UNITED STATES DISTRICT COURT
FOR THE
DISTRICT OF VERMONT

GREEN MOUNTAIN CHRYSLER PLYMOUTH DODGE JEEP; GREEN MOUNTAIN FORD MERCURY; JOE TORNABENE'S GMC; ALLIANCE OF AUTOMOBILE MANUFACTURERS; DAIMLERCHRYSLER CORPORATION; and GENERAL MOTORS CORPORATION, Plaintiffs, v. GEORGE CROMBIE, Secretary of the Vermont Agency of Natural Resources; JEFFREY WENNBERG, Commissioner of the Vermont Department of Environmental Conservation; and RICHARD VALENTINETTI, Director of the Air Pollution Control Division of the Vermont Department of Environmental Conservation, Defendants, CONSERVATION LAW FOUNDATION; SIERRA CLUB; NATURAL RESOURCES DEFENSE COUNCIL; ENVIRONMENTAL DEFENSE, VERMONT PUBLIC INTEREST RESEARCH GROUP; STATE OF NEW YORK; and DENISE M. SHEEHAN, in her official capacity as Commissioner of Environmental Conservation of the State of New York, Defendants-Intervenors.	Case No. 2:05-cv-302
	consolidated with
THE ASSOCIATION OF INTERNATIONAL AUTOMOBILE MANUFACTURERS, Plaintiff, v. GEORGE CROMBIE, in his official capacity as Secretary of the Vermont Agency of Natural Resources; JEFFREY WENNBERG, in his official capacity as Commissioner of	Case No. 2:05–cv-304

the Vermont Department of Environmental :
Conservation; RICHARD A. VALENTINETTI, :
in his official capacity as Director of :
the Vermont Air Pollution Control :
Division, :
:
Defendants, :
:
CONSERVATION LAW FOUNDATION; SIERRA :
CLUB; NATURAL RESOURCES DEFENSE COUNCIL;:
ENVIRONMENTAL DEFENSE; VERMONT PUBLIC :
INTEREST RESEARCH GROUP; STATE OF :
NEW YORK; and DENISE M. SHEEHAN, in her :
official capacity as Commissioner of :
Environmental Conservation of the State :
of New York, :
:
Defendants-Intervenors. :

OPINION and ORDER

TABLE OF CONTENTS

	Page
INTRODUCTION	1
BACKGROUND	6
I. Clean Air Act	6
II. Environmental Policy and Conservation Act	12
III. Massachusetts v. EPA	17
EVIDENTIARY ISSUES	24
I. Daubert Challenges	24
A. James Hansen, Ph.D.	29
1. Hansen's Qualifications	29
2. Hansen's Testimony	31
3. Reliability of Hansen's Testimony	38
4. Relevance of Hansen's Testimony	47
B. Admissibility of Testimony of Dr. Barrett N. Rock	48
1. Dr. Rock's Qualifications	48
2. Dr. Rock's Testimony	49
3. Reliability of Dr. Rock's Testimony	51
4. Relevance of Dr. Rock's Testimony	59

C. Admissibility of Testimony of K.G. Duleep 59
1. Duleep's Qualifications 60
2. Duleep's Testimony 64
a. Methodology 64
b. Validation of Results With Lumped Parameter Model 67
c. Duleep's Cost Analysis 69
3. Evaluating the Reliability of Duleep's Testimony 69
4. Relevance of Duleep's Testimony 78

II. Discovery Violation 78

FINDINGS AND CONCLUSIONS 86

I. The State Regulations 86
A. Implementation of California's AB 1493 86
B. Adoption of Vermont's GHG Emissions Standards 90
C. The Global Warming Connection 92
D. The GHG Regulation Provisions 98

II. Preemption 102
A. The Preemption Doctrines Do Not Apply 104
B. Express Preemption 120
1. De Facto Fuel Economy Standard 122
2. "Related to" Fuel Economy Standard 127
C. Field Preemption 130
D. Conflict Preemption 132
1. Frustration of Congressional Intent to Maintain Nationwide Fuel Economy Standards 134
2. Technological Feasibility and Economic Practicability, Including Restricting Consumer Choice, Reducing Employment and Decreasing Traffic Safety 135
a. History of Technology-forcing Regulations 137
b. Austin's Testimony 140
c. Manufacturers' Testimony 146
d. Duleep's Testimony 152
e. Conclusions 155
(1) Austin's baseline assumptions and methodology 155
(2) Alternative fuels 166

(a) Diesel 169
(b) Ethanol 175
(c) Hydrogen 182
(d) Plug-in hybrids 184
(3) Other technologies 185
(a) GDI/turbo 187
(b) Camless valve actuation 190
(c) Rolling resistance improvements 191
(d) Reductions in aerodynamic drag 192
(e) Continuously variable transmission ("CVT") 193
(f) Electronic power steering 195
(g) A/C credits 195
(h) Credit trading 196
(i) Efforts to promote technology generally 198
(4) Consumer choice 203
(5) Product withdrawal and job loss 207
(6) Safety 216

II. Foreign Policy Preemption 222
A. National Foreign Policy on GHG Emissions 223
B. *Zschernig* Preemption 228
C. *Garamendi* Preemption 230

CONCLUSION 234

ORDER 240

Introduction

In these consolidated cases, Plaintiffs, a collection of new motor vehicle dealers, automobile manufacturers and associations of automobile manufacturers, seek declaratory and injunctive relief from regulations adopted by Vermont in the fall of 2005 that establish greenhouse gas ("GHG") emissions standards for new automobiles. The Plaintiffs in Docket No. 2:05-cv-302[1] brought six claims for declaratory and injunctive relief: express and implied preemption under the Energy Policy and Conservation Act of 1975, 49 U.S.C. §§ 32901-32919 ("EPCA") (Count I); preemption under the Clean Air Act as amended, 42 U.S.C. §§ 7401-7671q ("CAA") (Count II); violation of the CAA (Count III); foreign policy preemption (Count IV); violation of the dormant Commerce Clause (Count V); and violation of the Sherman Act (Count VI). The Plaintiff[2] in Docket No. 2:05-cv-304 alleged preemption under EPCA (Count I) and under the CAA (Count II).[3] On May 3, 2006,

---

[1] Green Mountain Chrysler Plymouth Dodge Jeep, Green Mountain Ford Mercury, Joe Tornabene's GMC, Alliance of Automobile Manufacturers, Daimler Chyrsler Corporation, and General Motors Corporation.

[2] Association of International Automobile Manufacturers.

[3] Some of the plaintiffs in this lawsuit have filed a similar suit in the Eastern District of California challenging California's regulations and the state law directing the California Air Resources Board to implement the regulations. *See Central Valley Chrysler-Jeep, Inc. v. Witherspoon*, No. 1:04-cv-06663-REC-LJO (E.D. Cal. filed Dec. 7, 2004) ("*Central Valley Chrysler*"). Similar plaintiffs have also filed similar lawsuits in Rhode Island. *See Ass'n of Int'l Automobile Mfrs. v. Sullivan*, No. 06-cv-69 (D.R.I. filed Feb. 13, 2006); *Lincoln Dodge, Inc. v. Sullivan*, No. 06-cv-70 (D.R.I. filed Feb. 13,

five non-profit environmental advocacy groups[4] were permitted to intervene as defendants in the cases, and on July 27, 2006 the State of New York was also permitted to intervene as a defendant.

Prior to trial, Defendants twice sought to stay these cases, pending resolution of the related case filed in California, *Central Valley Chrysler-Jeep, Inc. v. Witherspoon*, No. 1:04-cv-06663-REC-LJO (E.D. Cal. filed Dec. 7, 2004), and the Supreme Court's review of *Massachusetts v. EPA*, 415 F.3d 50 (D.C. Cir. 2005), *rev'd* 127 S. Ct. 1438 (2007). The requests were denied, on May 3, 2006, and February 15, 2007.

Defendants also sought to obtain dismissal of these cases for lack of ripeness via motions to dismiss for lack of subject matter jurisdiction (Doc. 48) and judgment on the pleadings (Doc. 162), because their regulation had not received a waiver from EPA, a necessary antecedent to enforcement. The Court concluded that the cases were constitutionally and prudentially ripe, given that the Vermont regulation had been formally enacted, those affected by the regulation had to begin now to comply with it, the constitutional challenges were currently as concrete and fit for decision as they would be in the future, and Plaintiffs' demonstration of hardship tipped the balance in favor of

---

2006).

[4] Conservation Law Foundation, Sierra Club, Natural Resources Defense Council, Environmental Defense, and Vermont Public Interest Research Group.

exercising jurisdiction on prudential grounds. Mem. Op. & Order 17-19 (Doc. 165).

Defendants moved for judgment on the pleadings on all counts of both complaints, and the '304 plaintiff moved for partial summary judgment on the ground that the regulations are preempted by EPCA. Although Defendants initially agreed with the '304 plaintiff that the case was appropriate for summary adjudication (although differing on the appropriate outcome), at oral argument they took the position, shared by the '302 plaintiffs, that significant material facts remained in dispute. Accordingly, the Court deferred ruling on the motions and allowed the case to proceed to trial. The '302 plaintiffs dismissed their Counts III, V and VI, and the consolidated cases proceeded to trial on the remaining claims. The trial was conducted over sixteen days in April and May, 2007. This opinion constitutes the Court's findings of fact and conclusions of law pursuant to Rule 52(a) of the Federal Rules of Civil Procedure.

Presented as a challenge to the validity of a state statute on preemption grounds, this case involves the degree of interplay and overlap between two federal statutes, the Clean Air Act, 42 U.S.C. §§ 7401-7671q, and the Energy Policy and Conservation Act, 49 U.S.C. §§ 32901-32919. Section 202 of the CAA requires the Environmental Protection Agency ("EPA") to establish standards for the control of any air pollutant emitted from new motor

vehicles or new motor vehicle engines which in its judgment causes or contributes to air pollution that may endanger public health or welfare. 42 U.S.C. § 7521(a)(1). Section 209(a) preempts a state from adopting its own motor vehicle emission control standards, while Section 209(b) requires EPA to waive preemption for a California-adopted standard that meets certain conditions. 42 U.S.C. § 7543(a), (b). Other states may adopt a California standard for which a waiver has been granted, as long as the states adopt the standard at least two years before the commencement of the model year. 42 U.S.C. § 7507.

In 2004, California adopted a comprehensive set of GHG emissions regulations for new motor vehicles, including standards applicable to large-volume motor vehicle manufacturers beginning in model year 2009. California applied to EPA for a waiver of federal preemption under the CAA in 2005; its application remains pending. Also in 2005, Vermont adopted California's GHG regulations.[5]

Section 502 of EPCA directs the Department of Transportation ("DOT") to set fuel economy standards for new passenger vehicles and light trucks. 49 U.S.C. § 32902. Section 509 of EPCA preempts any state laws or regulations related to fuel economy standards. 49 U.S.C. § 32919(a). Because there is a

[5] Connecticut, Maine, Maryland, Massachusetts, New Jersey, New York, Oregon, Pennsylvania, Rhode Island and Washington, in addition to Vermont, have adopted California's standards for GHG emissions, pursuant to § 7507.

relationship between decreasing carbon dioxide emission from the tailpipe of a motor vehicle and increasing its fuel economy, Plaintiffs challenged Vermont's regulations as preempted by EPCA, among other contentions.

Recently, in *Massachusetts v. EPA*, 127 S. Ct. 1438 (2007), the United States Supreme Court confirmed that EPA has the authority to regulate GHG emissions from new motor vehicles under Section 202(a)(1) of the CAA. It commented: "that DOT sets mileage standards in no way licenses EPA to shirk its environmental responsibilities. . . . The two obligations may overlap, but there is no reason to think the two agencies cannot both administer their obligations and yet avoid inconsistency." 127 S. Ct. at 1462.

Given that automobile manufacturers require lead time in order to make design changes to their vehicles to attempt to comply with the regulations, and given that it has taken years to process waiver applications (although EPA has consistently granted California's applications for a waiver of preemption), the Court and the parties have proceeded with this case on the assumption that EPA will grant California's waiver application. If it does not, of course, Vermont's regulation is preempted by the CAA's section 209(a).

In this decision the Court addresses first the statutory background of the case, and includes a summary of the decision in

Massachusetts v. EPA, 127 S. Ct. 1438 (2007). The Court turns next to the question whether the opinions and testimony of Defendants' witnesses Duleep, Rock and Hansen must be excluded from consideration either as a sanction for discovery violations or as precluded by *Daubert v. Merrill Dow Pharmaceuticals, Inc.*, 509 U.S. 579 (1993). Then, in the first section of the Findings and Conclusions, the Court outlines the context of the GHG regulation in California and Vermont, along with the concerns about global warming that led to the regulation's development, and details the GHG regulation itself. Next the Court discusses express and implied preemption, concluding first that this is not rightly a case about federal preemption, but about potential conflict between two federal statutes. Second, the Court concludes that EPCA does not expressly preempt Vermont's GHG regulations, nor are Vermont's GHG regulations precluded under principles of field or conflict preemption. Finally, the Court deals with the remaining legal challenge to the regulation, concluding that the regulation does not impermissibly intrude upon the foreign affairs prerogatives of the President and Congress of the United States.

Background

I. Clean Air Act

EPA is the federal agency entrusted with overseeing the regulation of pollution, including air pollution from mobile

sources. In 1965, Congress enacted the Motor Vehicle Air Pollution Control Act, to be added to the CAA as Title II, to control emissions from new motor vehicles. Pub. L. No. 89-272, 79 Stat. 992 (1965); *see Motor Vehicle Mfrs. Ass'n of the United States, Inc. v. N.Y. State Dep't of Envtl. Conservation*, 17 F.3d 521, 524-25 (2d Cir. 1994) (*"MVMA III"); Motor & Equip. Mfrs. Ass'n, Inc. v. EPA*, 627 F.2d 1095, 1101 (D.C. Cir. 1979) (*"MEMA* I"). The original enactment did not contain a preemption provision. The House Committee acknowledged States' basic rights and responsibilities for control of air pollution,[6] although it alluded to its conviction that federal standards were preferable to regulation by individual states. H.R. Rep. No. 89-899, (1965), *reprinted in* 1965 U.S.C.C.A.N. 3608, 3612; *see also* H.R. Rep. No. 90-728 (1967), *reprinted in* 1967 U.S.C.C.A.N. 1938, 1955-56 (discussing legislative history of Pub. L. No. 89-272); *accord MEMA I*, 627 F.2d at 1108 & n. 24.

---

[6] Congress conceived of the undertaking to regulate air pollution as necessitating "cooperative federal state and local programs to prevent and control air pollution," 42 U.S.C. § 7401(a)(4), and made it a goal "to encourage or otherwise promote reasonable Federal, State, and local governmental actions . . . for pollution prevention." *Id.* § 7401(c). Congress also directed the EPA to "cooperate with and encourage cooperative activities by all Federal departments and agencies having functions relating to the prevention and control of air pollution, so as to assure the utilization in the Federal air pollution control program of all appropriate and available facilities and resources within the Federal Government." *Id.* § 7402(b). These Congressional declarations appeared with some differences in language in 1963 amendments to the Clean Air Act, Pub. L. No. 88-206, 77 Stat. 392, 393 (1963).

With the enactment of the Air Quality Act of 1967, Pub. L. No. 90-148, 81 Stat. 485 (1967), Congress amended Title II, redesignated as the National Emission Standards Act, to address the question of the extent to which the newly promulgated federal standards should supersede state and local laws on motor vehicle emissions. The new provision preempted states' power to set standards for emissions from new motor vehicles and engines, but provided that more stringent standards could be set for California if it had shown that it required such standards to meet compelling and extraordinary conditions, and the standards were consistent with the federal emission standards. *Id.*, 81 Stat. at 501.[7] The provision represented a compromise "between the states, which wanted to preserve their traditional role in regulating motor vehicles, and the manufacturers, which wanted to avoid the economic disruption latent in having to meet fifty-one separate sets of emissions control requirements." *MEMA I*, 627 F.2d at 1109.

In 1970 Congress amended the CAA to require a ninety percent

[7] Section 208(b) of the National Emission Standards Act provided for waiver from preemption for any State that had adopted standards, other than crankcase emission standards, for the control of emissions from new motor vehicles or new motor vehicle engines prior to March 30, 1966. Pub. L. No. 90-148, 81 Stat. at 501 (codified as amended at 42 U.S.C. § 7543(b)). California is the only State that satisfies this criterion.

reduction in tailpipe emissions from light-duty vehicles[8] of carbon monoxide and hydrocarbons within five years and of nitrogen oxides within six years. Clean Air Amendments of 1970, Pub. L. No. 91-604, 84 Stat. 1676 (1970). Section 202(a)(2) of the amended statute required EPA to take technical and economic factors into consideration when prescribing a regulation's effective date, providing that any regulation could only take effect "after such period as the Administrator finds necessary to permit the development and application of the requisite technology, giving appropriate consideration to the cost of compliance." *Id.* sec. 6(a), § 202(a)(2), 84 Stat. at 1690 (codified as amended at 42 U.S.C. § 7521(a)(2)).

Although the deadlines were extended, by the early 1980s the required reductions had been achieved, largely by the development and introduction of the catalytic converter. *See* Holly Doremus, "Constitutive Law and Environmental Policy," 22 Stanford Envtl. L.J. 295, 345-46 (2003); *Whitman v. Am. Trucking Ass'ns*, 531 U.S. 457, 492 (2001) (Breyer, J., concurring) (catalytic converter technology helped achieve substantial reduction in emissions without predicted economic catastrophe).

The 1977 Amendments to the CAA, "lengthy, detailed,

---

[8] In this statute "light-duty vehicle" is essentially synonymous with "passenger car." *Natural Resources Defense Council, Inc. v. U.S. EPA*, 655 F.2d 318, 323 n.3 (D.C. Cir. 1981).

technical, complex, and comprehensive," *Chevron U.S.A., Inc. v. Natural Resources Defense Council, Inc.*, 467 U.S. 837, 848 (1984), included the waiver provision that currently appears at § 7543(b). Clean Air Act Amendments of 1977, Pub. L. No. 95-95, sec. 207, § 209(b). With the 1977 Amendments Congress also permitted other states to adopt California's standards, if that state's standards "are identical to the California standards for which a waiver had been granted," and both states adopt the standards at least two years before the commencement of the model year to be regulated. *Id.* sec. 177 (codified at 42 U.S.C. § 7507); *see MVMA III*, 17 F.3d at 525.

Amid growing concern over the threat of global warming, acid rain, and "holes" in the atmospheric ozone layer, and following a decade of stalemated debate in Washington over air pollution control, Congress enacted the Clean Air Act Amendments of 1990, Pub. L. No. 101-549, 104 Stat. 2399 (1990). *See* James Miskiewicz & John S. Rudd, *Civil & Criminal Enforcement of the Clean Air Act After the 1990 Amendments*, 9 Pace Envtl. L. Rev. 281, 286 (1992). Title II of its eleven titles imposed new controls on motor vehicles. *See* Secs. 201-35, 104 Stat. at 2471-2531. Stringent "Tier I" emissions requirements for nonmethane hydrocarbons, carbon monoxide, oxides of nitrogen and particulate matter were to be phased in during model years 1994 to 1996. *See* Sec. 203, § 202, 104 Stat. at 2474-75. More stringent "Tier II" standards

would be imposed by EPA for model year 2004 and thereafter unless it determined that such standards were not necessary, technically feasible, or cost-effective. *See id.*, 104 Stat. at 2476-78.[9] The 1990 CAA amendments aimed to clean up gasoline and diesel fuel by setting requirements for reduced fuel volatility, fuel reformulation, oxygenated fuels and desulfurization of diesel fuels, as well as the complete phase-out of lead in gasoline by the end of 1995. *See* Secs. 216-17, 219-20, § 211, 104 Stat. at 2489-2501. The act also created a clean-fuels vehicle program. *See* Sec. 229(a), §§ 241-250, 104 Stat. at 2511-29.

Currently, Section 202 of the CAA authorizes the EPA Administrator to establish "standards applicable to the emission of any air pollutant from any class or classes of new motor vehicles or new motor vehicle engines, which in his judgment cause, or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare." 42 U.S.C. § 7521(a)(1). Any such regulation, which currently applies to emissions of hydrocarbons, carbon monoxide, oxides of nitrogen and particulate matter, may take effect only after any necessary period "to permit the development and application of the requisite technology, giving appropriate consideration to the

---

[9] EPA promulgated rules implementing the Tier II standards effective April 10, 2000. *See* Final Rule, Control of Air Pollution from New Motor Vehicles: Tier II Motor Vehicle Emissions Standards & Gasoline Sulfur Control Requirements, 65 Fed. Reg. 6698 (Feb. 10, 2000).

cost of compliance." *Id.* § 7521(a)(2).

Section 209(a) of the CAA prohibits any state or political subdivision from adopting or attempting to enforce "any standard relating to the control of emissions from new motor vehicles or new motor vehicle engines." 42 U.S.C. § 7543(a). Section 209(b) requires EPA to waive federal preemption for California, if California has determined that its state standards "will be, in the aggregate, at least as protective of public health and welfare as applicable Federal standards," unless EPA finds that California's determination is arbitrary and capricious, the state doesn't need the standards to meet compelling and extraordinary conditions, or the standards are not consistent with § 7521(a). *Id.* § 7543(b). Section 177 allows a state to adopt and enforce standards identical to California standards for which a waiver has been granted, as long as the standards are adopted at least two years before the commencement of the model year to which they apply. *Id.* § 7507.

II. Environmental Policy and Conservation Act

In 1975, in response to the energy crisis of the 1970's, Congress enacted the Energy Policy and Conservation Act. Pub. L. 94-163, 89 Stat. 871 (1975); *see General Motors Corp. v. Nat'l Highway Traffic Safety Admin.*, 898 F.2d 165, 167 (D.C. Cir. 1990). The Act's purposes included "provid[ing] for improved energy efficiency of motor vehicles." Pub. L. No. 94-163, § 2,

89 Stat. 87, 874 (1975) (codified at 42 U.S.C. § 6201). EPCA's Title III amended the Motor Vehicle Information and Cost Savings Act by adding a new Title V, devoted to improving automotive efficiency by establishing average fuel economy standards. *See* Sec. 301, §§ 501-12, 89 Stat. at 901-16.

Title V set mandatory average fuel economy performance standards for passenger automobiles, beginning in model year 1978 at eighteen miles per gallon (mpg) and increasing to 27.5 mpg by model year 1985. This had the effect of requiring manufacturers to improve the fuel economy of their fleets by fifty percent by model year 1980, and by one hundred percent by model year 1985. *General Motors*, 898 F.2d at 167. Although Congress set the standard for passenger automobiles at 27.5 mpg by 1985, EPCA authorizes the Secretary of Transportation to set standards at the maximum feasible level for light duty highway vehicles for each model year, and for passenger automobiles after model year 1985. *See* S. Rep. No. 94-516, at 119, 153-54 (1975) (Conf. Rep.), *reprinted in* 1975 U.S.C.C.A.N. 1956, 1959-60, 1994-95. The Secretary of Transportation has delegated his EPCA authority to the National Highway Traffic Safety Administration ("NHTSA"). 49 C.F.R. § 1.50(f).

The statute thus provided for fleet-wide average fuel economy standards that would apply to all passenger automobiles or light-duty trucks sold by a manufacturer in a given year,

known as "corporate average fuel economy," or "CAFE" standards. Pub. L. No. 94-163, Sec. 301, § 502, 89 Stat. at 902. Manufacturers that fail to comply may be assessed civil penalties. *Id.* § 508.

In determining maximum feasible average fuel economy, NHTSA was directed to consider: "(1) technological feasibility; (2) economic practicability; (3) the effect of other Federal motor vehicle standards on fuel economy; and (4) the need of the Nation to conserve energy." *Id.* § 502; *see also* S. Rep. No. 94-516 at 154, 1975 U.S.C.C.A.N. at 1995. It did not prescribe the formula for determining CAFE standards but "gave [NHTSA] broad guidelines within which to exercise its discretion." *Competitive Enter. Inst. v. NHTSA*, 901 F.2d 107, 121 (D.C. Cir. 1990) ("CEI I"). NHTSA exercised its authority to decrease CAFE standards from the Congressional benchmark of 27.5 mpg for passenger automobiles for model year 1986, 1987, 1988 and 1989. *See id.* at 124; *Pub. Citizen v. NHTSA*, 848 F.2d 256, 260 (D.C. Cir. 1988).

As enacted, EPCA included a preemption clause, § 509(a), which provided that "[w]henever an average fuel economy standard established under this part is in effect, no State or political subdivision of a State shall have authority to adopt or enforce any law or regulation relating to fuel economy standards or average fuel economy standards applicable to automobiles covered by such Federal standard."

In 1994 Congress recodified certain laws related to transportation, including the fuel economy laws, into Title 49 of the United States Code. Revision of Title 49, United States Code Annotated, "Transportation," Pub. L. No. 103-272, 108 Stat. 745 (1994). Both House and Senate reports accompanying the bill stated that the purpose of the bill was to "revise, codify, and enact [the laws] without substantive change . . . and to make other technical improvements in the Code." S. Rep. No. 103-265, at 1 (1994); H.R. Rep. No. 103-180, at 1, *reprinted in* 1994 U.S.C.C.A.N. 818, 818. The Senate Report described standard changes that were made uniformly throughout the revised subtitles of Title 49, including:

> "United States Government" is substituted for "United States" (when used in referring to the Government), "Federal Government," and other terms identifying the Government the first time the reference appears in a section. Thereafter, in the same section, "Government" is used unless the context requires the complete term to be used to avoid confusion with other governments.

S. Rep. No. 103-265, at 4. The report stated: "this bill makes no substantive change in the law." *Id.* at 5.

The current section setting forth the factors that the Secretary of Transportation must take into consideration when determining maximum feasible average fuel economy has not changed substantively from the 1975 enactment. Section 32902(f) now reads: "When deciding maximum feasible average fuel economy

under this section, the Secretary of Transportation shall consider technological feasibility, economic practicability, the effect of other motor vehicle standards of the Government on fuel economy, and the need of the United States to conserve energy." 49 U.S.C. § 32902(f). NHTSA has interpreted economic practicability to include consideration of consumer choice, economic hardship for the automobile industry, and vehicle safety. *See, e.g., CEI I*, 901 F.2d at 120, n.11; *Center for Auto Safety v. NHTSA*, 793 F.2d 1322, 1340 (D.C. Cir. 1986) ("CAS I").

EPCA's current preemption provision also is essentially unchanged from its original enactment: "[w]hen an average fuel economy standard prescribed by this chapter is in effect, a State or a political subdivision of a State may not adopt or enforce a law or regulation related to fuel economy standards or average fuel economy standards for automobiles covered by an average fuel economy standard under this chapter." 49 U.S.C. § 32919(a).

Currently, the average fuel economy standard for passenger automobiles remains at 27.5 mpg, the standard enacted in 1975 and in place since model year 1985. *See* 49 U.S.C. § 32902(b).

In 2006 NHTSA reformed the structure of the CAFE program for light trucks and has permitted manufacturers to comply with either the reformed or the unreformed standards during a transition period of model years 2008 through 2010. *See* Final Rule, Average Fuel Economy Standards for Light Trucks Model Years

2008-2011, 71 Fed. Reg. 17566 (Apr. 6, 2006). Under reformed CAFE, a manufacturer's required fuel economy level for a particular light truck is a function of the truck's "footprint" (calculated by multiplying the vehicle's wheelbase by its average track width), the target fuel economy for that footprint value, and the actual production figures for the vehicle. *Id.* at 17568. The unreformed CAFE standards for light trucks are 22.5 mpg for model year 2008, 23.1 mpg for model year 2009, and 23.5 mpg for model year 2010. *Id.* NHTSA projects industry-wide fuel economy levels under reformed CAFE at 22.7 mpg for model year 2008, 23.4 mpg for model year 2009, and 23.7 mpg for model year 2010. *Id.* at 17624. There is no CAFE standard for light trucks currently in place for any model year past 2010.

III. *Massachusetts v. EPA*

Based on respected scientific opinion that rising global temperature is related to a significant increase in the concentration of carbon dioxide in the atmosphere, a group of private organizations petitioned EPA to begin regulating carbon dioxide and other GHG emissions from new motor vehicles under § 202 of the Clean Air Act. The petitioners contended that GHG emissions, because of their heat-trapping ability, have significantly accelerated climate change, and that the United Nations Intergovernmental Panel on Climate Change ("IPCC") had warned that "carbon dioxide remains the most important

contributor to [man-made] forcing of climate change." *Massachusetts v. EPA*, 127 S. Ct. at 1449 (quoting 1995 IPCC report). EPA denied the petition, giving two grounds for its decision: 1) it lacked authority under the Clean Air Act to regulate greenhouse gases; and 2) even if it had authority, it would not be appropriate to issue such regulations at this time. EPA Notice of Denial of Petition for Rulemaking, 68 Fed. Reg. 52,922, 52,925 (Sept. 8, 2003).

The petitioners, joined by several states and local governments, challenged this determination in the United States Court of Appeals for the District of Columbia Circuit. Several states and trade associations joined EPA in opposing the appeal. Although the three judges on the panel wrote separate opinions, two judges agreed "that the EPA Administrator properly exercised his discretion under § 202(a)(1) in denying the petition for rulemaking." *Massachusetts v. EPA*, 415 F.3d 50, 58 (D.C. Cir. 2005), *rev'd* 127 S. Ct. 1438 (2007).

Judge Randolph's opinion announcing the judgment of the Court assumed that the petitioners had Article III standing to challenge the denial of the rulemaking petition, and assumed that EPA had statutory authority to regulate greenhouse gases from new motor vehicles. *Id.* at 55-56. Given the considerable discretion enjoyed by the EPA Administrator, the multitude of policy considerations that entered into the Administrator's decision not

to regulate, and precedent that counseled "uphold[ing] agency conclusions based on policy judgments" concerning "issues on the frontiers of scientific knowledge," *Envtl. Def. Fund v. EPA*, 598 F.2d 62, 82 (D. C. Cir. 1978), the decision not to regulate was a proper exercise of discretion, according to the opinion. *Massachusetts v. EPA*, 415 F.3d at 58.

Judge Sentelle wrote separately because he concluded that the petitioners had not demonstrated the element of injury necessary to establish standing under Article III. *Id.* at 59 (Sentelle, J., dissenting in part and concurring in judgment). He concurred in the judgment, however, as the outcome closest to the one he would have preferred.

