Title: Regulatory Reforms to Nurture the Resurgence of the US Manufacturing Sector

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ABSTRACT

This working paper presents two case studies of complex regulatory systems that impose significant costs on the US manufacturing sector. The first case study addresses federal and state regulations of automakers that are designed to reduce greenhouse gas emissions from new passenger cars and light trucks. The second case study addresses regulations designed to reduce conventional air pollutants from stationary sources (e.g., steel plants), where the stringency of the requirements are influenced by the setting of the health-based national air quality standards.

Both case studies find that regulatory programs are well intended to produce significant public health and environmental benefits. However, the case studies suggest that regulatory reforms could be adopted that would accomplish comparable environmental results at significantly less cost to the manufacturing sector. Themes of the regulatory reforms are (1) greater use of economic incentives instead of command-and-control regulations; (2) greater use of modern tools of risk analysis and cost-benefit analysis in the design of regulatory requirements; (3) reductions in the sheer number of distinct regulators with authority over the manufacturing sector; and (4) better coordination of state and federal regulation of manufactured products and facilities. In both case studies, a variety of legislative and executive reforms are proposed for future consideration by scholars, stakeholders, and policy makers.

INTRODUCTION

Since 1981, manufacturers have been subject to 2,183 unique rulemakings, almost half attributable to one federal agency (the US Environmental Protection Agency).[1] The administrations of both George W. Bush and Barack Obama have recognized that manufacturing is one of the most regulated sectors in the US economy. Both administrations have also sought to streamline existing federal regulations of manufacturing in order to reduce economic burdens that threaten the competitiveness of US manufacturing. However, a recent report by the Regulatory Studies Center at George Washington University found that the retrospective reviews of manufacturing regulations under both presidential administrations have had limited impact. Indeed, some of the retrospective reviews appear to have led to greater regulatory burdens rather than diminished burdens.[2]

In this working paper, we present case studies of two environmental programs that are each widely recognized as a major source of economic burdens for manufacturing firms. Both programs are also recognized as a source of significant environmental benefits, so the simple option of deregulation may not be particularly promising. We argue that creative regulatory reforms can accomplish most or all of the anticipated environmental benefits, at considerably reduced cost to regulated firms, workers, and consumers.

The first case study addresses federal and state regulation of the auto industry to reduce greenhouse gas emissions from new cars and light trucks. The study is of special interest because the auto industry is the largest single subsector in manufacturing and has been a significant boost to the US economic recovery since 2009. The second case study addresses federal and state regulation of stationary manufacturing facilities that emit conventional air pollutants that have been linked to smog and soot. Unlike the first case study, which focuses on regulation of the manufactured product, the second case study focuses on regulation of the facilities where products are made. The second case study is of special interest because it covers plants in virtually every manufacturing subsector, since all such plants typically have some level of conventional air pollution.

In both case studies, we identify key features of regulatory design that are likely to impose increasing costs on manufacturers in the future. We propose options for regulatory reform that are designed to streamline and modernize regulatory requirements and reduce regulatory costs, while still allowing the regulatory program to accomplish significant environmental results. A practical theme of our case studies is that reforms enacted through executive power are more likely to occur than those that require new legislation by the Congress.

CASE STUDY #1: REGULATION OF MOTOR VEHICLES TO CONTROL GREENHOUSE GASES

Companies that manufacture new cars or light trucks in the United States are subject to an increasingly complex and stringent set of requirements related to fuel economy and greenhouse gas (GHG) emissions. The requirements are well intended in the sense that they seek to reduce the greenhouse gas emissions that are linked to global climate change. The requirements also have secondary benefits in reducing smog and soot in the air and reducing America's dependence on oil, a commodity whose

[1] Manufacturers Alliance for Productivity and Innovation. Macroeconomic Impacts of Federal Regulation of the Manufacturing Sector. 2012.

[2] Sofie Miller. EPA's Retrospective Review of Regulations: Will It Reduce Manufacturing Burdens? Engage. 14(2), 4-14.

availability and volatile price are influenced by unstable political regimes in the Mideast and other parts of the world.[3] EPA has estimated that the vehicle-related GHG requirements for model years 2012 to 2016 provide roughly $30 billion in net benefits. The consumer would pay an additional $950 per vehicle for green technology but save approximately $1,200 over three years in fuel savings.[4]

Looking past model year 2016, two distinct regulatory programs will become more stringent: a scheduled increase in average new passenger vehicle fuel economy from 35.5 miles per gallon in 2016 to 54.5 miles per gallon in 2025; and a scheduled increase in the share of new vehicles that achieve "zero emissions" from less than 1% in 2016 to 15% in 2025, the latter applying only in the State of California and nine other states that have chosen to align with California's zero-emission plan. (Those states account for about 30% of new vehicle sales in the US). Recognizing how challenging the 2025 mandates might be and the long lead times for manufacturing new models, regulators and interested stakeholders agreed in 2012 to a mid-term review of the 2022-2025 requirements in the 2016-17 period.[5]

This case study reveals that current regulatory requirements are more complex and stringent than they need to be in order to accomplish efficiently the stated public policy objectives. Multiple regulators are working the same problem without adequate coordination. Key features of the regulatory system are not well-supported by cost-benefit analysis. Some specific companies and technologies are favored over others, without adequate public policy rationale.[6] The preferences of consumers are given relatively little weight in the process, which means that a dysfunctional wedge may be driven between what manufacturers must produce to satisfy regulators and what they must produce to serve their customers.

If the current regulatory system is not streamlined and modernized in the forthcoming "mid-term" review, the remarkable 2009-2015 recovery of the U.S. automotive industry may be put at risk, with serious consequences for companies, consumers, workers and the communities that benefit from a flourishing automotive manufacturing sector. Moreover, a political backlash against the current regulatory system could jeapardize the environmental benefits that have been accomplished to date and the additional benefits that might be accomplished by 2025. Thus, all stakeholders, politicians, and regulators have a keen interest in pruning or refining any features of the current regulatory system that are burdensome but unhelpful in advancing environmental progress.

A. The Regulators

The U.S. Department of Transportation (DOT) and the U.S. Environmental Protection Agency (EPA) both have regulatory authority relevant to the greenhouse gas emissions from motor vehicles. DOT requires

[3] The public rationale for California's ZEV requirements, beginning at a public hearing in December 2009, shifted from primary emphasis on control of local smog and soot to control of greenhouse gases. CARB. Advanced Clean Cars. Staff Report: Initial Statement of Reasons. 2012 Proposed Amendments to California Zero Emission Vehicle Program Regulations. December 7, 2011.

[4] Gloria Helfand and Reid Dorsey-Palmateer. The Energy Efficiency Gap in EPA's Benefit-Cost Analysis of Vehicle Greenhouse Gas Regulations: A Case Study. Journal of Benefit-Cost Analysis. 6(2). June 2015, 432-454, esp. 436-7 (Table 1).

[5] Alan J Krupnick, Joshua Linn, Virginia McConnell. Preparing for the Midterm CAFÉ Review. Resources for the Future. 2014; Nick Bunkley. Midterm Review Could Alter Fuel Economy Rules. Automotive News. October 15, 2012, 28.

[6] Most notable is the fact that federal and state regulatory policies seem to be a de facto mandate for electric vehicles. Christopher Knittel. California's Auto Emissions Policy Hits a Tesla Pothole. Wall Street Journal. February 15-16, 2014, A15.

that vehicle manufacturers meet corporate average fuel economy (miles-per-gallon) targets, measured as the fleet-wide average of their new vehicles. EPA requires that vehicle manufacturers limit the greenhouse gas emissions of new motor vehicles through a performance standard defined in terms of grams of carbon dioxide emissions per mile.

Meanwhile, the California Air Resources Board (CARB) (and the aligned states) have enacted a separate set of limitations on carbon-dioxide emissions from new motor vehicles. CARB also has put in place an aggressive zero-emission vehicle (ZEV) mandate that is widely interpreted as a de facto mandate of plug-in electric vehicles.

In 2009-2012 the Obama administration sought to establish a uniform national policy that would allow vehicle manufacturers to simultaneously comply with DOT fuel-economy regulations and EPA and CARB carbon standards. However, the administration did not incorporate the ZEV mandate into the uniform national policy. The optimal compliance path for national regulatory policy will not necessarily bring vehicle manufacturers into compliance with the California ZEV mandate.[7]

B. The Regulated Industry

The new passenger vehicle market in the United States is dominated by large producers that sell products globally: Toyota, Volkswagen, General Motors, Hyundai/Kia, Nissan-Renault, Ford, Fiat-Chrysler, Honda, Suzuki, BMW, Daimler, Mazda and Mitsubishi.[8] Organized by the United Auto Workers of America (UAW), the Big Three (GM, Ford and Fiat Chrysler) have business models that depend primarily on sales of "light trucks", which include pick-up trucks, sport-utility vehicles (SUVs), and vans. In recent years, the Japanese and other foreign producers, which have few UAW-organized plants, have begun to challenge the Big Three's dominance of the light-truck market.

Toyota and Honda dominate the passenger-car market, though Hyundai/Kia, Volkswagen, and the Big Three are offering a mix of re-engineered and new products that challenge Japanese dominance. Daimler and BMW are major players in the market for upscale sedans and luxury "cross-over" vehicles, the latter being one of the most rapidly growing and profitable segments in the industry.[9]

The Japanese, Korean and German auto makers historically imported all of their vehicles into the US. To avoid unfavorable US tariffs and currency issues and to establish an economic and political presence in the US, those companies have increasingly located assembly plants in North America.[10] The first

[7] For a limited period of time, CARB did allow automakers that exceed federal mileage/carbon requirements to earn credits that can be applied to state ZEV requirements. Christina Rogers. ZEV Mandate: Coming to Your State? Automotive News. April 16, 2012.

[8] The companies are ordered by global production, with several companies (PSA Citroen, Suzuki, SAIC) excluded because they do little or no passenger-vehicle business in North America. Lindsay Chappell. Ghosn Spurs Renault-Nissan to Greater US Clout. Automotive News. April 7, 2014, 4.

[9] Alisa Priddle, Chris Woodyard, Nathan Bomey. American Love Affair with SUVs Continues. USA Today. May 31, 2013, 5B; Cheryl Jensen. Modern Maturity for the Original Cute Ute. New York Times. June 16, 2013, 10; Vanessa Fuhrmans. German Automakers to Shake Up Luxury Market. Wall Street Journal. January 15, 2013, B6; Joseph B White. Car Makers Pitch Power as the Ultimate Luxury. Wall Street Journal. April 10, 2013, D3; Diana T Kurylko. Demand is Strong for Europe's Small Luxury Cross Overs. Automotive News. June 18, 2009.

[10] The transplants share of North American production has risen from 22% in 2000 to 31% in 2005 and 46% in early 2013. It is projected to exceed 50% by 2017. Diana T Kurylko. Transplants Keep Rolling in North America. Automotive News. April 22, 2013, 3.

"transplant" plants were located in Marysville, Ohio (Honda-1982) and Smyrna, Tennessee (Nissan-1983), but the largest ones today (measured by vehicle production) are located in Montgomery, Alabama (Hyundai-2005), San Antonio, Texas (Toyota-2006), Greenburg, Indiana (Honda-2008), Woodstock, Ontario (Toyota-2008), West Point, Georgia (Kia-2009), Blue Springs, Mississippi (Toyota-2011) and Chattanooga, Tennessee (Volkswagen-2011).[11] Both the Big Three and foreign automakers are also locating an increasing share of their North American production in Mexico, often in close proximity to the US border.[12]

In order to understand the structure of the auto industry, one must look beyond the assembly plants to the supply chains for engines, parts, batteries and other components.[13] GM, Ford and Fiat-Chrysler share a network of suppliers that is somewhat distinct and often organized by the UAW. However, the Big Three are increasingly diversifying their supplier base within North America while also importing more parts from outside the US. The transplants assemble the vehicle in North America but often import the parts from overseas.

