comes to environmental regulations. Third, VW pretended to be above the law in its unwillingness to cooperate with CARB when they were first questioned about the high NOx emissions in on-the-road testing. They lied to the EPA when the problem first came to light, claiming that they were facing technical problems, until they had to admit that they had programmed the defeat device so that emission controls were only on in test mode. This does not sit well with American moral sensitivities in particular.⁷³ To make things worse, this was followed by CEO Matthias Müller’s response: “We did not lie. We didn’t understand the question first.”⁷⁴

e. Reasonable Disagreement

Suppose that there is a human-health catastrophe on the horizon and a public health organisation is operating in a region in which the government carries responsibility for this catastrophe by adhering to a clearly unreasonable position. For example, think of blocking anti-retroviral drugs in Mbeki’s South Africa or the opposition to polio vaccination in Nigeria, Pakistan and Afghanistan. Then the organisation may have few moral qualms in bending or bypassing the law to help the population (though it may refrain from doing so on prudential grounds).

But the situation in the US is different. The charge that the EPA has no reasonable ground for setting NOx levels as low as they did and that only protectionism can explain this is unwarranted. Rather, there are reasonable disagreements between the EU and the US about priority setting. Here are some considerations that help us understand the EPA policy on NOx.

First, the US has always been a forerunner in air quality control. CARB was established in 1967 and since its inception it aimed to reduce smog in the huge metropolitan Los Angeles area with particular meteorological conditions and heavy transportation needs involving passenger cars.⁷⁵ Congress established the Clean Air Act in 1970 and the EPA is charged with implementing it.^{76,77} Since NOx is a major contributor to smog and poor air quality, it is no wonder that NOx standards are set low.

Second, the prioritisation of present people through NOx reduction even at the expense of not meeting CO₂ targets can be explained by an unwillingness to sacrifice lives of present people and an optimism that we will come up with technological fixes to save future people, as I argued above.

Third, considering (i) rising smog levels in EU cities with a fleet of over 50% diesel engines, (ii) the persistent high NOx levels in on-the-road testing for diesel engines, (iii) diesel’s limited potential of providing at best a 20% reduction in CO₂ over petrol, and (iv) the current momentum

⁷³ Hulverscheidt, “VW-Abgasskandal lässt Volkswagen-Image in den USA einbrechen.”

⁷⁴ Ginton, “‘We Didn’t Lie,’ Volkswagen CEO Says Of Emissions Scandal.”

⁷⁵ California Environmental Protection Agency, “History of Air Resources Board.”

⁷⁶ US EPA, “Overview of the Clean Air Act and Air Pollution.”

⁷⁷ US EPA, “Summary of the Clean Air Act.”

behind renewables and electric vehicles, a good case can be made that we should be shifting our bets away from diesel. Also in the EU similar voices are heard.⁷⁸

In such an environment, the case for increasing the market share of diesel in the fight against CO₂ emissions while continuing to bring down NO_x through improved technology, is at best a valid position in the debate. Under condition of reasonable disagreement, there is no justification to bend or bypass the law. One may argue and try to convince, but at the end of the day, one needs to respect the policy decisions that are set by the country in which one aims to do business.

f. The US Business Environment

It is disingenuous to try to exonerate VW by pointing to a business environment of car manufacturing in which emission-control evasion tactics are rife and oversight is minimal due to political pressure to meet CO₂ targets. This may be true in the EU, but VW was capturing a share of the US passenger car market with low-cost diesel models.

In this market the NO_x limits are lower, the testing cycle is more demanding and enforcement programmes are more robust. The EPA permits the use of a defeat device but, unlike in the EU, the conditions under which emission controls are disabled need to be documented and justified.⁷⁹ The EPA may not be susceptible to cost-effectiveness arguments from German car manufacturers unlike the EU Directorate-General for the Environment, but also the EPA stresses in its Tier 2 regulations that they are the outcome of a “collaborative effort by a wide range of stakeholders” including car manufacturers.⁸⁰