Judge Tatel dissented, concluding that at least one petitioner, the Commonwealth of Massachusetts, had standing. He examined the language of CAA section 202(a)(1), which authorizes EPA to prescribe standards for the emission of any air pollutant from new motor vehicles that in the Administrator's judgment cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare. 42 U.S.C. § 7521(a)(1). Although EPA had concluded that carbon dioxide and other greenhouse gases are not air pollutants, Judge Tatel noted that Congress had defined "air pollutant" very broadly to include "any air pollution agent or combination of such agents, including any physical, chemical, biological, radioactive . . . substance

or matter which is emitted into or otherwise enters the ambient air." 42 U.S.C. § 7602(g). In his view, EPA had disregarded the plain language of the statute without justification. *Massachusetts v. EPA*, 415 F.3d at 67-73 (Tatel, J., dissenting).

One justification offered by EPA had been its contention that the only practical way to regulate carbon dioxide emissions from motor vehicles is to require increased fuel economy, and that such regulation would overlap with DOT's authority to set average fuel economy standards under EPCA. Judge Tatel dismissed the argument: "[g]iven that the two regulatory regimes--one targeted at fuel conservation and the other at pollution prevention--are overlapping, not incompatible, there is no reason to assume that Congress exempted CO2 from the meaning of 'air pollutant' within the CAA." *Id.* at 72. He pointed out that Congress accepted regulatory overlap in this area, as evidenced by EPCA's recognition of the relevance of other motor vehicle standards of the Government in setting fuel economy standards, and by the 1977 CAA Amendments' emphasis on EPA's comprehensive authority over air pollutants, even those already regulated by another agency. *Id.* at 73.

Judge Tatel also rejected EPA's second reason for declining to act: that the agency gave appropriate reasons for its decision and acted within its discretion.

The Supreme Court granted certiorari to address whether EPA

has the authority to regulate GHG emissions from new motor vehicles under § 202(a)(1), and whether EPA may decline to issue such emission standards based on policy considerations. The Court held as a preliminary matter that the petitioners had standing to challenge the EPA's denial of their rulemaking petition. *Massachusetts v. EPA*, 127 S. Ct. at 1458.

In connection with its ruling on standing, the Supreme Court noted that "EPA does not dispute the existence of a causal connection between man-made greenhouse gas emissions and global warming," but "does not believe that any realistic probability exists that the relief petitioners seek would mitigate global climate change and remedy their injuries." *Id.* at 1457. The Court disagreed: "[j]udged by any standard, U.S. motor-vehicle emissions make a meaningful contribution to greenhouse gas concentrations and hence, according to petitioners, to global warming." *Id.* at 1457-58. Moreover, the Court noted the legitimacy of small and incremental regulatory steps: "[a]gencies, like legislatures, do not generally resolve massive problems in one fell regulatory swoop. They instead whittle away at them over time, refining their preferred approach as circumstances change and as they develop a more nuanced understanding of how best to proceed." *Id.* at 1457.

On the issue of EPA's authority to regulate, the Supreme Court held that it had "little trouble concluding" that it did,

given the CAA's "sweeping" definition of air pollutant. *Id.* at 1459-60. The Court rejected outright the argument that EPA is not permitted to regulate carbon dioxide emissions from motor vehicles because it would have to tighten mileage standards, which is the province of the Department of Transportation under EPCA.

> But that DOT sets mileage standards in no way licenses EPA to shirk its environmental responsibilities. EPA has been charged with protecting the public's 'health' and 'welfare,' a statutory obligation wholly independent of DOT's mandate to promote energy efficiency. The two obligations may overlap, but there is no reason to think the two agencies cannot both administer their obligations and yet avoid inconsistency.

Id. at 1462 (internal citations omitted). The Court stressed that with the broad language of § 202(a)(1) Congress intended to confer regulatory flexibility on EPA, to cope with changing circumstances and scientific developments as they arose. *Id.*

As to the second issue, the Supreme Court ruled that deference to agency discretion did not permit EPA to ignore its statutory mandate. "Under the clear terms of the Clean Air Act, EPA can avoid taking further action only if it determines that greenhouse gases do not contribute to climate change or if it provides some reasonable explanation as to why it cannot or will not exercise its discretion to determine whether they do." *Id.* The Court refused to debate the wisdom of EPA's "laundry list" of policy judgments justifying its refusal to regulate, but noted

that EPA's reasons were irrelevant to the statutory question of whether it is able to form a judgment that GHG emissions from new motor vehicles contribute to climate change. *Id.* at 1462-63. In the absence of a reasoned explanation for its refusal to regulate, grounded in the statute, EPA acted arbitrarily, capriciously and otherwise not in accordance with law. *Id.* at 1463.

The Supreme Court remanded the case for EPA to review its decision not to regulate.

In response to the Supreme Court's decision in *Massachusetts v. EPA*, President Bush issued an executive order calling for cooperation among the agencies to protect the environment with respect to GHG emissions from motor vehicles. Exec. Order No. 13,432, 72 Fed. Reg. 27,717 (May 14, 2007). He renewed his call to reduce gasoline usage by twenty percent in ten years, first presented in his State of the Union address in January 2007. In that address President Bush had announced a policy initiative that assumed CAFE standards would increase by four percent per year beginning in model year 2010 for cars and beginning in model year 2012 for light trucks. *See* 2007 State of the Union Policy Initiatives, Jan. 23, 2007, http://www.whitehouse.gov/stateoftheunion/2007/initiatives/sotu2007.pdf. NHTSA has requested updated information from manufacturers regarding their future product plans to aid in implementing the president's plan.

See Request for Comments, 72 Fed. Reg. 8664 (Feb. 27, 2007).

Evidentiary Issues

I. *Daubert* Challenges

The '302 plaintiffs move under *Daubert v. Merrell Dow Pharmaceuticals, Inc*., 509 U.S. 579 (1993), to exclude the expert testimony of three witnesses called by Defendants: Dr. James Hansen, Dr. Barrett Rock and Mr. K.G. Duleep. There is no debate as to the adequacy of these experts' credentials; rather, the plaintiffs have moved to strike their testimony on the grounds that it is not reliable scientific evidence and does not assist the trier of fact.

The party proffering expert testimony has the burden of establishing its admissibility "by a preponderance of proof." *Daubert*, 509 U.S. at 592 n. 10. Rule 702 of the Federal Rules of Evidence provides that:

> [i]f scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise, if (1) the testimony is based upon sufficient facts or data, (2) the testimony is the product of reliable principles and methods, and (3) the witness has applied the principles and methods reliably to the facts of the case.

Fed. R. Evid. 702.

To be admissible as scientific knowledge under this rule, expert opinion testimony must meet a "standard of evidentiary reliability." That is, it must be "derived by the scientific

method" and "supported by appropriate validation." *Daubert*, 509 U.S. at 590. Proffered testimony must be based upon "sufficient facts or data." Fed. R. Evid. 702. This sufficiency analysis is quantitative rather than qualitative, and "facts or data" may include reliable opinions of other experts and hypothetical facts that are supported by the evidence. *See id.* advisory committee's note. The expert opinions offered must be the product of reliable principles and methods that have been reliably applied to the facts of the case. Fed. R. Evid. 702. While the testimony must be reliable, its subject need not be "'known' to a certainty; arguably, there are no certainties in science." *Daubert*, 509 U.S. at 590. Experience alone, or experience combined with other knowledge, skill, training or education, may be the basis for expert testimony under the Rule. Fed. R. Evid. 702 advisory committee's note.

The focus under *Daubert* must be on principles and methodology, not on the conclusions that they generate. *Daubert*, 509 U.S. at 595. However, a district court is not required to "admit opinion evidence that is connected to existing data only by the *ipse dixit* of the expert." *Gen. Elec. Co. v. Joiner*, 522 U.S. 136, 146 (1997).

In *Daubert*, the Supreme Court set forth a non-exclusive list of four considerations that may bear on whether a theory or technique has sufficient scientific validity to constitute

reliable evidence: (1) "whether it can be (and has been) tested," *Daubert*, 509 U.S. at 593; (2) "whether [it] has been subjected to peer review and publication," *id.*; (3) as to a scientific technique, its "known or potential rate of error, and the existence and maintenance of standards controlling the technique's operation," *id.* at 594 (citation omitted); and (4) "widespread acceptance." *Id.; see also Campbell v. Metro. Prop. & Cas. Ins. Co.*, 239 F. 3d 179, 185 (2d Cir. 2001). These factors are to be considered in addition to the three enumerated in the rule itself. While a theory's acceptance in the expert community is a factor to be considered, "general acceptance" is not an "absolute prerequisite" to admissibility under Rule 702. *Daubert*, 509 U.S. at 588.

The inquiry into scientific validity is a flexible one, *see id.* at 594, and courts applying *Daubert* have used the enumerated factors in a flexible manner, finding other factors pertinent or recognizing that the *Daubert* factors do not apply to all types of expert testimony. *See, e.g.*, *Blanchard v. Eli Lilly &* Co., 207 F. Supp. 2d 308, 315-16 (D. Vt. 2002) (citing cases). *Kumho Tire Co. v. Carmichael*, 526 U.S. 137, 141 (1999), clarified that the specific factors mentioned in *Daubert* must be considered only when their consideration "will help determine that testimony's reliability." A district court enjoys "broad latitude when it decides how to determine reliability." *Id.* at 142 (emphasis

deleted); *see also Wills v. Amerada Hess Corp.*, 379 F.3d 32, 41 (2d Cir. 2004); *Amorgianos v. Nat'l R.R. Passenger Corp.*, 303 F.3d 256, 265 (2d Cir. 2002). Each stage of an expert's testimony "must be evaluated practically and flexibly without bright-line exclusionary (or inclusionary) rules." *Heller v. Shaw Indus., Inc.*, 167 F.3d 146, 155 (3d Cir. 1999).

Factors not listed in *Daubert* but found to be relevant by the Circuit courts include: (1) whether the expert proposes to testify about matters derived from research independent of the litigation, *see Daubert v. Merrill Dow Pharms., Inc.*, 43 F.3d 1311, 1317 (9th Cir. 1995); (2) whether the expert has adequately accounted for obvious alternative explanations, *see Claar v. Burlington N.R.R.*, 29 F.3d 499 (9th Cir. 1994); *cf. Ambrosini v. Labarraque*, 101 F.3d 129, 139-40 (D.C. Cir. 1996) (the possibility of uneliminated causes goes to weight rather than admissibility, provided that the expert has considered and reasonably ruled out the most obvious); (3) whether the expert has employed the same level of intellectual rigor in the courtroom as in the relevant field of expertise, *see Kumho Tire*, 526 U.S. at 152; (4) the non-judicial uses to which the method has been put, *see Elcock v. Kmart Corp.*, 233 F.3d 734, 746 (3d Cir. 2000); (5) whether the expert's discipline itself lacks reliability, *see Kumho Tire*, 526 U.S. at 151, and (6) whether the expert has unjustifiably extrapolated from an accepted premise to

an unfounded conclusion. *See Joiner*, 522 U.S. at 146.

Overall, the Supreme Court has emphasized the "liberal thrust" of the Federal Rules of Evidence with regard to expert opinion testimony. *Daubert*, 509 U.S. at 588. In ruling that an expert's testimony is reliable for the purposes of admission into evidence, a trial court does not indicate that contradictory expert testimony is unreliable or inadmissible. As the Advisory Committee Notes to the 2000 Amendments to Rule 702 explain, the Rule permits the introduction of "testimony that is the product of competing principles or methods in the same field of expertise." Fed. R. Evid. 702 advisory committee's note. The proponent of an expert's testimony need prove only that the opinions offered are reliable, not that they are correct. *Id.* (citing *In re Pauli R.R. Yard PCB Litig.*, 35 F.3d 717, 744 (3d Cir. 1994)); *United States v. Vargas*, 471 F.3d 255 (1st Cir. 2006) (internal citations omitted)). "Vigorous cross-examination, presentation of contrary evidence, and careful instruction on the burden of proof are the traditional and appropriate means of attacking shaky but admissible evidence." *Daubert*, 509 U.S. at 596 (citing *Rock v. Arkansas*, 483 U.S. 44 (1987)). In this case, both parties have availed themselves of opportunities for cross-examination and for the presentation of contrary evidence.

The Rules' liberal approach to the admission of expert testimony is particularly appropriate in a bench trial. Expert

testimony is likely to hold "unique weight" in the minds of a jury. *See Nimely v. City of New York*, 414 F.3d 381, 397 (2d Cir. 2005). Here, by contrast, much of the testimony presented on each side was expert testimony, and the Court is accustomed to evaluating the strengths and weaknesses of such testimony. Therefore, the Court can weigh the evidence admitted without being unduly swayed by a witness's designation as an expert.

A. James Hansen, Ph.D.

The '302 plaintiffs contend that Dr. Hansen's opinions are inadmissible as unreliable. They seek to exclude his testimony regarding the impact of the regulation, and more specifically his "tipping point" theory, including his testimony regarding ice sheet disintegration. They apparently do not seek to exclude his testimony regarding species extinction and regional effects of global warming, except insofar as these effects are presented as consequences of the Earth passing a "tipping point."

1. Hansen's qualifications

There can be no dispute that Dr. Hansen is qualified "by knowledge, skill, experience, training, or education" as an expert in climatology. *See* Fed. R. Evid. 702. Dr. Hansen has had an illustrious scientific career. His work history includes positions as a Resident Research Associate at the NASA Goddard Institute for Space Studies, between 1967 and 1969; a position as an NSF Postdoctoral Fellow at the Leiden Observatory in the

Netherlands; a three-year position as a Research Associate at Columbia University, and a long stint as a staff member and space scientist at the Goddard Institute, where he was also the Manager of the Institute's Planetary and Climate Programs, from 1972 until his appointment as the Institute's Director in 1981. Hansen Resume, Hansen Decl. App. A. Hansen continues to holds his position as the Director of the Goddard Institute. *Id.*; Tr. vol. 13-A, 145:2-3 (Hansen, May 3, 2007). He is also an Adjunct Professor in Earth and Environmental Sciences at Columbia University, where he teaches Introduction to Planetary Atmospheres and Climate Change and a graduate level class on Atmospheric Radiation. Hansen Resume.

Hansen's impressive educational background includes an undergraduate degree in physics and mathematics, and a master's degree and doctorate in astronomy. Tr. vol. 13-A, 147:1-17. He has particular expertise in climatology and the science of global warming; he testified at trial that since the late 1970s, he has focused all of his time on trying to understand the climate of the Earth. *Id.* at 148:21-24. During the last thirty years, he has published more than 100 peer-reviewed articles on the general topic of climatology, and edited a book on the subject of climate change and the paleoclimate. *Id.* at 153:1-14.

Dr. Hansen's expertise has been honored on many occasions and in many settings. He is a member of the American Geophysical

Union, the American Meteorological Society, and the National Academy of Sciences. *Id.* at 149:7-9. He has won awards including the Duke of Edinburgh Award from the World Wildlife Fund; the Rogen Ravel Medal from the American Geophysical Union; the Leo Szilard Lectureship Award from the American Physical Society; and the Heinz Environment Award. *Id.* at 151:6-152:4. Between 1977 and 2005 Hansen won eighteen awards for his scientific work, including winning the Goddard Institute's "Best Scientific Publication" award, determined by a peer vote, three times. *Id.* at 152:5-11; Hansen Resume. His testimony at trial revealed his extensive familiarity with research and data on climate history, climate change and its likely effects.

2. Hansen's testimony

Hansen testified that human emissions of greenhouse gases, including carbon dioxide and methane, are climate "forcing" agents that can cause warming of the Earth's surface.[10] Tr. vol. 13-B, 12:7-8 (Hansen, May 3, 2007). Since pre-industrial times, there has been a drastic increase in atmospheric concentrations

[10] A "forcing" is an imposed perturbation to the planet's energy balance, measured in watts per meter squared. Tr. vol. 13-B, 10:2-10 (Hansen, May 3, 2007). Greenhouse gases absorb heat radiation, so that an increase in the amount of these gases in the atmosphere is a mechanism for making the Earth's surface warmer. Such warming can be measured in the same way as other causes of temperature change, such as changes in the sun's brightness. *Id.* at 12:16-24.

of such gases, due primarily to fossil fuel burning.[11] *Id.* at 13:8-14:3. On long term scales, the climate is very sensitive to even small forces, and human-made forces are now much larger than the changes that drove glacial to interglacial changes in the past. *Id.* at 30:22-31:1.

Hansen's "tipping point" theory posits that at a certain point the changes associated with global warming will become dramatically more rapid and out of control. The "tipping point" is the point at which very little, if any, additional forcing is needed for substantial changes to occur. *Id.* at 50:18-23. Hansen testified that based on the historical temperature record, drastic consequences, including rapid sea level rise, extinctions, and other regional effects, would be inevitable with a two to three degrees Celsius warming expected if no limits are imposed and emissions continue at their current rate. Such changes could happen quickly once a tipping point is passed. On the other hand, Hansen theorizes that if GHG emissions are

---

[11] The concentration of carbon dioxide in the ambient atmosphere in the present time, averaged over the world, is about 383 parts per million, compared with 280 parts per million in the pre-industrial era. *Id.* at 13:8-13. This increase is due primarily to fossil fuel burning, which accounts for about eighty percent of the increase. To find carbon dioxide concentrations as high as current ones, it is necessary to look at a period two to five million years ago. Current annual increases in carbon dioxide emissions are two parts per million, up from one part per million when measurements began in 1958. They are predicted to rise to about four parts per million per year by the middle of the century under the business-as-usual scenarios. *Id.* at 58:15-59:3.

reduced, warming may remain within the upper limit of previous interglacial periods and might avoid the most drastic consequences of global warming. *See id.* at 48:7-49:1.

In the last one hundred years the temperature has increased to within less than one degree Celsius of the warmest interglacial period in the past 1.3 million years.[12] *Id.* at 37:15-38:2. Hansen testified that warming may be less dangerous as long as it stays within that range, and certainly it would have a less drastic effect than the warming that is expected if GHG emissions continue unchecked by regulation. He posits that an "alternative scenario" in which regulations are imposed to keep the temperature in that range is necessary. *Id.* at 38:4-13.[13]

Hansen testified that sea level rise is likely to take place in a nonlinear fashion because of multiple positive feedbacks.[14]

---

[12] This data is from the temperature as measured in ocean cores.

[13] Hansen supports this conclusion by looking at the historical record. In the middle Pliocene period 3-1/2 million years ago, the temperature was two to three degrees Celsius warmer than the present global temperature, approximately the level of global warming that Hansen predicts absent regulation of greenhouse gases. Sea level rose twenty-five meters. *Id.* at. 28:3-9. During the past 1.3 million years, while temperature fluctuations were less dramatic, sea level was at least a few meters higher than today's during some periods, but the rise was less drastic. *Id.* at 38:20-24.

[14] Feedbacks magnify the effect of a forcing. Even a very small forcing may have a large effect because warming will cause the release of carbon dioxide from oceans, increasing the forcing, and decrease ice cover, increasing the amount of warmth

Id. at 52:7-20. Once a certain point is reached, rather than melting at a consistent rate, ice sheets may rapidly disintegrate. Hansen pointed to evidence in the paleoclimate record for such abrupt climate changes.[15] *Id.* at 46:22-47:18. Huge changes, on the scale of one hundred meters of sea level rise, have frequently taken place over the course of only a few thousand years. There are multiple instances in which sea level has risen several meters per century, in response to smaller forcings than those currently underway. *Id.* at 51:8-21. Based on this record, Hansen's opinion is that the time scale of the response of an ice sheet depends on the time scale of a forcing. *Id.* at 51:12-15. The scale of the GHG forcing currently underway shows that it is virtually certain that such a large-scale rise will occur if GHG emissions continue to increase. *Id.* at 52:7-20.

To support his testimony regarding ice loss, Hansen presented substantial data, including satellite observations and gravitational measurements from the GRACE satellite in Greenland

---

that is absorbed by the Earth rather than reflected. These feedbacks will cause still more carbon dioxide release and melting of ice. Id. at 22:22-23-1.

[15] For example, in the transition from the last ice age to the current interglacial period, there was a period in which sea level increased twenty meters in four hundred years, or about one meter every twenty years, a phenomenon known as Meltwater Pulse 1A. That ice sheet was at a lower latitude than the Greenland or Antarctic ice sheets, but was subject to a much smaller forcing. *Id.* at 47:7-18.

and West Antarctica, showing patterns that suggest that ice sheets are both melting and becoming increasingly unstable.[16] *Id.* at 44:3-46:4; 119:11-120:5.

Hansen also testified regarding likely regional climate changes resulting from global warming. Climate history underscores the likelihood of species extinction resulting from climate change; in the history of the Earth there have been five or six global warming events comparable to or larger than that predicted for the end of the 21st Century, each resulting in the extinction of a majority of the species on the planet. *Id.* at 69:13-23.

As to regional effects, climate models agree on an intensification of the climatic patterns of rainfall belt in the

---

[16] Satellite observations support Hansen's belief that the Earth is at risk from ice sheet disintegration. Satellites show increasing meltwater on the ice sheet in Greenland during the summers. *Id.* at 43:9-15. Icewater finds the lowest spot and burrows a hole through the base of the sheet, lubricating the base of the sheet and speeding the discharge of giant icebergs to the ocean. On the largest ice stream in Greenland, the flux of icebergs has doubled in the last five years. *Id.* at 43:25-44:2. The satellite GRACE, which measures the gravitational field of the Earth to show changes in ice sheet mass, shows that the ice sheet is melting faster than it is being increased by additional snowfall. *Id.* at 44:17-45:3. The frequency of earthquakes in Greenland has doubled between 1993 and 1999, and again between 1999 and 2005, a pattern consistent with a nonlinear process in which the ice sheet is becoming less stable. *Id.* at 45:11-46:4. The ice sheet of greatest concern is the West Antarctic Ice Sheet, which sits on bedrock, below sea level, in direct contact with the ocean. This ice sheet contains sufficient water that, if melted, could cause sea level to rise a total of seven meters. Its ice shelves are now melting several meters per year. *Id.* at 49:2-16.

tropics and dry subtropical regions on both sides, leading to more intense dry conditions in the western United States and Mediterranean and parts of Africa and Australia. *Id.* at 56:24-57:11.

Addressing these problems, according to Hansen, means addressing emissions of carbon dioxide, the most important greenhouse gas,[17] through an alternative scenario. *Id.* at 25:5-10. That scenario contemplates an initial slow decrease in carbon dioxide emissions followed by more rapid decreases later in the century as new technologies are developed. *Id.* at 59:6-63:1. The vehicle emissions reductions that the GHG regulation requires are consistent with the alternative scenario's conception of the necessary steps to check global climate change before the Earth reaches a tipping point leading to the disastrous results described above.[18]

---

[17] Although methane is a far more powerful greenhouse gas, it is not released in the same large quantities and does not have the same lengthy lifetime. A century after carbon dioxide is released a third of the carbon dioxide will remain in the atmosphere. After five hundred years, a quarter will remain. Although some carbon dioxide is taken up by the ocean, carbon dioxide taken up by the ocean exerts a back pressure on the atmosphere, so a significant fraction will remain in the atmosphere until that previously taken up has been deposited in the sediments of the ocean, a process taking thousands of years. *Id. at* 29:10-30:12.

[18] Hansen and his students used the National Research Council report on vehicle efficiencies to determine how vehicle emissions reductions could fit in with such a scenario. By taking the improvements outlined in that report that would basically pay for themselves and forecasting a phase-in of those recommendations over a ten year period, they found that with the

Hansen did not testify that GHG regulations such as Vermont's will solve the global warming problem. *Id.* at 71:24-72:4. Rather, he testified to his opinion that the Vermont regulations' emissions reductions are scientifically important, not because of their effects when taken alone, but because they are consistent with the rates of change necessary to avoid the most drastic consequences of global warming. *Id.* at 72:18-73:2. Hansen testified that it is hard to say what straw will break the camel's back in terms of tipping points. *Id.* at 73:6-12. In addition, he noted that the effects of the regulation may be magnified if its adoption encourages reductions in other parts of the country and the world. *Id.* at 73:16-21.

If the alternative scenario is to be achieved, action must be immediate. One more decade of business as usual--that is, another ten years of two percent increases in carbon dioxide emissions annually--would lead to emissions in 2015 that are thirty-five percent greater than those in 2000. It would then be virtually impossible to reduce emissions to the level necessary to meet the alternative scenario. *Id.* at 69:24-70:7.

---

expected growth in vehicle numbers, those improvements actually cause a moderate decrease in total vehicle emissions, which continues for a few decades without further improvements. *Id.* at 63:2-64:1. That report used slightly weaker emissions requirements than those that the regulation imposes. *Id.* at 67:20-68:8.

3. Reliability of Hansen's testimony

The '302 plaintiffs assert that Hansen's testimony does not meet Rule 702's reliability requirements, arguing that his opinions "arise out of pure speculation." Pls.' Renewed Mot. to Exclude Test. of Hansen 1 (Doc. 485). As to the *Daubert* factors, they argue that Hansen's testimony "meets none of *Daubert's* criteria for reliability: his "technique certainly has no known error rate and his hypothesis has not been, and cannot be, tested; the scientific community has explicitly considered and rejected his view as lacking scientific support; and his projections regarding the tipping point and sea level rise find no objective support in the scientific literature."[19] *Id.* at 7.

Hansen's testimony is based on sufficient facts and data and reliable methods, applied reliably to the facts. Hansen cited abundant data in support of his theories regarding climate change, including historical data gathered from a number of sources including measured temperatures, ice cores and ocean cores, as well as modeling results. He also cited substantial data regarding the likelihood of ice sheet disintegration,

[19] Plaintiffs did not produce any evidence to contradict Hansen's testimony on likely species extinctions and devastating regional impacts of global warming other than ice sheet disintegration. In addition, they do not address that testimony in their Motion. Therefore, the Court assumes that their motion seeks the exclusion of Hansen's testimony as to the concept of a "tipping point" and as to his predictions regarding ice sheet disintegration and sea level rise, but does not seek the exclusion of his testimony as to the effects of global warming on species extinction or regional impacts.

including satellite imagery and the GRACE satellite's gravitational field data showing recent losses of mass in Greenland and Antarctica, increases in ice quakes in Greenland, recent accelerations in ice streams flowing off Greenland, and historical data on sea level rise at other warm periods in paleoclimate history. As the '302 plaintiffs note in their motion to exclude Hansen's testimony, historical data is not a perfect predictor of what will happen in our current climate. *Id.* at 9. The unprecedented nature of current human-made forcings means that history is not a perfect guide. However, that the situation is unprecedented does not mean that scientists may not testify reliably as to global warming's likely effects.

Plaintiffs' rebuttal expert, Dr. John Christy,[20] testified that Hansen's hypothesis regarding rapid sea level rise is unsupported by the scientific evidence. Christy critiqued the use of data from the GRACE satellite; while he agreed that the data was accurate, he noted that only a few years worth of data are available. Tr. vol. 14-A, 109:5-14 (Christy, May 4, 2007). Since the GRACE data was only one of several sources supporting Hansen's conclusions, objections to that data are insufficient to render Hansen's testimony inadmissible. In addition, the Court, as the trier of fact, can take into account the short time period

[20] Christy is the Alabama state climatologist. He is also a professor of atmospheric science and Director of the Earth Systems Science Center at the University of Alabama at Huntsville. Tr. vol. 14-A, 66:15-19 (Christy, May 4, 2007).

for which GRACE measurements exist. This limitation goes to the weight, rather than to the admissibility of Hansen's testimony.[21]

As to sea level rise, Hansen acknowledges that no existing mathematical or scientific model can predict the sea level rise that will result from ice sheet disintegration, when it will occur, or the exact sea level rise it will cause. Tr. vol. 13-B, 96:14-15; 122:5-123:1 (Hansen, May 3, 2007). Under these circumstances, Hansen's use of his expertise to make a prediction based on climate history is not an unreasonable choice of methodology. Hansen's predictions need not be certainties to be admissible under Rule 702, nor need his estimates of the timing and amount of sea level rise be exact to be admissible. The '302 plaintiffs refer to an "absence of any objective evidence" to support Hansen's opinion, Pls.' Mot. 12, but Hansen did reference substantial supporting evidence in his testimony, including several examples from climate history. The lack of a model to

---

[21] Christy also suggested that some data shows that snowfall increases over ice sheets resulting from global climate change will make ice sheets larger, not smaller. *Id.* at 116:10-117:21. Hansen's response demonstrated his familiarity with the data that Christy referenced, and referenced additional data to support his position. These differences in the experts' interpretations of the available data are not grounds for the exclusion of Hansen's testimony. In addition, it appears that the bulk of scientific opinion opposes Christy's position. In recent testimony on the IPCC's findings to the U.S. House of Representatives Committee on Science and Technology, Dr. Richard Alley noted that "melting is now widespread," including in "the great ice sheets of Greenland and Antarctica, and we see it even when there is more snow falling. And so it's really hard to blame loss of ice and of snow if there is more snow in some places, and yet it is melting faster." PX 1238.

address ice sheet disintegration does not mean that evidence on that point is *de facto* unreliable.

The '302 plaintiffs repeatedly compare the IPCC's sea level rise predictions to Hansen's, arguing that Hansen's estimates are flawed because they are higher. The comparisons are misleading. The IPCC predicted a sea level rise of between eighteen and fifty-nine centimeters under a "business-as-usual" scenario. PX 1297 at 13. Although the IPCC takes into account runoff of snow and land-based ice from mountain glaciers, and continued ice sheet stream flow rates the same as those experienced from 1993-2003, in addition to thermal expansion, it does not address the possibility of ice sheet disintegration, which would cause much of the sea level rise that Hansen predicts. IPCC hearing transcript at 9:7-14; PX 1297 at 14. It is common and acceptable for trained experts to extrapolate from existing data, as Hansen has done in making predictions from available information on the Earth's climate history. *See Joiner*, 522 U.S. at 146. Although a "court may conclude that there is simply too great an analytical gap between the data and the opinion proffered," *id.*, there is no such gap here.