The auto parts industry, which is the sector responsible for the largest amount of manufacturing employment in the US (734,000 employees in 2012), is not spread equally around the country. A large majority (over 70%) of the employment is concentrated in ten states: Michigan, Ohio, Indiana, Tennessee, Kentucky, Illinois, Alabama, Texas, North Carolina and South Carolina.[14] When combined with the assembly plants, which tend to be located in these same states, one can readily see why the health of the auto industry is of greater concern to politicians in the South and Midwest than it is to politicians representing the coasts.

Tesla and several other small-volume producers of electric vehicles are part of a loose network of venture capitalists, suppliers of batteries and chargers, electric utilities, and environmental advocacy groups with a common goal: electrification of the transportation sector. Interestingly, several of the key companies and investors in this network are based in California.[15] The Obama administration has championed a variety of tax advantages, loans, and subsidies to stimulate the electric vehicle industry. Although the administration used loans and subsidies to help nurture US producers of automotive-grade lithium-ion batteries and electric drivetrains, some of those firms have failed commercially and thus the supply base for plug-in electric vehicles is now dominated by Asian companies.

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[11] Diana T Kurylko. Transplants Keep Rolling in North America. Automotive News. April 22, 2013, 3.

[12] Indeed, three of the largest assembly plants in North America are located in Mexico (Puebla, Volkswagen; Aquascalientes-Nissan; Hormosillo-Ford. "Ten Busiest North American Assembly Plants." Automotive News. January 2, 2012.

[13] In 2014 the US imported a record $138 billion in car parts, up from $89 billion in 2008 and $32 billion in 1990. The 2015 Ford Escape had 55% US/Canadian parts content, down from 90% for the 2010 Escape. James R Hagerty, Jeff Bennett. U.S. Car-Making Boom? Not for Auto-Industry Workers. Wall Street Journal. March 24, 2015, A1.

[14] Andrew Thurlow. Study: Parts Industry Makes Up 2.3% of U.S. GDP. Automotive News. April 15, 2013, 28.

[15] CARB has acknowledged that "very little component and final assembly (of vehicles occurs) in California" and that many California companies stand to benefit from enlarged sales of EV charging equipment. CARB. 2011, 68-9. Indeed, regulators in California defend the Clean Car Rule (including the ZEV mandate) on economic as well as environmental grounds, arguing that the regulations will create thousands of jobs in California by "transforming California into the advanced car capital of the world." Statement of CARB Chairman Mary Nichols quoted in "California Adopts Clean Car Rules." Environmental News Service. January 30, 2012; financial benefits from the ZEV program have already flowed to California-based Tesla, which is selling ZEV credits to large vehicle manufacturing and thereby curtailing the losses it would otherwise show on its balance sheet. Chris Woodyard, Brent Snavely, Nathan Bomey. Tesla Shares Sizzle on Hot Profit and Hotter Review. USA Today. May 14, 2013, 5B.

C. Compliance Paths for Industry

In order to comply with regulations on fuel economy and carbon emissions, automakers need to evaluate a range of technologies in conjunction with the structure of the regulatory system. Some of the most obvious compliance strategies do not help much because of the precise design of the regulatory systems. Consider, for example, introduction of more diesel-powered vehicles or downsizing of vehicles.

Any approach that relies primarily on greater use of clean-diesel technology has limited promise because use of diesel fuel produces 15% more CO2 emissions per gallon than gasoline.[16] Thus, even though diesel engines can achieve 30% higher mileage ratings than gasoline engines and help comply with the DOT fuel-economy requirements, about a third of the advantage in fewer GHG emissions is offset by the larger carbon content of diesel fuel, which makes it harder for diesel to comply with the EPA requirements.[17] In addition, the cost premium for a diesel engine is about $3,000 to $3,800 per vehicle and, due primarily to tax policy, the price of a gallon of diesel fuel to the consumer is about 10% higher than the price of a gallon of gasoline. That price spread is projected to widen in the years ahead.[18] Moreover, a big investment in diesel engines does nothing to move a company close to compliance with CARB's ZEV requirements.

Likewise, any approach that saves fuel by downsizing vehicles (i.e., reducing their footprint) is unlikely to succeed because the federal performance standard is designed to impose more stringent compliance targets on vehicles with smaller footprints. The footprint adjustment was included by regulators to protect the safety of consumers. Had the footprint adjustment not been made, the regulation would have had a disproportionate impact on producers of light trucks and large cars (especially the Big Three). Even if the footprint adjustment were eliminated, manufacturers would face the reality that downsizing, though it generally saves fuel (due to improved aerodynamics and diminished vehicle weight), does not help with ZEV compliance.

In the early years of the revitalized federal program (2005-2016), automakers began by complying through a variety of refinements to existing vehicles: replacing rear-wheel drive with front-wheel drive; replacing V-8 engines with turbocharged V-6 engines; installing direct fuel injection systems, six-speed transmissions, and stop/start technology; and substituting light-weight materials (e.g., aluminum) for steel. Analysts differ as to whether the 2025 targets can be met without making substantial use of alternative powertrains such as conventional hybrid engines (e.g., as exemplified by the Toyota Prius) and/or plug-in electric vehicles.[19] The regulatory analysis produced by EPA/DOT for model year 2025 does not presume widespread commercialization of conventional hybrids or plug-in vehicles but some industry analysts are beginning to question that assumption. Moreover, the structure of the federal regulations contain compliance multipliers that favor plug-in electric vehicles over conventional hybrids and other fuel-saving technologies. Those multipliers, though temporary (they expire by 2025), are a form of subsidy that enlarges the direct subsidies that the federal government and some states provide

[16] National Research Council. 2015, 3-5, Table 3.1 (diesel engines reduce gasoline consumption by 32-34% compared to gasoline engines, but the reduction of CO2 on a gram/mile basis is in the range of 20-24%).
[17] EPA's rule does not account for the fact that diesel fuel requires less energy in the refining process than does gasoline, which is a GHG advantage for diesel. National Research Council. 2015, 3-2.
[18] National Research Council. 2015, 3-2, 3-13.
[19] David Sedgwick. Supplier Sees a Path to 54.5 MPG Without EVs. Automotive News. January 20, 2014, 21.

to consumers. Thus, the federal system provides enticement for investments in plug-in vehicles but not conventional hybrids (except for some applications to light trucks).

For each global automaker, the optimal pathway to compliance may be somewhat different. Their product mixes differ (e.g., sales of light trucks versus small cars), their access to capital differs considerably (which is crucial if entirely new propulsion systems are to be envisioned), and their access to technological expertise varies (e.g., the Germans are known to have an advantage in diesel technology while the Koreans and Japanese are ahead in battery technology). Judging by the intercompany trading of EPA compliance credits (2010-2012), it appears that the compliance challenge is greatest at Ferrari, Chrysler and Mercedes-Benz and easiest at Honda, Nissan and Tesla.[20] We speculate about three specific companies below, in order to illustrate the complexity of the compliance challenge.

For a company like Toyota, that has a strong edge in conventional hybrid technology,[21] one might think offering hybrid engines on a wide range of Toyota products would be a fruitful strategy. Indeed, Toyota has expanded its offerings of hybrids significantly over the last several model years.[22] Despite the enhanced offerings, the hybrid market share has risen far less than projected.[23] A variety of explanations have been offered: the significant price premiums for hybrid vehicles compared to comparably-sized gasoline vehicles; declining gasoline prices that hurt the payoff to the consumer from an investment in hybrids;[24] the removal of HOV lane access for conventional hybrids, which had helped boost hybrid sales in California and other congested areas;[25] the removal of state and federal tax benefits for conventional hybrids that reduced the price premium faced by consumers; the emergency of greener versions of the gasoline-powered vehicle; and the growth of public subsidies and social marketing for plug-in electric vehicles.[26] Proponents of the conventional hybrid argue that Toyota's new version of the Prius, due in showrooms within the year, will be crucial in determining the

[20] Crain Communications. Fuel Economy Report Shows Crusiers, Stragglers. Automotive News. May 5, 2014, 50.
[21] The Prius has been characterized as the product of a 30-year strategic investment of the Japanese government and Toyota, including a 50% subsidy for sales in Japan in the early years of Prius marketing. Michael Goldstein. All of Us Want Cleaner Cars, But How Many of Us Are Willing to Pay for Them? September 19, 2014, http://green.autoblog.com/2014/09/19/ugly-economics-of-green-vehicles.
[22] Globally, Toyota is offering dozens of models with conventional hybrid technology. Mike Ramsey. Toyota: Our Future Hybrids Will Be More Sporty. Wall Street Journal. August 29, 2013, B5; on US offerings see Dan Neil. The Fuel-Sipping Prius Gets a Bigger Brother. Wall Street Journal. June 18-19, 2011, D8. The overall number of hybrid nameplates on the US market rose from 24 in 2009 to 47 in 2014. Mark Rechtin. Have Hybrid Cars Hit Their Peak? Automotive News. June 9, 2014, 3.
[23] In 2008, JD Power and Associates projected that the hybrid share of the new-car market in the US would rise from 2.2% to 7.0% by 2015. Shamit. J.D. Power Sees Three-Fold Growth for Hybrids by 2015. Hybridcars.com. April 8, 2008; the actual share in 2014 was 3.5% and will likely decline in 2015. Mark Rechtin. Have Hybrid Cars Hit Their Peak? Automotive News. June 9, 2014, 3. One of the unknowns is why the number of hybrids sold is far smaller than the number of new-car buyers who state an interest in purchasing a conventional hybrid. Stephen Popiel. From Nozzle to Plug: Achieving Zero Emissions. SAE 2011 Hybrid Vehicle Symposium. Anaheim, CA. February 9-11, 2011.
[24] Mark Huffman. What's Up With Declining Hybrid Sales? ConsumerAffairs.com. April 14, 2015; Neal E. Boudette. Can Prius Set the Pace Again? Automotive News. September 22, 2014, 17.
[25] When California removed HOV lane access for the Prius, within it lost it's status as the number #1 selling passenger vehicle in California. Jerry Hirsch. Honda Accord Beats Toyota Prius as Top Seller in California. Los Angeles Times. February 13, 2015; Abby Sewell, Kate Mather, Ari Bloomekatz. For Hybrid Drivers, It's Now the Past Lane. Los Angeles Times. July 2, 2011.
[26] Chris Woodyard. Toyota's Next Prius May Hit Some Bumps. USA Today. September 8, 2015, B1.

commercial success of conventional hybrids, as consumers may be shying away from the current version of the Prius because they know that the new version will be out soon.[27]

An even larger problem with the conventional-hybrid strategy is that it does not comply with the California ZEV mandate, since California no longer gives partial compliance credits for conventional hybrid technology. Toyota is publicly skeptical about the commercial promise of plug-in vehicles and instead has been making greater R&D investments in hydrogen fuel cells.[28] And CARB's ZEV program provides multiplier incentives for qualified fuel-cell offerings. However, hydrogen fuel cells may not be ready for significant commercialization until the 2030-2040 time frame.[29] Thus, it is not yet apparent how Toyota will simultaneously comply with the federal and ZEV requirements (though it is possible that Toyota's proprietary plans are clear on this question).[30]

Ford Motor Company, whose yearly profits are linked largely to sales of pick-up trucks, has taken a big commercial risk with its F-series by replacing steel with aluminum to a greater extent than any other auto maker.[31] Although aluminum is lighter and produces significant fuel savings, it is more expensive than steel and may be more difficult to service and repair after crashes.[32] Aluminum may also not perform as well as steel in rugged applications that are important to some drivers of pick-up trucks. General Motors has been using advertisements on social media to raise questions about Ford's conversion to aluminum, and it is not yet clear how the marketing battle over steel vs. aluminum will unfold in the marketplace.[33] While aluminum has some drawbacks and light-weight steel alternatives[34] are being marketed, Ford's competitors in the pick-up truck market (especially GM, Chrysler, Toyota and Nissan) have been less transparent about compliance strategies for their trucks.