The ICCT compares NO_x emissions between diesels with different control technologies under stricter laboratory test conditions and finds that LNT technology in comparison to the more expensive SCR technology does particularly poorly. They then compare what technologies are more and less prevalent as we move from 2012-14. Not surprisingly, LNT increases in the EU and almost fully disappears in the US, except for a massive presence by VW in their low-cost models. Some companies don’t even try the US market, others have a dual strategy—LNT for the EU, SCR for the US.⁸¹

We see the same pattern in reports about fuel efficiency. The posted measures of fuel efficiency in the EU are based on the New European Drive Cycle (NEDC), a laboratory test that is quite removed from real-driving fuel efficiency.⁸² In the US, the test procedures are more realistic and

⁷⁸ For recent concerns raised by the poor Paris and London air quality caused by Diesel engines, see Rosemain, “Paris Smog Obscuring Eiffel Tower Threatens Diesel-Car Dominance.” and Carrington, “The Truth about London’s Air Pollution.”

⁷⁹ Yang et al., “NO_x Control Technologies for Euro 6 Diesel Passenger Cars.” p. iii

⁸⁰ US EPA, “Tier 2 Vehicle and Gasoline Sulfur Program.”

⁸¹ Figure 5 in Yang et al., “NO_x Control Technologies for Euro 6 Diesel Passenger Cars.”

⁸² The EU is now transitioning to the more realistic WLTC/P and RDE tests.

the EPA retests 10-15% of models.⁸³ Hence, as is to be expected, the gap between miles per gallon certified and real driving miles per gallon is much greater in the EU than in the US.⁸⁴

If VW gets caught cheating with emission tests in the US, then it is disingenuous to say that the problem is systemic and that we should not scapegoat a particular company. The fact of the matter is that VW was caught evading *US* emission targets. These targets are driven by a concern for clean air, are not the result of being taken hostage by political interests to meet CO₂ targets, and are typically subject to more realistic test procedures.

This difference in business climate did ultimately cost VW, but in a roundabout way. It is not because they failed the EPA's NOx emission control procedure—the defeat device would take care of this. But rather, the ICCT reasoned that if VW is able to market low-cost diesels with NOx trap technology *in the US*, then they must have found a genuine technological solution, since who would want to mess with the EPA? And this fix would be gold to bring to the EU market in which more than half of the cars sold are diesels and there have been smog alerts in major EU cities. The ICCT teamed up with West Virginia University and CARB and they find, not a technological solution, but rather that NOx emissions of the VW Jetta Diesel are 15 to 35 times higher than the EPA Tier 2 NOx limits.⁸⁵

If other car manufacturers are wise enough not to touch the US market with low-cost diesel engines that cannot meet EPA Tier 2 standards and stricter testing and oversight, then one can hardly exonerate VW by pointing to the poor testing procedures and the lack of oversight in the EU business environment of car manufacturing.

4. Conclusion

Introducing low-cost diesel into the market of passenger cars can be made out as an instance of the trolley problem with the five on the track ahead being future people affected by CO₂ emissions and the one on the sidetrack being present people affected by NOx and particulate matter. If this analogy holds, it could provide a partial defence of VW.

Admittedly, VW aims to maximise profit rather than save future people by expanding its diesel market—but intentions do not matter here. And neither can we blame VW for not getting the trolley on a third track—that option is closed off by consumer preferences for low cost and high performance vehicles.

⁸³ US EPA, “Office of Transportation and Air Quality FAQ.”

⁸⁴ Emission Analytics, “Real Driving Emissions – Are You Ready?”. Europe is transitioning to the World Harmonised Light Test Cycle and Procedures (WLTC/P) as the new laboratory test which will be more realistic and hence make it more difficult to meet CO₂ targets. See: Mock, “The WLTP: How a New Test Procedure for Cars Will Affect Fuel Consumption Values in the EU.”

⁸⁵ International Council on Clean Transportation, “FAQ: In-Use NOx Emissions from Diesel Passenger Cars.”

However, it is not clear that the numbers can bear out the analogy—there may well be more expected casualties on the sidetrack than on the track ahead. Furthermore, because of the uncertainty and the temporal structure, there is the option of safeguarding the one on the sidetrack now, trusting that we will find a solution for the five on the track ahead later. This fits with a decision rule of minimising the chance of causing substantial harm rather than minimising expected harm.