It is true that Hansen's predictions do not have a known error rate and cannot be tested, at least not in a laboratory. *Daubert's* factors are meant to be applied flexibly, *see Blanchard*, 207 F. Supp. 2d at 315-16, and they by no means

indicate that Hansen's testimony is inadmissible. Hansen's testimony is of a different nature from much of the expert testimony on which there is more extensive caselaw. Hansen presented a wide-reaching theory regarding the worldwide effects of unprecedented human-created climate change, not a theory about a drug's causation of birth defects, as in *Daubert* itself, or the likely credibility of witnesses, as in *Nimely v. City of New York*, 414 F.3d 381 (2d Cir. 2005), or the likelihood that exposure to toxins was harmful, as in *Wills*, 379 F.3d at 46, and *Amorgianos*, 303 F.3d at 269-70. Although this theory must still be proven reliable, some *Daubert* factors may be less applicable here than in other cases involving expert testimony.

Hansen didn't testify to a screening test for a disease or genetic trait, which one would expect to have a particular error rate. Rather, he used various sources of evidence to make a prediction about the future of the Earth, a prediction which it is difficult to assign a defined error rate. As the conclusion which he reached is supported by evidence, the absence of a defined error rate does not render it inadmissible.

Plaintiffs argue at length that Hansen's theory is unreliable because it has not been tested by controlled scientific experimentation. It is difficult to imagine a conclusive test for any theory about the future climate effects of the world's current emissions of greenhouse gases. The

appearance of Hansen's predicted large-scale impacts following a global temperature rise of two to three degrees Celsius would be the only entirely conclusive proof of his theories, but clearly it would be ridiculous to exclude his testimony on the grounds that this has not yet occurred. A prediction on this enormous scale must necessarily be tested by the extent to which it is confirmed by evidence such as the historical record and model results, rather than through testing. The same would be true of a theory on global warming offered by any expert. While the '302 plaintiffs complain that the theory has not been tested, their motion does not describe what sort of "controlled scientific experiment" they propose. Pls.' Mot. 8. The absence of controlled scientific testing does not undermine the reliability of Hansen's opinions given the nature of the predictions that he offers.

Plaintiffs argue that Hansen's theories are unreliable because they have not been subjected to peer review. Hansen published a paper in 2000 defining the "alternative scenario." *See* DX 2285. Hansen's views on the likelihood of rapid ice sheet disintegration have also been published; in 2005 he published an editorial essay projecting that two to three degrees Celsius warming would likely cause a sea-level rise of at least six meters within a century due to ice sheet disintegration. *See* James E. Hansen, A Slippery Slope: How Much Global Warming

Constitutes "Dangerous Anthropogenic Interference"?, 68 Climatic Change 269 (2005). While not peer-reviewed, this publication did serve to place his views before the scientific community. More recently, a paper regarding Hansen's sea level rise theory was published in a peer-reviewed journal. *See* James Hansen et al., Dangerous Human-Made Interference with Climate: A GISS Model E Study, 7 Atmos. Chem. Phys. 2287 (May 7, 2007).

Daubert notes that peer review is a relevant consideration in determining whether expert testimony is reliable because "submission to the scrutiny of the scientific community is a component of 'good science,' in part because it increases the likelihood that substantive flaws in methodology will be detected." 509 U.S. at 593. Although not extensively peer-reviewed, his publications demonstrate that Hansen's opinions have been thoroughly presented to the scientific community and are longstanding rather than framed for litigation purposes alone. *See Daubert*, 43 F.3d at 1317. In any case, this single factor is not determinative, and does not justify exclusion of his testimony under these circumstances, where his testimony is otherwise reliable.

There is widespread acceptance of the basic premises that underlie Hansen's testimony. Plaintiffs' own expert, Dr. Christy, agrees with the IPCC's assessment that in the light of new evidence and taking into account remaining uncertainties,

most of the observed warming over the last fifty years is likely to have been due to the increase in GHG concentrations. Tr. vol. 14-A, 145:18-148:7 (Christy, May 4, 2007). Christy agrees that the increase in carbon dioxide is real and primarily due to the burning of fossil fuels, which changes the radiated balance of the atmosphere and has an impact on the planet's surface temperature toward a warming rate. *Id.* at 168:11-169:10. Christy also agreed that climate is a nonlinear system, that is, that its responses to forcings may be disproportionate, and rapid changes would be more difficult for human beings and other species to adapt to than more gradual changes. *Id.* at 175:2-174:11. He further agreed with Hansen that the regulation's effect on radiative forcing will be proportional to the amount of emissions reductions, and that *any* level of emissions reductions will have at least some effect on the radiative forcing of the climate. *Id.* at 174:16-23.

The '302 plaintiffs contend that there is no support in the scientific community for Hansen's theories on sea level rise. Again, this is not accurate. At trial, Defendants introduced, in connection with Dr. Hansen's testimony, a peer-reviewed article by a group of scientists including Dr. Richard Alley, a top glaciologist, in which Dr. Alley and his coauthors conclude that "current knowledge cannot rule out a return to . . . conditions [in which ice sheets have contributed meters above modern sea

level in response to modest warming] in response to continued GHG emissions. Moreover, a threshold triggering many meters of sea-level rise could be crossed well before the end of this century." DX 2287; *see also* DX 2292 (Antarctica is actually losing mass at a significant rate despite the increase in snowfall rate in the center of the ice sheet, contrary to previous beliefs).[22]

The '302 plaintiffs further argue that Hansen's testimony is inadmissible due to lack of evidence that the regulation will avoid triggering a tipping point. Pls.' Renewed Mot. 12. This objection to Dr. Hansen's testimony appears to rest on a misunderstanding of the opinion that he has offered.[23] Hansen does not argue that the change in GHG emissions that will result from the regulation challenged in this case will itself have the immense impact of preventing the Earth from reaching a "tipping point." Rather, he articulates a pressing need for the worldwide community to act in a comprehensive variety of arenas to reduce GHG emissions, as described in his "alternative scenario." He states that the reductions implied by the regulation at issue are

---

[22] In addition, the National Academy of Science ("NAS") published a 2002 report in which it found that abrupt climate change is likely in the future, referencing the concept of "thresholds" or "tipping points." National Academy of Sciences, Abrupt Climate Change, Inevitable Surprises (2002) at page v, available at http://books.nap.edu/openbook.php?isbn=0309074347.

[23] Plaintiffs' expert Dr. Christy estimated that implementing the regulations across the entire United States would reduce global temperature by about 1/100th (.01) of a degree by 2100. Hansen did not contradict that testimony.

consistent with that scenario. The fact that global warming will not be solved by changes in any one industry or by regulation of any one source of emissions in no way undercuts the vital nature of the problem or the validity of partial responses; rather, it points to the necessity of responses, however incomplete when viewed individually, on any number of fronts. *See Massachusetts v. EPA*, 127 S.Ct. at 1457 ("Agencies, like legislatures, do not generally resolve massive problems in one fell regulatory swoop. They instead whittle away at them over time.").

The Court finds that Hansen's opinions are reliable for purposes of their admission into evidence.

4. Relevance of Hansen's testimony

Hansen's testimony provides the Court with important information on the nature and risks of global warming. As the regulation at issue was crafted in response to a recognition of these risks, understanding the nature of the regulation and its effects depends on an understanding of the science that underlies global warming. By explaining how such warming begins and grows, as well as how it may be addressed at this point in time, Hansen illulminated important background to the issues in this case. While Hansen does not, as noted above, argue that the regulation will in itself solve the global warming problem, his testimony provided valuable context for the Court's consideration of the Plaintiff's contentions that the regulation is essentially

useless. Therefore, the Court finds that Hansen's opinions do assist the Court, as the trier of fact in this case.

The Renewed Motion to Exclude Testimony of James E. Hansen (Doc. 485) is **denied.**

B. Barrett N. Rock, Ph.D.

The '302 plaintiffs move to exclude Dr. Rock's testimony on the grounds that his opinions are not relevant to this litigation and are methodologically flawed and unreliable.

1. Dr. Rock's qualifications

Dr. Rock's qualifications are undisputed. He has been a professor at the University of New Hampshire ("UNH") for thirty-five years, and is the past director of the Complex Systems Research Center at the Institute for the Study of Earth, Oceans and Space at UNH. Tr. vol. 14-A, 7:20-8:4 (Rock, May 4, 2007). He has an undergraduate degree, a master's degree, and a Ph.D. in botany, focusing on the comparative study of forest conditions. *Id.* at 10:10-15. He has published peer-reviewed articles on those subjects and belongs to a variety of relevant professional associations. *Id.* at 10:20-11:3. Of particular relevance to this case, Rock has done substantial work on the impact of climate on forest health in the eastern United States and elsewhere. *Id.* at 11:4-15. His peer-reviewed articles appeared in the New England Regional Assessment (the "regional assessment" or "NERA"), one of sixteen regional studies conducted as part of

the U.S. Global Change Research Program's national assessment. *Id.* at 11:16-12:1; *see also* PX 2297, PX 2298. Rock was the lead author of the regional assessment. Tr. vol. 14-A, 13:10-11. Rock clearly is qualified to offer an expert opinion on the effects of climate change on Vermont's climate, forests, and associated industries.

2. Dr. Rock's testimony

Dr. Rock testified that the past one hundred years have seen a warming trend in the New England region and the state of Vermont.[24] In the regional assessment, Rock used two climate models--the Hadley climate model and the Canadian climate model–-which predicted six degrees Fahrenheit warming by 2100, and ten degrees Fahrenheit warming by 2100, respectively. *Id.* at 19:23-20:5. Rock testified that either level of warming would place at risk iconic elements of the Vermont experience and economy including fall foliage, maple syrup production, and the ski industry.

As to foliage, Rock testified that increased warming would result in very muted color displays, given that color changes in maples result from seasonal changes in temperature and day

[24] His data is from the National Climate Data Center's historic climate network, and is based on data from approximately 350 monitoring sites across the region. The data includes New York in the New England region. Tr. vol. 14-A, 15:23-16:6 (Rock, May 4, 2007). Overall warming in the region was 0.7 degrees Fahrenheit between 1895 and the present, while warming in Vermont was 1.6 degrees Fahrenheit. *Id.* at 15:12-20.

length. *Id.* at 18:16-24. In addition, climate change could cause the loss of maple trees in Vermont, as they are unable to tolerate a warmer climate. With the warming that either model predicts, there would eventually be no more maples in New England. *Id.* at 18:24-19:3, 20:6-12.

Warming will also lead to shorter and warmer winters in Vermont, according to Rock, which will mean less snow. *Id.* at 28:16-19. The regional assessment found that average snowfall for Vermont decreased by fifteen percent from 1953 to 1993. *Id.* at 28:22-29:9. The period during which snow is on the ground each year has decreased by about a week between 1953 and 1998. *Id.* at 29:10-30:4. Differences in snowfall are likely to affect the skiing industry.

Finally, Rock testified that warming will affect maple sugar production. *Id.* at 30:14-17. Syrup production requires specific conditions: freezing temperatures at night (below twenty-seven degrees Fahrenheit), and warming temperatures during the day (above thirty-two degrees and preferably between thirty-seven and thirty-eight degrees). These conditions cause bubbles to form in the sap that drive it up the tree to provide sugar to developing buds. The sap varies in sugar content based on conditions during what is known as the “cold recharge period,” which normally takes place during parts of November, December, January, and beginning mid-to-late February. *Id.* at 30:20-31:21. The last few sugar

seasons have been poor because December temperatures have been too high for an adequate cold recharge, which has affected both quality and quantity of syrup. *Id.* at 32:12-17. Lately, the sap season has become shorter and begun earlier in the season, which is a problem for sugar manufacturers who are accustomed to tap trees around President's Day and miss the first sap run if it begins early.[25] *Id.* at 31:22-32:11.

3. Reliability of Dr. Rock's testimony

The '302 plaintiffs attack specific portions of Rock's testimony on reliability grounds. Specifically, they argue that: (1) his testimony as to likely temperature increases in Vermont and New England relies on models which are methodologically flawed; (2) his testimony as to the impact of warmer temperatures on maple sugar production is flawed due to reliance on a study which references those same models; (3) his testimony regarding the impact of warmer regional temperatures on the ski industry is unreliable because it is based on a study of New Hampshire, rather than Vermont; and (4) his testimony as to the impact of warmer temperatures on fall foliage is unreliable because Rock has not shown that leaf color will actually change or tested his hypothesis to that effect. Pls.' Renewed Mot. to Exclude Test. of Rock (Doc. 479). The '302 plaintiffs have not attacked the

[25] The first run is when the sap has the highest sugar content and lowest metabolic by-products, and makes the highest quality, Grade-A fancy syrup. *Id.* at 32:21-33:4.

science underlying Rock's testimony about how maple sugar is formed or about the conditions that favor maple syrup production or create fall foliage color.

Rock relied upon the National Climate Data Center's U.S. Historical Climate Station Network (the "Network") in his testimony regarding historical changes in Vermont's climate. Christy, testifying as a rebuttal witness to Rock, stated that the Network produces questionable results as to long-term variations. Tr. vol. 14-A, 120:7-15 (Christy, May 4, 2007). Christy has studied the accuracy of the Network in other regions and concluded that it has some bias toward showing too much warming over time. *Id.* at 120:16-25. Christy does not offer an alternate source of data. Christy's opinion that the data was flawed was drawn from his studies in other regions, not New England. In addition, the data that the Network produces does not result from the application of a model or formula; rather, it is a compilation of actual measurements from regional monitoring sites. Christy's only explanation for why the measurements might show inaccurate trends over long time periods is that stations move or other things happen to them. *See id.* at 120:16-21. However, a study updating the NERA report, published in 2005, used data only from stations with continuous records, excluding discontinuous or incomplete records, and still found that Vermont was warming faster than the region overall. Tr. vol. 14-A, 17:3-

18:5 (Rock, May 4, 2007).

Rock's testimony as to likely temperature increases in Vermont and New Hampshire is based on NERA's report, which uses the Hadley and Canadian models. The '302 plaintiffs argue that his testimony on future climate change in the region is inadmissible due to the use of those models. Both are global models, which NERA downscaled for use at the regional level. They do not take into account regional environmental factors affecting regional climate, such as coastal orientation, grade change in elevation, latitude and position of the zone of westerlies. *Id.* at 44:4-14. Dr. Rock agreed that the models were not "ideal" and that regional models are needed; however, he nonetheless stated that the models were useful and standard in the scientific community. *Id.* at 43:21-44:3.

Christy criticized the Hadley and Canadian models, suggesting that they were extreme and were downscaled unreliably. Tr. vol. 14-A, 121:13-122:4 (Christy, May 4, 2007). Although Christy testified that he had used climate models, however, he did not claim to be an expert on climate modeling. *Id.* at 78:20-79:3. In fact, his view of the reliability of climate models does not fall within the mainstream of climate scientists; his view is that models are, in general, "scientifically crude at best," although they are used regularly by most climate scientists and he himself used the compiled results of a variety

of climate models in preparing his report and testimony in this case. *Id.* at 152:23-153:3; 155:12-156:18.

The Hadley and Canadian models were selected by the United States government for use in the U.S. Global Climate Change Research Project's assessment of regional global warming impacts. National Assessment Synthesis Team Climate Change Impacts on the United States: The Potential Consequences of Climate Variability and Change (2000) at 16. Studies released after the regional assessment was complete confirm the results of those models.[26] *See* Tr. vol. 14-A, 60:11-61:5 (May 4, 2007). In that study, Katherine Hayhoe measured the likely increase in Northeast temperatures using a total of nine climate models using a more sophisticated form of downscaling, and found nearly the same results as those upon which Rock relied. *Id.* at 61:11-62:15. As an "ideal" model was not available to Rock, his failure to use one does not render other models unreliable, particularly since their results have been validated by other studies. Rock's methods are not unreliable, as he used models which other

---

[26] *See* K. Hayhoe et al., Past and Future Changes in Climate and Hydrological Indicators in the U.S. Northeast, 28 Climate Dynamics 381, 404 (March 4, 2007) (models "are capable of reproducing the dominant influence on regional temperature-related climate indicators"); *see also* K. Hayhoe et al., Quantifying the Regional Impacts of Global Climate Change, in review at Bulletin of the American Meteorological Society. Another regional study reaching similar conclusions is a report of the Climate Change Research Center, at UNH. *See* Clean Air–Cool Planet and C. P. Wake, Indicators of Climate Change in the Northeast, 2005.

scientists at the U.S. Global Change Research Project had determined were reliable and which were later validated.

Next, the '302 plaintiffs assert that Rock's testimony should be excluded as inadmissible under Rule 703, which states that "[t]he facts or data in the particular case upon which an expert bases an opinion or inference may be those perceived by or made known to the expert at or before the hearing." Fed. R. Evid. 703. The '302 plaintiffs argue that Rock's reliance on global climate models which he did not create and which he lacks the modeling expertise to fully evaluate violates Rule 703.

"Facts or data" on which an expert relies may include reliable opinions of other experts, or hypothetical facts. Fed. R. Evid. 702 advisory committee's note. Rock's use of the models essentially amounts to reliance on the experts who created and validated them; their primary function is to provide a scenario for him to use in describing the effects of the warmer temperatures that they predict, as the advisory committee expected that scientists would do with information that they gained from other experts.[27] *See id.*

The '302 plaintiffs move for the exclusion of Rock's opinions regarding the likelihood that global warming will cause

[27] The gist of Rock's testimony was not a prediction as to the exact level of warming that is likely to occur in Vermont. Rather, his testimony concerned the effects of such warming, which is also the area in which he has the most experience and knowledge. Therefore, that is the testimony to which the Court has given weight.

the loss of maple trees in Vermont, arguing again that he improperly relies on a study performed by other scientists. First, they argue that the Iverson and Prasad study, on which Rock relied in concluding that warming would cause the loss of maple trees, is unreliable because it is based on the Hadley and Canadian studies. For the reasons noted above, the Court does not find the use of those models to be a source of unreliability.

Second, the '302 plaintiffs argue that Rock has improperly used the study, which merely "indicat[es] . . . the potential impact on species' distribution" to "forecast" the loss of maple trees in Vermont. The distinction between an "indication" and a "forecast" does not affect the admissibility of Rock's testimony. Rock has expertise regarding the effect of climate change on trees and forests independent of the study that underlies his opinion regarding loss of maple trees. As the study is only part of the basis for Rock's ultimate opinion regarding the effect of warming on Vermont's forests, Rock's conclusions need not perfectly track those of the study.

Finally, the '302 plaintiffs argue that Rock is insufficiently informed as to the means by which Iverson and Prasad arrived at their conclusions. Again, however, it is legitimate for Rock to use information gained experts in other fields as data in support of his own conclusions. *See* Fed. R. Evid. 702 advisory committee's note. Rock testified that it is

customary for scientists in his field to use the output of climate models--and projections generated by other experts--in generating their opinions. Tr. vol. 14-A 21:14-20. In addition, he testified that his conclusion as to the loss of maples is based on his "knowledge of tree physiology in terms of how sugar maples are adjusted to the current climate conditions, and what those changes would have to be under the climate scenarios provided." *Id.* at 21:22-22:2. Testimony from Rock's own knowledge and experience would be acceptable even in the absence of citation to a study confirming his conclusions. *See* Fed. R. Evid. 702 advisory committee's note ("Nothing in this amendment is intended to suggest that experience alone–or experience in conjunction with other knowledge, skill, training or education–may not provide a sufficient foundation for expert testimony.").

Rock's testimony regarding the impact of warmer regional temperatures on the ski industry is also admissible. The '302 plaintiffs object to this testimony because Rock bases his conclusions on a study of the New Hampshire ski industry, rather than the Vermont industry. They argue that Rock did not perform a proper analysis to determine whether factors affecting the success of the New Hampshire industry would have the same effects in Vermont. Rock's testimony on this point was relatively simple: he essentially used the New Hampshire study to support

his conclusion that warmer temperatures were likely to lead to less snow and have an effect on Vermont's ski industry. This seems, as a proposition, unarguably true. The study's origin in a neighboring state rather than Vermont does not negate its applicability to the Vermont ski industry; the states are small and contiguous and have similar climates. Insofar as the Plaintiffs have articulated relevant differences between Vermont and New Hampshire ski conditions and industries, those differences affect the weight, not the admissibility of Rock's testimony.

Finally, the '302 plaintiffs have attacked Rock's testimony as to the impact of warmer temperatures on Vermont's fall foliage. This testimony falls within Rock's core area of expertise. The '302 plaintiffs object that Rock has not shown that warming will affect fall foliage color, but in fact, Rock did present evidence that foliar color will diminish with warming. He has expertise on the issue of how fall colors are produced and the role that temperature and season play in that transformation, which he has properly applied to the temperature changes that he found are likely in Vermont. The '302 plaintiffs note that Rock did not perform tests to demonstrate the truth of his opinions regarding temperature's effect on the amount of sugar in the leaf and resulting color. Given Rock's extensive expertise on this topic and coherent explanation of the

mechanisms of foliar color change, the lack of such a test does not render his testimony on this point inadmissible.

The ‘302 plaintiffs object to Rock’s reliance on a graph of first frost data which dealt only with Burlington, Vermont. The fact that the data was only from Burlington and not the entire state does not entirely eliminate its usefulness as a marker of change in the state’s climate. As noted above, minor limitations in some of the data on which Rock relied goes to the weight of Rock’s testimony on this point, not its admissibility.

In light of the evidence presented by all of the parties, it is the Court’s conclusion that Rock’s testimony meets Rule 702's threshold reliability requirement.

4. Relevance of Rock’s testimony

Rock’s testimony is relevant to this matter, and assists the Court, for the reasons given above concerning the relevance of Hansen’s testimony. His testimony focused on effects on Vermont in particular, and demonstrated some reasons that avoiding global warming is of particular interest to this state. His testimony adds to Hansen’s by providing local information which is useful to the Court’s understanding of the regulation.

The Renewed Motion to Exclude the Testimony of Barrett N. Rock (Doc. 479) is **denied.**

C. K.G. Duleep

The ‘302 plaintiffs move to exclude the testimony of

Defendants' Expert Mr. K.G. Duleep on the grounds that it is unreliable due to his use of allegedly flawed methods.

1. Duleep's Qualifications

Duleep has extensive experience in the study of fuel economy and emissions in the automobile industry. He is a managing director at Energy and Environmental Analysis, Inc. ("EEA"), where he is responsible for directing all studies in the area of automotive emission control and fuel economy. Tr. vol. 12-A, 83:23-84:4 (Duleep, May 2, 2007). Major projects in that area include analysis of the technical feasibility of improving vehicle fuel economy up to 2025; estimation of automotive technology attributes such as costs, performance, and fuel economy benefit; strategic planning support to manufacturers in engine/emission control technology; and regulatory strategy definition and evaluation for state, local, and foreign governments to control mobile source emissions. DX 2687.

Duleep was a Senior Professional at EEA between 1979 and 1987. During that period he served as the company's lead engineering analyst on all mobile source emissions and fuel economy issues, and worked on projects including the development of emission factors for EPA's MOBILE3/4 models; estimates of 1990-1995 fuel economy potential for domestic auto manufacturers; an analysis of heavy duty truck emission standards in Canada in 1990; and analysis of alternative fuel vehicle technology

development. *Id.* Prior to his employment with EEA, Duleep worked as a Senior Engineer in the Electronics and Engine Control Systems Group at Bendix, where he was involved in a variety of design and development projects; as a research assistant at the University of Michigan's Department of Aerospace Engineering; and as a junior scientific officer at the Aeronautical Development Establishment. *Id.*

Duleep's educational background includes a 1972 Bachelor of Technology degree, specialized in Aerospace Engineering, from the Indian Institute of Technology; a 1975 Master's degree in Aerospace Engineering/Computer Information and Control Engineering from the University of Michigan; completed course-work as a doctoral candidate in aerospace engineering specializing in combustion at the University of Michigan; and a 1989 M.B.A. with a specialization in finance from the University of Pennsylvania's Wharton School. *Id.*; Tr. vol. 12-A, 86:25-87:6, 88:6-10.

Duleep has published more than ten articles in peer-reviewed journals and has authored about one hundred reports to clients. DX 2687; Tr. vol. 12-A, 102:15-24. His presentations, papers and articles produced in recent years include many on the topics of marketability and feasibility of new automotive technologies and

the relationship between tires and energy consumption.[28] DX 2687.

Duleep frequently consults for various governmental entities. He has done substantial work for the Department of Energy ("DOE") and NHTSA, including providing DOE with more than twenty reports on the fuel economy potential of light-duty vehicles. *Id.*; *see* Tr. vol. 12-A, 90:19-91:4. Duleep served as the principal consultant to a National Academy of Science ("NAS") committee on the future of CAFE standards in 2001 and 2002.[29] The NAS used Duleep's analysis of the technological feasibility and cost of improving fuel efficiency for light-duty vehicles in

---

[28] These articles include: *Market Prospects for Alternative Hybrid Designs*, presented at the SAR Hybrid Vehicle Technologies Symposium, San Diego CA, February 2006; *Tires, Technology and Energy Consumption*, presented at the International Energy Agency Workshop on Tire Rolling Resistance, Paris, France, November 2005; *Prospects for Hybrid, Diesel and Hydrogen Vehicles*, presented at Air Pollution as Climate Forcing: A Second Workshop, sponsored by NASA, Honolulu, HI, April 2005; *Vehicle Energy Use and the Tire Contribution*, presented at the Second Meeting of the Committee for National Tire Efficiency Study, National Academy of Sciences, Davis CA, March 2005; and *The Potential Market and Fuel Economy Impacts of Hybrid and Diesel Technologies* (co-authored with Drs. Greene and McManus) presented at the 10th Diesel Engine Emission Reduction Conference, Coronado CA, August 2004. Duleep has also authored two encyclopedia articles: *Automotive Engines--Efficiency*, *in* Encyclopedia of Energy Technology and the Environment 379 (John Wiley 1995), and *Internal Combustion Engine Vehicles*, *in* Encyclopedia of Energy 497 (Elsevier 2004). *See* DX 2687.

[29] The NAS is an independent governmental body that responds to requests from the President's administration or Congress to study topics of interest. It is composed of leading scientists in various fields who are elected to membership. Tr. vol. 12-A, 92:14-21 (Duleep, May 2, 2007).

2015 in its 2002 study. *See* DX 2007 at 1. In 2005, Duleep supported the NAS tire rolling resistance committee with technical information and analysis. Tr. vol. 12-A, 93:24-94:3. Duleep completed a joint report in May 2006 for DOE and the Department of Transportation ("DOT"), updating the 2002 NAS report's estimates of technology cost and attributes for use in developing new fuel economy standards and an evaluation of whether alternative methodologies should be used in future NAS reports. *Id.* at 91:5-92:3.[30]

Duleep has testified three times before the United States Senate and three times before the House of Representatives. The bulk of his testimony in each chamber was on the subject of fuel economy technology. *Id.* at 100:5-102:12.

In addition to his clients in the United States government, Duleep works extensively outside the United States. He has worked for Natural Resource Canada, Transport Canada, Australia, Sweden, and the World Bank. *Id.* at 96:5-97:12. He also has private automakers and suppliers as clients in the areas of

---

[30] Duleep's other work for U.S. government entities includes projects for the Congressional Office of Technology Assessment, for which he fulfilled a request in the mid-1990s to examine the potential for fuel economy of vehicles until the year 2020, and for the Energy Information Administration, which he has assisted in determining how fuel economy can change in the future in response to the macroeconomic forces of fuel price, income, and other factors. *Id.* at 94:19-95:4, 97:17-98:4. During the 1980s and 1990s Duleep worked for EPA's Ann Arbor Motor Vehicle Emissions Laboratory on the development of new emissions standards. *Id.* at 95:20-96:2.

vehicle drive train technology planning and active safety technologies. Nearly half of his work is for these private clients. *Id.* at 98:11-99:25.

2. Duleep's testimony

a. Methodology

Duleep examines whether the automobile industry as a whole can comply with the regulation, but does not speak to individual manufacturers' ability to comply or likely compliance strategies. *Id.* at 121:9-14. He explores pathways to compliance for a set of representative vehicles, but these pathways are descriptive, not prescriptive. *Id.* at 134:24-135:3.

To determine whether the regulation is technologically feasible in the time frame provided, Duleep began by assembling a list of all available technological options that could be feasibly introduced during the relevant period.[31] *Id.* at 118:22-24. Second, he evaluated each technology based on the method by which it obtains fuel economy, its cost, and its potential fuel economy gain in various applications.[32] *Id.* at 119:6-11. Finally, Duleep adopted the cheapest technology relative to the

[31] Due to his work for the DOE and other parties, Duleep's company has a list of such technologies and their likely availability, constantly updated based on current trade press technical journals. *Id.* at 118:24-119:5.

[32] Duleep gathered this more detailed information on specific technologies through Society of Automotive Engineers meetings, and by discussing the issues with tier one suppliers and auto manufacturers, as well as through his attendance at technical conventions. *Id.* at 119:12-25.

benefit provided. He did this by assessing a cost-benefit ratio for each technology, then adding technologies in the order of cost effectiveness until the standard was met. *Id.* at 120:9-15. Duleep has used this basic methodology for twenty years. *Id.* at 121:2-3.

As a baseline Duleep divided vehicles into different classes based on size, then took a typical vehicle from each for the year 2005.[33] He then examined each vehicle to see whether there was sufficient technology available to allow it to meet the regulation's requirements. *Id.* at 122:18-123:1. To do so, he first listed the technologies already present in a specific vehicle to avoid double-counting, then applied additional technologies based on cost-effectiveness and availability. *Id.* at 125:10-17.

After identifying the relevant technology set for each vehicle in his baseline analysis, Duleep outlined the average fuel economy benefit and cost of the technologies, and used a simple multiplicative model to provide an initial assessment of each technology combination. *Id.* at 127:22-128:3. The multiplicative model estimates how technologies will work when applied in combination to a vehicle. For example, if a

---

[33] Specifically, he used three representative vehicles in his PC/LDT1 category--a small compact/subcompact car, an intermediate/mid-sized car, and a large car--and three representative vehicles in his LDT2 category--the compact Ram, an intermediate sized SUV, and a large pickup. *Id.* at 123:9-124:4.

technology improves fuel economy ten percent, then adding it to a car will reduce that car's fuel consumption to ninety percent of its starting level. If a second technology improves economy five percent, then adding it to the same car would reduce fuel economy by five percent, but from the ninety percent consumption, not from the car's original consumption, so that a diminishing amount of fuel is saved as additional technologies are added. *Id.* at 128:13-129:3.

In addition to these diminishing returns, some technologies have dys-synergies. If two technologies affect the same source of energy loss, then putting them both on a vehicle won't result in cumulative fuel savings. *Id.* at 129:13-20. Based on his experience, Duleep adjusted for dys-synergy loss by reducing the multiplicative model's estimate of fuel consumption reduction by nine to ten percent where these sorts of overlapping technologies were present; he referred to this step as the use of a dys-synergy factor. *Id.* at 129:21-130:7.