For a financially-stressed company like Fiat-Chrysler, the pathways to compliance with federal carbon requirements and the ZEV mandate are far from clear.[35] Chrysler's business model, which has been compensating for Fiat's poor European performance, is heavily dependent on sales of jeeps, minivans, and pick-up trucks, the types of vehicles that are most difficult to offer as high-mileage vehicles.[36] The

[27] David Undercoffler. Next-Gen Prius May Be Ill-Timed, But Not Ill-Fated. Automotive News. June 29, 2015.
[28] Hans Greimel. Toyota, Nissan Green-Divide Widens. Automotive News. June 23, 2014, 24 (quoting Jim Lentz, CEO of Toyota North America: "I would rather invest my dollars in fuel cell development than in another 2,500 EVs.")
[29] National Research Council. Cost, Effectiveness, and Deployment of Fuel Economy Technologies for Light-Duty Vehicles. National Academy Press. Washington, DC. 2015, 4-32-4-38.
[30] Toyota is offering for sale in California its first fuel cell electric cars, the Murai, at a list price of $58,000. James R Healey. Toyota Ready to Roll Out Murai Fuel Cell Car. USA Today. May 7, 2015, B3.
[31] Mike Ramsey. Ford's Aluminum F-150 Marks New Era. Wall Street Journal. January 13, 2014, B1.
[32] Nathan Bomey. GM's Chevrolet Takes Shots at Ford's Aluminum F-150. USA Today. July 7, 2015, 6B.
[33] Mike Colias. Chevy Ad Escalates Pickup War, Steel vs Aluminum Issue on the Table. Automotive News. July 6, 2015, 1.
[34] Steelmakers are countering the shift to aluminum with new light-weight steels. John W. Miller, Mike Ramsey. Aluminum Cars Take Heat from ArcelorMittal CEO. Wall Street Journal. June 17, 2014, B3.
[35] On why Fiat-Chrysler lags behind other major automakers in fuel economy, see Larry P Vellequette. Hiat Chrysler Lags Rivals in EPA's MPG Report. Automotive News. October 13, 2014, 3.
[36] Fiat-Chrysler's recent surge in profitability is linked to the commercial success of vehicles with relatively low fuel economy (e.g., Jeep Grand Cherokee and Dodge Ram pickup truck), but a small electric car, the Fiat 500e is being offered in California. Christina Rogers. Chrysler Weighs Jeep Expansion. Wall Street Journal. January 13, 2014, B4; Larry P Vellequette. Chrysler's New Roadmap. Automotive News. February 4, 2013, 6; Larry P Vellequette. Buy a Fiat 500e, Use Alternate Cars for Free. Automotive News. April 1, 2013.

leadership of Fiat-Chrysler has publicly criticized the regulatory fascination with electric cars[37] and is publicly searching for a merger partner that would provide access to lower-cost capital, technology sharing, economies of scale in production, and averaging opportunities in compliance with regulatory requirements.[38] The most plausible merger candidate (GM) has publicly declined to have any interest in a merger with Fiat-Chrysler. For the rank-and-file, UAW-organized workers at Chrysler plants, the 2025 regulatory requirements may increasingly appear as a threat to their economic futures.

D. Could the 2025 Regulatory Requirements Stifle the Automotive Recovery?

The U.S. economic recovery from the Great Recession (2007-2009) has been the slowest on record, but one of the bright spots has been the revival of the auto industry. Annual sales of passenger vehicles (cars and light trucks) in the USA averaged 16 million from 1998 to 2007. That sales rate collapsed to 10.4 million in 2009, reflecting the combined impact of accelerating underemployment, declining incomes, falling consumer confidence, defaults on home mortgages, and lack of consumer access to affordable car loans.[39]

Since 2009 the auto recovery has been impressive. After six straight years of sales growth, the industry is now (2015) selling more than 17 million new passenger vehicles, a record for the USA. Virtually all of the Big Three and the other global automakers have been reporting increasing revenue and profit in the post-Recession period. Although the margins for investments in the auto sector are less than in other sectors,[40] the recent period of profitability has allowed the Big Three to offer multiple years of bonuses to their workers and to make some new plant investments in North America.[41] Foreign automakers have also announced new plant investments in the USA. As a result, auto-related employment in the USA – both at assembly plants and at facilities that make engines, components and parts – has rebounded significantly from the depressed levels of 2008-9, though it remains far below the pre-Recession levels.

The last time regulators analyzed the economic impact of the 2025 requirements was 2011-2012. CARB did not present an estimate of the impact of the ZEV mandate on new vehicle car sales. It did find that, over the life of the vehicle, the consumer would benefit from fuel savings that are about equal to the ZEV's higher purchase price.[42] In 2012 EPA/DOT also declined to supply an estimate of impact on new vehicle sales.[43] They concluded, however, that concluded that the near-term fuel savings would more

[37] Eric Beech. Fiat Chrysler CEO: Please Don't Buy 500e Electric Car. May 22, 2014, http://news.yahoo.com/fiat-chrysler-ceo;

[38] Amy Wilson. Duplicating Vehicle Engineering Pushes Costs and Prices Higher. Automotive News. August 17, 2015, 17.

[39] Mike Ramsey. Automakers Rebound as Buyers Go Big. Wall Street Journal. January 4-5, 2014, A1.

[40] The rate of return on capital in the auto industry (7.8 per cent for large automakers) is much smaller than both the oil and gas (10.0%) and aerospace/defense (19.0%) sectors. Eric Sylvers, Christina Rogers. Fiat Chrysler Pitched GM, Others about Consolidation. Wall Street Journal. May 30-31, 2015, B1.

[41] Edward Niedermeyer. Welcome to General Tso's Motors. Wall Street Journal. May 1, 2013, A17; John D Stoll, Judy McKinnon. GM Plans $5.4 Billion in US Investments. Wall Street Journal. May 1, 2015, B3.

[42] California Air Resources Board. Staff Report: Initial Statement of Reasons. Advanced Clean Cars; 2012 Proposed Amendments to the California ZEV Regulations. December 7, 2011, 64-65.

[43] EPA/DOT. 2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emission and CAFÉ Standards. Federal Register. 77(199). October 15, 2012, 62623-63200, 62947; U.S. Environmental Protection Agency. Regulatory Impact Analysis. Final Rulemaking for 2017-2025 Light-Duty Vehicle GHG Emission Standards and Corporate

than pay for the costs of the required fuel-saving technologies.[44] Those consumer-payback conclusions rest on a variety of assumptions, some that seem valid today, some that were questionable when they were made originally, and some that look increasingly dubious in light of changing economic conditions and new evidence of consumer indifference to – or undervaluation of – fuel savings from new technologies.

The good news is that the cost-effectiveness of some fuel saving technologies appear to be superior today than was anticipated in the 2011-2012 period. Aluminum and other light-weight materials (e.g., light-weight steel) appear to be delivering larger fuel savings at lower cost than was projected in 2011-2012.[45] It is generally assumed that the production costs of new technologies will decline over time due to "learning by doing" and economies of scale in the production cost. The extent of those cost savings are difficult to predict in advance and they cannot be guaranteed.

Indeed, the cost of mass production of lithium ion batteries remains above $10,000 per vehicle and has not declined as fast as some analysts predicted, which partially explains why the market penetration of plug-in electric vehicles has been slower than anticipated.[46] Even if plug-in vehicle production expands, the batteries are likely to be produced in Asia since the US battery producers, despite federal subsidies, have not been able to compete effectively with LG Chem, Samsung, and Panasonic.[47]

More sobering are two weaknesses in the original regulatory analyses that need to be reconsidered in the forthcoming midterm review. These weaknesses, when corrected, may alter the economic determinations of the regulators.[48]

First, EPA/DOT started with a baseline vehicle (e.g., a 2016 vehicle) with certain fuel-consuming characteristics (e.g., engine performance, safety features, trunk space, cargo-carrying and towing capability, and ride height). Those characteristics were held constant by regulatory analysts from 2016 to 2025 as fuel-saving technologies were added to comply with increasingly stringent mileage and carbon-reduction requirements. The flaw in this assumption is that consumers have been demanding (and manufacturers have been delivering) steady improvements in most of these characteristics for decades.[49] Any automaker that stops innovating on those dimensions will be vulnerable to a competitor that continues to innovate. If EPA/DOT had made the more realistic assumption that automakers will continue to improve vehicles on those fuel-consuming characteristics (e.g., performance, safety, and

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Average Fuel Economy Standards. EPA-420-R-12-016. August 2012, 8-1; U.S. Department of Transportation. Corporate Average Fuel Economy for MY 2017-2025 Passenger Cars and Light Trucks. Final Regulatory Impact Analysis. Washington, DC. August 2012.

[44] US Environmental Protection Agency/US Department of Transportation. 2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emission Standards and Fuel Economy and Corporate Average Fuel Economy Standards. Final Rule. Federal Register. 76(179). 2012, 62623-63200.

[45] National Research Council. 2015, 6-4 to 6-27.

[46] Neil Winton. Electric Car Prospects Stall, Awaiting Promised Battery Improvements. Forbes. July 24, 2015; National Research Council. 2015, 4-41-42; National Research Council. Overcoming Barriers to Deployment of Plug-In Electric Vehicles. National Academy Press. Washington, DC. 2015, 27; National Research Council. 2015, 4-12.

[47] Mike Ramsey. Auto Industry's Ranks of Electric-Car Battery Suppliers Narrow. Wall Street Journal. August 20, 2015, B5.

[48] The Alliance of Automobile Manufacturers recently commissioned a team at Indiana University to explore this question. Results will be shared with federal agencies during the mid-term review.

[49] Christopher R Knittel. Automobiles on Steroids: Product Attribute Tradeoffs and Technological Progress in the Automobile Sector. American Economic Review. 101(7). 2011, 3368-99.

cargo space), then the regulatory analyses would have concluded that more fuel-saving technologies will be required and thus the costs of complying with the 2025 regulatory requirements are even greater than they were estimated to be.[50] And as consumers continue to shift their vehicle tastes from small and mid-sized cars to performance-oriented sedans and light trucks, the assumptions underlying the 2011-12 regulatory analyses may become even more untenable. In effect, regulators may have underestimated significantly the extent of costly fuel-saving technologies that automakers will have to add to cars and light trucks.[51]

Second, EPA/DOT and CARB envisioned a consumer who was facing high and rising gasoline prices and was willing to invest in the green technologies that would save on fuel expenses during vehicle operation.[52] CARB, for example, assumed a fuel price of $4.02 per gallon in 2025 and fuel savings that accumulate for 15 years at an annual discount rate of 5%. EPA assumed a starting fuel price of $3.87 per gallon that rises to an average of $4.13 per gallon for the 2017-2050 period.[53] From 2009 to 2011, the US Energy Information Administration raised its oil-price forecasts, suggesting that oil-saving regulations have longterm value.[54]

Due to recent changes in global oil markets, including the shale revolution in North America, the average US price of gasoline has plummeted below $2.50/gallon and the low fuel prices may not be temporary. The EIA has already revised downward some of its long-term oil-price and fuel-price forecasts: in the reference and low cases, the average price of gasoline remains below $3.00/gallon ($2013) through 2025; in the high case, it reaches $4.25/gallon in 2025.[55] More revisions may occur between now and the midterm review in 2017 and when new vehicles are offered for sale in 2025. EIA's next forecast is scheduled for the spring of 2016.