Deceit and evading detection may be defensible in certain circumstances but it is implausible to make the case for VW. First, there is no *culpable threat*: the disagreement about strategies to address climate change is a reasonable disagreement which cannot justify disrespect for the law of the land. Second, there is no *unjust treatment*: Grievances about unduly strict legislation and protectionism do not bear out because the emphasis on NO_x reduction fits in with the US's leading role in the protection of air quality. Third, there is no failure of *securing buy-in*: The EPA does engage in consultation with stakeholders but it would be asking too much for it to compromise on air quality so that a foreign company can open up new markets. Fourth, we cannot appeal to *context-relative* and *enforcement-relative morality*: Resorting to the line that VW is not to blame but that the problem is systemic is a stretch because the charge of lax legislation and oversight for political reasons is a charge that sticks in the EU context, but VW is being charged within the US context.⁸⁶

Bibliography

- An, Feng, Robert Earley, and Lucia Green-Weiskel. "Global Overview on Fuel Efficiency And Motor Vehicle Emission Standards: Policy Options and Perspectives for International Cooperation." Retrieved June 5, 2016. http://www.un.org/esa/dsd/resources/res_pdfs/csd-19/Background-paper3-transport.pdf
- Barrett, Steven R H, Raymond L Speth, Sebastian D Eastham, Irene C Dedoussi, Akshay Ashok, Robert Malina, and David W Keith. "Impact of the Volkswagen Emissions Control Defeat Device on US Public Health." *Environmental Research Letters* 10, no. 11 (November 1, 2015): 114005. doi:10.1088/1748-9326/10/11/114005.
- Blanco, Sebastian. "Fiat Diesels Might Also Cheat Emissions Tests." *Autoblog*. Retrieved June 5, 2016. <http://www.autoblog.com/2016/04/25/fiat-diesels-cheat-emissions-tests/>.
- . "Mercedes-Benz Diesels Use Cheat Device, Claims Lawsuit." *Autoblog*. Retrieved June 5, 2016. <http://www.autoblog.com/2016/04/08/lawsuit-mercedes-diesels-systemic-failure-emissions/>.

⁸⁶ I am grateful for discussion or comments from Julius Andersson, Anna Bartsch, Mark Budolfson, Susanne Burri, Christina Easton, Wlodek Rabinowicz, Dean Spears, and Fabian Wagner. My research was supported by the University Center for Human Values in Princeton University. I am an Associate in the LSE Grantham Research Institute on Climate Change and the Environment.