To determine whether manufacturers could comply with the regulation, Duleep calculated the percentage fuel consumption reduction necessary for each of the baseline vehicles that he used to achieve compliance. Duleep found that compliance was possible in each category, though some vehicles would require conversion of some of the fleet to hybrid vehicles. *Id.* at 132:5-24.

b. Validation of results with the lumped parameter model

After Duleep estimated potential GHG emissions reductions using the multiplicative method, he checked his work using a lumped parameter model. *Id.* at 130:21-25. The model categorizes the benefits of the various technologies according to the source of loss that they address. *Id.* at 131:6-15. Conventional technologies can improve the fuel economy of an engine or transmission in just a few ways: by increasing the engine's peak efficiency, by reducing pumping loss, or by reducing friction loss. Tr. vol. 12-B, 14:18-25. The purpose of the lumped parameter model is to keep track of how each technology affects each type of loss and to compute the cumulative effects of multiple technologies on pumping loss, friction loss, and peak efficiency. *Id.* at 15:5-13. In other words, the model outlines technology interactions when several technologies are applied to a single vehicle.

Duleep did not rely on the lumped parameter model as his primary mode of analysis in this case; rather, he formed an opinion using the simple multiplicative model, which he adjusted based on his experience and understanding of the technologies used to account for dys-synergies. The lumped parameter model is merely a way of confirming his initial conclusion, while ensuring that his application of multiple technologies didn't violate any

fundamental principles of physics or engine operation. *Id.* at 16:21-17:15.

The lumped parameter model takes each technology and distributes its benefits among efficiency, pumping, and friction, using information derived from Duleep's external review of each technology, review of literature, and discussions with auto manufacturers and suppliers to the auto industry. *Id.* at 17:22-18:2; 19:4-21. The model begins with a baseline vehicle whose characteristics, including EPA-measured fuel economy, are known. It uses that knowledge to estimate the energy required to move the vehicle over the entire EPA driving cycle. *Id.* at 20:14-21. Next, it determines how that energy is derived. It then determines how much of the energy that the engine puts out is lost in the drivetrain and how much is lost in the accessories, to come up with the engine's total energy output. *Id.* at 20:22-21:14. Finally, it calculates how much fuel has to go into the engine to result in that output. *Id.* at 21:15-19. These computations result in a determination, based on the actual measured fuel economy, of the pumping and friction loss for a particular vehicle. *Id.* at 21:20-23. Given that knowledge, Duleep can use the model to apply particular technologies to that vehicle, reducing the base values of loss in accord with each technology's known characteristics. *See id.* at 21:23-23:2. He goes through that process for each of the technologies that he

applies to the vehicle, keeping track of pumping, friction and peak efficiency changes. The end result is a picture of the fuel economy that will result from the cumulative application of all of the technologies, taking into account the dys-synergies that result from multiple technologies affecting the same sources of loss. *Id.* at 15:4-13.

c. Duleep's cost analysis

Duleep arrived at an initial cost of compliance estimate based on the costs of technologies that he found necessary to apply to vehicles to reach required emissions levels. He adjusted that amount to reflect the effects of other regulations in effect in Vermont. He arrived at an estimated net cost of about $1500 per vehicle in the PC/LDT1 category and $1450 in the LDT2/MDPV category. *Id.* at 46:11-47:25.

3. Evaluating the Reliability of Duleep's testimony

The '302 plaintiffs assert as an initial matter that the boundaries of the subject matter of Duleep's testimony are in themselves a "flawed use of his chosen methodology" and a source of unreliability. Pls.' Renewed Mot. to Exclude Test. of Duleep 12-13 (Doc. 487). In fact, they describe his choice not to perform a manufacturer-specific compliance analysis as "egregious." *Id.* 13. To the contrary, the fact that Duleep's analysis is general rather than aimed at specific manufacturers' situations in no way diminishes its usefulness to the Court or

its reliability. Duleep's testimony was perfectly transparent as to the boundaries of his analysis and the topics included in his testimony.

Thomas Austin is Plaintiffs' expert on manufacturers' ability to comply with the regulations.[34] Insofar as Austin and Duleep address different subjects, since Duleep modeled the compliance ability of the industry as a whole while Austin projected the likely compliance choices of individual manufacturers, both experts bring useful though diverse perspectives to the Court's attention. In this bench trial, the Court is capable of understanding the differing utilities of each model in conducting its review of the evidence, and it is useful to the Court to see data that covers the industry as a whole.

The '302 plaintiffs have focused their criticism of Duleep's testimony on his methodology. The multiplicative model appears to be a relatively straightforward method of applying technologies to a baseline to see their effects. The '302 plaintiffs criticize Duleep's use of a dys-synergy factor to adjust for the effects of combining technologies that address the same sources of loss. They argue that the factor that Duleep chose is not replicable or reliable and is not widely accepted.

[34] Austin is a founding senior partner at Sierra Research, Inc. ("Sierra"), a research and consulting firm in California that specializes in research and regulatory matters relating to emissions control and fuel economy. Tr. vol. 6-B, 62:23-63:10 (Austin, Apr. 20, 2007). He is the former head of CARB's motor vehicle emission control program. *Id.* at 69:11-22; 70:15-71:15.

However, it is undisputed that it is necessary to somehow account for dys-synergies between technologies applied to a vehicle.

Duleep developed his dys-synergy factor based on his substantial experience in the motor vehicle industry and detailed knowledge of technology and technology interactions. *See* Fed. R. Evid. 702 advisory committee's note (experts may testify based on experience alone). In addition, he validated that factor through the use of the lumped parameter model, which confirmed his results. The '302 plaintiffs persistently frame their criticism of Duleep's methods as though the multiplicative method (including the use of the dys-synergy factor) and the lumped parameter method were operating in two entirely separate spheres; in fact, their confirmation of one another's results lends each credibility since they are both using the same data but applying entirely different methodologies.

Plaintiffs additionally criticize Duleep's use of the lumped parameter model (again, without acknowledging any interaction between the two models). They rely on testimony by their own experts, Austin and Dr. Donald Patterson,[35] for arguments that the lumped parameter model's results are not replicable and, when replicated, yield results that overstate the fuel economy benefits of some technologies. However, this testimony is

[35] Dr. Patterson is a professor *emeritus* in mechanical engineering at the University of Michigan. Tr. vol. 16-A, 6:20-24 (Patterson, May 8, 2007).

ultimately unconvincing in light of Duleep's and others' validation of that model's results.

The reliability of the lumped parameter model has been tested in two ways. First, Duleep used a vehicle from a year before certain technologies were applied as a baseline, then used the model to add to it technologies found in a later vehicle. The comparison between the estimate of the later vehicle's fuel economy resulting from the model and the actual measured fuel economy of that vehicle serves as a validation.[36] Tr. vol. 12-B, 26:5-21 (Duleep, May 2, 2007). Second, when Duleep consulted for NAS during their fuel economy study, in order to check his results' consistency with other commonly used models, both Duleep and Austin used the same set of inputs in their respective models (the lumped parameter model and VEHSIM). The results were very close, in all cases within four percent of one another, and neither model gave uniformly higher or lower results. *Id.* at 30:25-32:9. The rate of error of Duleep's methods, as illustrated in these tests, is relatively low.

Patterson agreed that one way to evaluate a model is to

[36] Duleep started with the Ford Focus and compared it to the 2005 Honda Civic, which incorporated a subset of the technologies that Duleep modeled for the small car for his report in this case. He arrived at an estimated fuel economy very slightly lower than the Civic's actual fuel economy, but within the margin of error. Tr. vol. 12-B, 28:9-30:11 (Duleep, May 2, 2007). He has performed similar validations in each size class that he modeled, and in each case found that he was able to predict the fuel economy of various vehicles using his model. *Id.* at 30:12-22; 33:4-35:1.

compare its estimates to real-world vehicle attributes, but insisted that correlation between the model's results and the real-world measurements does not necessarily mean that the process used to get the estimates is correct. Tr. vol. 16-A, 17:23-18:2 (Patterson, May 8, 2007). Other experts in his field believe that reliability of a model is normally assessed in this manner. Dr. John Heywood[37] has submitted a declaration to the Court in which he states that in his field, "the reliability of a model's results is typically assessed by comparing the model's results to the measured results from existing vehicles, such as the EPA Test Car List." Heywood Decl. ¶ 10. Dr. Marc Ross,[38] in a similar declaration, states that he also validates results from models "by comparing them to measured fuel economy values on EPA's Test Car List–in other words, to known data from actual vehicles." Ross Decl. ¶ 9. Therefore, it appears that Duleep has undertaken to validate his model, with results suggesting that the model can successfully predict real-world results of the

[37] Heywood is the Sun Jae Professor of Mechanical Engineering at the Massachusetts Institute of Technology where he has taught and researched since 1968. Heywood Decl. ¶ 1. Patterson testified that he knows Professor Heywood, has used Heywood's textbook in his own teaching, and considers Heywood one of the leading mechanical engineers in the country. Tr. vol. 16-A 23:11-24:24.

[38] Ross is a professor *emeritus* in the Physics Department at the University of Michigan, where he has taught and performed research since 1963 in the area of environmental physics, with a focus on "energy use, its impacts, and how to reduce those impacts through efficiency and conservation." Ross Decl. ¶ 1.

use of various technologies. He has performed what appear to be standard checks on his methodology, and has used multiple methodologies to validate his results.

There is wide or moderate acceptance of both of Duleep's primary methods of analysis. The simple multiplicative model is widely accepted in the community of experts on fuel economy. The simple multiplicative model was used in the NAS report, and is currently used by DOT and NHTSA in setting standards. Tr. vol. 12-B, 41:3-12 (Duleep, May 2, 2007). Canada largely bases its standards on the United States' standards, but has used the results of the lumped parameter model for some purposes. *Id.* at 41:17-23. Japan does not use a vehicle simulation method in setting its standards. *See id.* at 41:24-42:6.

Patterson testified that a second-by-second vehicle simulation model, such as Austin's VEHSIM, is the only reliable method of modeling, such that both the multiplicative and lumped parameter models are by definition unreliable. Tr. vol. 16-A, 31:8-13; 32:3-8 (Patterson, May 8, 2007). He was unaware of the methodologies used by NHTSA, Japan, and Canada in setting fuel economy standards, but stated that he would consider those methods unreliable if they did not use a second-by-second model. *Id.* at 23:15-24; 37:7-38:8.

It is clear that Patterson's view does not express a consensus within the relevant scientific community. *See Daubert*,

509 U.S. at 594. Heywood states that he has used aggregated parameter engine models, simpler models than VEHSIM, like the lumped parameter method. He and other colleagues used these models in a 2000 study assessing technologies that could reduce GHG emissions from passenger cars by the year 2020, and he believes that "well-formulated aggregated parameter models can reasonably accurately simulate fleet-wide vehicle characteristics." Heywood Decl. ¶¶ 6-9 (referencing Malcolm A. Weiss, John B. Heywood et al., On the Road in 2020: A Life-Cycle Analysis of New Automobile Technologies (MIT Energy Laboratory October 2000). Ross explains that VEHSIM and similar models, and Duleep's lumped parameter models, all operate by "solv[ing] the equations that describe a vehicle's fuel consumption," at "different levels of disaggregation and complexity." Ross Decl. ¶ 5. Ross uses a model which, like Duleep's, uses about ten to twelve parameters and is intended to model the entire light-duty fleet. Ross's research has led him to the conclusion that, "when simulating fleetwide vehicle characteristics, a model with a dozen parameters is just as accurate as a model with two hundred parameters for the large majority of vehicles." *Id.* ¶ 6.[39]

[39] Ross also details recent research by one of his students which supports this conclusion. One of his graduate students used his model to calculate the fuel economy of approximately 1300 vehicles using only four parameters, and found that the results were accurate to within five to ten percent of the fuel economy values on the EPA Test Car List for about ninety percent of the vehicles, while many results were much closer. Ross Decl. ¶ 7. The vehicles falling outside of the five to ten percent range did so because they were "hybrids or flexible fuel vehicles

The '302 plaintiffs also cite the testimony of Kenneth Patton, an engineering group manager in the GM power train advanced engineering group, who testified that he has never worked on the design or development of an engine without employing vehicle simulation methods. Tr. vol. 10-B, 30:8-23 (Patton, Apr. 30, 2007). However, as Duleep was not engaged in actually designing an engine for production but in estimating the effects of the addition of a large number of technologies to current vehicles, his methods need not be the same as those used internally by automakers in creating new engines. Patton's testimony does not address the reliability of Duleep's methods.

The opinions of experts such as Heywood and Ross demonstrate that Duleep's methods are generally accepted for purposes of *Daubert* and Rule 702. *Daubert* requires general, not universal acceptance; even "substantial criticism as to one theory or procedure will not be enough to find that the theory/procedure is not generally accepted." *United States v. Bond*, 12 F.3d 540, 562 (6th Cir. 1993).

For the most part, Duleep's work has not been published. Duleep is not an academic, but a professional consultant, whose work is typically performed for government entities or private

---

whose fuel economy cannot be accurately modeled on a model designed for conventional gasoline engines," or were "very high performance European sports cars" which are driven differently and would require adjustments to the model. *Id.* ¶ 8. The light-duty vehicles that Duleep modeled are in neither category.

clients rather than for publication. Publication is "not a *sine qua non* of admissibility" and "does not necessarily correlate with reliability." *Daubert*, 509 U.S. at 593. The *Daubert* court noted, in particular, that some theories may not have been published because they are "well-grounded but innovative" or "too particular, too new, or of too limited interest" for publication. *Id.* Duleep need not back his testimony with published studies that unequivocally support his conclusions. *See Amorgianos*, 303 F.3d at 266.

In any case, Duleep's work has been subjected to the extensive scrutiny of the relevant community of experts. In his work for governmental clients, Duleep's work is often checked by others. In the thirty years that he has worked for DOE, Duleep has submitted about twenty reports to the agency, many regarding automotive technologies and effects on fuel economy. Tr. vol. 12-B, 37:3-7 (Duleep, May 2, 2007). DOE routinely checks the results of his work by asking scientists at Oak Ridge National Lab and Argonne National Lab to review it; in periods of high interest they have also sent his reports for external review by leading academics, and in a few instances he was asked to defend his work to auto makers. *Id.* at 37:18-38:19. This extensive review, while not taking place through the publication mechanism, fully serves the purpose of testing the validity of his methods and increases the likelihood that significant flaws in his

methods would have been exposed during the lengthy period in which he has used those methods.

In light of all of the evidence, the Court finds that Duleep's testimony is reliable. Objections to his methods go to the weight, not the admissibility, of his opinions.

4. Relevance of Duleep's testimony

There is no debate as to the relevance of Duleep's testimony. Like that of Austin and several of the witnesses who testified on behalf of the auto manufacturer plaintiffs, his testimony addresses the ability of the auto industry to comply with the regulations adopted by Vermont.

The Motion to Exclude the Testimony of K.G. Duleep (Doc. 487) is **denied.**

II. Discovery Violation

The '302 plaintiffs have leveled a series of accusations concerning Duleep's and the defendants' alleged failures to comply with their expert discovery obligations, for which they seek the exclusion of Duleep's testimony as a sanction.

Expert witness disclosures must be accompanied by an expert report, which "shall contain a complete statement of all opinions to be expressed and the basis and reasons therefor; the data or other information considered by the witness in forming the opinions; any exhibits to be used as a summary of or support for the opinions;" and other information regarding the expert's

qualifications and compensation. Fed. R. Civ. P. 26(a)(2)(B). At issue is whether Duleep and the defendants failed to disclose data and information which Duleep used to form his opinions, in violation of that rule.

First, the '302 plaintiffs allege that Duleep "disclosed and attempted to rely upon an entirely new methodology--his dys-synergy theory--to support his opinion just days before the start of trial." Pls.' Renewed Mot. for Sanctions 5 (Doc. 486). Essentially, they argue that they were unaware that Duleep uses the lumped parameter model only to confirm the results of his initial estimate, reached by using the simple multiplicative method and then applying a dys-synergy factor to account for the interactions between technologies.

In evaluating this allegation, the focus must be on whether information provided to Plaintiffs was sufficient for them to understand the nature of Duleep's methodology, not whether Duleep consistently used the same terminology to describe it.

In his initial expert report, Duleep reported that he estimates the synergistic effect of technologies acting together on GHG emissions in three ways: first, through data from existing vehicle models that use the technology combinations in question; second, through the lumped parameter model; and third, by examining results of second-by-second simulation models. Duleep Tech. Rpt. 8-9, Aug. 2006. He did not mention the multiplicative

model. However, at his first deposition, he explained that:

> [F]irst we looked at of course the individual benefits of these technologies and, just based on my experience in this field, just did sort of an off-the-cuff estimate of whether these had a reasonable prospect for compliance, so very much along the lines of what I termed earlier as a gut feel by powertrain engineers as to what particular combinations of technologies can get. So I . . . have a feel for . . . what level of technologies might be required.
>
> The second step in sort of confirming that would be--for me to check through the lumped parameter model what the net benefit of the package would be for a given vehicle.

Duleep Dep. 102:7-103:6 (Nov. 21, 2006). Duleep also stated:

> I can do an approximate computation on a piece of paper . . . so I could do that, or I could use this [lumped parameter] model. I'm not relying on this model; I'm just using it to inform my opinion. So it's not--this is not a modeling exercise in the sense of the exercise that Mr. Austin went through. So this is basically something that I would use to check my intuitions on what multiple technologies would do.

Id. at 627:10-628:9. This is a fair, though less detailed, description of Duleep's methodology as he explained it at trial. Certainly Duleep was clear at his deposition that the lumped parameter model was used to "check" or "confirm" his initial results. Other declarations submitted in this case similarly state that the lumped parameter model is merely a confirmation of Duleep's initial results. *See, e.g.,* Duleep Decl. ¶¶ 3-4, Feb. 15, 2007.

The '302 plaintiffs claim that they were unaware of Duleep's methodology until February or March, 2007. Assuming without

concluding this to be the case, they had the opportunity to depose Duleep on this issue, as he sat for a full day of deposition on March 20, 2007, and for an additional four-hour deposition on April 29, 2007.

Second, the '302 plaintiffs accuse Duleep of failing to disclose the sources for certain cells in his lumped parameter model. Although Duleep did provide the sources of representative cells in the model, covering three technologies and his analysis of the mid-sized car in Sheets 1 and 2 of the model, he did not provide the sources for Sheets 3 through 7.

Duleep initially developed the lumped parameter model as a way of checking his conclusions in the course of his regular work, not for use in litigation. Duleep Decl. ¶ 4, Feb. 15, 2007. He developed the values for cells in the spreadsheets relying on published literature, but did not document how each individual input was derived. *Id.* ¶¶ 5,7. He did provide Plaintiffs with the published materials on which he relied, but tracking the process of deriving the value in each cell from those publications would have taken so much time that he would have had to close his business for a month in order to devote himself to the task. *Id.* ¶ 6. A person with sufficient expertise could discover, from those disclosures, how the values were derived, though doing so would be a lengthy process. *Id.*

The dispute over the sufficiency of Duleep's disclosure is

insufficiently grave to justify exclusion of Duleep's testimony. Duleep's lumped parameter model merely confirms his initial analysis, conducted by means of the simple multiplicative method, which appears sufficiently documented and explicated.

In addition, Duleep testified that reviewing the sources for his model is not necessary and is not the ordinary way of ensuring the accuracy of his projections. A more usual practice is to compare the results of a model to existing vehicle data. Tr. vol. 12-B, 25:22-26:21 (Duleep, May 2, 2007).

Other experts confirm that it is ordinary practice to validate model results in this way; Ross writes that "[a]s far as I know, validation of a model of the entire light-duty fleet is not systematically done. I validate results from model [sic] by comparing them to measured fuel economy values on EPA's Test Car List–in other words, to known data from actual vehicles." Ross Decl. ¶ 9. Heywood similarly writes, "I do not know any standard validation procedure for these types of models . . . However, in my field, the reliability of a model's results is typically assessed by comparing the model's results to the measured results from existing vehicles, such as the EPA Test Car List." Heywood Decl. ¶ 10. In addition, Heywood states that neither he nor his students has ever "validated a model's results by evaluating all of the model's sources and logic." *Id.* ¶ 11. Finally, he writes, "I also do not believe that it is possible fully to

identify and check all of the sources of most models. Most models contain both sourceable and unsourceable sections of subroutines. The unsourceable components depend on the experience, knowledge, and judgment of the modeler and therefore cannot be sourced." *Id.*

These experts confirm that it would be an enormous burden to Duleep to identify the source of each cell of the lumped parameter model, and that such an effort is not necessary to check the accuracy of Duleep's results.[40]

Finally, the '302 plaintiffs criticize Duleep's failure to retain notes from meetings with automakers and suppliers that he attended both before and after the state of California hired him as an expert to defend the regulation. The interviews at issue were not conducted pursuant to Duleep's contract with California, but for an earlier project which he undertook for the DOE/DOT, updating information and technology attributes for the 2006 update to the 2001 NAS report, to be used in promulgating reformed CAFE standards. Tr. vol. 13-A, 109:19-110:6 (Duleep, May 3, 2007).

---

[40] Austin testified that he was not able to replicate Duleep's work using VEHSIM, because Duleep's inputs were not sufficiently detailed. Tr. vol. 15, 116:8-21 (Austin, May 7, 2007). Duleep noted in his declaration that when providing the NAS with a "second opinion" regarding Duleep's work in 2001, Austin ran the same packages that Duleep had simulated through VEHSIM. Where Duleep's inputs didn't contain enough detail, Austin used his own engine maps and assumptions. Duleep Decl. ¶¶ 13-14. It is not clear, then, why there are obstacles to Austin's use of this method of validation in this case.

It is Duleep's normal practice to destroy notes of his interviews with automakers upon completing a project, in order to protect confidential information. *Id.* at 50:14-16. His usual agreement with automakers and suppliers is that he will not reveal their individual information, and will release only aggregated information for the entire industry. *Id.* at 110:7-13. As far as Duleep knows, the practice of destroying such notes is typical in his field with respect to confidential information. *Id.* at 110:20-24.

As is his practice, Duleep destroyed the notes when his project for the DOE/DOT was completed. *Id.* at 110:14-17. A comparison between the initial and final reports that Duleep submitted to the DOE reflects that the only significant change made as a result of those interviews was an upward revision in the cost of one automotive technology, the continuously variable transmission. *Id.* at 110:25-116:11. It is clear that Duleep did not willfully destroy evidence on which he relied in any significant way in forming his opinions in this case.

Denying this motion for sanctions is consistent with the Court's practice throughout the trial in this case. The Court has attempted to ensure that reliable and relevant evidence is admitted, even where allowing the admission of that evidence has presented counsel with real challenges in preparing a response to previously undisclosed witnesses. In particular, on two

occasions after trial had commenced, and over the strong objections of Defendants, the Court allowed Plaintiffs to present the testimony of previously undisclosed witnesses.

First, Christy was called as a substitute for the previously disclosed Plaintiffs' witness, Dr. Patrick Michaels, who declined to testify. Although the topics on which Christy testified were the same as those on which Michaels was scheduled to testify, their opinions differed on some details. In addition, Christy had different qualifications, publications, and connections than Michaels, which counsel for Defendants had to explore prior to his testimony. Preparing an effective cross-examination at essentially the last minute was no small burden in a case of such technical complexity.

Second, the Court allowed Plaintiffs to add Patterson to the witness list only days before his testimony. Patterson was added specifically to address Duleep's testimony, based on Plaintiffs' assertion that Duleep's methods as described at trial were different from the methods which they had previously understood him to describe. Plaintiffs have had a full opportunity to understand and rebut Duleep's testimony in this case, and are in no way prejudiced by the Court's decision to admit his testimony.

The Renewed Motion for Sanctions for Expert Discovery Violations (Doc. 486) is **denied.**

Findings and Conclusions

I. The State Regulations

A. Implementation of California's AB 1493

In 2002, the California legislature enacted Chapter 200 (A.B. No. 1493), section 3, ("AB 1493") directing the California Air Resources Board ("CARB") to adopt the maximum feasible and cost-effective reduction of GHG emissions from motor vehicles. Cal. Health & Safety Code § 43018.5 (West 2003). CARB staff undertook an analysis of the technologies and fuels available to reduce GHG emissions, the effectiveness of such technologies, and their cost, pursuant to the legislature's mandate to consider technological feasibility, the impact of GHG regulation on the state's economy, and flexibility in methods of compliance. *See* § 43018.5(c)(1)-(3).

For its analysis CARB relied heavily on a study by Northeast States Center for a Clean Air Future ("NESCCAF"), which it believed to be "the most advanced and accurate evaluation of vehicle greenhouse gas emission reduction technologies that has been conducted to date."[41] PX 264 at 7. In that study, NESCCAF

[41] At trial, Plaintiffs took issue with aspects of the NESCCAF study's methodology and conclusions. Plaintiffs' criticisms included suggestions that some modeled vehicles did not maintain performance characteristics such as "launch," acceleration time from fifty to seventy miles per hour, and gradeability; that NESCCAF did not properly model the performance of turbo-charged engines; and that NESCCAF improperly used blended engine maps. These criticisms are limited in scope and are disputed by representatives of CARB and workers on the NESCCAF study whose depositions have been admitted into evidence

simulated various technology packages for five classes of vehicles "to predict the emissions impacts of incorporating various technology combinations in new vehicles." PX 767 at xiii. NESCCAF concluded that "existing and emerging automotive technologies can achieve substantial and cost-effective reductions in motor vehicle GHG emissions in the 2009 to 2015 timeframe. Specifically, GHG emissions from light-duty vehicles can be reduced from 12-54 percent in this timeframe." *Id.* at 3-23.

---

in this case. *See*, *e.g.*, Cooper Dep. Tr. 218:11-15 (Sep. 13, 2006) (performance was held constant in modeled vehicles, and NESCCAF would have rejected any package that decreased performance); Brueckner Dep. Tr. 58:10-20; 63:1-6 (Sep. 15, 2006) (launch was implicit in the NESCCAF study insofar as zero to sixty mph was held constant); *id.* at 72:4-73:2 (many options are available to correct any problems in launch arising from the technologies chosen); *id.* at 81:16-86:5(the modeling used in the study kept the transmission in top gear when accelerating between fifty and seventy miles per hour, when a real vehicle would downshift, eliminating deteriorations in fifty to seventy mph time); Cooper Dep. Tr. 151:6-153:2; *id.* at 167:3-169:5 (gradeability was an issue with some of the trucks modeled, but none of the final packages showed any problems in gradeability); Brueckner Dep. Tr. at 101:3-10 (turbo lag was explicitly modeled in all turbo-charged models); *id.* at 140:12-16 (blended engine maps are used routinely in evaluating automobile technologies). Plaintiffs also argued that NESCCAF used too low a retail price equivalent (RPE) adjustment factor and improperly adjusted its costs to account for unforeseen innovation during the time period of the regulation. Record evidence disputes the conclusion that the RPE used was incorrect; for example, the NAS used the same RPE in its 2002 study. *See* DX 2007 at 41. Furthermore, it is not clear to the Court that an adjustment in costs to account for potential innovation over the next ten years is incorrect. In any case, the NESCCAF study is not the basis for the Court's conclusions in this case; rather, the Court has based its understanding of the regulation's feasibility on the expert testimony that Plaintiffs and Defendants presented in far more detail at trial.

CARB concluded that its regulation was feasible for all manufacturers both in terms of cost effectiveness and technological capacity. Shulock Dep. Tr. 40:3-5, 54:5-7 (Aug. 18, 2006). CARB also calculated the regulation's cost to manufacturers, finding that when fully phased in the near-term standards (through the 2012 model year) resulted in an estimated average cost increase of $367 for the smaller vehicle category, and $277 for the larger vehicle category, as compared to the baseline 2009 model year vehicle. The cost of compliance with the mid-term standards (through model year 2016) was higher, with a fully phased in cost increase of $1064 for the smaller category and $1029 for the larger category. PX 264 at 11. CARB also concluded that these costs would be "more than offset by operating cost savings over the lifetime of the vehicle." *Id.*

Overall, CARB concluded that the regulation was cost-effective since the technology packages that are the basis for the standards "result in operating cost savings that exceed the capital cost, resulting in a net savings to the consumer over the lifecycle of the vehicle." *Id.*[42] CARB expected the regulation's net effect on the economy to be "small but positive" and concluded that there would be "no significant adverse environmental impact" based on changes in fleet turnover due to the regulation. *Id.* at 13.

[42] Lost savings were calculated using an assumed gasoline price of $1.74 per gallon.

CARB also considered the regulation's impact on the automobile industry's sales, jobs, and consumers. CARB used the CARBITS model to examine how changes in vehicle cost and fuel use would affect vehicle sales. Feizollahi Dep. Tr. vol. 2, 343:11-18 (Aug. 18, 2006). The model shows an increase in sales between 2009 and 2013, and a drop in sales beginning in 2014. Feizollahi Dep. Tr. vol. 1, 153:17-22; 157:11-158:4 (Aug. 16, 2006). The model predicted a 4.7 percent decrease in sales in 2020, a difference which a CARB economist described as insignificant to the automobile industry's future. *Id.* at 117:8-11; 117:20-118:6. CARB's assessment was that job loss resulting from the sales loss that it predicted would be small. Cackette Dep. Tr., 348:1-5 (Oct. 13, 2006). CARB did not expect that the regulation would affect the availability of new vehicles or cause manufacturers to withdraw any vehicles from the market; rather, it concluded that the manufacturers could comply while maintaining full model availability. Feizollahi Dep. Tr. vol. 1, 176:2-7 (Aug. 16, 2006); Hughes Dep. Tr. 210:19-211:15 (Aug. 23, 2006).

Thus, CARB examined virtually the same factors that NHTSA examines when it sets a CAFE standard: technological feasibility and economic impact, including cost to manufacturers, cost to consumers, and job loss, although its economic analysis was limited to California.