When consumers make investment decisions in new vehicles, it is the current gasoline price that tends to influence their degree of interest in green technologies,[56] and the current price in 2025 may be much smaller than EPA/DOT and CARB assumed in their regulatory analyses. Moreover, industry experience and a small but growing – and somewhat conflicting -- body of academic literature suggests that some consumers "undervalue" the private fuel-saving benefits of green technologies (e.g., by applying inordinately high discount rates or counting only those fuel savings that occur within three years of the

[50] National Research Council. 2015, 10-38 (Finding 10.8, Recommendation 10.7).
[51] Anup Bandivadekar, Lynette Cheah, Christopher Evans, Tiffany Groode, John Heywood, Emmanuel Kasseris, Matthew Kromer, Malcolm Weiss. Reducing the Fuel Use and Greenhouse Gas Emissions of the US Vehicle Fleet. Energy Policy. 36. 2000, 2754-2760.
[52] In the three years prior to the federal rulemaking, average retail prices per gallon of gasoline in the US rose from $2.35 in 2009 to $2.78 in 2010 to $3.53 in 2011 to $3.63 in 2012. NADA. Plug-In Electric Vehicles: Market Analysis and Used Price Forecast. Q2 2013, 7.
[53] EPA. 2012, 5-26, 5-30 (Table 5.5-3), 7-2.
[54] In 2009, EIA's reference oil price forecast for 2030 was $70/barrel ($2006); the low and high forecasts were $42 and $119 per barrel, respectively. In 2011 EIA's reference oil-price forecast was upped to $125/barrel ($2009) by 2035; the low and high forecasts were set at $50/barrel and $200/barrel.
[55] Energy Information Administration. Energy Prices. Annual Energy Outlook 2015. http://www.eia.gov/forecasts/aeo/section_prices.cfm.
[56] Soren T Anderson, Ryan Kellogg, James M Sallee, Richard T Curtin. Forecasting Gasoline Prices Using Consumer Surveys. American Economic Review Papers and Proceedings. 101(3). 2011, 110-114; Soren T Anderson, Ryan Kellogg, James M Sallee. Journal of Environmental Economics and Management. 66. 2013, 383-403; Jeff Bennett, Neal E Boudette. Lower Gas Prices Drive Auto Sales. Wall Street Journal. November 2, 2013, B3.

purchase decision).[57] A related concern is that the resale values of used electric cars have fallen to dismally low levels, further suggesting that consumer interest in green technology is not as strong as regulators may have assumed.

The estimated price increases associated with the 2025 EPA/DOT standards range from an average of $2,556 per vehicle (EPA/DOT estimates) to $5,112 per vehicle (Scenaria Inc, a unit of the Australian engineering firm AVL Group).[58] The variation in estimates arise from differences in forecasts of which technologies will be implemented and how much those technologies cost and how large the fuel savings are. The most authoritative cost and fuel-saving information come from two National Academy of Engineering reports, one issued in 2011 and an update issued in 2015.[59] Although those two reports provide valuable information, they do not provide cost estimates that are readily compared to the estimates cited above.

If consumers are offered new vehicles in 2025 that have unattractive price-attribute combinations, consumers have a viable decision alternative that should not be forgotten. They can simply buy a used vehicle or hold on to their existing vehicle for a longer period of time. In 2013 there were 42 million used cars sold in the USA, with an average selling price of $17,000.[60] That price is roughly half of the average new vehicle price on a volume of sales that is 2.5 times the number of new vehicle sales. The median age of vehicles on the road has been steadily rising for decades. The burst of new vehicle sales after the Great Recession is partly explained by the fact that some consumers delayed their purchases during the depressed months of 2007-2009. In other words, there is ample evidence that consumers look at new vehicle sales in the context of decision making that includes used vehicles and holding an existing vehicle for a longer period of time.

One might argue that the federal and state governments will subsidize the transition to greener automobiles by offering a variety of generous monetary and non-monetary inducements to consumers. A committee of the National Research Council has issued a report suggesting a variety of subsidies that could help overcome barriers to the commercialization of plug-in vehicles.[61] In Norway, for example, where plug-in electric vehicles rose temporarily to almost one-third of all new vehicle sales, the government provided a subsidy at purchase that accounted for a substantial share of the cost of purchasing a plug-in vehicle. The U.S. federal government already offers an income tax credit to purchasers of electric vehicles that can be as large as $7,500. Some states and localities chip in additional cash rebates and/or offer HOV lane access or reduced-rate parking to users of plug-in

[57] For a sampling of this literature, see DL Greene. Why the Market for New Passenger Cars Generally Undervalues Fuel Economy. Discussion Paper 2010-6. International Transportation Forum. OECD. Paris, France. 2010, http://cta.ornl.gov/eta/Publications/Reports/Why-the-Market; Thomas S Turrentine, Kenneth S Kurani. Car Buyers and Fuel Economy. Energy Policy. 35. 2007, 1213-23; James Sallee. Rational Inattention and Energy Efficiency. NBER. 2012; K Gillingham, K Palmer. Bridging the Energy-Efficiency Gap: Insights from Theory and Empirical Analysis. Discussion Paper 13-02. Resources for the Future. 2013; K Gillingham, RG Newell, K Palmer. Energy Efficiency Economics and Policy. 1. 2009, 597-620.

[58] Christina Rogers. NADA: CAFÉ Plan Adds $5,000 to Stickers. Automotive News. January 23, 2012. Lindsay Chappell. One Study Says Feds' Cost Estimate is Low. Automotive News. October 15, 2012, 28.

[59] National Research Council. Assessment of Fuel Economy Technologies for Light-Duty Vehicles. Committee on the Assessment of Technologies for Improving Light-Duty Vehicle Fuel Economy. 2010.

[60] Christine Rogers. Some Automotive Companies to Start Used-Car Dealership Chain. Wall Street Journal. August 18, 2014, B3.

[61] National Research Council. Overcoming Barriers to Deployment of Plug-In Electric Vehicles. National Academy Press. Washington, DC, 2015.

vehicles. Both Massachusetts and Connecticut have recently added cash incentives for the purchase of plug-in vehicles.[62]

There is growing evidence, however, that taxpayers and politicians have limited patience for public subsidies of green vehicles. The generous incentives once made available for conventional hybrids were eliminated several years ago. The federal government has already eliminated the $2,000 tax credit for purchase of a home or office recharging station. Several conservative politicians and radio talk-show hosts are raising public awareness of the fact that tax credits and subsidies of plug-in vehicles benefit primarily households with incomes in the top 1% of the US income distribution. The State of California recently amended its Clean Car rebate program by disallowing wealthy households from accessing the rebates.[63] The states of Georgia and Illinois recently eliminated their cash incentive programs for electric vehicles.[64] Some states, responding to voter outrage that Tesla owners do not pay fuel taxes for highway repairs, have enacted flat fees on registration of plug-in electric vehicles. If gasoline taxes are replaced by mileage fees (as has been proposed in several states), owners of electric vehicles will face somewhat higher operating costs for their green vehicles. Perhaps the most telling indicator is the government of Norway, which has announced a decision to phase out its generous subsidies of plug-in electric vehicles, in part because they are seen as having accomplished their purpose and in part because they are seen as fiscally unsound.

Thus, as the midterm review of the 2025 requirements approaches, it would be imprudent to assume that the higher purchase prices of high-mileage vehicles will be entirely or substantially offset by public subsidies and incentives. While the politics of green cars are somewhat difficult to predict, it seems more likely that public subsidization in the USA will decline (rather than increase) from the levels of subsidy expected by EPA/DOT and CARB in 2011/2012.

E. Perverse Ramifications of a Decline in New Vehicle Sales.

If the 2025 regulatory requirements are not modified and do result in a significant decline in new vehicle sales (compared to the volume of sales that would have occurred in the absence of the requirements), the effects on the United States would be perverse in both obvious and non-obvious ways. The obvious outcome would be reduced levels of employment at auto assembly plants as well as the supply chain that provides the engines and other parts for new vehicle assembly. Those employment losses and the communities that are harmed will be concentrated in the Midwest and southern states where the auto recovery has been the strongest. Plants organized by the UAW and operated by Fiat Chrysler might be severely impacted but several other companies that rely on sales of lower-mileage vehicles might also be adversely affected (Chrysler, GM, Ford, BMW and Daimler).[65] Honda, Nissan, and Toyota, due to their smaller product mixes and accumulated compliance credits, might be less impacted.

Less obvious ramifications of a lower rate of new vehicle sales are (1) more miles of travel by older vehicles that are less fuel efficient and less safe than new vehicles, (2) higher prices for used vehicles, which hurts the lower-income families that rely on the used-vehicle market to meet their transportation

[62] Jamie LaReau. Connecticut Offerrs EV Rebates to Jolt Sales. Automotive News. August 24, 2015, 10.
[63] Stephen Edelstein. California Ends Electric-Car Rebates for Wealthy Buyers; Boosts Them for Poorest. Green Car Reports. July 21, 2015
[64] "EV Credits – and Debits." Automotive News. June 8, 2015, 4.
[65] Thomas Klier, Joshua Linn. New Vehicle Characteristics and the Cost of the Corporate Average Fuel Economy Standard. Federal Reserve Bank of Chicago. WP 2008-13. November 2008.

needs. If the losses in new vehicle sales from the ZEV requirements are large, those losses could readily cause indirect environmental and safety harm that is greater than the direct environmental benefits of the ZEV requirements.[66]

The prospects of a political backlash against the 2025 requirements are not hypothetical since a backlash of this form occurred previously after the initial run-up of federal mileage standards from 1975 to 1985. During the George Herbert Walker Bush administration, DOT was compelled to relax mileage requirements temporarily because gasoline prices fell sharply and consumers were not purchasing the high-mileage vehicles that regulators compelled auto companies to produce. When the Clinton-Gore administration pledged a rapid rise of federal mileage requirements in 1993-94, a potent political coalition of automakers, suppliers, dealers, the UAW, farmers and small businesses put the matter to rest over the objections of environmentalists. An appropriations rider was passed by Congress with bipartisan support that froze federal mileage standards for almost a decade.[67] It was not until fuel prices rose rapidly again from 2000-2002 that Congress reluctantly removed the freeze and allowed federal mileage requirements to rise again (initially only for light trucks). Later in the Bush administration, Congress went further and mandated a substantial tightening of federal mileage requirements but this occurred in a period when oil prices were high and rising and consumers were angered about the rising prices of gasoline at the pump. When presidential candidate Barack Obama pledged his 50 mile-per-gallon program during the 2007-8 campaign, he did so in response to public concerns about rising fuel prices and oil dependence as well as climate change.[68]

F. The Search for Solutions

The 2016-2017 mid-term review process will be the key forum to consider a wide range of solutions to the dilemmas outlined in this case study. Proposals that can be implemented through executive action are more promising than proposals that require legislative change, since gridlock has been an increasingly common feature of the US Congress. Below we sketch out a few reform options, without subjecting any to detailed analysis.