- . “Mitsubishi Admits It Lied about MPG Ratings for All Vehicles in Japan.” *Autoblog*. Retrieved June 5, 2016. <http://www.autoblog.com/2016/05/11/mitsubishi-reportedly-lied-about-mpg-ratings-for-all-jdm-models/>.
- Bovens, Luc, and Marc Fleurbaey. “Evaluating Life or Death Prospects.” *Economics and Philosophy* 28, no. Special Issue 02 (July 2012): 217–49. doi:10.1017/S0266267112000235.
- Broder, John M. “E.P.A. Clears Way for Greenhouse Gas Rules.” *The New York Times*, April 18, 2009, sec. Science / Environment. <http://www.nytimes.com/2009/04/18/science/earth/18endanger.html>.
- California Environmental Protection Agency. “History of Air Resources Board.” Retrieved June 5, 2016. <http://www.arb.ca.gov/knowzone/history.htm>.
- Carrington, Damian. “The Truth about London’s Air Pollution.” *The Guardian*, February 5, 2016. <http://www.theguardian.com/environment/2016/feb/05/the-truth-about-londons-air-pollution>.
- DARA. “Climate Vulnerability Monitor: A Guide to the Cold Calculus of a Hot Climate,” 2012. Retrieved June 5, 2016. <http://daraint.org/climate-vulnerability-monitor/climate-vulnerability-monitor-2012/report/>.
- Domjahn, Thomas. “Hans-Werner Sinn: Ökonomen Sind Weltverbesserer.” *SÜDKURIER Online*, October 15, 2015. <http://www.suedkurier.de/nachrichten/wirtschaft/Hans-Werner-Sinn-OEkonomen-sind-Weltverbesserer;art416,8228236>.
- Dörner, Astrid, and Martin Murphy. “EPA Scrutinizing Daimler Diesel Emissions After Suit.” *Handelsblatt Global Edition*, February 29, 2016. <https://global.handelsblatt.com/edition/378/ressort/companies-markets/article/clearing-the-air-at-daimler>.
- Emission Analytics. “Real Driving Emissions – Are You Ready?” Retrieved June 5, 2016. <http://emissionsanalytics.com/real-driving-emissions-are-you-ready/>.
- European Commission. “EUR-Lex - 32016R0646.” Retrieved June 5, 2016. <http://eur-lex.europa.eu/eli/reg/2016/646/oj>.
- Eurostat, “CO2 Emissions per inhabitant in the EU and in developing countries.” Retrieved June 5, 2016, from <http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tsdgp410&plugin=1>.
- Eurostat. “Passenger Cars in the EU - Statistics Explained.” Retrieved June 5, 2016. http://ec.europa.eu/eurostat/statistics-explained/index.php/Passenger_cars_in_the_EU.
- Exner, Thomas. “Uns Verbraucher trifft Mitschuld am Abgas-Skandal.” *Welt Online*, April 22, 2016, sec. Meinung. <http://www.welt.de/debatte/kommentare/article154660506/Uns-Verbraucher-trifft-Mitschuld-am-Abgas-Skandal.html>.
- Foot, Philippa. 1967. “The Problem of Abortion and the Doctrine of the Double Effect.” *Oxford Review*, No. 5. Retrieved June 5, 2016, from <http://philpapers.org/archive/FOOTPO-2.pdf>.
- “Frequently Asked Questions – The Cost of Carbon Pollution.” Retrieved June 5, 2016. <http://costofcarbon.org/faq>.
- Fuller, Gary. “Putting a Price on NOx Health Impacts.” *The Guardian*, October 4, 2015. <http://www.theguardian.com/environment/2015/oct/04/nitrogen-oxides-cost-health-impacts-diesel>.
- Gauthier, David P. *Morals by Agreement*. Oxford University Press, UK, 1986.