CARB approved the adoption of the regulation at issue in

this case in September 2004, to take effect in 2006, and to apply to new passenger vehicles and light-duty trucks beginning in model year 2009. *See* Cal. Code Regs. tit. 13, § 1961.1 (2007). The regulation is incorporated, together with other automotive emissions standards, into California's existing Low-Emission Vehicle ("LEV II") program, a set of standards regulating motor vehicle pollutants including nonmethane organic gases, nitrogen oxides, particulate matter, and carbon monoxide.[43] The GHG standards are intended to phase in during the 2009 through 2016 model years. *Id.*

B. Adoption of Vermont's GHG Emissions Standards

Vermont first adopted California emissions standards for new motor vehicles regulations pursuant to § 177 of the CAA in 1996, when it adopted the LEV program. Vermont adopted California's LEV program because motor vehicles account for much of Vermont's air pollution, and the California standards required greater pollution reductions than the federal standards. Tr. vol. 11-A, 11:1-9 (Moye, May 1, 2007). Vermont has amended the LEV regulations several times in order to remain consistent with California's standards; its November 2005 amendment adopted the standards at issue in this litigation. *See* Air Pollution Control

[43] The LEV II standards have received a waiver of preemption from EPA. *See* Notice of Decision: California State Motor Vehicle Pollution Control Standards, 68 Fed. Reg. 19,811 (Apr. 22, 2003).

Regulations, Subchapter XI, Low Emission Vehicles: Regulations to Control Greenhouse Gas Emissions from Motor Vehicles, & Table 4, http://www.anr.state.vt.us/air/docs/apcregs.pdf. The regulation meets the CAA's requirement for a state to adopt a California regulation: the regulation is identical to the California regulation, and it affords at least two years of lead time before its effective date. 42 U.S.C. § 7507.

The Air Pollution Control Division of Vermont's Agency of Natural Resources ("ANR") relied on CARB's materials in its evaluation of the regulation, including CARB's initial and final statements of reasons and the publicly available documents that CARB relied on, such as the NESCCAF study. Tr. vol. 11-A, 29:16-30:2 (T. Moye, May 1, 2007). ANR did not redo CARB's analysis, but carefully reviewed the documents and comments received. *Id.* at 30:5-17. It also consulted with an outside engineering firm, Meszler Engineering Services, which worked on the NESCCAF study, in reviewing and responding to comments regarding Vermont's proposed adoption of the regulation. *Id.* at 31:16-32:8. ANR also made some adjustments to CARB's analyses. Specifically, it used different assumptions in calculating operating cost savings to Vermont consumers, intended to account for the harsher driving conditions in Vermont, and it used $2.10 per gallon as the price of gas, rather than CARB's estimate of $1.74 per gallon. *Id.* at 33:19-34:11. Like CARB, ANR assumed that manufacturers would

largely continue to sell the same types of vehicles, and would add technologies to existing vehicles rather than eliminate vehicles that people wanted to buy. *Id.* at 57:11-58:2.

C. The Global Warming Connection

When it enacted AB 1493, the California legislature found that global warming is a matter of increasing concern for public health and the environment in the state, that the control and reduction of emissions of greenhouse gases are critical to slow the effects of global warming, and that passenger vehicles and light-duty trucks are responsible for some forty percent of the total greenhouse gas pollution in the state. AB 1493, §§ 1(a), (c), e). In its Final Statement of Reasons for Rulemaking, CARB elaborated on the impetus for enacting AB 1493. It stated that projected future climate change may affect public health in California due to more extreme temperatures and weather events, increases in air pollution, and easier transmission of infectious diseases. PX 264 at 6. It described a variety of environmental and economic effects of global warming expected to threaten the state, including sea level rise, storm surges, loss of coastal wetlands, saltwater contamination of drinking water, and altered temperature and rainfall producing detrimental changes to the agricultural industry and forest ecosystems. *Id.* at 6-7.

Vermont adopted the regulation as part of a comprehensive strategy to reduce GHG emissions in the state, recognizing that

these emissions contribute to global warming. Vermont is undertaking other initiatives to deal with greenhouse gases, including participation in the Regional Greenhouse Gas Initiative (RGGI), an agreement among nine Northeast and mid-Atlantic states to adopt a regional cap and trade program for GHG emissions associated with large stationary sources such as power plants. Tr. vol. 11-A, 12:14-13:3 (Moye, May 1, 2007); DX 2400. Other initiatives include the Vermont Governor's Commission on Climate Change, which is charged with inventorying actions that the state could take to reduce GHG emissions. *Id.* at 16:1-24; DX 2399. The GHG regulation is a significant element of Vermont's overall strategy to address global warming; its transportation sector contributes forty-five percent of Vermont's GHG emissions, the largest single source of GHG emissions in the state. Tr. vol. 11-A, 11:10-15.

According to Thomas Moye, the Chief of the Mobile Sources Section of the Air Pollution Control Division at ANR, Vermont does not expect that its regulation will solve or cure global warming. *Id.* at 38:14-16. Rather, he emphasized that the regulation should be viewed in combination with other Vermont initiatives, other states' initiatives, and other national and international bodies. *Id.* at 38:21-39:6.[44]

---

[44] In its recent decision in *Massachusetts v. EPA*, the Supreme Court endorsed Moye's view that partial solutions to the problem of global warming are valid. In confirming that Massachusetts had standing to challenge EPA's refusal to

Evidence presented to this Court also supports the conclusion that regulation of greenhouse gases emitted from motor vehicles has a place in the broader struggle to address global warming. Dr. James Hansen testified that global warming could have disastrous effects on the entire planet. Hansen compared scenarios from the report of the International Panel on Climate Change ("IPCC"), which predicts likely increases in greenhouse gases absent new regulations (the "business as usual" scenarios), to an "alternative scenario." *See* Tr. vol. 13-B, 33:23-35:11 (Hansen, May 3, 2007). The "business as usual" scenarios, described in the IPCC report as the A1B and A2 scenarios, expect approximately two percent per year increases in fossil fuel carbon dioxide emissions, resulting in a temperature increase of two to three degrees Celsius.[45] *Id.* at 34:6-18; PX 1197. This increase, at the climate sensitivity that Hansen and other

---

regulate, the Court declared:

> EPA overstates its case in arguing that its decision not to regulate contributes so insignificantly to petitioners' injuries . . . that there is no realistic possibility that the relief sought would mitigate global climate change and remedy petitioners' injuries . . . . Agencies, like legislatures, do not generally resolve massive problems in one fell swoop . . . but instead whittle away over time, refining their approach as circumstances change and they develop a more nuanced understanding of how best to proceed . . . . Leaving aside the other greenhouse gases, the record indicates that the U.S. transportation sector emits an enormous quantity of carbon dioxide into the atmosphere. . .

Massachusetts, 127 S.Ct. at 1442 (internal citations omitted).

[45] The IPCC report lists a variety of scenarios, of which these scenarios are by no means the most drastic. *See* PX 1197.

scientists in his field have calculated, would lead to global warming of about three degrees Celsius by the end of the current century.[46] *Id.* at 59:4-5.

The business-as-usual scenarios assume that there will be no restrictions on GHG emissions. *Id.* at 34:19-22. By contrast, Hansen describes an alternative scenario in which future forcings are altered to keep global warming from exceeding one degree Celsius in the future.[47] *Id.* at 34:23-34:3. The alternative scenario calls for a decline in increases in carbon dioxide emissions to 1.3 parts per million by the middle of this century, then a sharper decline to stop increases altogether by the year 2100, stabilizing emissions at 475 parts per million. *Id.* at 59:6-16. This scenario would lead to total global warming of about 8/10ths of a degree Celsius. *Id.* at 59:17-20.

Hansen highlighted several specific possible consequences of the abrupt climate change that he believed will be associated with the business-as-usual scenarios, including ice sheet

---

[46] Predictions of climate future depend on an understanding of climate sensitivity. Climate sensitivity is the amount of global warming for a given unit of forcing, measured in degrees Celsius per watt per meter squared. Tr. vol. 13-B, 16:16-19 (Hansen, May 3, 2007). Climate models show a sensitivity of about 3/4 of a degree Celsius for each watt of forcing. This number is confirmed by comparing the climate sensitivity implied by temperature changes in historical periods for which there is data on various climate forcings. *Id.* at 20:23-21:1.

[47] Achieving that limitation on warming would mean keeping additional forcing, from this time forward, below 1-1/2 watts, so that with some decrease in methane, carbon dioxide does not exceed about 450 or 475 parts per million. *Id.* at 34:23-35:8.

disintegration; species extinction; and regional climate disruptions. *Id.* at 35:12-36:24. At an additional three degrees of warming, the equilibrium response by ice sheets would mean that the entire East Coast of the United States would be underwater, including most of Florida. Populous areas such as Bangladesh and many parts of China would also be underwater. *Id.* at 46:5-15.

Climate change also presents a risk of species extinction. The temperature changes projected in the business-as-usual scenarios would cause the extinction of a significant fraction of species on the planet. *Id.* at 53:17-20. Plants and animals can live only in certain climatic zones. *Id.* at 53:6-12. Although they will attempt to migrate as climate changes, temperature zones are moving more rapidly than migrations are occurring. *Id.* at 53:13-54:3. In addition, many species are confined to specific reserves so that migration is not a realistic possibility.[48] *Id.* at 54:3-5.

Regional climate change, unlike ice sheet disintegration and species extinction, is not irreversible, but presents severe

[48] During the last thirty years, the period in which most global warming has occurred, rapid movement of isotherms, or temperature zones, has been occurring. The total movement of isotherms has been generally smaller than the size of the climatic zone in which a species can exist up to this time, but under the business-as-usual scenario, the rate of migration of isotherms will be twice as large by the end of the century and will be cumulative during that period, causing stress on many species and many extinctions. *Id.* at 54:5-18.

challenges. As the planet warms, there will be an increase in regional extremes. *Id.* at 56:12-23. Expected changes would seriously affect the water supply for many of the people on the planet. *Id.* at 57:18-20. Meanwhile, changes in regional precipitation would also lead to more intense floods. *Id.* at 57:23-58:3. Hansen believes that achieving his alternative scenario would mitigate or prevent many of the effects outlined above. In addition, he testified that the regulation's emissions standards were consistent with the alternative scenario, which contemplated reducing motor vehicle emissions. *Id.* at 67:20-68:8.

Scientific evidence likewise emphasizes the severity of the effects that global warming may have on the state of Vermont in particular. Dr. Barrett Rock testified that global warming poses severe risks to Vermont's economy; specifically, Rock outlined risks to the continued survival of maple trees in Vermont, as well as more short-term effects on foliage, maple sugar production and the ski industry. Tr. vol. 14-A, 18:16-24:8; 28:16-30:4; 30:14-33:10 (Rock, May 4, 2007).

That global warming is taking place as a result of human emissions of carbon dioxide and other greenhouse gases, and that its consequences are likely to be harmful, is widely accepted in the scientific community. The IPCC Report predicts an increase in global average temperatures between 1.8 and four degrees

Celsius by the end of the 21st century, and warns that continued GHG emissions at or above current rates would induce changes during the 21st century that would very likely be larger than those observed during the 20th century. *See* PX 1297 at 13.

In its recent decision in *Massachusetts v. EPA*, 127 S. Ct. 1438, 1455-56 (2007), the Supreme Court stated that "[t]he harms associated with climate change are serious and well recognized," potentially including "a precipitate rise in sea levels by the end of the century," "irreversible changes to natural ecosystems," "a significant reduction in water storage in winter snowpack in mountainous regions," and an "increase in the spread of disease." The Supreme Court's discussion of the potential damage to the environment was informed by amicus briefs to which both Dr. Hansen and Dr. Christy contributed. *See* Brief of Amici Curiae Climate Scientists et al.; Amici Curiae Brief of Climatologists and Scientists et al., *Massachusetts v. EPA*, 127 S. Ct. 1438 (2007) (No. 05-1120).

D. The GHG Regulation Provisions

The GHG regulation covers large-volume motor vehicle manufacturers beginning in 2009, and intermediate and small manufacturers beginning in 2016. *See* Cal. Code Regs. tit. 13, § 1961.1. It identifies two categories of covered vehicles: passenger cars and small light-duty trucks weighing 0 to 3750 pounds loaded vehicle weight ("PC/LDT1") and larger light-duty

trucks and medium duty passenger vehicles weighing 3751 to 8500 pounds loaded vehicle weight ("LDT2" or "LDT2/MDPV"). *See* § 1961.1(a). Vehicles above 8500 pounds are not covered by the regulation. There are separate fleet average emission standards for each category, and within each category, the sales-weighted average of a manufacturer's vehicles is required to comply with the standard. *See* § 1961.1(a)(1)(B). Thus, some of a manufacturer's vehicles may have emissions exceeding the standard, provided that sufficient other vehicles have lower emissions.

The regulation applies to new vehicles, and sets decreasing limits on manufacturers' fleet average emissions, expressed as grams of carbon dioxide equivalent per mile (gpm). For example, the PC/LDT1 category permits new vehicles to emit a fleet average of 323 gpm in model year 2009, decreasing to 205 gpm in model year 2016. The LDT2 category permits a fleet average emission of 439 gpm in 2009, decreasing to 332 gpm in 2016. *See* § 1961.1(a)(1)(A). The regulation does not set fuel economy standards; the GHG emissions standards and the EPCA fuel economy standards, however, both measure carbon dioxide emissions, the one to determine vehicle GHG emissions and the other to determine fuel consumption.[49]

[49] Because there is a mathematical relationship between fuel consumption and carbon dioxide emissions, it is possible to express these emissions standards as fuel economy standards in miles traveled per gallon of gasoline consumed. Plaintiffs have

The regulation provides for methods of compliance in addition to reducing carbon dioxide emissions. Manufacturers may receive credits for meeting the standards before model year 2009 or for surpassing the standards in later years. *See* § 1961.1(b). These credits may be "banked" for later use, transferred between vehicle categories or sold to another manufacturer. A manufacturer that over-complies in the LDT2 category, for example, may use the resulting credits to make up a shortfall in the PC/LDT1 category. If a manufacturer fails to meet the standard in a particular model year, it will begin to accrue debits; at that point it will have five years to make up for the debits, either by generating credits, or by purchasing credits from another company.

The regulation includes adjustment values for corn ethanol (typically blended with gasoline as E85), liquid petroleum gas, and propane and compressed natural gas. These values account for "upstream" or "well-to-tank" emissions associated with the production and transport of fuels, in addition to the emissions associated with combustion in the vehicle engine itself (primarily tailpipe emissions). Adjustment values are calculated against a baseline of upstream emissions for gasoline. The

---

determined that for PC/LDT1s the mileage equivalents are 27.6 mpg in model year 2009, increasing to 43.7 mpg in model year 2016. For LDT2s, they calculate the mileage equivalents as 20.3 mpg in model year 2009, increasing to 26.9 mpg in model year 2016.

regulation also establishes values for GHG emissions associated with vehicles that run on hydrogen or electricity; these vehicles do not have any tailpipe emissions of carbon dioxide, but do have emissions associated with their power sources, that is, upstream emissions from the production of electricity or hydrogen. *See* § 1961.1(a)(1)(B).

Motor vehicle air conditioning systems can leak hydrofluorocarbons, potent greenhouse gases. Credits are available for changing the type of refrigerant used, for reducing the leakage of hydroflourocarbons from the air conditioning system, or for improvements in the air conditioning system's efficiency that reduce the tailpipe's carbon dioxide emissions by reducing the load on the engine. *See id.*

II. Preemption[50]

The Supremacy Clause[51] "invalidates state laws that 'interfere with, or are contrary to,' federal law." *Hillsborough County, Fla. v. Automated Med. Labs., Inc.*, 471 U.S. 707, 712 (1985) (quoting *Gibbons v. Ogden*, 9 Wheat. 1, 211 (1824)). In Count I of their complaints Plaintiffs allege that Vermont's GHG regulations, which adopt California's standards, are preempted by EPCA, both according to the express terms of EPCA's preemption provision, and by implication.

"State action may be foreclosed by express language in a congressional enactment, by implication from the depth and

[50] The parties agree that enforcement of Vermont's GHG standards is preempted by Section 209(a) of the Clean Air Act, 42 U.S.C. § 7543(a), unless and until the EPA Administrator grants California a waiver under Section 209(b), 42 U.S.C. § 7543(b), for its identical GHG regulations. California applied for a waiver from preemption on December 21, 2005. *See* Cal. State Motor Vehicle Pollution Control Standards; Request for Waiver of Federal Preemption; Opportunity for Public Hearing, 72 Fed. Reg. 21,260 (April 30, 2007). The EPA scheduled public hearings on California's request on May 22 and May 30, 2007. *See id.*, 72 Fed. Reg. 26,626 (May 10, 2007). The deadline for submission of written comments was June 15, 2007. 72 Fed. Reg. 21,260. By law, the State of Vermont is not permitted to enforce its GHG regulation before EPA grants California a waiver. *See MVMA III*, 17 F.3d at 534 (waiver is a precondition to enforcement, not adoption). Plaintiffs' CAA counts are therefore moot. This section addresses the question of preemption under the Energy Policy and Conservation Act, assuming EPA will grant California's waiver application.

[51] "This Constitution, and the Laws of the United States which shall be made in Pursuance thereof; . . . shall be the supreme Law of the Land; and the Judges in every State shall be bound thereby, any Thing in the Constitution or Laws of any State to the Contrary notwithstanding." U.S. Const. art. VI, cl. 2.

breadth of a congressional scheme that occupies the legislative field, or by implication because of a conflict with a congressional enactment." *Lorillard Tobacco Co. v. Reilly,* 533 U.S. 525, 541 (2001) (internal citations omitted); *accord Wachovia Bank, N.A. v. Burke*, 414 F.3d 305, 313 (2d Cir. 2005); *Clear Air Markets Group v. Pataki*, 338 F.3d 82, 86-87 (2d Cir. 2003). Conflict preemption exists either when "compliance with both federal and state regulations is a physical impossibility," *Florida Lime & Avocado Growers, Inc. v. Paul*, 373 U.S. 132, 142-43 (1963), or where state law "stands as an obstacle to the accomplishment and execution of the full purposes and objectives of Congress." *Hines v. Davidowitz*, 312 U.S. 52, 67 (1941).

EPCA's express preemption provision, 49 U.S.C. § 32919(a), forbids a state from adopting or enforcing a law or regulation related to fuel economy standards or average fuel economy standards for automobiles covered by an average fuel economy standard under Chapter 329 of Title 49. Defendants argue that once EPA issues California a waiver for its regulations the California and Vermont regulations effectively have the force of federal regulations and are not susceptible to federal preemption. They also argue that Vermont's GHG regulations are not fuel economy standards, nor are they "related to" fuel economy standards.

A. The Preemption Doctrines Do Not Apply.

The Supremacy Clause is not implicated when federal laws conflict or appear to conflict with one another. In such a case courts have a duty to give effect to both provisions, if possible. *See United States v. Borden Co.*, 308 U.S. 188, 198 (1939); *accord Radzanower v. Touche Ross & Co.*, 426 U.S. 148, 155 (1976).

In *Massachusetts v. EPA* the Supreme Court found overlap but no conflict between EPA's authority to regulate greenhouse gases from new motor vehicles under the CAA's Section 202(a) and NHTSA's authority under EPCA to promote energy efficiency by setting mileage standards. 127 S. Ct. at 1461-62. At issue in this case is whether EPA's authority to issue a waiver under the CAA's Section 209(b) for a California GHG emissions standard presents the same situation: overlap without conflict.

There is no dispute that if California fails to receive a waiver from EPA for its standards, then Vermont's GHG standards are invalid.[52] If and when the California standards upon which Vermont's GHG standards are based receive a waiver from EPA, however, Defendants argue that the standards become "other motor

[52] Vermont enacted its GHG regulations pursuant to Section 177 of the CAA, which allows a state to adopt and enforce standards relating to control of emissions if the standards are identical to the California standards for which a waiver has been granted and both states adopt the standards at least two years before commencement of the applicable model year. 42 U.S.C. § 7507.

vehicle standards of the Government," whose effect NHTSA is required to take into consideration when setting maximum feasible average fuel economy standards. *See* 49 U.S.C. § 32902(f). Once approved by EPA, California and Vermont's GHG standards become part of the regulatory backdrop against which NHTSA must design maximum feasible fuel economy levels. If EPA denies California's waiver request, then Vermont's regulations are invalid under the CAA, and the issue of preemption under EPCA is moot.

The resolution of a potential conflict between two federal statutes--Section 209(b) of the CAA and EPCA--depends on an analysis of Congressional intent. *See N.Y. Tel. Co. v. N.Y. State Dept. of Labor*, 440 U.S. 519, 540 n.32 (1979).

Section 209(b) requires EPA to waive federal preemption for California if California has determined that its state standards will be at least as protective of public health and welfare as applicable Federal standards, unless EPA finds that California's determination is arbitrary and capricious, the state doesn't need the standards to meet compelling and extraordinary conditions, or the standards are not consistent with 42 U.S.C. § 7521(a).

Congress allowed California to avoid preemption not only because it was persuaded that California had uniquely severe air pollution problems and a burgeoning number and concentration of automobiles, *see, e.g.,* 113 Cong. Rec. 30,946 (bound ed. Nov. 2, 1967) (remarks of Rep. Bell); 30,950 (remarks of Rep. Corman),

referenced in Cal. State Motor Vehicle Pollution Control Standards; Waiver of Federal Preemption Notice of Decision, 49 Fed. Reg. 18887, 18890 (May 3, 1984), but because California had led the nation in establishing motor vehicle emission control requirements. It determined that there were potential benefits for the nation in allowing California to continue to experiment and innovate in the field of emissions control. *See Motor & Equip. Mfrs. Ass'n, Inc. v. EPA*, 627 F.2d 1095, 1110 (D.C. Cir. 1979) ("*MEMA* I") (citing legislative history for the 1967 amendment); *accord Motor Vehicle Mfrs. Ass'n of the United States, Inc. v. N.Y. State Dep't of Envtl. Conservation*, 17 F.3d 521, 525 (2d Cir. 1994) ("*MVMA III*").

Often over the years California, with its more stringent standards, served as a proving ground for new technology that would later be introduced nationwide pursuant to federal regulations. *See* EPA, Motor Vehicle Pollution Control Suspension Granted, Decision of Administrator, 38 Fed. Reg. 10,317, 10,318-19 (Apr. 26, 1973) (discussing pattern of encouraging phase-in of new technology); California State Motor Vehicle Pollution Control Standards: Waiver of Federal Preemption Notice of Decision, 49 Fed. Reg. 18,887, 18,894-95 (May 3, 1984) (same); Arnold W. Reitze, Jr., *The Legislative History of U.S. Air Pollution Control*, 36 Houston L. Rev. 679, 741 n.169 (1999). Thus, for

forty years California has acted "as a 'laboratory'[53] for motor vehicle regulation. . . . [I]n any area [of motor vehicle emissions control] in which other states are preempted from acting, California and the EPA each have regulatory authority." *Engine Mfrs. Ass'n v. United States EPA*, 88 F.3d 1075, 1090-91 (D.C. Cir. 1996) (quoting *MEMA I*, 627 F.2d at 1110).

When it enacted EPCA in 1975 Congress obviously desired to balance the need for energy conservation, the concerns of the automobile industry and the effect of other federal laws and regulations that affected fuel economy. *See* 49 U.S.C. § 32902(f); *Ctr. for Auto Safety v. NHTSA*, 793 F.2d 1322, 1338-39 (D.C. Cir. 1986) ("CAS I"). Congress was specifically concerned about the relationship of emission controls and fuel economy; it noted that the effect of emission controls on fuel economy is particularly difficult to assess, and it cited an EPA study finding that fuel economy increased between model year 1974 and 1975, although emissions of carbon monoxide and hydrocarbons decreased. H.R. Rep. No. 94-340, at 86-87 (1975), *reprinted in* 1975 U.S.C.C.A.N. 1762, 1848-49. The change was attributable to the installation of catalytic converters on eighty-five percent of cars sold outside California, and virtually every car sold in

[53] *See New State Ice Co. v. Liebman*, 285 U.S. 262, 311 (1932) (Brandeis, J., dissenting) ("It is one of the happy incidents of the federal system that a single courageous State may, if its citizens choose, serve as a laboratory; and try novel social and economic experiments without risk to the rest of the country.").

California. *Id.* at 87; 1975 U.S.C.C.A.N. at 1849. The 1975 California standards, requiring a further reduction in emissions, were expected to result in a fuel economy penalty, although estimates varied widely. *Id.*

The 1977 Amendments to the CAA endeavored to "intensify the war against air pollution, to establish a permit program that struck a balance between economic and environmental interests, and to stimulate technology to control pollution." *New York v. EPA*, 443 F.3d 880, 889 (D.C. Cir. 2006). In this major overhaul to the CAA, Congress enacted the waiver provision that currently appears at 42 U.S.C. § 7543(b). *See* Clean Air Act Amendments of 1977, Pub. L. No. 95-95, sec. 207, § 209(b), 91 Stat. 685, 755. In doing so, it intended to "ratify and strengthen the California waiver provision and to affirm the underlying intent of that provision, i.e. to afford California the broadest possible discretion in selecting the best means to protect the health of its citizens and the public welfare." H.R. Rep. No. 95-294, at 301-02 (1977), *reprinted in* 1977 U.S.C.C.A.N. 1077, 1380-81.

Before the 1977 amendments, California could only obtain a waiver if every feature of its standards were as stringent as the federal standards. The 1977 Amendments allowed California to adopt and enforce emissions standards that it determined to be in the public interest, even if some aspect of its standards were less stringent than the federal standards. As a panel of the

D.C. Circuit Court of Appeals noted in 1979, "[t]he history of congressional consideration of the California waiver provision, from its original enactment up through 1977, indicates that Congress intended the State to continue and expand its pioneering efforts at adopting and enforcing motor vehicle emission standards different from and in large measure more advanced than the corresponding federal program; in short, to act as a kind of laboratory for innovation." *MEMA I*, 617 F.2d at 1111.

Congress remained well aware of a potential conflict between tighter air pollution control standards and improved fuel economy, but noted again that use of new technologies had enabled improved fuel economy as well as reduced emissions. *See* H. Rep. No. 95-294 at 245-246, 1977 U.S.C.C.A.N. at 1324-25. It emphasized that "the experience of the stricter California standards shows that tighter standards do not necessarily mean a fuel economy reduction." *Id.* at 249, 1977 U.S.C.C.A.N. at 1328.

Thus, two years after the enactment of EPCA Congress reaffirmed its commitment to ambitious efforts at reducing emissions from new motor vehicles, and particularly to strengthening the California waiver scheme, while acknowledging an overlap between regulations designed to improve motor vehicles' fuel economy and regulations designed to reduce their emissions.

As the House Report made clear, once a waiver is granted,

compliance with California's standards is deemed to satisfy federal standards. *Id.* at 302, 1977 U.S.C.C.A.N. at 1381. A state adopting California's standards pursuant to Section 177 would also be deemed to satisfy federal standards.

Section 502(d) of EPCA as originally enacted provided that any manufacturer could apply to the Secretary of Transportation for modification of an average fuel economy standard for model years 1978 through 1980 if it could show the likely existence of a "Federal standards fuel economy reduction," defined to include EPA-approved California emissions standards that reduce fuel economy. § 502(d)(1)-(3); *see also* S. Rep. No. 94-516, at 156 (1975), 1975 U.S.C.C.A.N. 1956, 1997. Thus, in 1975 when EPCA was passed, Congress unequivocally stated that federal standards included EPA-approved California emissions standards. § 502(d)(3)(D)(i). In 1994, when EPCA was recodified, all reference to the modification process applicable for model years 1978 through 1980, including the categories of federal standards, was omitted as executed. However, the 1994 recodification was intended to "revise[], codif[y], and enact[]" the law "without substantive change." Pub. L. No. 103-272, 108 Stat. 745, 745 (1994); *see also* H. R. Rep. No. 103-180, at 1 (1994), *reprinted in* 1994 U.S.C.C.A.N. 818, 818; S. Rep. No. 103-265, at 1 (1994). If the recodification worked no substantive change in the law, then the term "other motor vehicle standards of the Government"

continues to include both emission standards issued by EPA and emission standards for which EPA has issued a waiver under Section 209(b) of the CAA, as it did when enacted in 1975.

NHTSA has consistently treated EPA-approved California emissions standards as "other motor vehicle standards of the Government," which it must take into consideration when setting maximum feasible average fuel economy under § 32902. *See, e.g.*, Final Rule: Average Fuel Economy Standards for Light Trucks Model Years 2008-2011, 71 Fed. Reg. 17,566, 17643 (Apr. 6, 2006) (CARB standards discussed in section X.D. "Federal Motor Vehicle Emissions Standards).[54] In fact Plaintiffs do not dispute that a

[54] *See also* Final Rule: Light Truck Average Fuel Economy Standards Model Years 2005-2007, 68 Fed. Reg. 16,868, 16898 (Apr. 7, 2003) (CARB and § 177 States' standards discussed in section VIII.B. "Federal Motor Vehicle Emissions Standards); Final Rule: Light Truck Average Fuel Economy Standard, Model Year 2004, 67 Fed. Reg. 16,052, 16057 (Apr. 4, 2002) (CARB and § 177 States' standards discussed in section V.B. "Effect of Other Federal Standards on Fuel Economy"); Final Rule: Light Truck Average Fuel Economy Standards, Model Years 1996-1997, 59 Fed. Reg. 16,312, 16,317 (Apr. 6, 1994) (California standards discussed in section IV.B. "Other Federal Standards: Revised Emissions Standards"); Final Rule: Light Truck Average Fuel Economy Standards Model Year 1995, 58 Fed. Reg. 18019, 18023-24 (Apr. 7, 1993) (California standards discussed in section IV.B. "Other Federal Standards: Revised Emissions Standards"); Final Rule: Light Truck Average Fuel Economy Standards: Model Years 1993-1994, 56 Fed. Reg. 13,773, 13,779 (Apr. 4, 1991) (California standards discussed in section IV.3. "Effect of Other Federal Standards"); Final Rule: Light Truck Average Fuel Economy Standards: Model Years 1990-91, 53 Fed. Reg. 11,074, 11,078 (Apr. 5, 1988) (California standards discussed in section IV.B. "Effect of Other Federal Standards"); Final Rule, Light Truck Average Fuel Economy Standards Model Year 1989, 52 Fed. Reg. 6564, 6570 (Mar. 4, 1987) (California standards discussed in "Other Federal Standards" section); Final Rule: Light Truck Average Fuel Economy Standards, Model Year 1988, 51 Fed. Reg. 15,335, 15,341 (Apr. 23, 1986) (California

California regulation that receives an EPA waiver is a government standard for purposes of § 32902.