The most obvious option is a delay in the 2025 requirements to 2030 to 2035. The delay will offer more time to develop and implement cost-saving innovations in green technologies. If the costs of green technologies can be reduced through enhanced R&D, the burdens on the regulated industry and consumers will be lessened. The downside of this option is slower progress against greenhouse gas emissions and a perceived weakening of the US commitment to address climate change at a time when the US is striving to persuade developing countries to join a global climate policy.

A more modest idea is the addition of fuel-price triggers to the 2021-2025 requirements. Under this plan, a more gradual path upward in mileage requirements would automatically take effect if average national fuel prices remain below $3.00 per gallon between now and 2018. A variant of the plan would link the required mileage levels to fuel-price levels. A complication is that automakers must make capital investments on new models 4 to 6 years before the models appear on the showroom floor. Nonetheless, if automakers know that the stringency of federal mileage requirements will adjust

[66] Howard Gruenspecht. Zero Emission Vehicles: A Dirty Little Secret. Resources. RFF. Winter 2001 (Issue 142), 7-10.
[67] John D Graham. Bush on the Home Front. Indiana University Press. 2010, 168-169.
[68] John D Graham. 2010, 175-179.

automatically with changes in average fuel prices, the political uncertainty in the process will be lessened. This option might be feasible through rulemaking, without the need for new legislation.

An alternative option is a higher gasoline tax or new carbon tax that would stimulate consumer interest in greener vehicles, thereby removing the wedge that has been inserted between what consumers want to purchase and what regulators are requiring automakers to produce. Either tax would have to be quite substantial to have much effect on consumers, but a larger federal tax of any magnitude is politically toxic in today's partisan politics. Some states are adopting higher gasoline taxes for highway repairs but the magnitudes are trivial in the context of the issues being discussed here.

The federal government already imposes a "gas-guzzler" tax that could be replaced with a "feebate system" that offers rebates to consumers that purchase high-mileage vehicles and imposes fees on consumers that purchase low-mileage vehicles. Those feebates could also replace the unorganized array of subsidies and credits that now exist. Feebates can be seen as supplements or alternatives to the 2025 regulatory requirements. While this idea appeals to policy designers, the politics are quite complicated and the same form of political backlash that could freeze federal mileage/carbon requirements could easily block a legislative proposal for feebates.

In order to provide more compliance flexibility for vehicle manufacturers, Congress or federal agencies might provide additional compliance options. Automakers are already seeking "off-cycle emissions credits" toward the federal requirements for innovations such as greater use of glass and paint that reflect solar rays, for ventilated seats, for LED lights, for active grill shutters, for stop/start systems, for more efficient transmissions, for adaptive cruise control, for real-time traffic updates on nearby roads and highways, for enhanced alerts that oil changes are needed, and for more efficient AC compressors. The fuel savings from such "off cycle" improvements do not show up on the laboratory dynamometers that are used to measure federal compliance.[69] Another option would be to replace 87 octane gasoline with 95 octane, which would increase fuel economy and lower carbon dioxide emissions. But, higher octane gasoline is more expensive to produce and could add 30-40 cents per gallon to the price at the pump.[70] Moreover, shifting the regulatory burden from car makers to refiners confront political complications, since the refining industry is already facing a bevy of EPA regulations.

Congress could take steps to reduce the number of regulators in this arena from three to two or even one. The Obama administration was successful in engineering an unusual degree of coordination between EPA, DOT and CARB as it relates to mileage and carbon standards. Whether future administrations can accomplish a similar degree of coordination is questionable. On the other hand, CARB's ZEV program is not well coordinated with the national requirements. Indeed, the additional plug-in vehicles stimulated by the California program may do little or nothing to reduce overall greenhouse gases since those ZEVs can be counted by global automakers in their compliance plans for federal requirements. Stated differently, each ZEV mandated by California and the aligned states may be offset by an additional low-mileage vehicle sold somewhere in the country.[71]

[69] Neil Roland. Experts Urge New Technologies Be Stirred Into CAFÉ Scores. Automotive News. November 30, 2009; Gabe Nelson. Daimler Asks EPA to Let Tech Features Bolster its Mileage Ratings. Automotive News. November 4, 2013, 4.

[70] Richard Truett. Higher Octane Fuel Could Add MPG, SAE Panel Says. Automotive News. April 27, 2015, 25.

[71] This is a phenomenon that economists call leakage, and it has been shown to undermine the effectiveness of other greenhouse gas rules in California. See Lawrence H Golder, Mark R Jacobson, Arthur A van Bentham.

Using executive authority and the EPA waiver authority under the Clean Air Act, it may be feasible for the federal government to withdraw its waiver for the California ZEV program unless California and the aligned states offer a variety of compromises.[72] For example, the percentage ZEV requirements may need to be softened and/or states that enforce ZEV requirements must be prepared to demonstrate that they are offering significant public subsidies for ZEVs. Whether creative use of the waiver authority can survive judicial scrutiny is an important question beyond the scope of this paper. Congress could provide EPA such authority in reform legislation, thereby reducing any legal uncertainties about EPA's current authority. In general, the waiver authority for California's programs needs to become sensitive to national economic and cost-benefit concerns rather than focus exclusively on whether California's program is more environmentally protective than the federal program.

In summary, one of the bright spots of the US economic recovery has been the resurgence of the auto industry since the bleak depths of the Great Recession (2007-2009). The 2025 mileage and ZEV requirements, though well intended to achieve environmental and energy-security objectives, could represent a threat to the economic recovery by triggering a significant decline in new vehicle sales. The forthcoming mid-term review of federal and California policies, scheduled for 2016-2017, should take a careful look at modifications of current policy that will lessen economic risk without stopping progress in the control of greenhouse gases.

CASE STUDY #2: REGULATION OF MANUFACTURING FACILITIES UNDER THE CLEAN AIR ACT

Unlike the first case study, which focuses on regulation of a manufactured product, the second case study addresses an environmental program that regulates the way that manufacturing plants and facilities produce their products. The second case is of special interest because the EPA program in question touches on the operation of virtually every manufacturing facility in the United States, though the program is known to have disproportionate impacts on steel plants, cement kilns and a variety of other facilities with significant emissions of conventional air pollutants.

A. NAAQS

The Clean Air Act (CAA) requires that EPA establish National Ambient Air Quality Standards (NAAQS) for pollutants ubiquitous "criteria" pollutants such as SO2, NO2, fine PM and ozone. The Standards are to protect human health and welfare. As we shall see, the structure of the standard-setting process and advances in science almost assures a periodic ratcheting down of these standards. As a result, the location of new or revitalized manufacturing facilities is becoming more challenging in many areas of the US.

The statutory language requires primary health-based ambient air standards "…which in the judgment of the Administrator, based on such criteria and allowing an adequate margin of safety, are requisite to protect the public health..."[73] The Clean Air Act also requires EPA review of the NAAQS every 5 years.[74]

Unintended Consequences from Nested State and Federal Regulations: The Case of the Pauley GHG-Per-Mile Limits. National Bureau of Economic Research. Working Paper 15337. September 2009.

[72] At an October 2012 EPA hearing, the Alliance of Automobile Manufacturers urged EPA to block California's request for a ZEV waiver. Ryan Beene. ZEV 'Straightjacket'? Automotive News. January 7, 2013,4.

[73] Section 109 of the CAA

[74] Ibid.

While EPA has not recently met the 5 year deadline for any criteria air pollutant, environmental groups have forced EPA into what amounts to an almost continuous review of the several NAAQS. Since advances in the health sciences permit increasingly sophisticated studies focused of subtle effects on sensitive subpopulations, the stage is set for greater stringency in the NAAQS for each air pollutant. The result has been and will continue to be a continuing pressure to ratchet down the NAAQS in future years.

In the last several years, EPA has set more stringent NAAQS for SO2, NO2, and fine PM. This month (October 15 deadline), EPA has adopted a more stringent ozone NAAQS (proposed range .06 to .07). These NAAQS can impose substantial costs on the U.S. economy and, in particular, on the manufacturing sector. For the ozone NAAQS NPRM, EPA estimated costs of $3.9 billion/year at 70 ppb and $15 billion per year at 65 ppb. Some major metropolitan areas like Los Angeles, Houston, and the East Coast megalopolis are in continuous non-attainment of the ozone and fine PM NAAQS. These areas face a continuing pressure to reduce emissions from the transportation and manufacturing sectors. Other large cities find that with a ratchet down in the NAAQS they are in nonattainment again (after spending years to meet an earlier standard) and must adopt additional/more stringent emission controls. In addition to requiring further control of existing plants, these NA areas must contend with CAA provisions that limit the siting of any major new sources of air pollution.[75]

The resulting more stringent standards impose direct costs on the US economy by requiring further emissions control in areas that fail to meet the NAAQS—so-called non-attainment (NA) areas. In both existing NA areas and the additional areas newly designated as NA areas, manufacturing, mobile (cars & trucks) and area sources will be required to meet increasingly costly emission controls or switch to non-polluting technologies. In addition, the continuing ratcheting downward of the NAAQS is making it increasingly difficult to site major new manufacturing sources. In this case study, we explore the effects of a ratcheting down of the NAAQS on the manufacturing sector, including the effects on siting new manufacturing facilities.

Background

Studies of the historical effect of the CAA on economic activity report significant economic costs in NA areas. (Henderson 1996, Greenstone 2002, List 2003) For example, Greenstone (2002) estimated that NA counties lost $37 billion in capital, $75 billion of economic production (1987 $) and 590,000 jobs over the period from 1972 to 1987 as compared to attainment counties in the US. In a recent study, Greenstone et al. (2012) estimated a significant decline in total factor productivity for pollutant intensive plants in NA areas. They report that this decline in productivity translates into a loss of $450 billion for polluting plants in NA areas over the 1972 to 1993 period of study.

While these studies suggest a substantial shift of pollution-intensive industry away from NA areas in the U.S., these studies may simply reflect a shift of activity within the US from NA areas to attainment areas.

[75] To be sure, there are additional health and welfare benefits associated with more stringent NAAQS. In the case of Ozone, EPA estimates in its RIA that benefits increase significantly with successively more stringent standards. And, even net benefits arguably increase with the more stringent Ozone standards. This result is largely driven on the benefit side by the substantial additional reductions in premature mortality with successively more stringent Ozone NAAQS. On the cost side EPA assumes that the cost of needed emission reductions will be capped at $15,000 per ton, arguing that technological innovation and the ability of States and local governments to delay unreasonably costly measures will mitigate the cost of the NAAQS.

There are relatively few studies in the economic literature evaluating the effect of environmental regulation on the competitiveness of the U.S. manufacturing sector. A variety of other factors likely play an important—even dominant—role in decisions on whether to locate in the U.S. versus another country. These factors include, for example: access (and cost of) important factors of production, transportation costs, existing investment in facilities and infrastructure in the U.S., tax considerations, and exchange rate effects. Any empirical evaluation of the effect of environmental regulations is difficult to do because it must account for these other factors in teasing out any regulatory effect. Only a few studies have attempted to do it. This limited empirical literature suggests that environmental regulation has been a relatively minor factor in determining location. (Jaffe et al. 1995; Levinson & Taylor 2008) On the basis of this limited set of studies, Aldy & Pizer suggest that the adverse effect of NA/CAA requirements in shifting economic activity and jobs away from NA areas to "clean" areas within the U.S. has been more important than the effects in terms of forcing this economic activity offshore to pollution havens.[76]

These economic studies have looked at the past history of the CAA in the decades before 2000. With further tightening of the NAAQS, the difficulty of siting major manufacturing sources in the U.S. may result in a more decided shift to off-shore sites.