- Geiger, Friedrich. "Merkel Complained in 2010 About California Emissions Rules." *Wall Street Journal*, November 12, 2015, sec. Business. Retrieved June 5, 2016. <http://www.wsj.com/articles/merkel-complained-in-2010-about-california-emissions-rules-1447349303>.
- Genesis 34. Retrieved June 5, 2016. <http://biblehub.com/nasb/genesis/34.htm>.
- Geuss, Megan. "Volkswagen's Emissions Cheating Scandal Has a Long, Complicated History." *Ars Technica*, October 8, 2015. <http://arstechnica.com/cars/2015/10/volkswagens-emissions-cheating-scandal-has-a-long-complicated-history/>.
- Glinton, Sonari. "'We Didn't Lie,' Volkswagen CEO Says Of Emissions Scandal." *NPR.org*. Retrieved June 5, 2016. <http://www.npr.org/sections/thetwo-way/2016/01/11/462682378/we-didnt-lie-volkswagen-ceo-says-of-emissions-scandal>.
- Goodman, Leah. "Volkswagen Is Thriving in the Wake of 'Dieselgate.'" *Newsweek*, May 31, 2016. <http://europe.newsweek.com/volkswagen-sales-post-dieselgate-epa-scandal-464961>.
- "Green Car Congress: NRC Canada Team Investigates Effect of Gasoline Particulate Filter on PM from Light-Duty GDI Engine." Retrieved June 5, 2016. <http://www.greencarcongress.com/2015/09/20150917-gpf.html>.
- Hoekman, S. Kent. "Comment on 'Damages and Expected Deaths Due to Excess NOx Emissions from 2009 to 2015 Volkswagen Diesel Vehicles.'" *Environmental Science & Technology* 50, no. 7 (April 5, 2016): 4135–36. doi:10.1021/acs.est.6b00856.
- Holland, Stephen P., Erin T. Mansur, Nicholas Z. Muller, and Andrew J. Yates. "Damages and Expected Deaths Due to Excess NOx Emissions from 2009 to 2015 Volkswagen Diesel Vehicles." *Environmental Science & Technology* 50, no. 3 (February 2, 2016): 1111–17. doi:10.1021/acs.est.5b05190.
- . "Response to Comment on 'Damages and Expected Deaths due to Excess NOx Emissions from 2009–2015 Volkswagen Diesel Vehicles.'" *Environmental Science & Technology* 50, no. 7 (April 5, 2016): 4137–38. doi:10.1021/acs.est.6b01157.
- Honsel, Gregor. "Kommentar zu VW: Luschige Abgas-Kontrollen." *Heise Online*. Retrieved June 5, 2016. <http://www.heise.de/newsticker/meldung/Kommentar-zu-VW-Luschige-Abgas-Kontrollen-2822648.html>.
- Hulverscheidt, Claus. "VW-Abgasaffäre: Abgasskandal lässt Volkswagen-Image in den USA einbrechen." *sueddeutsche.de*, February 29, 2016, sec. wirtschaft. <http://www.sueddeutsche.de/wirtschaft/volkswagen-ein-fall-fuer-das-lehrbuch-1.2885197>.
- International Council on Clean Transportation. "FAQ: In-Use NOx Emissions from Diesel Passenger Cars." Retrieved June 5, 2016. <http://www.theicct.org/news/faq-use-nox-emissions-diesel-passenger-cars>.
- . "Global PV Standards Chart Library." Retrieved June 5, 2016. <http://www.theicct.org/global-pv-standards-chart-library>.
- Joseph, Noah. "Suzuki Latest to Admit to Falsifying Fuel Economy Tests." *Autoblog*. Retrieved June 5, 2016. <http://www.autoblog.com/2016/05/18/suzuki-admits-falsifying-fuel-economy-tests/>.
- Luke 15: 3-7. Retrieved June 5, 2016. <http://biblehub.com/context/luke/15-3.htm>.
- Lussenhop, Jessica. "Why Do American Car Buyers Shy Away from Diesel?" *Why Do American Car Buyers Shy Away from Diesel?*, 09 2015. <http://www.bbc.com/news/world-us-canada-34329596>.