It seems beyond serious dispute therefore that once EPA issues a waiver for a California emissions standard, it becomes a motor vehicle standard of the government, with the same stature as a federal regulation with regard to determining maximum feasible average fuel economy under EPCA. Congress has consistently acknowledged interplay and overlap between emissions reductions regulations and fuel economy regulations, and could not have intended that an EPA-approved emissions reduction regulation did not have the force of a federal regulation.

It bears noting here that EPCA expresses no environmental objective or purpose, and EPCA contains no requirement to take environmental factors into consideration when setting fuel economy standards. Congress, aware that it had authorized EPA to set motor vehicle standards with environmental implications, required that NHTSA take those standards into consideration when setting its fuel economy levels, thereby ensuring that environmental concerns be given appropriate weight when NHTSA balances its four factors.

---

standards discussed in “Other Federal Standards: Environmental Standards” section); Final Rule: Light Truck Average Fuel Economy Standards, Model Years 1983-85, 45 Fed. Reg. 81593, 81,597 (Dec. 11, 1980 (California standards discussed in section e. “The effects of other Federal Standards on Fuel economy”); Final Rule: Light Truck Fuel Economy Standards, 43 Fed. Reg. 11,995, 12,009-10 (Mar. 23, 1978) (California standards discussed in section e. “The Effect of Other Federal Motor Vehicle Standards”).

Plaintiffs object, however, that the EPA waiver process is so limited that EPA cannot give real consideration to two of the factors that EPCA requires NHTSA to consider when determining fuel economy standards: technological feasibility and economic practicability, and particularly the issues of consumer choice, effect on the automotive industry, and highway safety, which NHTSA has determined are part of its economic practicability analysis.

California applied for a waiver of preemption under Section 209(b) of the CAA, 42 U.S.C. § 7543(b), on December 21, 2005. *See* Cal. State Motor Vehicle Pollution Control Standards; Request for Waiver of Federal Preemption; Opportunity for Public Hearing, 72 Fed. Reg. 21,260 (April 30, 2007). Its application is pending. Pursuant to Section 209(b), CARB made the determination that its GHG standards are at least as protective of public health and welfare as applicable federal standards. *See* 42 U.S.C. § 7543(b). Section 209(b) requires EPA, after notice and opportunity for public hearing, to waive preemption if California has determined that its standards are in the aggregate at least as protective of public health and welfare as applicable federal standards, unless EPA finds that (1) California's determination was arbitrary and capricious; (2) California does not need these standards to meet compelling and extraordinary conditions; or (3) the standards are not consistent with § 7521(a) of title 42. *Id.*

Section 202(a) authorizes EPA to regulate air pollutants from new motor vehicles that may in its judgment cause or contribute to air pollution that may reasonably be anticipated to endanger public health and welfare. 42 U.S.C. § 7521(a)(1). Any such regulation shall only take effect "after such period as the Administrator finds necessary to permit the development and application of the requisite technology, giving apropriate consideration to the cost of compliance within such period." *Id.* § 7521(a)(2). EPA considers that a state standard is inconsistent with section 202(a) if it affords "inadequate lead time to permit development of necessary technology giving appropriate consideration to the cost of compliance within that time period." Cal. State Motor Vehicle Pollution Control Standards; Request for Waiver of Federal Preemption; Opportunity for Public Hearing, 72 Fed. Reg. at 21,261; *see also MVMA III*, 17 F.3d at 526.

EPA evaluates a waiver application based on factors that Congress expressly or impliedly intended the agency to consider. *Motor & Equip. Mfrs. Ass'n v. Nichols*, 142 F.3d 449, 467 (D.C. Cir. 1998) ("*MEMA II*"); *accord MEMA I*, 627 F.2d at 1116. By statute, these factors include technological feasibility (adequate time to permit development and application of requisite technology) and economic practicability (cost of compliance within that lead time). *See* § 7521(a)(2).

Given the broad discretion accorded to California to fashion its own motor vehicle emissions standards, EPA "'is not to overturn California's judgment lightly,'" *MEMA II*, 142 F.3d at 463 (quoting H.R. Rep. No. 95-294, at 302 (1977), *reprinted in* 1977 U.S.C.C.A.N. at 1381), nor to substitute its own judgment for that of the state. *MEMA I*, 627 F.2d at 1122 n.54 (quoting H.R. Rep. No. 95-294, at 302 (1977), *reprinted in* 1977 U.S.C.C.A.N. at 1381).

Nevertheless, over the years EPA has denied portions of an application for waiver, or delayed implementation of California's standards, to ensure their consistency with § 7521(a).[55] EPA has eventually issued waivers to California in virtually all of California's applications, however, and has never denied California an emissions waiver in its entirety. *See* Ann E. Carlson, *Federalism, Preemption, and Greenhouse Gas Emissions*, 37 U.C. Davis L. Rev. 281, 293 (2003).

EPA has held public hearings and invited comments on the

[55] *See, e.g.,* Motor Vehicle Pollution Control: California State Standards, 38 Fed. Reg. 30136 (Nov. 1, 1973) (waiver granted in part and denied in part); California State Motor Vehicle Pollution Control Standards: Waiver of Federal Pre-Emption, 40 Fed. Reg. 30,311 (July 18, 1975) (delay of implementation); California State Motor Vehicle Pollution Control Standards: Waiver of Federal Pre-Emption, 43 Fed. Reg. 998 (Jan. 5, 1978) (denial of one of three requests for waiver); California State Motor Vehicle Pollution Control Standards: Waiver of Federal Pre-Emption, 58 Fed. Reg. 4166 (Jan. 13, 1993) (deferring consideration of portions of waiver request); California State Motor Vehicle Pollution Control Standards: Waiver of Federal Preemption, 67 Fed. Reg. 54180 (Aug. 21, 2002) (granting waiver with certain exceptions).

statutory criteria for waiver in California's pending application, including whether the standards are consistent with § 7521(a). If opponents of California's regulations can show that there is inadequate lead time to develop necessary technology at an appropriate cost in order to satisfy the requirements of the regulations, then EPA will deny the waiver or delay its implementation to afford adequate lead time. *See* § 7543(b); § 7521(a).

Plaintiffs argue that EPA will not consider the regulation's effect on consumer choice or the welfare of the automobile industry. These factors, although not explicitly listed in the CAA as criteria, are implied to some extent in EPA's consideration of the cost of compliance with the regulation. Moreover, Plaintiffs overemphasize the significance of these criteria, suggesting that case law confirms that NHTSA interprets its mandate to avoid any regulation that might result in a manufacturer's reducing the types of vehicles it offers. On the contrary, NHTSA historically has stressed its balancing role, declaring that it "assesses what is technologically feasible for manufacturers to achieve without leading to . . . a significant loss of jobs or the unreasonable elimination of consumer choice." Final Rule: Light Truck Average Fuel Economy Standards Model Years 2005-2007, 68 Fed. Reg. 16,868, 16,872-73 (Apr. 7, 2003); *see also CAS I*, 793 F.2d at 1340 ("it would clearly be

impermissible for NHTSA to rely on consumer demand to such an extent that it ignored the overarching goal of fuel conservation”).

Thus, the EPA waiver process is an opportunity to challenge the technological feasibility or economic practicability of the GHG regulation, an opportunity that many of the plaintiffs in this case have taken. *See* California State Motor Vehicle Pollution Control Standards; Request for Waiver of Federal Preemption, Docket ID No. EPA-HQ-OAR-2006-0173, http://www.regulations.gov/fdmspublic/component/main. Should EPA find that lead time is insufficient to permit necessary technological development at an appropriate cost, EPA will conclude that the GHG regulation is not consistent with Section 202(a) of the CAA. *See* § 42 U.S.C. § 7543((b).

In response to the Supreme Court’s decision in *Massachusetts v. EPA*, President Bush issued an executive order calling for cooperation among the agencies to protect the environment with respect to GHG emissions from motor vehicles. Exec. Order No. 13,432, 72 Fed. Reg. 27,717 (May 14, 2007). In response to *Massachusetts v. EPA* and the President’s call for inter-agency cooperation, the EPA Administrator announced that EPA will be undertaking rulemaking with regard to controlling GHG emissions from new motor vehicles, working closely with the Departments of Transportation, Energy and Agriculture. Briefing by Conference

Call on the President's Announcement on CAFE and Alternative Fuel Standards, May 14, 2007, http://www.whitehouse.gov/news/releases/2007/05/20070514-6.html.

In his January 2007 State of the Union address, President Bush had proposed measures that would increase the CAFE standard for passenger vehicles by four percent per year beginning in 2010. Tr. vol. 3-B, 37:3-38 (Modlin, Apr. 12, 2007). In connection with implementing the President's proposal, NHTSA has requested updated information from manufacturers regarding their future product plans and costs of compliance. Before the House Subcommittee on Energy and Air Quality, NHTSA Administrator Nicole Nason testified on February 8, 2007 that NHTSA is "basing [its] standard on the President's goal . . . of a four percent annual increase." PX 1301 at 12-13. Nason explained that although that number was a "goal" rather than a certainty, "we are proposing a rulemaking on the four percent issue from 2010 to 2017," with the understanding that "this is a priority for [the President]." *Id.* at 23-24.

Should a conflict between a state emissions standard undergoing EPA waiver review and a NHTSA-promulgated CAFE standard become apparent, the federal agencies involved--EPA and NHTSA--are capable of and even encouraged to cooperate in a joint accommodation or resolution. See Exec. Order No. 13,432, 72 Fed. Reg. 27,717 (requiring coordination of regulatory action,

undertaken jointly and/or in consultation with and with concurrence of other agencies where possible).

For the reasons stated above, the Court concludes that the preemption doctrines do not apply to the interplay between Section 209(b) of the CAA and EPCA, in essence a claim of conflict between two federal regulatory schemes. Nevertheless, the Court has conducted a standard federal preemption analysis in the alternative for two reasons: one, the express language of EPCA's preemption provision appears literally to forbid the enactment or enforcement of Vermont's GHG regulation; and two, Plaintiffs have alleged that the GHG regulation actually conflicts with EPCA's fuel economy standards. *See e.g., Chevron U.S.A., Inc. v. Hammond*, 726 F.2d 483, 491 (9th Cir. 1984) (conversion of state statute into a federal Clean Water Act standard did not obviate preemption challenge); *Central Valley Chrysler-Jeep v. Witherspoon*, 456 F. Supp. 2d 1150, 1172 (E.D. Cal. 2006) (no indication that Congress intended to allow an EPA-approved California regulation to disrupt the CAFE program). Therefore the Court turns to the preemption arguments, addressing first the question whether EPCA's preemption clause expressly preempts Vermont's regulation, either because it is essentially a fuel economy regulation, or because it is related to fuel economy standards.

B. Express Preemption

Given the role of the States as separate sovereigns in our federal system, where Congress has legislated in a field which the States have traditionally occupied, a Supremacy Clause analysis begins "with the assumption that the historic police powers of the States [are] not to be superseded by the Federal Act unless that [is] the clear and manifest purpose of Congress." *Rice v. Santa Fe Elevator Corp.*, 331 U.S. 218, 230 (1947); *accord United States v. Locke*, 529 U.S. 89, 107-08 (2000); *see also Madeira v. Affordable Housing Foundation, Inc.*, 469 F.3d 219, 237 (2d Cir. 2006) ("'Our Federalism' prescribes that the national government, 'anxious though it may be to vindicate and protect federal rights and federal interests, always endeavors to do so in ways that will not unduly interfere with the legitimate activities of the States,'" quoting Justice Hugo Black in *Younger v. Harris*, 401 U.S. 37, 44 (1971)). As discussed above, Congress acknowledged that the regulation of air pollution from mobile sources was traditionally a state responsibility. H.R. Rep. No. 89-899 (1965), *reprinted in* 1965 U.S.C.C.A.N. 3608, 3612.

In fact, regulation of greenhouse gases from new motor vehicles cannot clearly be categorized as either an area of traditional state regulation--such as medical negligence, *eg., Medtronic Inc. v. Lohr,* 518 U.S. 470, 485 (1996)--or an area in which federal control predominates, such as national banks, *eg.,*

Watters v. Wachovia Bank, N.A., 127 S. Ct. 1559, 1566-67 (2007), or maritime commerce. *Eg., Locke*, 529 U.S. at 99. From the beginning of federal involvement in environmental pollution regulation, the area has been regarded as a cooperative state federal legislative effort. *See, e.g.,* Robert L. Glicksman, *From Cooperative to Inoperative Federalism: The Perverse Mutation of Environmental Law and Policy*, 41 Wake Forest L. Rev. 719, 719 (2006); Carlson, *supra*, at 285. The states and the federal government have overlapping spheres of authority, and regulate concurrently. Specifically, EPA and DOT have authority to regulate concurrently in the area of GHG emissions from motor vehicles. *Massachusetts v. EPA*, 127 S. Ct. at 1462.

EPCA's preemption provision cannot invalidate Vermont's GHG regulations unless Congress had the clear and manifest purpose to do so. *Rice*, 331 U.S. at 230; *accord Lorillard,* 533 U.S. at 542; *Cipollone v. Liggett Group, Inc.*, 505 U.S. 504, 516 (1992). Congressional purpose is therefore "'the ultimate touchstone'" of preemption analysis." *Id.* (quoting *Malone v. White Motor Corp.*, 435 U.S. 497, 504 (1978)).

If an act contains an express preemption clause, "the task of statutory construction must in the first instance focus on the plain wording of the clause, which necessarily contains the best evidence of Congress' pre-emptive intent." *CSX Transp., Inc. v. Easterwood*, 507 U.S. 658, 664 (1993). Section 32919(a) of EPCA

provides that when a fuel economy standard is in effect states are prohibited from adopting or enforcing any regulation "related to fuel economy standards or average fuel economy standards for automobiles."[56] Plaintiffs argue that Vermont's GHG emissions standards not only are "related to fuel economy standards," but essentially constitute "de facto fuel economy standards." Post-Trial Br. of '304 Pl. 7-21 (Doc. 478); Proposed Concl. of Law of '302 Pls. 6-12 (Doc. 493).

1. De facto fuel economy standard findings and conclusion

Vermont's law regulates GHG emissions--methane, nitrous oxide, hydrofluorocarbons and carbon dioxide--as air pollutants. To be sure, carbon dioxide represents the bulk of GHG emissions, and one way a motor vehicle manufacturer may choose to comply with the GHG regulations is to improve the average fuel economy of its fleet. But the GHG regulations embrace much more than a simple requirement to improve fuel economy, cloaked in the rhetoric of reducing carbon dioxide emissions.

There is indeed a mathematical relationship between the carbon content of a fuel and the carbon which is released through

---

[56] Section 32919(a) provides:

> When an average fuel economy standard prescribed under this chapter is in effect, a State or a political subdivision of a State may not adopt or enforce a law or regulation related to fuel economy standards or average fuel economy standards for automobiles covered by an average fuel economy standard under this chapter.

49 U.S.C. § 32919(a).

emissions of hydrocarbons, carbon monoxide, or carbon dioxide. Tr. vol. 5-A, 20:8-11 (Haskew, Apr. 19, 2007). The "carbon balance equation" allows EPA to calculate fuel economy based on measured carbon in a vehicle's exhaust, for purposes of the CAFE standards. *Id.* at 14:8-15:10; 22:3-12; *see also* PX 965 (illustrating the carbon balance equation for gasoline).[57] The same basic equation can be used for fuels other than gasoline, such as E85 (a combination of eighty-five percent ethanol and fifteen percent gasoline) and diesel, but must include different numbers to adjust for differences in fuel properties like carbon-to-hydrogen ratio, specific gravity, density, and net heating value. Tr. vol. 5-A, 22:15-23:5 (Haskew, Apr. 19, 2007).[58]

Vermont's regulation measures "carbon dioxide equivalents," in order to cover greenhouse gases other than carbon dioxide. The term "carbon dioxide equivalent" includes methane (a hydrocarbon), carbon monoxide, and nitrous oxide, each of which is weighted according to its global warming potential. *Id.* at

[57] The numerator of the equation represents the grams of carbon per gallon of fuel; the denominator shows carbon fractions in the three carbon-containing compounds in the exhaust multiplied by a coefficient, which is the carbon fraction that is in the hydrocarbons. Tr. vol. 5-A, 20:12-23 (Haskew, Apr. 19, 2007). The ultimate outcome of the equation is a measure of miles traveled per gallon of fuel. *Id.* at 21:22-25.

[58] To change the equation to reflect the characteristics of diesel fuel, for example, it would be necessary to adjust the numerator to reflect the fact that diesel has a larger number of grams of carbon per gallon than gasoline. *Id.* at 24:1-11; PX 966.

39:21-40:6. Therefore, while there is a near-perfect correlation between fuel consumed and carbon dioxide released, there is no such perfect correlation between fuel consumed and emissions of hydrocarbons or carbon monoxide.[59] *Id.* at 38:2-7; 38:12-16; *see also* PX 971; PX 972. This fact undermines the assertion that the GHG regulation is nothing more than a fuel economy standard, since it encompasses emissions which do not correlate with fuel economy.

Plaintiffs' expert Dr. Harold M. Haskew[60] stressed that eliminating methane emissions entirely and obtaining all available air conditioning credits would not enable a manufacturer to comply with the regulation without improving fuel economy. Tr. vol. 5-A, 43:24-45:11. But the fact that manufacturers may have to increase fuel economy to some degree in order to comply does not per se convert an emissions standard to a fuel economy standard.

Diesel contains more carbon than gasoline; burning less of it therefore produces more energy. Tr. vol. 11-A, 140:19-141:12

[59] Methane has about twenty-five times the global warming potential of carbon dioxide, and nitrous oxide has almost three hundred times the global warming potential of carbon dioxide. Emissions rates for these gases are very low compared to carbon dioxide emissions, but the regulation takes their potency into account in calculating the amount of carbon dioxide to which each is considered equivalent. *Id.* at 40:7-14; 41:7-17.

[60] Haskew is the president and principal engineer of Harold Haskew and Associates, an emissions consulting group in Milford, Michigan. *Id.* at 7:23-25.

(Jackson, May 1, 2007). The fuel economy benefits of diesel surpass its emissions benefits; it provides about a thirty percent increase in fuel economy but only about a twenty percent emissions reduction. DX 2510. E85 has a lower carbon content than gasoline, so that vehicles driven on E85 have poorer fuel economy, and fewer GHG emissions. Tr. vol. 1-B, 34:5-36:12 (Weverstad, Apr. 10, 2007). Vehicles powered by electricity offer zero tailpipe emissions, in which case there would be no relationship at all between GHG emissions and fuel consumption or fuel economy. Tr. vol. 5-A, 70:22-71:13 (Haskew, Apr. 19, 2007).

Haskew opined that the regulation is the equivalent of a fuel economy regulation because motor vehicle manufacturers can only reduce carbon dioxide emissions by reducing the fuel consumed--that is, by increasing fuel economy. *Id.* at 31:2-17. However, this is only true if one assumes a static, “business-as-usual” scenario, accepting that the mix of alternative fuel vehicles remains constant for the foreseeable future. If ten percent of a fleet were converted to flexible-fuel vehicles running on E85, the fleet’s fuel economy measured in miles per gallon would decrease, but its emissions of greenhouse gases, taking into account upstream emissions, would decrease as well.

Additionally, the Vermont and California regulations are not the equivalent of fuel economy standards because multiple approaches, with various levels of fuel economy, allow compliance

with the standard. Manufacturers may take advantage of the regulation's credits for air conditioning, or may use alternative fuels, or may use plug-in hybrid vehicles. Compliance with the regulation is not achieved solely by improving a fleet's fuel economy. Tr. vol. 12-A, 111:25-112:11 (Duleep, May 2, 2007).

Notably, the federal CAFE standard does not take into account upstream emissions associated with different types of fuels. *See* Tr. vol. 5-A, 71:14-23 (Haskew, Apr. 19, 2007). Vermont and California's regulation includes upstream emissions adjustments for corn ethanol, liquid petroleum gas, or propane, and compressed natural gas. The regulation also includes adjustment values for GHG emissions for energy sources that do not have tailpipe emissions of greenhouse gases, such as electricity and hydrogen. Tr. vol. 11-A, 131:17-135:23 (Jackson, May 1, 2007); DX 2421. This further undercuts the idea that the regulation is a de facto fuel economy standard; upstream emissions are not associated with the fuel economy of a particular vehicle or even a particular fleet of vehicles.

The evidence demonstrated that over the next few years non-gasoline technologies will be used in a substantially greater percentage of American motor vehicles, and that non-gasoline or mixed fuels will be increasingly available, broadening the means of compliance with the regulation. There is no persuasive evidence that Vermont's GHG regulation is a de facto fuel economy

standard.

2. "Related to" fuel economy standard

The text of EPCA's preemption provision is broad; it provides that no state may "adopt or enforce a law or regulation related to fuel economy standards. . . ." 49 U.S.C. § 32919(a). As the Supreme Court has pointed out, however, "[i]f 'relate to' were taken to extend to the furthest reach of its indeterminacy, then for all practical purposes preemption would never run its course," and this would "read the presumption against pre-emption out of the law whenever Congress speaks to the matter with generality." *N.Y. Conference of Blue Cross & Blue Shield Plans v. Travelers Ins. Co.*, 514 U.S. 645, 655 (1995). "Relate to" could be interpreted to include virtually all state provisions with even a tangential connection to fuel economy. EPCA's use of "related to" takes this case out of a simple "plain wording" analysis, requiring this Court to, as the Court in *New York Conference* did, "go beyond the unhelpful text and the frustrating difficulty of defining its key term, and look instead to the objectives of the . . . statute as a guide to the scope of the state law that Congress understood would survive." *Id.* at 656.

EPCA's objectives are to conserve energy. Title V was enacted to improve automotive efficiency by setting fuel economy standards. A state law that controlled or superseded a core EPCA function--to set fuel economy standards for automobiles--would

appear to be preempted. *See e.g., Gerosa v. Savasta & Co.*, 329 F.3d 317, 324 (2d Cir. 2003) (state laws that tend to control or supersede central ERISA functions have typically been found to be preempted).

Congress's undoubted intent was to make the setting of fuel economy standards exclusively a federal concern, but it enacted EPCA against the backdrop of other regulations that affected motor vehicles and could have an effect on fuel economy, such as emissions standards under Section 202 of the CAA, emissions standards under Section 209(b) of the CAA, motor vehicle safety standards and noise emission standards. *See* Pub. L. No. 94-163, Sec. 502., Stat. (1975). The Committee reports accompanying the bill that became EPCA contained no discussion of the intended scope of the preemption clause. The Senate Conference Report merely noted: "The States and their political subdivisions are prohibited from adopting or enforcing any law or regulation relating to fuel economy or average fuel economy standards applicable to automobiles covered by this title." S. Conf. Rep. No. 94-516 (1975), 1975 U.S.C.C.A.N. 1956, 2001.

Construing the statute as a whole, Congress could not have considered an EPA-approved California emissions standard to be automatically subject to express preemption as a "law or regulation relating to fuel economy standards," because it required that NHTSA take into consideration the effect of such

standards when determining maximum feasible average fuel economy. *See* 49 U.S.C. § 32902(f).

Nothing in EPCA or its legislative history indicates that Congress intended to displace emission regulation by California that would have an effect on fuel economy; on the contrary, the legislative history is quite clear that Congress expected NHTSA to take such regulations into consideration. EPCA's preemption section may have been intended to achieve uniformity of fuel economy standards, *see, e.g., Geier v. Am. Honda Motor Co.*, 529 U.S. 861, 871 (2000) (preemption provision in National Traffic & Motor Vehicle Safety Act reflected desire to set uniform federal safety standards), but the arena of emissions standards is characterized by support for a California as well as a federal standard.

The general language of the preemption clause and the absence of any indication of Congressional intent about its limits, combined with the specific requirement to take EPA-approved California emissions regulations into consideration, supports a conclusion that Congress did not clearly intend to preempt such regulations. Unless this Court is to ignore decades of EPA-issued and approved regulations that also can be said to "relate to" fuel economy, this regulation does not "relate to" fuel economy within the meaning intended by Congress. Vermont's GHG emissions regulation is not expressly preempted by §

32919(a).

C. Field Preemption

Under the doctrine of field preemption, state law is preempted if it attempts to regulate in a field that Congress intended the federal government to occupy exclusively. *English v. General Elec. Co.*, 496 U.S. 72, 79 (1990). That intent must be "'clear and manifest,'" where the field "includes areas that have 'been traditionally occupied by the States.'" *Id. (*quoting *Jones v. Rath Packing Co.*, 430 U.S. 519, 525 (1977)). Such an intent may be inferred from a pervasive scheme of federal regulation that leaves no room for a state to supplement, or where Congress legislates in "'a field in which the federal interest is so dominant that the federal system will be assumed to preclude enforcement of state laws on the same subject.'" *Id.* (quoting *Rice v. Santa Fe Elevator Corp.*, 331 U.S. 218, 230 (1947)); *accord Madeira v. Affordable Housing Foundation, Inc.*, 469 F.3d 219, 240 (2d Cir. 2006). The Supreme Court has described field preemption "as a species of conflict preemption: a state law that falls within a preempted field conflicts with Congress' intent (either express or plainly implied) to exclude state regulation." *English*, 496 U.S. at 79 n. 5. Again, Congressional intent is the "ultimate touchstone" of preemption analysis. *Freeman v. Burlington Broadcasters, Inc.*, 204 F.3d 311, 320 (2d Cir. 2000) (quoting *Cipollone v. Liggett Group,*

Inc., 505 U.S. 504, 516 (1992)).

The Supreme Court recently made clear that the regulation of carbon dioxide emissions from motor vehicles is not the exclusive province of the federal Department of Transportation. *See Massachusetts v. EPA*, 127 S.Ct. at 1462. EPA has the obligation under the CAA to protect public health and welfare by regulating the emission of air pollutants, which may include carbon dioxide. *Id.* Under the CAA, California may set its emissions standards, subject to EPA waiver review, and Vermont, among other states, may adopt those EPA-approved standards. When Congress enacted EPCA, it was well aware of this long-standing practice of permitting California to apply for waivers from EPA for its emissions standards pursuant to the CAA.

It follows that the Congressional regulatory scheme to improve fuel economy does not express so dominant or pervasive a federal interest that EPA-approved state regulation is precluded. By contrast, courts have tended to find field preemption either by narrowly defining the field or in areas where states have not traditionally regulated. *See, e.g., Pac. Gas & Elec. Co. v. State Energy Resources Conserv. & Dev. Comm'n*, 461 U.S. 190, 212 (1983) (nuclear safety concerns); *Campbell v. Hussey*, 368 U.S. 297, 330 (1961) (tobacco grading); *Wells Fargo Bank, N.A. v. Boutris*, 419 F.3d 949, 967 (9th Cir. 2005) (licensing requirements for operating subsidiaries of national banks); *Publ.*

Util. No. 1 v. IDACORP Inc., 379 F.3d 641, 649 (9th Cir. 2004) (public utility rate regulation); *California ex rel. Lockyer v. Dynegy, Inc.*, 375 F.3d 831, 851 (9th Cir. 2004) (wholesale power rates); *Witty v. Delta Air Lines, Inc.*, 366 F.3d 380, 384-85 (5th Cir. 2001) (air safety standards); *Freeman*, 204 F.3d at 320 (radio frequency interference regulation). Here, Plaintiffs have not shown that Congress exhibited a clear and manifest intent to render the regulation of carbon dioxide emissions from motor vehicles exclusively a federal domain.

D. Conflict Preemption

A state law is invalid under the principle of conflict preemption if it actually conflicts with a federal statute or regulation, or "'stands as an obstacle to the accomplishment and execution of the full purposes and objectives of Congress.'" *Int'l Paper Co. v. Ouellette*, 479 U.S. 481, 492 (1987) (quoting *Hillsborough County v. Automated Medical Labs., Inc.*, 471 U.S. 707, 713 (1985)); *accord Geier*, 529 U.S. at 873.[61]

"The mere fact of 'tension' between federal and state law is generally not enough to establish an obstacle supporting preemption, particularly when the state law involves the exercise of traditional police power." *Madeira*, 469 F.3d at 241. "What constitutes a sufficient obstacle 'is a matter of judgment,' to

[61] Plaintiffs do not contend that it is physically impossible to comply with EPCA standards and Vermont's regulations.

be informed by reference to the overall federal statutory scheme." *Id.* (quoting *Crosby v. Nat'l Foreign Trade Council*, 530 U.S. 363, 373 (2000)).

It is undeniable that a state statute is not shielded from preemption merely because it expresses a different objective than the federal statute. *See New York State Comm'n on Cable Television v. FCC*, 669 F.2d 58, 62 (2d Cir. 1982) (courts "look to the effect, rather than the purpose of the state law"). To the extent that the state statute intrudes upon Congressional objectives as expressed by the federal statute, to that extent the statute is preempted. *Id.* (citing *Hines v. Davidowitz*, 312 U.S. 52, 67 (1941)). Nevertheless, a finding of conflict preemption "turns on the identification of 'actual conflict,'" *Geier*, 529 U.S. at 884, and a court "should not find pre-emption too readily in the absence of clear evidence of a conflict." *Id.* at 885.

The bulk of the parties' evidence at trial addressed the issue of conflict preemption, and the Court has carefully weighed the claims and the evidence that supports or weakens them.

Plaintiffs argue that Vermont's regulation actually conflicts with the federal CAFE program in several ways: first, that it frustrates Congressional intent to maintain a single, nationwide fuel economy standard; second, that it upsets the balance that NHTSA has chosen to strike in setting "maximum

feasible average fuel economy" levels by restricting consumer choice, reducing employment in the domestic automobile industry, and decreasing traffic safety; and third, that EPA's waiver process will not ensure the absence of a conflict with EPCA objectives.

1. Frustration of Congressional intent to maintain nationwide fuel economy standards

The legislative history of EPCA and the CAA, and the agencies' practices, demonstrate that there is no inherent conflict between the mandate of the CAA to regulate air pollution and the mandate of EPCA to regulate fuel economy. As the Supreme Court recently pointed out: "EPA has not identified any congressional action that conflicts in any way with the regulation of greenhouse gases from new motor vehicles." *Massachusetts v. EPA*, 127 S. Ct. at 1461. To the argument that regulating carbon dioxide emissions from motor vehicles would require EPA to encroach upon NHTSA's prerogative to set fuel economy standards, the Court emphasized that the agencies had independent statutory obligations that might overlap but could be administered without inconsistency. *Id.* Congress understood that EPCA standards and standards adopted pursuant to the CAA could overlap, and directed NHTSA to consider the effect of other motor vehicle standards of the Government when setting fuel economy standards. 49 U.S.C. § 32902(f).