B. New Source Review

The CAA requires that new plants and major modification of existing plants must go through a preconstruction review. New plants and major modifications in non-attainment (NA) areas are required to adopt Lowest Achievable Emission Rate control technology and obtain offsetting emission reductions from other sources within the NA area sufficient to ensure that the plants emissions do not affect ambient air quality. These requirements make it difficult to site new plants in NA areas.

In particular, discussions with industry sources suggest that the cost of emission offsets effectively prohibit the siting of any major plant (from a pollutant intensive industry) in major metropolitan non-attainment areas. In Houston, emission reduction credit prices vary from $150,000 to $200,000 per ton for VOCs and $80,000 to $100,000 per ton for NOx. [77] In the South Coast NA area in California, average emission credit prices in 2014 were $23,500 per ton for VOCs and $63,000 per ton for NOx.[78] Table 1 provides reported prices and quantities for major areas in California. The prices of emission offsets in these areas substantially exceed reported control costs for Best Available Control Technology (BACT) control in attainment areas. In addition, the quantities involved in these emission offset transactions are relatively small as compared to the emissions from a new major source—with VOC and/or NOx emissions of at least 40 tons per year--coming into a NA area. If the applicant does not have a facility in the NA area that it can readily control (or tear down) to provide offsets, then, emissions offsets for 5 or more years in the future are hard to find.

More stringent NAAQS standards will also have an important effect on the siting of new sources in attainment areas. Under the Prevention of Significant Deterioration (PSD) provisions of the CAA, new

[76] Aldy & Pizer (2011). THE COMPETITIVENESS IMPACTS OF CLIMATE CHANGE MITIGATION POLICIES. NBER Working Paper 17705 http://www.nber.org/papers/w17705

[77] Element Markets, September 9, 2014, Update on Scarcity of Houston-Galveston-Brazoria (HGB) Emission Reduction Credits (ERCs) and Allowances, and use of NOx ERCs for VOC ERCs http://www.awma-gcc.org/docs/Sept2014Presn.pdf

[78] http://www.arb.ca.gov/nsr/erco/erc14.pdf

plants and major modifications in attainment areas must also go through a pre-construction permitting process. This process requires that these plants:

- Adopt best available control technology (BACT) for the CAA conventional pollutants (SO2, …)
- Provide an analysis of the effect of plant emissions on ambient air quality, including both pre-construction monitoring of air quality in the area and air quality modeling of the effect of the plant emissions on ambient air quality.

The permitting authority—generally the States—must then assure that plant emissions do not result in changes in ambient air quality that exceed the primary and secondary National Ambient Air Quality Standards for these pollutants and does not result in an increase in ambient air levels that exceed the allowable increase set by the PSD increments provided by the CAA.[79]

C. Costs of the NSR Process and Permitting Delays

The permit application process can involve up to five different stages: permit preparation; determination of application "completeness"; public notice and comment; response to comments; and possible administrative and judicial appeals.[80] EPA's 2001 NSR Report notes that "most developers describe [NSR] permitting as an extremely complex and time-consuming process."[81] A recent comment filed by an industry coalition stated:[82]

> Sources generally invest years in engineering, design and assessment studies before submitting a permit application for a major source. Even under optimistic conditions, it can take at least two years from the beginning of the frontend engineering work until public notice of the draft permit is published.

The NSR process imposes direct costs in terms of the time and resources required to prepare the permit application (and to provide responses to questions and issues that arise in the permitting process). The uncertainty and delay that attend the permitting process may impose additional costs, including financial costs and penalties.[83] The opportunity costs associated with delays or cancellation of projects include the additional production forgone and the reduction in emissions from these well-controlled

[79] The CAA established PSD increments for PM and SO2 for the three classes of attainment areas (Class I [pristine], Class II [intermediate], and Class III [growth]). EPA has established PSD increments for the other conventional pollutants through rulemaking.
[80] NSR 90-Day Review Background Paper, at 5.
[81] Id. at 11.
[82] Air Permitting Forum (March 17, 2015). Comments of the Air Permitting Forum: National Ambient Air Quality Standards for Ozone; Proposed Rule.
[83] EPA's 2001 NSR Background Report states: "Permitting (including required public hearings and comment processes) can be costly not only because of the time and human resources involved, but also because of uncertainty and delay." (EPA 2001, 22)

new or retrofitted facilities.[84] In addition, the potential for long delays and uncertainty could lead to suboptimal decisions in upgrading existing capacity and installing new capacity.[85]

Some economists and industry representatives have argued that the focus of NSR on preconstruction review of new or modified plants and the attendant significant costs associated with the NSR program has penalized the construction of new plants and the retrofit of existing plants—resulting in a "new source bias".[86] Thus it has arguably been more economic in some cases to continue to operate older, inefficient, dirtier plants than to install new facilities or to upgrade existing facilities with the best pollutant control technology.[87] To the extent this has occurred, NSR review has had the perverse effect of delaying reductions in pollutants like SO2 and NOx.[88]

Historical Record: NSR Permit Delays

A recent RFF Discussion Paper provides a snapshot of the NSR process from the date EPA or State notifies applicants that the NSR application is complete to the issuance of the final permit.[89] Over the period from 2002 to 2014, the nationwide average time to obtain an NSR permit for coal and natural gas–fired electric generating units (EGUs) and refineries was roughly 14 months.[90] This represents a

[84] EPA's 2001 NSR Report notes that "delay, for example, can cause a developer to miss advantageous financial circumstances when interest and equity costs are low." Id. at 11. In addition, the applicants may have penalty clauses associated with delays in the start of construction in their contracts with engineering and construction firms. These penalties could be as much as $35,000 to $40,000 per day. Private communication from Jeff Holmstead.

[85] These time-cost considerations may be particularly important in the petroleum refining industry, where the National Petroleum Council claimed that "the most critical factor in the U.S. refining industry's ability to meet new fuel requirements in a timely manner is the ability to obtain permits. Id. at 44. National Petroleum Council, U.S. Petroleum Refining: Assessing the Adequacy and Affordability of Cleaner Fuels, June 2000. EPA's 2001 Background Report also cited statements by several oil company executives claiming that the NSR process impedes the US refinery industry's capacity to expand. See NSR 90-Day Review Background Paper, at 44.

[86] Gruenspecht and Stavins, New Source Review under the Clean Air Act: Ripe for Review, 20-21 RESOURCES FOR THE FUTURE, Spring 2002, Issue 147, available at http://www.rff.org/RFF/Documents/RFF-Resources-147.pdf; and NSR 90-Day Review Background Paper. The direct costs to add pollution controls at existing facilities are often significantly greater than the corresponding control cost for a new plant, because pollution controls can be incorporated in the initial design of a new facility, whereas compatibility problems and space constraints at existing facilities often complicate the retrofit of controls at these facilities. See supra note 7, at 18.

[87] EPA's 2001 NSR Report found some evidence to support this argument, reporting that NSR for existing sources "has impeded or resulted in the cancellation of projects which would maintain and improve reliability, efficiency, and safety of existing energy capacity." EPA, New Source Review: Report to the President. June 2002, at 1, available at http://www.epa.gov/nsr/documents/nsr_report_to_president.pdf. Cited by NATIONAL ACADEMY OF SCIENCES, New Source Review for Stationary Sources of Air Pollution (2006), at 45.

[88] Clean Air Act Requirements and History, US ENVIRONMENTAL PROTECTION AGENCY (last modified Aug. 15, 2013), available at http://www.epa.gov/air/caa/requirements.html. To be sure, supporters of the current NSR program argue that NSR review yields important reductions in the covered pollutants. For example, EPA's 2001 NSR Report estimated that PSD best available control technology (BACT) permitting over the period 1997–1999 avoided 1.4 million tons per year in conventional pollutant emissions (largely reductions in SO2 and NOx emissions). NSR 90-Day Review Background Paper, at 8.

[89] Fraas, Neuner, & Vail, EPA's New Source Review Program: Evidence on Processing Time, 2002–2014, RFF (February 2015)

[90] Average processing times for NSR permits issued over the 2002–2014 period were substantially longer than the reported permitting times for the 1997–2001 period. The difference in processing times between nonattainment and attainment areas was small, and not statistically significant. These data are taken from EPAs RACT/BACT/LAER

substantial increase in average processing time for NSR permits as compared to the reported permitting times for the 1997–2001 period. The distributions are skewed—median values are less than the mean—with some projects requiring substantially longer to obtain NSR approval. Over this period, average processing times for new combined cycle EGUs were roughly comparable to the times for new greenfield coal-fired plants—roughly 16 months.[91] By comparison, processing times were shorter—10 months--for combustion turbines. In addition, we found a significant variation across EPA regions in the processing time required for approval of new natural gas-fired EGUs—varying from 7 months for Region 7 (IA, KS, MO, NE) to 19 months for Region 9 (AZ, CA, NV).

The data also show substantial year-to-year variation in processing times, with markedly longer processing times over the 2003–2005 and 2009–2011 periods. (Table 2.) The increase in permitting time over the 2003–2005 period may reflect the uncertainty in the NSR program with the DC Circuit Court review of EPA's 2002 and 2003 revisions to the program.[92] The longer processing times over the 2009–2011 period may reflect a transition as the Obama administration put its climate policy in place and as sources faced new air quality modeling requirements with EPAs revision of the NO2, SO2 and fine PM NAAQS. Figure 1 provides the distribution of processing times for NSR approval for combined cycle plants over the period 2010 to 2014. Two-thirds of these combined cycle plants received their NSR permits within one year (as required by Section 165(c) of the CAA); but the processing delay by the State or EPA permitting authorities ranged from over one year to three years for the remaining one-third of these plants .

NSR Review Delays

For NSR, several different layers of government are likely to be involved. Where EPA has approved the State Implementation Plan (SIP) provisions for NSR, the State is the primary permitting authority. However, under EPA regulations, EPA retains authority on air quality modeling and the States may be required to consult with the EPA region (and EPA headquarters) on modeling issues.[93] In States which have not obtained EPA SIP approval for their NSR process, EPA is the permitting authority. In most of these States, EPA has delegated the NSR process to the States, but retains ultimate permitting authority and must be consulted on all air quality modeling issues. In a relatively few cases, the State has refused to do NSR for one or more pollutants and in these cases EPA issues the NSR permit.

Changes in the NAAQS—for example, the recent changes in the NO2, SO2, fine PM and Ozone NAAQS--can further complicate the NSR review resulting in the delay in approval of projects and in the decision by industry to defer or cancel projects.[94] While EPA staff believe the States know how to proceed when

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Clearinghouse (RBLC). EPA staff report that they believe only half of the approved NSR projects are reported to the RBLC database.

[91] However, the clearinghouse database had few entries for new plants in recent years--only one additional NSR permit for a new coal-fired plant in 2012 and no additional permits for coal-fired plants in 2013 and 2014.

[92] The DC Circuit largely upheld EPA's 2002 revisions to its NSR program in June 2005. New York v. EPA, 413 F.3d 3 (DC Cir., June 24, 2005). On December 24, 2003, however, the DC Circuit blocked the 2003 NSR rule revising the routine maintenance, repair, and replacement provisions from going into effect until the court reached a final decision. In New York II, the DC Circuit held that the 2003 NSR revision was invalid. New York v. EPA, Case No. 03-1380 (DC Cir., March 17, 2006).