- Mathiesen, Karl. "Have Diesel Cars Been Unfairly Demonised for Air Pollution?" *The Guardian*, March 11, 2015. <http://www.theguardian.com/environment/2015/mar/11/have-diesel-cars-been-unfairly-demonised-for-air-pollution>.
- Mock, Peter. "The WLTP: How a New Test Procedure for Cars Will Affect Fuel Consumption Values in the EU." Retrieved June 5, 2016. <http://www.theicct.org/wltp-how-new-test-procedure-cars-will-affect-fuel-consumption-values-eu>.
- Moore, Frances C., and Delavane B. Diaz. "Temperature Impacts on Economic Growth Warrant Stringent Mitigation Policy." *Nature Climate Change* 5, no. 2 (February 2015): 127–31. doi:10.1038/nclimate2481.
- "Motor Vehicle Emissions Controls: Fuel Types" Retrieved June 5, 2016. <http://www.air-quality.org.uk/26.php>.
- Neuerer, Dietmar. "Ifo-Chef Sinn zur Abgasaffäre: „Bei VW Wird Mit Zweierlei Maß Gemessen“." Retrieved June 5, 2016. <http://www.handelsblatt.com/politik/deutschland/ifo-chef-sinn-zur-abgasaffaere-bei-vw-wird-mit-zweierlei-mass-gemessen/12370064.html>.
- Oldenkamp, Rik, Rosalie van Zelm, and Mark A. J. Huijbregts. "Valuing the Human Health Damage Caused by the Fraud of Volkswagen." *Environmental Pollution* 212 (May 2016): 121–27. doi:10.1016/j.envpol.2016.01.053.
- Peters, Eric. "No More Affordable Diesels — Courtesy of the EPA | The American Spectator." Retrieved June 3, 2016. http://spectator.org/64302_no-more-affordable-diesels-courtesy-epa/.
- Plato. *The Republic - Book 2*. Translated by Benjamin Jowett, n.d. Retrieved June 5, 2016. <http://classics.mit.edu/Plato/republic.3.ii.html>.
- Pressemitteilung, DUH. "Fahrverbote Für Diesel-PKW in Deutschen Städten Ab 2016 Und Entzug Der Typengenehmigung Als Folge Des Audi/VW-Skandals in Den USA." *Deutsche Umwelthilfe*. Retrieved June 5, 2016. [http://www.duh.de/pressemitteilung.html?&tx_ttnews\[tt_news\]=3611](http://www.duh.de/pressemitteilung.html?&tx_ttnews[tt_news]=3611).
- "Regulation No 715/2007 of the European Parliament and of the Council." Retrieved June 5, 2016. <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:171:0001:0016:EN:PDF>.
- "Renault Recalls Captur Diesels to Fix Emissions Glitch." *Automotive News*, January 19, 2016. <http://www.autonews.com/article/20160119/ANE/160119744/renault-recalls-captur-diesels-to-fix-emissions-glitch>.
- Robinson, Aaron. "Caught Black-Handed: Why Did Volkswagen Cheat?" Retrieved June 3, 2016. <http://blog.caranddriver.com/caught-black-handed-why-did-volkswagen-cheat/>.
- Rosemain, Mathieu. "Paris Smog Obscuring Eiffel Tower Threatens Diesel-Car Dominance." *Bloomberg.com*. Retrieved June 5, 2016. <http://www.bloomberg.com/news/articles/2015-06-19/paris-smog-obscuring-eiffel-tower-threatens-diesel-car-dominance>.
- Schäfer, Karsten. "Kommentar Zum Abgas-Skandal: Opel Ist Der Falsche Schuldige." *Heise Online*. Retrieved June 5, 2016. <http://www.heise.de/newsticker/meldung/Kommentar-zum-Abgas-Skandal-Opel-ist-der-falsche-Schuldige-3211342.html?view=audio>.
- Schipper, Lee, and Lew Fulton. "Disappointed by Diesel?: Impact of Shift to Diesels in Europe Through 2006." *Transportation Research Record: Journal of the Transportation Research Board* 2139 (December 2009): 1–10. doi:10.3141/2139-01. Retrieved June 5, 2016, from http://metrostudies.berkeley.edu/pubs/reports/004_trb_diesel.pdf.