NHTSA and EPA have recognized since the inception of rule-

making under EPCA that there is a technological overlap between emissions control and fuel economy. Fuel economy values for the various types of motor vehicles were to be determined according to procedures established by EPA. EPA and the Department of Transportation worked together to evaluate the effects of emissions control standards on fuel economy. NHTSA explicitly recognized that technological changes to engines for fuel economy improvement might reduce exhaust emissions, and vice versa. *See* Final Rule: Passenger Automobile Average Fuel Economy Standards, 42 Fed. Reg. 33,534, 33,541 (June 30, 1977).

When Congress enacted the Clean Air Act Amendments of 1977 two years after it enacted EPCA, it examined the relationship between emission standards and fuel economy standards, and concluded that its legislation struck the proper balance between reducing emissions levels and improving fuel economy. H.R. Rep. No. 95-294, at 244-51 (1977), *reprinted in* 1977 U.S.C.C.A.N. 1077, 1101-11. Plaintiffs have not demonstrated that Congress's purpose and objectives have been thwarted by Vermont's GHG regulation.

2. Technological feasibility and economic practicability, including restricting consumer choice, reducing employment and decreasing traffic safety

EPCA requires NHTSA to set CAFE standards to achieve the maximum feasible average fuel economy, taking into consideration "technological feasibility, economic practicability, the effect

of other motor vehicle standards of the government on fuel economy, and the need of the United States to conserve energy." 49 U.S.C. § 32902(f). NHTSA interprets the requirement that it consider technological feasibility and economic practicability to include a requirement that the standards do not limit the choice of cars and trucks available to consumers; do not cause economic hardship for the automobile industry; do not result in a significant loss of domestic employment; and do not result in adverse safety consequences. *See CEI I*, 901 F.2d 107, 121 n.11 (D.C. Cir. 1990); *Ctr. for Auto Safety* v. NHTSA, 793 F.2d 1322, 1340 (D.C. Cir. 1986) ("CAS I").

Trial testimony focused on whether the regulation's requirements are technologically feasible in the time frame provided, and whether they are economically practicable. The parties also presented evidence directed to the regulation's effect on consumers, workers, and safety. The evidence presented was detailed, technical and complex, and addressed the advantages and disadvantages of the regulation, and its impact on consumers, workers, drivers and passengers, specific companies, the automobile industry as a whole, the international community, and the planet. Evaluating this evidence involved complex questions of science and engineering, as well as the balance among a variety of public policy concerns.

In evaluating the evidence regarding the regulation's

technological and economic feasibility, the Court first discusses the expert testimony offered by Austin and the manufacturers' representatives on behalf of Plaintiffs and by Duleep on behalf of Defendants. The Court examines the strengths and weaknesses of the parties' competing models.

Next, the Court evaluates several means of potential compliance with the regulation, including various technologies, alternative fuels, air conditioning credits, and credit trading. Finally, the Court examines the evidence of other factors that NHTSA includes when it evaluates technological feasibility and economic practicability: effect on consumer choice, economic hardship to the automobile industry, employment and safety.

Ultimately, the Court concludes that Plaintiffs have not met their burden to demonstrate that the regulation stands as an obstacle to EPCA's objectives because it is not technologically feasible or economically practicable.

a. History of technology-forcing regulations

Congress deliberately chose a technology-forcing approach in the 1970 CAA amendments to require EPA to "'press for the development and application of improved technology rather than be limited by that which exists today,'" *Natural Resources Defense Council, Inc. v. U.S. EPA*, 655 F.2d 318, 328 (D.C. Cir. 1981) (quoting S. Rep. No. 91-1196 (1970)), and to force the industry "to develop pollution control devices that might at the time

appear to be economically or technologically infeasible." *Union Elec. Co. v. EPA*, 427 U.S. 246, 257 (1976); *see also Int'l Harvester Co. v. Ruckelshaus*, 478 F.2d 615 (D.C. Cir. 1973) ("Congress was aware that these 1975 standards were 'drastic medicine,' designed to 'force the state of the art.'"). Manufacturers were skeptical; in 1973 General Motors predicted that:

> If GM is forced to introduce catalytic converter systems across the board on 1975 models, the prospect of an unreasonable risk of business catastrophe and massive difficulties with these vehicles in the hand of the public must be faced. It is conceivable that complete stoppage of the entire production could occur . . . Short of that ultimate risk, there is a distinct possibility of varying degrees of interruption with sizable dislocations.

Tr. vol. 1-B, 76:14-23 (Weverstad, Apr. 10, 2007). But General Motors did successfully install catalytic converters in its vehicles beginning in 1975. *Id.* at 77:4-7. Ultimately the automobile industry's effectiveness at reducing emissions has been "one of the greatest success stories in environmental control in the world." Tr. vol. 12-B, 19:6-10 (Sperling, May 2, 2007).

Similarly, new technology-forcing emissions standards in the 1990 CAA amendments produced the same industry outcry that the 1970 technology-forcing standards had received: the technology did not exist, could not be developed, and the automobile

companies' product lines would shrink to sub-compact vehicles.[62]

EPCA also was a technology-forcing statute, "with the recognition that 'market forces . . . may not be strong enough to bring about the necessary fuel conservation which a national energy policy demands.'" *CAS I*, 793 F.2d at 1339.

Historically, within the auto industry, fuel efficiency has improved approximately one percent per year. *See* DX 2575; PX 918. The EPA Trends Report, an annual data report, states that fuel economy has experienced four phases since 1975. First, fuel economy went through a rapid increase between 1975 and the mid-1980s following the passage of EPCA, followed by a slower increase into the late 1980s. *See* DX 2575. Then fuel economy gradually declined into the mid-1990s, and has held constant since then. *See id.* All the while, fuel efficiency has

---

[62] In discussing the legislation, one legislator commented:

> Do not forget not too many years ago when this Congress asked the auto industry to build catalytic converters the industry said it could not be done, the technology was not there, impossible; that is, they could not reduce tail-pipe emissions 90 percent, could not be done. Congress determined, 'Well, we hear you, auto industry, but it is such a great problem we think you should proceed. By the way, we think you can. We trust you. We have more faith in you, auto industry, than you have in yourself. We think you can develop the new technology to reduce the tail-pipe emissions 90 percent.' And guess what? It happened. Tailpipe emissions were reduced 90 percent. It happened not in 15 years, not in 23 years, but in 5 years. In 5 years, the auto industry developed catalytic converters to reduce tailpipe emissions by 90 percent. I have great faith in American industry. They can do the job.

136 Cong. Rec. S592-02, at S620 (Jan. 31, 1990) (statement of Sen. Baucus).

improved. In these latter years, without constraints from heightened CAFE standards, manufacturers have chosen to increase vehicle weight and performance rather than improve fuel economy. PX 917; DX 2575. The trend "clearly has been to apply these innovative technologies to accommodate increases in average new vehicle weight, power and performance while maintaining a relatively constant level of fuel economy." PX 917.
As discussed below, the Court does not find convincing the claims that consumers will be deprived of their choice of vehicles, or that manufacturers will be forced to restrict or abandon their product lines.

b. Austin's testimony

The testimony of Thomas Austin is central to Plaintiffs' case. Austin was qualified as an expert in the analysis of fuel economy and automotive air pollution regulation. Tr. vol. 6-B, 63:24-71:13 (Austin, Apr. 20, 2007). He testified that compliance with the regulation would be technologically possible only through the use of a large percentage of hybrid vehicles in each category of motor vehicle, and would be so costly as to be effectively impossible. He predicted that as a result, three manufacturers--Ford, General Motors, and DaimlerChrysler--would leave the market for passenger cars in the states that have enacted the regulation. Other Plaintiffs' witnesses used Austin's opinions as the basis for their own predictions that the

regulation would cause the loss of jobs and reductions in highway safety.

Austin first created a baseline for the year 2009, intended to represent the fleet in the absence of the standard. To establish the baseline, Austin took each major automobile manufacturer's 2004 product line, then applied changes in vehicle attributes such as performance and weight to reflect the products that he expected would be offered in 2009.[63] Tr. vol. 7-A, 21:15-21; 29:22-30:7 (Austin, Apr. 23, 2007). Austin next considered whether it was necessary to add technology to that projected baseline in order to maintain compliance with the CAFE standards. Such additions were necessary to account for increases in the fuel economy standards for trucks, and increased weight and power trends in passenger cars that would require increased fuel economy to remain in compliance with the current CAFE standard. *Id.* at 30:8-14. Austin then considered what additional technology, over that needed to comply with the CAFE standards, would be required to comply with the regulation's GHG emission standards, and calculated its cost. *Id.* at 30:15-19.

At this stage, Austin made several assumptions. First, he assumed that manufacturers had the capital resources to make

[63] There are ten auto manufacturers, or original equipment manufacturers ("OEMs") affected by the regulation. These OEMs serve ninety-five percent of the market. They are General Motors, Ford, DaimlerChrysler, Honda, Toyota, Hyundai, Nissan, BMW, Volkswagen and Porsche. Tr. vol. 7-A, 9:10-10:7 (Austin, Apr. 23, 2007).

capital investments required to make necessary technology changes. *Id.* at 34:14-18. Second, he assumed that twelve years of lead time would be available to make necessary changes to the power trains of the vehicles, and that companies would devote their resources to improving fuel economy rather than improving other attributes of their vehicles, such as performance. *Id.* at 34:19-35:15. Third, he assumed that the cost of compliance would be based on fully "learned-out" costs. That is, he looked at long-term, rather than near-term costs, because over time developments in technology can be produced more efficiently and at lower cost. *Id.* at 35:16-36:1. Austin also assumed that consumers would still want to purchase the full range of vehicles available in the market today, rather than to choose smaller vehicles, and that they would want their vehicles to run on regular grade unleaded fuel. *Id.* at 36:11-25.

Next, Austin selected technologies for inclusion in his compliance analysis. He included only technologies for which research and development had been completed, because of the lead time required. *Id.* at 38:16-21. He also considered comparative costs of the technologies, assuming that manufacturers wouldn't include any technology that cost more per percent improvement in fuel economy than another available technology. *Id.* at 39:7-12. Finally, he did not use technologies that he considered commercially infeasible: for example, he excluded technologies

that would improve fuel economy but have effects on other vehicle attributes that he believed would be unacceptable in the marketplace. *Id.* at 39:13-17.

Accordingly, Austin excluded fuel cells, significant reductions in aerodynamic drag, the use of lower rolling resistance tires, mild or plug-in hybrids, diesel engines, downsized turbo engines with direct injection ("GDI/turbo"), continuously variable transmission (CVT), electric power steering, packaging improvements, camless valve actuation, and homogeneous charge compression ignition ("HCCI") from his analysis. Tr. vol. 7-B, 52:15-18 (Austin, Apr. 23, 2007).

Austin did use weight reduction due to additional use of high-strength lower-weight steels; reduced friction and accessories loads; valve train modifications, including variable valve lift and timing and cylinder deactivation; transmission improvements in which manufacturers would convert to six-speed automatic engines; and "motor assist" or "strong" hybrids, which have electric motors large enough to help drive the vehicle.[64] Tr. vol. 7-A, 41:21-44:5; PX 1036.

To determine the impact of his chosen technologies on GHG

[64] Hybrid vehicles combine internal combustion and electricity. A typical hybrid gets its electricity generated by the alternator on the vehicle, or through regenerative braking, in which the vehicle's slowing turns the generator to put energy back into the battery. Plug-in hybrids can also be plugged into wall circuits to recharge the battery. Tr. vol. 1-A, 117:9-21 (Weverstad, Apr. 10, 2007).

emissions, Austin used the second-by-second vehicle simulation model VEHSIM.[65] That model calculates a vehicle's power demand on a second-by-second basis, as a function of the frontal area of the vehicle, the drag coeffecient, the weight, and the rolling resistance. Tr. vol. 7-A, 50:11-17. It then calculates the fuel that must be burned to provide that power on a second-by-second basis over the driving cycle, using different modules to account for the vehicle's specific attributes such as axle, transmission, torque converter, different gear ratios, and accessories on the engine.[66] *Id.* at 50:18-25. The end result of the model's analysis is the vehicle's fuel economy, based on an analysis of second-by-second fuel consumption integrated over the driving cycle as a whole. *Id.* at 51:1-6.

Austin relied primarily on figures from the Martec Group, Inc., and Harbour Consulting to estimate the cost of the bundle of technology to be applied to each vehicle.[67] Tr. vol. 7-B, 64:14-66:16. The costs were meant to represent the fully

---

[65] Many of the witnesses at trial used vehicle simulations of this type, including the manufacturer witnesses. See Tr. vol. 10-A, 29:9-30:23 (Patton, Apr. 30, 2007).

[66] The VEHSIM model, like other models referenced at trial, uses a driving cycle based on the Federal Test Protocol. Tr. vol. 7-B, 36:6-38:16.

[67] Martec provided information on cost of components manufactured by supplies to OEMs. For components that OEMs make themselves, Harbour Consulting provided data on costs of engine components, transmissions, and body changes. For subsystems for which neither firm had solid data, Austin relied on what he heard from OEMs. *Id.* at 64:14-66:16.

learned-out costs of each technology. *Id.* at 83:6-20. Austin then used weight scaling to account for changes in costs when technologies are applied to heavier or lighter vehicles; cost typically rises with size, but Austin used different scaling for different components. *Id.* at 80:15-82:2. He marked up the costs that he was given with a variety of factors for different components, to account for the costs of integrating the technologies into vehicles, increased warranty costs, and increased dealer margins. *Id.* at 85:9-86:6.

Austin predicted that each company would require some percentage of hybrid technology in order to comply with the regulation, although the figure would be higher or lower depending on the nature of the company's fleet. For the lower-cost manufacturers--Honda, Toyota and Hyundai--Austin's expected cost per vehicle was close to $2,500.00. PX 1042. For higher-cost manufacturers, including Ford, DaimlerChrysler, Volkswagen, General Motors, and Nissan, costs were universally greater than $3,500.00 per vehicle, and greater than $4,500.00 per vehicle for Volkswagen, General Motors, and Nissan. *Id.* The path to compliance that Austin outlined would be very costly, particularly for Ford, DaimlerChrysler and General Motors, manufacturers that would have to introduce large percentages of hybrid vehicles into their fleets. Austin estimated that Honda, Toyota, and Hyundai would need to introduce less than thirty

percent hybrids, Ford and DaimlerChrysler would need to introduce between fifty and sixty percent, General Motors would need to introduce around sixty percent and Nissan would need to introduce between seventy and eighty percent hybrids. PX 1039.

Based on the costs that he estimated for each manufacturer, Austin concluded that it was infeasible for some manufacturers to implement the necessary technology changes across their entire product lines, and that DaimlerChrysler, Ford, and General Motors would ultimately be unable to sustain themselves in the full market in states enforcing the regulation. He predicted that these companies would become primarily truck manufacturers in those states. Tr. vol. 7-A, 82:17-21.[68]

c. Manufacturers' testimony

Each of the manufacturer Plaintiffs in this litigation undertook an internal evaluation of its ability to comply with the regulation and the likely costs of compliance. The scenarios that they presented are strikingly grim; their projected ability to comply is far below, and their projected costs are drastically above, Austin's predictions.

[68] Austin predicted that if the regulations were deployed nationwide, then manufacturers would be required to introduce a slightly different technology mix, which would reduce the average cost per vehicle. However, there would still be a differential between high and low-cost manufacturers that would make it difficult for some manufacturers to remain in the passenger car market. Tr. vol. 7-A, 84:13-25.

Alan Weverstad[69] testified for General Motors about its "maximum technology scenario." That scenario was not limited by cost or time, and involved the use of General Motors' CAFE Solver model to calculate the effect of including in a compliance plan all of the technologies that General Motors considered to be on-the-shelf, i.e., available and understood, and those that hadn't completed the entire engineering process, but for which General Motors did not "see a roadblock" to their completion and use.[70] Tr. vol. 1-B, 43:7-44:20 (Weverstad, Apr. 10, 2007); Tr. vol. 1-A, 128:10-23 (Weverstad, Apr. 10, 2007); *see also* PX 892 (a simplified version of the CAFE Solver with illustrative numbers). In the maximum technology scenario, General Motors modeled installing the advanced Hybrid System II in eighty-nine percent of the vehicles in the PC/LDT1 category and eighty-one percent in the LDT2 category. Tr. vol. 1-B, 44:13-20; PX 0904. Vehicles without room to package the hybrid technology were given six-speed automatic transmissions. Tr. vol. 1-B at 46:7-19. The maximum technology scenario does not include any vehicles using

[69] Alan Weverstad is the Executive Director of the General Motors Environment and Energy Staff. Tr. vol. 1-A, 104:4-5 (Weverstad, Apr. 10, 2007).

[70] The maximum technology scenario is meant to illustrate the maximum application of technology possible without constraints such as timing and cost, and is not meant to illustrate a scenario which is feasible for General Motors, that General Motors can actually afford, for which General Motors has the necessary manpower, or which General Motors could reasonably implement within the time frame of the regulation. Tr. vol. 2-A, 15:15-16:12 (Weverstad, Apr. 11, 2007).

alternative fuels, such as diesel or ethanol. *Id.* at 106:2-7; 109:18-21; Tr. vol. 1-C, 22:4-28 (Weverstad, Apr. 10, 2007).

According to Weverstad the maximum technology scenario would result in lower emissions than required by the regulation in 2009, but would result in a seven mile per gallon shortfall by 2016. Tr. vol. 1-B, 47:11-48:14. The total unrecoverable cost of these insufficient improvements would be greater than $6,000 per vehicle in each category, with total costs of more than ten billion dollars in the PC/LDT1 category and more than fifteen billion dollars in the LDT2/MDPV category. *Id.* at 51:1-22; 53:1-54:7; PX 0905; PX 0906.

General Motors' regular business plan, as opposed to the maximum technology scenario, would result in a shortfall of more than ten miles per gallon in the PC/LDT1 category, and a shortfall of more than four miles per gallon in the LDT2/MDPV category, in 2016. *See* PX 900, PX 903. Because CAFE standards are not set past 2011, the projected shortfalls assume no increase in the fuel economy of General Motors' fleet past that year. Tr. vol. 1-B, 88:9-25. As a result, these projected shortfalls are between the standard set by the regulation for model year 2016, and General Motors' projected fuel economy in model year 2011--which itself incorporates assumptions including a slight drop in the fuel economy of the General Motors fleet in model year 2009--extended with no improvements in fuel economy

whatsoever until model year 2016. *See* PX 900, PX 903. For example, Weverstad's demonstrative exhibit showing shortfalls in the PC/LDT1 category shows General Motors' projected fuel economy average in that group decreasing slightly between 2007 and 2008, decreasing slightly between 2009 and 2010, and then simply remaining flat between 2011 and 2016. *See* PX 900.

Such drastic shortfalls would result only if General Motors were either to stop making any improvements at all in fuel efficiency or to apply one hundred percent of those improvements toward building larger, more powerful vehicles, for five years. These are extremely unlikely scenarios, given the automobile industry's historical fuel efficiency improvements of an average one percent per year and the optimism and drive with which the industry is now focusing on fuel economy. *See* DX 2575 (EPA Trends Report notes historical one percent improvement in fuel efficiency even absent new regulation); *see also* PX 918.

General Motors' alternative to the maximum technology scenario is a gradual restriction of products in order to remain in compliance with the regulation. Following this alternative, it would simply remove products from the market in the affected states. By the year 2011, according to Weverstad, General Motors would offer only six models in the PC/LDT1 category for sale in Vermont, and none by model year 2016. Tr. vol. 2-A, 56:2-58:2, 59:16-18; PX 0908. By the year 2015 there would be no LDT2

models remaining in the market. *Id.* at 59:24-60:1; PX 0908.

Witnesses for DaimlerChrysler made similarly dire predictions concerning their company's compliance ability. Under its plan of record, DaimlerChrysler would not be in compliance with the regulation after 2009 in Vermont, New York or California. Tr. vol. 2-B, 74:25-75:22 (Modlin, Apr. 11, 2007). DaimlerChrysler's witness Reginald Modlin[71] and his staff created two scenarios for compliance with the regulation: an "add technology" scenario, in which the company would add technology to its vehicles in an attempt to comply with the regulation, and a "restrict product" scenario, in which DaimlerChrysler would add only the technology necessary to comply with CAFE standards, then remove products from the market in Vermont and other states as necessary to remain in compliance with the regulation. Tr. vol. 3-A, 35:4-36:25 (Modlin, Apr. 12, 2007).

In the add technology scenario, after exhausting easy, inexpensive technologies, DaimlerChrysler would add more expensive technologies. *Id.* at 45:5-21. Ultimately, Modlin testified, DaimlerChrysler would have to convert ninety percent of its fleet to fuel economy-optimized hybrid and diesel vehicles, drastic steps which still would not result in compliance in 2016 without some product restrictions. *Id.* at 45:22-46:10; 48:7-24. The costs for the add technology scenario

[71] Reginald Modlin is the Director of Environmental Affairs at DaimlerChrysler Corporation.

are in the billions of dollars, even accounting for reductions in the costs of technology as it becomes more familiar. *Id.* at 49:23-50:6.

Under the restrict product scenario, DaimlerChrysler would begin removing products from the Vermont market in 2012. *Id.* at 57:11-59:5. In 2016, the only DaimlerChrysler vehicles in the PC/LDT1 category still offered in Vermont would be a tiny vehicle called "Smart," seating only two people with virtually no storage space, and a B-segment vehicle smaller than a Dodge Neon, called a "Chery." *Id.* at 60:5-21. Only one or two LDT2s would be available. *Id.* at 64:17-65:8. The restrict product scenario assumes that DaimlerChrysler will make no improvements in its fleet's fuel economy beyond those required by current CAFE standards and already contained in the company's plan of record. *Id.* at 66:7-76:18. DaimlerChrysler has decided not to take action to comply with the regulation such as adding GHG emission-reducing technology to its products beyond its plan of record. Tr. vol. 3-B, 29:14-33:11.

Ford, which Austin placed among those companies likely to withdraw partially or entirely from the Vermont market, performed a "gap analysis" which led it to conclude that it could comply with the regulation through 2011 using technologies proposed by CARB that it deemed available and appropriate, but that it would be out of compliance beginning in 2012. Brown Dep. Tr. 314:5-

315:2, 317:20-318:19 (Sep. 20, 2006). Ford calculated that its average cost of compliance per vehicle would range from $500 to $2,000. *Id.* at 325:16-24, 316:20-25.

d. Duleep's testimony

Austin's conclusions, and the manufacturers,' are contradicted by Defendants' expert, K.G. Duleep.[72] Duleep testified that compliance with the regulation's emissions standards is possible in 2012 and 2016, on an industry-wide basis, with power train technologies now in use or soon to enter production. Duleep's analysis focused on representative vehicles from different categories, to which he applied technologies until the vehicles reached compliance, then evaluated the cost of each technology package. Tr. vol. 12-A, 122:18-123:1 (Duleep, May 2, 2007). Each vehicle had technology typical for a model year 2005 vehicle of its size and class. *Id.* at 122:8-10; DX 2659. The technology packages that Duleep used represent one pathway to compliance, but are not prescriptive; they are merely an example of one strategy that manufacturers could use to comply with the regulation. *Id.* at 134:24-135:6. Duleep applied technologies to each representative vehicle only until the GHG emissions standard was met; therefore, his technology packages do not represent the maximum possible reduction in GHG emissions for each of his

[72] Duleep's methodology is detailed in the section addressing the *Daubert* challenge to the admissibility of his testimony. *See supra* pp. 66-71.

representative vehicles. *Id.* at 146:19-147:5.

Duleep modeled three representative vehicles in the PC/LDT1 category--a small, midsize, and large car--and three representative vehicles in the LDT2 category--a compact van, mid-size SUV, and pickup.[73] *Id.* at 123:8-124:4. In the PC/LDT1 category, he found that twenty percent of the vehicles in the small car and mid-size car groups would have to be hybrids of the Toyota Prius type to meet the 2016 standard under the regulation, while sixteen percent of vehicles in the large car group would have to be hybrids. *Id.* at 132:5-133:13; 140:12-17; 142:17-143:1. In the LDT2 category, Duleep found that the technology combinations that he analyzed were able to exceed slightly the standard for 2016 in all three groups that he modeled, so that no hybrids would be necessary. *Id.* at 143:3-25. Given the regulation's credit trading provisions, these results reveal an opportunity for over-compliance in the LDT2 category which would allow manufacturers to under-comply in the PC/LDT1 category. *See id.* at 144:1-22.

Duleep found that the industry-average cost of compliance would range from $1,500 per vehicle in the PC/LDT1 category to $1,450 in the LDT2 category. Tr. vol. 12-B, 46:11-49:9 (Duleep,

[73] Representative vehicles in the PC/LDT1 category were the Ford Focus, the GM Buick Lacrosse, and the Ford Crown Victoria; representative vehicles in the LDT2 category were the Dodge Grand Caravan, the Ford Explorer, and Ford F-150 2WD. Tr. vol. 12-A 125:7-9; 133:15-23:140:19-141:1; 143:13-25; 145:9-15; 147:9-14.

May 2, 2007). These costs represent the amount that vehicle retail prices would rise, on average, as a result of compliance with the regulation, relative to a 2005 model year vehicle. *Id.* at 48:3-9. They represent the dollar amount that vehicle retail prices would rise on average for all manufacturers relative to a 2005 vehicle, rather than predicting the cost of any one specific vehicle, since manufacturers often cross-subsidize products or take reduced profit margins at times. *Id.* at 48:1-9. The costs assume a static baseline and do not account for the fact that many of the technologies which contribute to the cost amounts would likely come into the market due to industry competition regardless of the regulation; therefore, actual costs resulting directly from the regulation could be smaller. *Id.* at 48:9-23. Some manufacturers may be able to comply with the regulation at no additional cost, according to Duleep; in particular, he testified that Toyota and Honda will be able to comply with the 2012 standard at no additional cost. *Id.* at 49:2-15; 55:14-57:4.

Duleep's cost estimates are approximately half of Austin's. Tr. vol. 15, 80:21-24 (Austin, May 7, 2007). The great disparity between these two scenarios is the key factual dispute of the trial.

e. Conclusions

(1) Austin's baseline assumptions and methodology

Assumptions embodied in Austin's methodology and choice of a baseline represent a very conservative approach to the compliance analysis. In addition, his predictions--and, even more, the predictions of the manufacturers--are contradicted by the statements of vehicle manufacturers made outside and, at times, inside the courtroom. Mindful that Plaintiffs bear the burden of proof, the Court has looked closely at the assumptions underlying Austin's conclusions and compared and contrasted them with trial testimony from industry witnesses. In light of all of the evidence presented at trial, the Court concludes that many of Austin's baseline assumptions are unsupported by the evidence.

Austin focused his analysis on the situations of individual manufacturers, while Duleep's analysis covered the automobile industry as a whole. Austin's analysis was therefore more detailed in some ways, as he was able to consider factors affecting individual automakers as well as factors affecting the entire industry. However, this approach also has disadvantages.

Austin's baseline scenario was each manufacturer's model mix for 2004, with changes in performance and weight characteristics updated to represent Austin's view of the likely 2009 model mix. Tr. vol. 7-A, 29:22-30:7 (Austin, Apr. 23, 2007). Duleep testified that freezing manufacturers' products and identities at

a base year in this way incorporates assumptions that cannot be validated historically. Tr. vol. 12-A, 122:4-11 (Duleep, May 2, 2007). According to Duleep, a manufacturer-by-manufacturer analysis is inappropriate because conditions are changing so rapidly in the automobile industry, with manufacturers introducing and withdrawing models quickly and with major restructurings underway at Ford and DaimlerChrysler. *Id.* at 121:15-122:3. Conducting the analysis at the level of the industry as a whole avoids the necessity of guessing what will happen to each manufacturer and its products. *Id.* at 122:12-17.

Austin justified his choice to analyze each manufacturer's fleet separately by noting that manufacturers face different challenges in complying with the regulation due to differences in the characteristics of their vehicles. In particular, he emphasized that the characteristic which most strongly affects a vehicle's fuel economy is its weight, and that there is a strong correspondence between the average fuel economy of a manufacturer's fleet and the average weight of its vehicles. Tr. vol. 7-A, 15:1-19; 17:15-18:13 (referencing PX 1026). However, this correspondence is not due merely to the effects of weight, as Austin acknowledged, noting that Hyundai's fuel economy is poorer than Toyota's, although it makes lighter cars. *Id.* Although Toyota and Honda do sell a lighter mix of vehicles than General Motors, DaimlerChrysler and Ford, their vehicles are also

the most fuel-efficient within size classes. Tr. vol. 12-B, 57:8-17 (Duleep, May 2, 2007). Austin's decision to differentiate among manufacturers' compliance ability resulting from their historical concentration on vehicles in larger size classes did not result in more accurate model results, given the number of assumptions he had to make for each manufacturer.

Austin's assumption that product lines will remain sufficiently static for his analysis is undermined by the testimony of the manufacturer witnesses. By freezing his baseline to reflect an updated 2004 model mix, Austin ignored many of the factors that manufacturers themselves consider. Modlin testified that factors likely to develop over the next few years could influence DaimlerChrysler's decisions regarding how and whether to pursue compliance with the regulation. Such factors include, according to Modlin, the price of gas; NHTSA rulemaking; new CAFE requirement proposals before Congress; President Bush's proposed program to reduce fuel consumption and promote alternative fuels; and whether the EPA issues new rules regulating GHG emissions. Tr. vol. 3-B, 33:16-40:23 (Modlin, Apr. 12, 2007). Similarly, Weverstad testified that General Motors makes predictions as to what the CAFE standards will be in the future. Tr. vol. 1-B, 7:16-21 (Weverstad, Apr. 10, 2007). The political climate is one factor that GM takes into account in making these predictions; Weverstad agreed that this year the

political climate is particularly relevant. *Id.* at 8:16-9:13 (stating that in the past the political climate "hasn't been nearly the problem that it appears to be this year"). Austin's analysis ignores these factors.

Austin's baseline freezes the product lines of automakers that may themselves look very different in only a few years. Among the most significant pending changes is that it is likely that a sale of the Chrysler Group by DaimlerChrysler is imminent. Tr. vol. 4-B, 96:4-7 (Jollisaint, Apr. 19, 2007). Chrysler's likely product mix following such a sale is, of course, unknown. Whether other companies will be bought or sold or restructured during the time period which Austin analyzes is unknown as well.