[93] Appendix W

[94] For example, the Baton Rouge Area Chamber reported that four major industrial projects were either put on hold or re-directed to another location after EPA proposed to revise the Ozone NAAQS last December. Baton

a NAAQS is changed, the State agencies have disagreed in comments to the agency.[95] For example, in the case of the proposed Ozone NAAQS, the Association of Air Pollution Control Agencies reports that 26 State agencies raised background ozone as an achievability or implementation challenge and 21 of these States reported concerns and limitations with the tools identified by EPA for regulatory relief.[96] [Need to complete: Contact Clint Woods, Asoc of Air Pollution Control Agencies. (For example, Hart (Wisconsin Department of Natural Resources Bureau of Air Management) said, "It takes us a long time to change our rules to try to catch up with federal regulations. We get behind, and then the federal regulation says one thing and our regulation says another."[97]) (better examples? South Dakota DEQ? Others?]

Changes in the NAAQS: Problems in Transition

New or revised NAAQS, must be incorporated immediately into the PSD permits process.[98] This is the case even after EPA has determined that a permit application is complete unless EPA by rule provides for grandfathering certain pending permits (e.g., permits determined as complete prior to the date the new NAAQS requirement becomes effective). (EPA, Oct 15, 2012) This became an issue with EPAs recent revision to the NAAQS for NOx. EPA adopted stringent 1-hour primary standards--the 98th percentile 1-hour daily maximum averaged over 3 years—to supplement the existing annual standard. Shortly after the NO2 NAAQS was issued, EPA put out a memorandum re-stating its longstanding policy requiring that NSR projects provide air quality modeling demonstrating that plant emissions would not cause or contribute to a violation of the 1-hour NO2 NAAQS.[99] The adoption of this short term standard greatly complicated the air quality modeling sources were required to provide in obtaining an NSR permit.

The standard air quality models in place incorporate overly conservative assumptions for modeling single source effects on ambient NO2 levels. This overconservatism was not a problem with the annual NO2 NAAQS; but with the new, stringent 1-hour NO2 NAAQS, the required air quality modeling effectively blocked a showing that a number of new plants would not cause or contribute to nonattainment.[100] EPA has been working through the modeling issues raised by the short-term 1-hour NO2 NAAQS. A year after setting the revised NO2 NAAQS, EPA provided initial guidance on some of the modeling issues (e.g., the treatment of intermittent, auxiliary sources) and provided additional flexibility in terms of modeling the cumulative effect of other sources within the region. In addition, EPA recently issued an NPRM that addresses additional key issues with modeling the 1-hour NO2 NAAQS—five years after promulgating the 1-hour NO2 NAAQS.

Rouge has monitored ozone levels of 72 ppb—a level above EPAs proposed range of 65 to 70 ppb. Baton Rouge Top 20 Metro Letter (March 2, 2015)

[95] GREENWIRE — Thu., May 14, 2015 AIR POLLUTION:
Strong opinions, shaky data in arguments over permitting

[96] http://www.csg.org/aapca_site/documents/AAPCASurvey-StateEnvironmentalAgencyPerspectivesonBackgroundOzoneandRegulatoryRelief-June201.pdf

[97] GREENWIRE — Thu., May 14, 2015 AIR POLLUTION:
Strong opinions, shaky data in arguments over permitting

[98] Ninth Circuit

[99] EPA (April 1, 2010), Applicability of the Federal Prevention of Significant Deterioration Permit Requirements to New and Revised National Ambient Air Quality Standards (Memorandum).

[100] Similar problems also arose with EPAs promulgation of a 1-hour SO2 NAAQS in June of 2010. For a case study of one plants problems with the SO2 NAAQS, see Challenges with Modeling the 1-hr SO2 NAAQS Standard: An Aluminum Plant Case Study, March 15, 2012. http://www.epa.gov/scram001/10thmodconfpres.htm

The Avenal Power Center, one of the 1000 plus day combined cycle projects in Figure 1 above, provides a stark lesson in the obstacle course that is the NSR permitting process. Avenal is a state-of-the-art combined cycle electric generating project located in California. EPA's Region 9 notified Avenal that its NSR permit application was complete on March 19, 2008. On February 9, 2010, EPA revised the NO2 NAAQS by adopting a new stringent 1-hour NO2 standard to supplement the existing annual NO2 NAAQS. The Avenal project was not grandfathered as a part of the NO2 NAAQS rulemaking and, as a result, was required to show that it would not cause or contribute to a violation of the 1-hour NO2 NAAQS.

On March 9, 2010, two years after Region 9 found that its NSR application was complete, Avenal filed suit in Federal District Court charging that EPA had failed to act within 1 year as required by Section 165 (c) of the CAA.

In January of 2011, EPAs Assistant Administrator for Air reported to the D.C. District Court in the Avenal case that it was appropriate to grandfather certain PSD applications from the NSR requirement that projects meet the 1-hour NO2 NAAQS. In a filing with the D.C. District Court, EPA identified Avenal as one of the eligible projects and explained that it would request comments on its grandfathering proposal. On May 26, 2011, the Court issued an order requiring EPA to take final action on the NSR permit by August 27, 2011. EPA issued the draft NSR permit to Avenal one day later. In June, the EPAs Environmental Appeals Board (EAB) received 4 petitions seeking a review of the permit. On August 18, 2011, the EAB issued its decision, declining to review the permit given the time constraints imposed by the District Court order requiring the agency to make a final permit decision by August 27. The environmental opponents of Avenal also filed suit with the Ninth Circuit Court. The Ninth Circuit agreed with the environmental groups that Avenal must show that it would not cause or contribute to a violation of the one-hour NO2 NAAQS. Avenal has decided not to go forward with this project.

This issue is likely to arise again with the recently promulgated Ozone NAAQS. In the past, EPAs approach has been to "…assess the ozone impacts of an individual source…on a case-by-case basis in consultation with the appropriate EPA Regional Office and/or permit reviewing authority."[101] There has not been a "preferred or recommended analytical technique or modeling system" and analyses of single source effects for NSR have often only involved a qualitative assessment (although in some cases the source has been required to use sophisticated chemical transport modeling). EPA has outlined some of the steps it expects to take to clarify modeling requirements for the Ozone NAAQS as a part of its recent proposal to revise its *Guideline on Air Quality Modeling*.[102] In this proposal, EPA explains that it believes that advances in photochemical modeling have reached the point where it is reasonable to identify specific air quality models that are appropriate to use in assessing the effects of individual sources.[103] Thus, a qualitative evaluation will no longer be sufficient and new sources must provide air quality modeling to show that the plant will not cause or contribute to a violation of the new Ozone NAAQS. The bottom line is that new sources will be in a kind of limbo, nothing in terms of clear direction on modeling will be in place when EPA issues its final air quality modeling rule next spring. As a result, new

[101] EPA (June 30, 2015), Proposed Approach for Demonstrating Ozone PSD Compliance (Memorandum).
[102] 80 FR 45346. In 2012, EPA granted a Sierra Club petition and committed to undertake a rulemaking to evaluate whether updates to the *Guideline* are warranted and, if so, to incorporate new analytical techniques in the *Guideline* for ozone and fine PM.
[103] EPA proposed its revisions to the *Guideline* on July 29, 2015. (80 FR 45346-49) The *Guideline* is published as Appendix W, 40 CFR Part 51.

sources and the permitting authorities will face continuing uncertainty about the modeling required to demonstrate that plant emissions will not cause or contribute to a violation of the Ozone NAAQS.[104]

Of course, there may be sources that will have minimal impacts on Ozone air quality. But, EPA does not have anything in place to help identify de minimis sources. Instead, in its recent air quality modeling proposal, EPA explains that it will undertake a new rulemaking that will provide a technical basis to identify emissions levels and ambient impacts that would not be expected to contribute significantly to ambient Ozone levels.[105] EPA has set a schedule for this rulemaking that will take at least another two years—substantially lagging this October's change to the Ozone NAAQS.

Finding emission offsets in PSD areas

EPA has a longstanding policy of allowing new sources in PSD areas to use emission offsets to address cases where the plant emissions would cause or contribute to a violation of the NAAQS. Under the new Ozone NAAQS, a number of areas--currently meeting the 75 ppb standard--have monitored levels that exceed the new 70 ppb standard. It will be several years before these areas are designated non-attainment and have in place the institutional arrangements necessary for the generation of emission offsets. Until designated as NA, these areas will be subject to the PSD provisions for NSR, including the requirement that sources show that they will not cause or contribute to a violation of the new ozone NAAQS. Since monitored levels in these areas exceed the new standard, the only recourse these sources have is to obtain emission offsets.

But, these areas will not have the arrangements in place to generate offsets for several years. EPA allows offsets from other areas under certain circumstances. However, the opportunity to use these emission offset "trades" across areas are severely constrained and, in particular, the applicant must demonstrate a net air quality benefit across the region. Some commenters on the Ozone NAAQS proposal expressed/pointed to the difficulty of obtaining EPA approval of such trades.[106] Finally, it should be noted that rural areas with Ozone levels exceeding 70 ppb that do not have any other controllable sources may never be able to generate the needed emission offsets.

Prospective Issue: New Source Siting with a Stringent Ozone NAAQS

The increasingly stringent NAAQS are adding a new complication to the NSR process. NAAQS standards like the ozone NAAQS are approaching background levels leaving little "headroom" for sources in terms of showing that their residual emissions--after BACT control--will not violate the NAAQS standards.

In the case of the recent Ozone NAAQS, EPAs promulgated standard approaches likely background levels in some areas of the United States. Recent research has found that stratospheric intrusions—particularly in western States--have resulted in daily maximum 8-hour ozone levels of 70 ppb or more.[107]

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[104] EPA plans to propose these revisions next year and issue a final rule in 2017.

[105] EPA identifies these de minimis levels as Ozone Significant Impact Levels and Model Emission Rates for Precursors (MERP). EPA June 30, 2015. Proposed Approach for Demonstrating Ozone PSD Compliance (Memorandum).

[106] South Carolina; Air Permitting Forum

[107] Meiyun Lin et al., Springtime high surface ozone events over the western United States: Quantifying the role of stratospheric intrusions, 117 J. OF GEOPHYSICAL RESEARCH D00V22-, (Oct. 2012) (Lin et al. 2012). Allen S. Lefohn et al., Quantifying the Importance of Stratospheric-Tropospheric Transport on Surface Ozone Concentrations at High- and Low-Elevation Monitoring Sites in the United States, 62 ATMOSPHERIC ENV'T 646-656(2012) (Lefohn et

With the Ozone NAAQS at or below background, sources will find it impossible to show that they will not interfere with the standard. In addition, in PSD areas where there are no other existing sources of consequence, new plants will not be able to obtain offsetting emissions. As a result, the recent Ozone NAAQS may effectively ban the construction of new sources in these areas.

EPA has argued that stratospheric intrusions can be dealt with through its exceptional events policy. However, the exceptional events program has only been used infrequently by the States. And, EPAs approval rate has been low—perhaps in part because EPA has established a high hurdle for accepting State claims of exceptional events. In any event, the existing rule sets restrictive requirements for such claims. The current exceptional events rule restricts its use to cases where the States show a "clear causal relationship" between the measured level and the event that has affected air quality in the area. This requirement requires extensive monitoring and modeling in order to establish a clear causal relationship in a context where there continue to be significant questions on the accuracy of Ozone air quality modeling. Further, the State must show that the exceedance is in excess of normal historical fluctuations. It is not clear that States will be able to meet these restrictive conditions because there is little historical data on such intrusions. In the proposed Ozone rule, EPA signaled that it intends to propose revisions to the exceptional events rule—but any revisions will require several years.[108]

Revising EPAs Air Quality Modeling: One Approach to the Problem

EPAs current modeling guidance requires the use of deterministic air quality models using the maximum allowable emission rate and operating conditions for the specified operating time. EPA's NSR Manual requires that NAAQS and PSD increment modeling should reflect the maximum emission rate based on the maximum allowable operating conditions for each averaging time.[109] EPAs modeling guidance also requires the use of modeling assumptions that yield the maximum impact on air quality in calculating background, including the effect of other sources in the area. However, sources typically operate well below their maximum allowable emission rate, so that EPAs current modeling guidance substantially overstates ambient air quality effects of a potential new source.