- Smith, Geoffrey, and Roger Parloff. "Hoaxwagon." *Fortune*, 15 March 2016. Retrieved June 5, 2016. <http://fortune.com/inside-volkswagen-emissions-scandal/>.
- "SMMT Puts Record Straight on Diesel Cars with New Nationwide Consumer Campaign." *SMMT*, March 11, 2015. <http://www.smm.co.uk/2015/03/smm-puts-record-straight-on-diesel-cars-with-new-nationwide-consumer-campaign/>.
- Stern, Nicholas H. *The Economics of Climate Change: The Stern Review*. Cambridge: Cambridge University Press, 2007. Retrieved June 5, 2016 from http://www.hm-treasury.gov.uk/Independent_Reviews/stern_review_economics_climate_change/sternreview_index.cfm.
- "TDI: U.S. Market Success.pdf." Retrieved June 5, 2016. http://cleandieseldelivers.com/media/Douglas-Skorupski-VW0A_DTF_March2015.pdf.
- Than, Ker. "Estimated Social Cost of Climate Change Not Accurate, Stanford Scientists Say." *Estimated Social Cost of Climate Change Not Accurate, Stanford Scientists Say*, January 12, 2015. <https://news.stanford.edu/2015/01/12/emissions-social-costs-011215/>.
- Thompson, Gregory J., Daniel K. Carder, Marc C. Besch, Arvind Thiruvengadam, and Hemanth K. Kappanna. "In-Use Emissions Testing of Light-Duty Diesel Vehicles in the U.S.," May 30, 2014. <http://www.theicct.org/use-emissions-testing-light-duty-diesel-vehicles-us>.
- Thomson, J.J. 1985. "The Trolley Problem." *Yale Law Journal*, 94(6): 1395–1415.
- US EPA. "Health | Nitrogen Dioxide." Retrieved June 5, 2016. <https://www3.epa.gov/airquality/nitrogenoxides/health.html>.
- . "Office of Transportation and Air Quality FAQ." Overviews & Factsheets. Retrieved June 5, 2016. <https://www3.epa.gov/otaq/about/faq.htm>.
- . "Overview of the Clean Air Act and Air Pollution." Collections and Lists. Retrieved June 5, 2016. <https://www.epa.gov/clean-air-act-overview>.
- . "Social Cost of Carbon." Overviews & Factsheets,. Retrieved June 5, 2016. <https://www3.epa.gov/climatechange/EPAactivities/economics/scc.html>.
- . "Summary of the Clean Air Act." Overviews and Factsheets. Retrieved June 5, 2016. <https://www.epa.gov/laws-regulations/summary-clean-air-act>.
- . "Tier 2 Vehicle and Gasoline Sulfur Program," n.d. Retrieved June 5, 2016. <https://www3.epa.gov/tier2/>.
- US News Best Cars. "Best Hybrid and Electric Cars Rankings." Retrieved June 5, 2016. <http://usnews.rankingsandreviews.com/cars-trucks/rankings/Hybrid-Cars/>.
- "Verkehrsminister Dobrindt Ordnet Rückrufaktion an." *FOCUS Online*. Retrieved June 5, 2016. http://www.focus.de/auto/news/abgas-skandal/dobrindt-pk-im-live-ticker-rueckrufaktion-angeordnet-dobrindt-nimmt-die-autoindustrie-in-die-mangel_id_5460150.html.
- Vicente Franco, Francisco Posada Sánchez, John German, and Peter Mock. "Real-World Exhaust Emissions from Modern Diesel Cars," October 11, 2014. Retrieved June 5, 2016, from <http://www.theicct.org/real-world-exhaust-emissions-modern-diesel-cars>.
- Voelcker, John. "Volkswagen Jetta TDI: Much More Mileage Than EPA Admits?" *Green Car Reports*, Retrieved June 5, 2016. http://www.greencarreports.com/news/1019256_volkswagen-jetta-tdi-much-more-mileage-than-epa-admits.
- Wagner, Gernot, and Martin L. Weitzman. *Climate Shock: The Economic Consequences of a Hotter Planet*. Princeton: Princeton University Press, 2016.

- Walker, Peter, and Graham Ruddick. "Diesel Cars' Emissions Far Higher on Road than in Lab, Tests Show." *The Guardian*, 21 April, 2016. Retrieved June 5, 2016.
<https://www.theguardian.com/business/2016/apr/21/all-top-selling-cars-break-emissions-limits-in-real-world-tests>.
- "Web Archive: Diesel: The Facts - SMMT." October 9, 2015. Retrieved June 5, 2016, from
<https://web.archive.org/web/20151009081217/http://www.smmt.co.uk/industry-topics/diesel-facts#responsiveTabs1>.
- World Bank. "CO2 Emissions (metric Tons per Capita)." Retrieved June 5, 2016.
http://data.worldbank.org/indicator/EN.ATM.CO2E.PC/countries?order=wbapi_data_value_2011%20wbapi_data_value%20wbapi_data_value-first&sort=asc&display=defaulthttp://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tsdgp410&plugin=1.
- World Bank. "Turn down the Heat : Climate Extremes, Regional Impacts, and the Case for Resilience - Full Report," 2013. Retrieved June 5, 2016.
<http://documents.worldbank.org/curated/en/2013/06/17862361/turn-down-heat-climate-extremes-regional-impacts-case-resilience-full-report>.
- Yang, Liuhanzi, Vicente Franco, Alex Campestrini, John German, and Peter Mock. "NOx Control Technologies for Euro 6 Diesel Passenger Cars." Retrieved June 5, 2016.
<http://theicct.org/nox-control-technologies-euro-6-diesel-passenger-cars>.