One solution to the overconservatism of the current approach would be to adopt a probabilistic modeling approach. Adoption of probabilistic methods would allow the use of distributions to reflect the variability in actual emissions, meteorology, and background. One common approach is to use Monte Carlo analysis to combine the information from the various probability distributions to provide an estimate (in the form of a distribution) of the effect on air quality. Thus, probabilistic analysis provides information on the variability and uncertainty in the estimated air quality effects and on the extent to which current deterministic modeling requirements overestimate the air quality impacts of a new source. Adoption of probabilistic air quality modeling approaches would be particularly appropriate for the short-term NAAQS because they adopt a statistical form.[110]

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al 2012). Allen S. Lefohn et al., Background Ozone and Its Importance in Relation to the Health Risk and Exposure Assessment for Ozone Assessment Document, at 7 (Mar. 13, 2014).

[108] 79 FR 75385.

[109] This means the modeling must reflect allowable operating conditions as set out by "…federally enforceable emission limits, operating level, and operating factor" for each pollutant and averaging time. NSR Manual, C.44-45. Similar language in EPAs rule revising its *Guideline on Air Quality Models* requires the use of the operating conditions causing the "maximum ground-level concentrations". 70 FR 68218

[110] The 1-hour NO2 and 24-hour fine PM NAAQS require areas to meet the 98th percentile averaged over 3 years; the 1-hour SO2 NAAQS requires areas to meet the 99th percentile averaged over 3 years. [Add Ozone NAAQS]

Discussion

In the discussion above, I have identified several administrative actions that EPA could take to help address the NSR issues that arise with increasingly stringent NAAQS. First, EPA could grandfather those NSR applications that are reasonably complete in its final NAAQS rule. In its Ozone NAAQS proposal, EPA is already moving in this direction. Second, EPA could make sure that the necessary guidance and air quality models are already in place when it issues the final NAAQS rule. This would require a commitment of EPA resources (and a certain amount of foresight on the part of the agency). Third, EPA could adopt a probabilistic approach to air quality modeling to replace its current deterministic, upper bound modeling requirements. This would also require a philosophical shift within the agency to acknowledge that probabilistic modeling is a fully protective approach.

In addition, EPA could request legislative changes to the CAA that would help to ameliorate the NSR problems associated with the adoption of more stringent NAAQS. First, EPA could request that Congress amend the CAA to defer the requirement that new sources must demonstrate immediately that they will not cause or contribute to a violation of a new NAAQS. Instead, such a requirement could be deferred for several years, for example, until States designate areas as non-attainment. The CAA could also be amended to require EPA to use probabilistic modeling (in place of its current deterministic, upper bound approach). Of course, any re-opening of the CAA requires a major legislative effort.

These changes—as either administrative or legislative reforms--will only provide some stopgap relief; as EPA continues to ratchet down the NAAQS to levels close to background the ability to site new facilities will become ever more difficult even with the adoption of probabilistic methods.

There are also more substantial changes that would change the core elements of the CAA. For example, some authors have argued that the CAA should be changed to require the direct consideration of benefits and costs in the setting of the NAAQS. Under EPA current practice, benefit/cost analysis would support a stringent NAAQS for Ozone and fine PM at or near background. There are critics of EPAs analysis—EPAs premature mortality estimates largely ignore the uncertainty in the health science and capping the cost of control at $15,000 per ton seems unreasonably optimistic. A more robust (and rigorous) regulatory analysis might—or might not—yield a different result. Such an analysis would at least give us greater confidence in the estimated benefits and costs of alternative standards.

In addition, some have suggested that the entire NAAQS/NSR process be replaced by emissions fees. Under this approach, the magnitude of the fee could vary based on location, insofar as damages are known to vary by location. The same fee would apply whether it is a new or existing source, removing new source bias. Since the fee is automatic, it circumvents all of the costly preparations and delays and reduces the power of EPA and state officials over specific companies involved in construction or repair of existing facilities.

This approach would challenge the underlying tenet within the CAA that there is a clear “safe” amount of pollution that can be established by environmental science. This would represent a major large-scale overhaul of the CAA. In addition, to the extent fees would be based on estimated damages, an emissions fee approach would require a rigorous benefit analysis. Implementation would require a well-designed, implemented and enforced monitoring of emissions.

Bibliography

EPA, Oct 15, 2012, Timely Processing of Prevention of Significant Deterioration (PSD) Permits when EPA or a PSD-Delegated Air Agency Issues the Permit

Table 1: 2014 California Offset Prices for Emission Reduction Credits ($/ton)

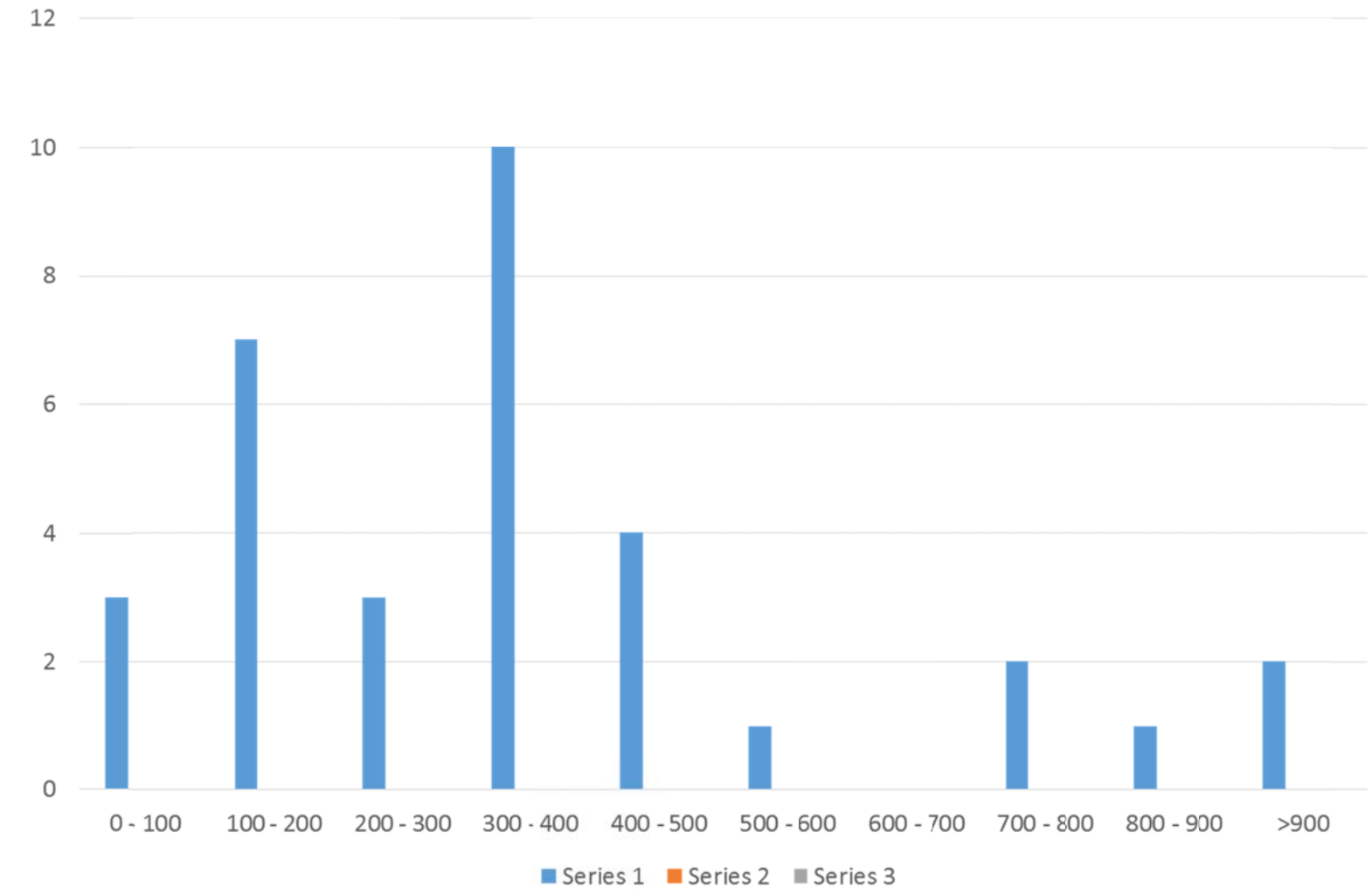
	VOC (&/ton)	VOC (tons)	NOx ($/ton)	NOx (tons)
Bay Area	$1200 - $9500 [$6196]	212	$14,500 - $15,000 [$14,643]	73
San Joaquin	$900 - $6000 [$3,877]	255	$18,000 - $44,000 [$36,519]	177
Santa Barbara	$125,000	0.06	$125,000	0.56
South Coast	$7400 - $32,880 [$23,462]	26	$63,014	5.5
Ventura	$15,000 - $70,000	21		

http://www.arb.ca.gov/nsr/erco/erc14.pdf

Table 2: Average Permitting Time for Natural Gas EGUs (Including PSD and Nonattainment Areas)

Year	All natural gas		New permits		Additions		Modifications	
	Mean	Number	Mean	Number	Mean	Number	Mean	Number
2002	321	73	324	47	299	25	769	1
2003	379	64	362	36	406	27	267	1
2004	612	46	521	27	829	13	551	6
2005	463	27	665	15	124	3	241	9
2006	290	23	355	6	286	11	231	6
2007	343	24	371	16	393	3	223	5
2008	377	21	384	3	715	4	278	14
2009	409	33	439	25	364	5	233	3
2010	468	24	554	14	372	5	321	5
2011	436	21	587	8	415	5	297	8
2012	268	31	245	14	223	11	403	6
2013	225	26	270	11	228	7	161	8
2014	235	3	—	0	—	0	235	3
Average	384	416	411	222	391	119	293	75

Figure 1: NSR Processing times for Combined Cycle EGUs, 2010 to 2014



Source: EPA, RACTBACTLAER Clearinghouse

Appendix: Chronology for PSD Application for Footprint Power Salem Harbor Development LP

Gas-Fired Combined Cycle EGU (630 MW)

Initial Application:	Dec. 21, 2012
Additional Info Submitted:	April 12, 2013
	June 10, 2013
	June 18, 2013
	Aug 6, 2013
	Aug 20, 2013
	Sept 4, 2013
	Sept 9, 2013
Draft PSD Permit Issued for Public Comment	Sept 9, 2013
Public hearing	Oct 10, 2013
Public comment extended	Nov 1, 2013
Revised GE guarantee	Nov 1, 2013
Response to EPA & other comments,	Dec 11, 2013
And emission update w/ addl GE guarantee	
Addl letter on startup/shutdown	Jan 10, 2013
Addl air quality monitoring for PM,	
And updated emission rates for CO & H2SO4	Jan 16-21, 2014
Draft Final Permit Issued	Jan 30, 2014
Petition Submitted to EAB	March 3, 2014
Petition Denied	Sept 2, 2014
Final Permit Issued	Sept 11, 2014