Neither Austin nor Duleep assumed any change in the mix of vehicles that manufacturers might produce. However, it is possible that consumer preferences and competition to meet them, rather than regulation, will drive manufacturers toward more fuel-efficient vehicles, or even smaller vehicles. Austin may well have misjudged the market when he assumed that vehicles will be still weightier and higher-performing in 2009 than in 2004, and that there will be no demand for a different set of products.[74]

Austin testified that overall changes in consumer choice

[74] Austin's expertise is primarily in the area of engineering. He does not have corporate financial analysis credentials, or credentials related to the prediction of consumer behavior.

following fuel price increases in recent years have not been "dramatic." Tr. vol. 7-A, 21:4-23:23. However, that conclusion is contradicted by the testimony of manufacturers. Modlin testified that Chrysler Group posted about a 1.4 billion dollar loss in 2006. The Chrysler Group Investor Relations Release stated (and Modlin agreed) that the reason for that loss was a "continuing difficult market environment" in the United States, due in part to a shift in consumer demand toward smaller vehicles and toward higher fuel economy vehicles within weight classes. DX 2031; Tr. vol. 3A 12:1-16:4 (Modlin, Apr. 12, 2007). DaimlerChrysler's plan to recover from this loss includes a new focus on fuel-efficient vehicles. DX 2034. Weverstad likewise testified that there is a great demand for more fuel-efficient vehicles in the United States marketplace. Tr. vol. 1-B, 117:6-11 (Apr. 10, 2007). Representatives of other automakers agree that consumer interest in fuel economy has risen significantly in recent years. *See* Bienenfeld Dep. Tr. 160:4-11 (Sep. 13, 2006)(Honda); Choe Dep. Tr. 195:1-196:13 (Aug. 31, 2006)(Nissan).

Austin also testified that he had not considered incentives and discounts offered by manufacturers, though he acknowledged that manufacturers do from time to time use incentives and discounts to influence consumers' product choices, and had used them to sell very high fuel-consuming vehicles in recent years. Tr. vol. 7-A, 153:21-154:9 (Austin, Apr. 23, 2007). The fact

that manufacturers are able to affect the popularity of different types of vehicles and have done so in favor of vehicles with poor fuel economy, suggests that consumers rejecting such strategies may impel manufacturers to produce vehicles with better fuel economy and lower emissions. There is no particular reason, given the current "climate," to assume, as Austin did, that the 2009 fleet would represent a continuing trend toward increased weight and power.

While it is certainly true that recent trends would suggest that it is likely that cars will be at least as heavy and powerful in 2009 as they are today, some statements by manufacturers contradict the assumption that those trends will continue. American companies including Ford, DaimlerChysler, and General Motors have emphasized weight and power in their production during recent years, over fuel economy. *See*, *e.g.*, Tr. vol. 2-B, 31:8-33:1 (Modlin, Apr. 11, 2007). As noted, DaimlerChrysler suffered a $1.4 billion loss in 2006, partially as a result of its miscalculation in focusing on larger, less fuel-efficient vehicles. Tr. vol. 3-B, 14:12-16:9 (Modlin, Apr. 12, 2007). It now has a new business plan which focuses on meeting customer desire for more fuel-efficient vehicles. *Id.* at 16:14-18:8. Ford's business strategy now is to move toward small cars, small utility vehicles, and crossovers, away from larger SUVs. Brown Dep. Tr. 56:3-11 (Sep. 6, 2006). General Motors also

prioritizes fuel economy in its development of new vehicles. Tr. vol. 1-A, 115:5-8 (Weverstad, Apr. 10, 2007). Based on these companies' stated intentions independent of any attempt to comply with the regulation, it appears that they have determined that consumers are seeking increased fuel economy.

The price of gas is another factor that may prompt changes to the model mix for many manufacturers. At the time that CARB conducted its rulemaking proceedings, the assumed price of gasoline was $1.74 per gallon. During the trial in this case, on May 7, 2007, the price of gasoline in Vermont was around $3.00 per gallon. Tr. vol. 15, 157:3-9 (Austin, May 7, 2007). Austin did not take changes in the price of gas into account in his analysis, although he agreed that sustained higher prices would have an impact on the model mix that manufacturers would choose to produce. *Id.* at 157:16-21.

In addition to possible changes in consumer preference and in market conditions (including the price of fuel), Austin did not take into account the rapidly changing regulatory landscape in the area of automobile emissions. Austin testified that he did not consider the effect of any changes to the CAFE standard. Tr. vol. 7-A, 114:14-20 (Austin, Apr. 23, 2007). The CAFE standard has been fixed at 27.5 miles per gallon for passenger vehicles for more than two decades. The increase that President Bush has proposed would make the new standard 36.2 miles per

gallon in 2016. *Id.* at 123:1-124:3. With such a substantial change to the federal fuel economy standard, putting manufacturers much closer to achieving the GHG emissions standards, Austin's prediction that certain manufacturers would withdraw from the passenger car market in states enacting GHG emissions standards doesn't seem realistic. The choice of baseline conditions critically affects the reliability of outputs from Austin's model. VEHSIM, while extremely precise, requires precise and accurate inputs in order to achieve accurate results. Duleep testified that the vehicle simulation method presents a risk of flawed results when its inputs are not both known and accurate. Tr. vol. 12-B, 40:4-18 (Duleep, May 2, 2007). Plaintiffs' expert Patterson agreed that the only way to get a reliable result from such a model is to use known and measured input data; the use of approximations makes the results less reliable.[75] Tr. vol. 16-A, 17:8-22 (Patterson, May 8, 2007). Similarly, Plaintiffs' witness Kenneth Patton noted that the process of simulation modeling is sensitive; manufacturers try to isolate the effects of the technology that they are testing from other effects, so constant application of other vehicle variables and accurate inputs are necessary. Tr. vol. 10-A, 30:24-32:7

[75] Robert Lee, the Vice President of Powertrain Engineering for DaimlerChrysler Corporation, testified that his model Raptor, which is a vehicle simulation model with characteristics similar to VEHSIM, has a very high degree of precision, but how close its predictions are to reality is a function of the quality of the input data. Tr. vol. 4B, 18:19-19:23 (Lee, Apr. 19, 2007).

(Patton, Apr. 30, 2007). Because Austin employed several unverifiable and arguably unreliable assumptions in formulating his baseline, his model results are not as reliable as they may appear.

There are also limitations to Austin's VEHSIM model. The second-by-second vehicle simulation model differs from Duleep's lumped parameter model: the lumped parameter model solves the same equations as VEHSIM but solves for the entire driving cycle as an average rather than second-by-second. Tr. vol. 12-B, 39:10-13 (Duleep, May 2, 2007). This makes the VEHSIM model conceptually superior, but problematic in practice because it requires many detailed inputs difficult for non-manufacturers to obtain except in the most general terms. *Id.* at 39:15-40:3. Duleep experimented at one time with using a vehicle simulation model like VEHSIM, but found that its data intensity made it unsuitable for a fleet-wide analysis. *Id.* at 40:4-7. A fleet-wide analysis was impossible to perform without estimating or guessing at many inputs, rendering the ultimate results of questionable accuracy. *Id.* at 40:7-41:2.

The detail and precision of certain aspects of the VEHSIM model masks the ways in which Austin's analysis is less precise than Duleep's. Although VEHSIM can model all of the components of the federal test protocol, in the modeling analysis that he performed for this case Austin used engine maps that didn't

include all of those components. Tr. vol. 7-B, 36:7-10 (Austin, Apr. 23, 2007). The VEHSIM model doesn't account for cold start--the first 505 seconds of the test protocol during which the vehicle is warming up--so Austin applied an adjustment factor to the VEHSIM results to reflect the increase in fuel consumption due to cold start effects. *Id.* at 36:11-37:10. Austin has inputs for VEHSIM that can run in four-wheel-drive mode, but in this case he only modeled two-wheel-drive vehicles and then applied another adjustment factor to account for the increase in consumption of a four-wheel-drive vehicle. *Id.* at 37:11-38:7. Other vehicle simulation models, such as GM's Unified Model, simulate cold start without the use of an adjustment factor. Tr. vol. 10-B, 59:3-22 (Patton, Apr. 30, 2007).

Duleep and Austin differed in their estimates of the lead time necessary to implement changes anticipated by their analyses. Austin assumed that manufacturers would take twelve years to implement changes, more time than the regulation currently grants them, because he believed that was the minimum lead time necessary. Tr. vol 7-A, 34:19-35:15 (Austin, Apr. 23, 2007). Duleep agreed that twelve years lead time--including four years to get a first model out and eight years to roll the technology across the fleet--is ordinarily necessary. Tr. vol. 12-B, 77:7-10 (Duleep, May 2, 2007). However, he contended that Austin incorrectly started the clock at the present, although

many of the technologies that both used are already starting to enter the market, so that lead time should be calculated from 2002 or 2003. *Id.* at 77:10-78:5.

The California legislature passed AB 1493 in 2002. CARB submitted its Final Statement of Reasons for Rulemaking in 2005. According to the testimony of industry representatives, automobile manufacturers have been fully engaged in testing various technological improvements designed to increase fuel efficiency for several years. They have responded in large part to consumers' demand for more fuel efficient vehicles. Austin's assumptions regarding a lead time of twelve years from the present makes little sense, since the manufacturers by their own testimony actively began to address fuel economy concerns several years ago.

Duleep and Austin also differed on the proper way to calculate the costs of the regulation. Duleep adjusted his cost calculations to account for fuel economy benefits that would result from manufacturers' expected use of hybrids to comply with the zero emissions vehicle ("ZEV") mandate, a choice with which Austin disagreed. Tr. vol. 15, 107:7-18 (Austin, May 7, 2007). Austin maintained that there are ways to get credits under the ZEV mandate that would not involve hybrids, and that while most manufacturers likely would include hybrids in their compliance plans, hybrids would be used to improve performance rather than

fuel economy. *Id.* at 121:16-124:2. However, his analysis made no attempt to quantify the expected influx of hybrids related to the ZEV mandate, or their type, issues which clearly affect the costs associated with compliance with the regulation, as well as manufacturers' likely baseline fleets during the period of the regulation. *See id.*

(2) Alternative fuels

The regulations account for the possibility that manufacturers may use alternative fuels as one way of reducing GHG emissions, by allowing for an adjustment factor to discount carbon dioxide equivalent emissions from vehicles running on certain fuels. Tr. vol. 11-A, 36:16-24 (Moye, May 1, 2007); DX 2421. Neither Duleep nor Austin uses alternative fuels in his compliance analysis; however, they differ significantly in their opinions as to whether alternative fuels will contribute to compliance. Duleep predicted that certain alternative fuels will likely make some contribution to compliance with the regulation. Austin testified flatly that in his opinion alternative fuels are not a feasible means of compliance with the regulation. Tr. vol. 8-A, 31:10-32:1 (Austin, Apr. 24, 2007). Several of the manufacturers' witnesses agreed with that testimony as to specific fuels.

This testimony is contradicted by manufacturers' public statements. It is clear that manufacturers are attempting to

promote alternative fuels and are positioning themselves to benefit from the advantages that those fuels offer. The Chairman and CEO of General Motors, G. Richard Wagoner, recently testified to the House Committee Regarding Climate Change and Energy Security that due to the "fact that we face an increasingly uncertain energy future on a global basis," it is necessary for the automobile industry to "develop alternative sources of propulsion, based on diverse sources of energy." DX 2513, p. 1. He further stated that General Motors was "committing massive resources to meet this challenge" and "make a difference in oil consumption and carbon dioxide emissions." *Id.* The President and CEO of Ford Motor Company, Alan Mulally, testified to the same committee that "the most cost effective solutions to lowering the carbon dioxide emissions from vehicles must be a combination of bio-fuels and vehicle technology advancements." DX 2511. The President and CEO of the DaimlerChrysler Corporation, Thomas LaSorda, stated that DaimlerChrysler was committed to addressing climate change and petroleum consumption, through technologies including alternative fuels such as ethanol and diesel, and through the use of hybrids, fuel cell vehicle production, and improved efficiency of gasoline engines. DX 2510. LaSorda similarly stated in 2006 that he believes it is possible for the United States to replace "more than 75 percent of our oil imports from the Middle East by 2025," largely through

renewable or biofuels. DX 2164.

While availability and cost are major considerations with regard to the feasibility of reliance on alternative fuels, partnerships between government and industry are possible which may address those considerations. The CEOs of Ford, DaimlerChrysler, and General Motors have all advocated for such partnership. DX 2161; DX 2513; DX 2164. There are also legal developments on the national and state levels that aim to promote alternative fuels. Initiatives in California include AB 1007, a legislative directive to CARB and the California Energy Commission to create a plan to increase the use of alternative fuels in the transportation sector to twenty percent of fuel by 2020 and thirty percent by 2030. Tr. vol. 11-B, 44:25-45:11 (Jackson, May 1, 2007).[76]

On the national level, EPA established a Renewable Fuel Standard program in April of 2007, authorized by the Energy Policy Act of 2005. DX 2585. The program is intended as a first step toward meeting President Bush's "20 in 10" goal, which seeks to reduce gasoline use by twenty percent within ten years. *Id.*

[76] Other initiatives in California include AB 32, the California Global Warming Solutions Act of 2006, which sets goals for reductions in greenhouse gases through various energy use sectors in California. Tr. vol. 11-A, 50:17-51:13 (Jackson, May 1, 2007). In addition, California's Governor Schwarzenegger has signed an executive order attempting to develop a regulation which will remove at least ten percent of the carbon from California's transportation fuels by 2020, including through the use of alternative fuels. *Id.* at 51:14-53:7.

President Bush has now set a more specific goal as well; the Alternative Fuel Standard proposal builds on the Renewable Fuel Standard and seeks to displace fifteen percent of projected annual gasoline use in 2017 through the use of alternative fuels, including but not limited to ethanol. *Id.* The Alternative Fuel Standard proposal also seeks to improve vehicle fuel economy to reduce gasoline consumption a further five percent. *Id.*

While a variety of alternative fuels were described, the evidence at trial primarily concerned whether either diesel or E85 could viably contribute to compliance with the regulation.

(a) Diesel

Diesel-powered vehicles offer GHG emissions reductions of about twenty percent, primarily because diesel contains more carbon than gasoline. Burning less diesel produces more energy but fewer tailpipe emissions. Tr. vol. 11-A, 140:19-141:12 (Jackson, May 1, 2007).

In Europe, General Motors offers diesel engine options for all of its passenger-size cars. Tr. vol. 1-B 91:25-92:2 (Weverstad, Apr. 10, 2007). In the premium and luxury category, more than seventy percent of diesels offered are clean diesels, which offer significantly better fuel economy than gasoline engine models and emit thirty to sixty percent less greenhouse gases. *Id.* at 92:3-94:21; DX 2555. In the European Union, fifty-one percent of all light-duty vehicles are diesel-powered,

while virtually all such vehicles are gas-powered in the United States. Tr. vol. 9-A, 104:8-11 (McMahon, Apr. 25, 2007).[77]

There are obstacles to introducing diesel engines, even clean diesels, in the United States in European numbers, including regulatory barriers and consumer preferences. Kevin McMahon testified for the Plaintiffs that the European Union has tax policies that cause customers to place a high value on fuel economy.[78] *Id.* at 90:11-14. In Europe, gasoline is taxed an average of $4.02 per gallon, while the diesel tax is about one dollar less, providing a strong incentive to consumers both to value fuel economy and to consider purchasing diesel vehicles. *Id.* at 92:11-18; PX 1122. United States tax rates are far lower, and disfavor diesel fuel. Tr. vol. 9-A, 91:20-93:8. Europeans have adjusted to these high tax rates, but they would be shocking

[77] Additional factors are also relevant to differences in GHG emissions and fuel economy between the United States and European Union vehicle fleets; for example, ninety-two percent of vehicles sold in the United States have automatic transmissions, while eighty percent of those sold in Europe have manual transmissions. Tr. vol. 9-A, 104:14-22 (McMahon, Apr. 25, 2007); PX 1129. There are also differences in engine size and configuration. Twenty-three percent of American buyers purchase eight-cylinder engines, forty-seven percent purchase six-cylinder engines, and just twenty-eight percent purchase four-cylinder engines. In Europe, eighty-four percent of engines sold are four-cylinder engines and five percent are three-cylinder engines. *Id.* at 105:3-106:5; PX 1130.

[78] Kevin McMahon is a principal and shareholder of The Martec Group, Inc., which provides technical and scientific marketing research services. McMahon manages the firm's transportation practice, primarily for automotive technology suppliers, some vehicle manufacturers and trade associations. Tr. vol. 9-A, 84:14-86:9.

to American consumers. *See* Tr. vol. 4-B, 82:11-85:12 (Jollisaint, Apr. 13, 2007) (discussing historical differences between the United States and European markets).

The European Union has prioritized fuel economy and GHG emissions over other environmental concerns, including other automotive emissions. Tr. vol. 9-A, 90:15-18 (McMahon, Apr. 25, 2007); *see also* PX 1124 (illustrating the correlation between laxer tailpipe standards and higher fuel economy in Europe versus the United States). Tailpipe emissions standards in the United States are far more stringent than in Europe, which has different, higher limits on emissions for diesel than for gasoline vehicles in order to limit the need for nitrous oxide after-treatment on diesel vehicles and avoid resulting increases in the prices of those vehicles. Tr. vol. 9-A, 93:9-94:22; *see also* Tr. vol. 1-B 95:3-7 (Weverstad, Apr. 10, 2007); PX 0845.

The viability of diesels in the United States market may be changing. Rising fuel prices in this country, coupled with greater consumer interest in higher fuel economy and lower GHG emissions, may result in a more competitive market for diesels here. Until recently, automobile manufacturers have not offered light duty diesel-powered vehicles in the United States because those vehicles could not comply with the federal Tier II bin 5 emission standards. Tr. vol. 11-B, 22:10-22 (Jackson, May 1, 2007). Selective catalytic reduction technology designed to

remove nitrous oxide increases the cost of the diesel configuration by about $880, but can enable vehicles to meet that standard. Tr. vol. 9-B, 8:22-9:14 (McMahon, Apr. 25, 2007).

In addition, the EPA has recently adopted a new diesel fuel rule which makes it easier for vehicles running on diesel fuel to comply with emissions standards by enabling the use of ultra low-sulfur fuel.[79] Tr. vol. 11-B, 23:23-24:14 (Jackson, May 1, 2007). CARB has a slightly different rule with essentially the same effect. *Id.* The use of ultra low-sulfur fuel makes it possible to use diesel after-burning treatment technology that can reduce emissions to comply with federal Tier II bin 5 standards. *Id.* at 25:21-26:9. There is sufficient production of low-sulfur fuel to make diesel-powered vehicles practical. *Id.* at 25:3-6. All of California's diesel fuel is now ultra-low sulfur, and on the national scale about eighty percent of all dispensing facilities must have low-sulfur fuel. *Id.* at 25:6-14.

Austin does not believe that diesels were as cost-effective as hybrids, and therefore did not include them in his analysis. Tr. vol. 7-A, 49:6-14. (Austin, Apr. 23, 2007). However, even assuming that diesel is not among the most cost-effective strategies for reducing fuel consumption across the board, it does not follow that it will play no role in manufacturers'

[79] Ultra-low sulfur fuel must have less than fifteen parts per million of sulfur to meet the standard. Tr. vol. 11-B, 24:22-24; 25:16-20 (Jackson, May 1, 2007).

compliance strategies. To the contrary, diesels are already being introduced in the United States by many companies. Thomas LaSorda, CEO of DaimlerChrysler Corporation, has publicly announced that DaimlerChrysler is offering seven light-duty diesels in 2007, vehicles that offer thirty percent increases in fuel economy and twenty percent reductions in GHG emissions. DX 2510. At trial, Modlin confirmed those statements. Tr. vol. 4-A 33:13-34:11 (Modlin, Apr. 13, 2007).

DaimlerChrysler and other manufacturers are working collaboratively to develop what is known as BLUETEC technology, which aims to improve the efficiency of diesel engines through improved combustion chambers or pistons, reducing exhaust emissions with a new particulate filter, and turbocharging. Tr. vol. 4-B, 48:21-49:16 (Modlin, Apr. 13, 2007). Lee believes that DaimlerChrysler is extremely competitive with other companies in its development of diesel technology. *Id.* at 49:23-50:12.

General Motors also is making progress in the introduction of diesel technology. Weverstad testified that diesels have gotten much cleaner in recent years, that General Motors sells diesels that meet existing emissions standards in vehicles weighing over 8500 pounds, and that it is working on developing a smaller diesel engine for SUVs. Tr. vol. 1-B, 90:16-91:24 (Weverstad, Apr. 10, 2007). Patton stated that the higher cost of diesel versus hybrid technology on a mile per gallon basis

doesn't mean that General Motors won't try to introduce diesel-powered vehicles in the future, since the heavier truck market includes customers who like diesel engines. Tr. vol. 10-B, 70:19-71:16 (Patton, Apr. 30, 2007).

Several other manufacturers have also announced intentions to introduce diesel-powered vehicles in the North American Market, designed to meet the federal Tier II Bin 5 standards. Toyota may bring diesels to the United States market before 2012. Love Dep. Tr. 125:14-23 (Aug. 3, 2006). Volkswagen plans to introduce a diesel engine in California and other states adopting the regulation, as well as to take other steps to reduce emissions and improve fuel economy. Johnson Dep. Tr. 22:24-23:10 (Sep. 20, 2006). It expects to introduce light-duty diesels which will get about ten miles more per gallon than comparable gasoline engines by model year 2011. *Id.* at 85:4-10, 88:17-21. Nissan expects to offer a Titan truck with a diesel engine in the near future. Choe Dep. Tr. 147:21-148:4 (Aug. 31, 2006). BMW's goal is to introduce diesels in all fifty states by model year 2011. Zwica Dep. Tr. 47:18-48:21 (Aug. 2, 2006). Honda expects to introduce a four-cylinder clean diesel engine in the United States within three years. Bienenfeld Dep. Tr. 91:14-92:1; 93:18-25 (Sep. 13, 2006).

It is clear from the testimony of the manufacturer-plaintiffs in this case that diesel-powered vehicles will play a

role in their future product lines, changes which will have an effect on their ability to comply with the regulation. There is also evidence in the record that suggests that consumers in the United States would be interested in purchasing diesel technology if it were more widely available here; General Motors found that nearly one in three new vehicle buyers in the United States said that they would consider purchasing clean diesel technology, about the same number that had heard of the technology. Tr. vol. 1-B, 95:12-24 (Weverstad, Apr. 10, 2007); DX 2555. In fact, McMahon predicted that despite all of the obstacles to widespread diesel use that he outlined in his testimony, diesel-powered vehicles could make up ten percent of the light-duty motor vehicle market in the United States by 2013. Tr. vol. 9-B, 12:1-4 (McMahon, Apr. 25, 2007); DX 2370 at 34. Although diesel may not be a viable compliance mechanism fleet-wide, its introduction even in a single vehicle type--for example, in pick-up trucks--will make compliance in that vehicle's category easier, and possibly result in credits that can be used in other categories. Tr. vol. 12-A, 148:23-149:4 (Duleep, May 2, 2007).

(b) Ethanol

The other alternative fuel which will play a role in manufacturers' compliance with the regulation is ethanol, in the form of E85. E85 is a mix of ethanol and gasoline, with ethanol making up roughly eighty-five percent of the fuel. E85 is used

in what are known as "flexible fuel vehicles," which can run on gasoline or gasoline mixed with up to eighty-five percent ethanol. Tr. vol. 1-B, 34:5-36:12 (Weverstad, Apr. 10, 2007). Vehicles operating on E85 have worse fuel economy than gasoline vehicles, but have lower carbon dioxide emissions under a well-to-wheel analysis. *Id.* at 103:5-7. Ethanol does not show a significant benefit in terms of the emissions emanating from a vehicle running on ethanol versus gasoline, but it has upstream benefits because plants used to make the fuel absorb carbon dioxide from the atmosphere.[80] Tr. vol. 11-A, 142:4-143:6 (Jackson, May 1, 2007). The regulation provides a fuel adjustment factor of .74 for E85, which is multiplied times tailpipe exhaust to give credit for upstream benefits associated with ethanol. *Id.* at 134:16-135:5; DX 2421.

Flexible fuel vehicles have been fully commercialized for some time, and their technology is well-developed and transparent to the driver, whether the vehicle is driven on gasoline or E85. Tr. vol. 11-B, 28:8-14 (Jackson, May 1, 2007). There are more than six million flexible-fuel vehicles on the road now in the United States. *Id.* at 28:14-17. The manufacturer-plaintiffs are

[80] Ethanol may be produced from either corn or sugar cane. Corn is fairly energy intensive to grow, so the upstream benefit for corn-E85 is relatively small. Tr. vol. 11-A, 142:4-143:6 (Jackson, May 1, 2007). The upstream benefit from sugar-cane E-85 is much larger, but sugar-cane E-85 is less readily available in the United States. *Id.* at 144:7-25. The regulation does not differentiate between cellulosic or sugar cane ethanol. Tr. vol. 11-B, 9:18-21 (Jackson, May 1, 2007).

putting a great deal of energy into the development of viable fleets of E85-capable vehicles. DaimlerChrysler, Ford, and General Motors are prepared to make half of their 2012 production flex-fuel vehicles or vehicles capable of running on biofuels. DX 2510; Tr. vol. 4-A, 37:14-38:1 (Modlin, Apr. 13, 2007); Tr. vol. 1-B 101:3-20; *id.* 34:5-36:12 (Weverstad, Apr. 10, 2007). Modlin testified before the Mobile Source Subcommittee of the Clean Air Act Advisory Committee that DaimlerChrysler plans to introduce nearly 500,000 flex-fuel vehicles in the 2008 model year. Tr. vol. 3-B, 71:23-72:19 (Modlin, Apr. 13, 2007); DX 2166.

Major hurdles to widespread use of E85 are availability and cost. There are currently no filling stations in Vermont offering E85, and only three in California. Tr. vol. 3-A, 19:12-25 (Modlin, Apr. 12, 2007). There are two planned E85 stations in New England. Tr. vol. 1-B, 38:19-24 (Weverstad, Apr. 10, 2007). Since E85 has lower fuel economy than gasoline--that is, it is possible to drive more miles on a gallon of gasoline than on a gallon of E85--it must have a lower price per gallon than gasoline to be commercially viable. In other words, it must be similarly priced on an energy basis, not on a volume basis. Tr. vol. 3-A, 21:25-22-20; Tr. vol. 1-B, 37:3-12. In the current market, retailers price ethanol at about twenty to thirty cents less per gallon than gasoline, which is insufficient to account

for the energy difference between the fuels. Tr. vol. 3-A, 24:12-25:1. The existing stations are concentrated in the Midwest, where ethanol is produced, and its pricing does not account for the costs of the transportation that would be necessary to sell ethanol on either coast. *Id.* at 25:2-11.

The reason for these prices is that ethanol now is used primarily in the low-blend market, where it is mixed with and sold as gasoline, such that its value is on a volume, not an energy basis, resulting in a price similar to gasoline. Tr. vol. 11-B, 35:13-38:4 (Jackson, May 1, 2007).

These obstacles to wider use of E85 are expected to be addressed through initiatives undertaken by the United States government and by automakers.[81] Ford expects that there will be an ethanol infrastructure in some areas within four or five years. Brown Dep. Tr. 129:5-11; 137:9-17 (Sep. 20, 2006). General Motors is a part of the 25 by '25 program, which intends to expand biofuels to meet twenty-five percent of the transportation needs of the United States by the year 2025. Tr.

[81] In its final rule establishing regulations to implement the renewable fuel program, EPA notes that today's domestic ethanol production capacity already exceeds 2007's renewable fuel requirement, with additional production capacity currently under construction. Final Rule, Regulation of Fuels and Fuel Additives: Renewable Fuel Standard Program, 72 Fed. Reg. 23900, 23954 (May 1, 2007). EPA states that the market already has the necessary production and distribution mechanisms in place in many areas, and the ability to expand these mechanisms into new markets, and expects that E85 will be increasingly available. *Id.* at 23903.

vol. 1-B, 101:3-20 (Weverstad, Apr. 10, 2007). The federal government has historically made efforts to promote the use of ethanol; for example, the CAFE program includes credits for the production and sale of E85-capable vehicles. Tr. vol. 8-A, 45:22-47:12 (Austin, Apr. 24, 2007). Currently, the Renewable Fuels Standard promulgated by the EPA requires that 7.5 billion gallons of ethanol be blended into gasoline by 2012. Tr. vol. 11-B, 29:8-10 (Jackson, May 1, 2007); DX 2585. Additional provisions in the 2005 Energy Policy Act create incentives for the use of ethanol through a fifty-one cent per gallon blender's credit and a thirty percent tax credit for the installation of production facilities or dispensing facilities at a retail station. *Id.* at 32:12-19.[82]

More initiatives are likely. In his 2007 State of the Union address President Bush called for expansions in the use of alternative fuels, including and especially ethanol. Tr. vol. 7-A, 136:24-137:17 (Austin, Apr. 23, 2007). Leaders of General Motors, Ford, and DaimlerChrysler Corporation have stated that they share the President's vision. DX 2588. As technology improves ethanol use may increase; Patton testified that he believes that if General Motors can create the right vehicle, the infrastructure will follow, although he qualified that statement

[82] The blender's credit applies whether ethanol is blended as a low-level blend in gasoline or as E-85. Tr. vol. 11-B, 32:7-19 (Jackson, May 1, 2007).

by noting that he was not necessarily representing the company's viewpoint. Tr. vol. 10-B, 55:13-22 (Patton, Apr. 30, 2007).

Production of ethanol is large and is increasing; it is now approaching seven billion gallons, almost at the level required by the Renewable Fuels Standard, and it is projected that in 2012 production will be above ten billion gallons. Tr. vol. 11-B, 28:3-29:15 (Jackson, May 1, 2007); *see also* Final Rule: Regulation of Fuels and Fuel Additives: Renewable Fuel Standard Program, 72 Fed. Reg. 23,900, 23,902 (May 1, 2007).

It may be difficult for some vehicles operating on E85 to meet standards for evaporative emissions in effect in California, Vermont, and New York. Tr. vol. 8-A, 37:4-38:13 (Austin, Apr. 24, 2007).[83] Evaporative emissions from ethanol/gasoline mixtures are higher than those from gasoline, particularly at lower concentrations of ethanol, and emissions standards require a demonstration that a vehicle can meet the evaporative emissions limits on a full range of E85 and gasoline combinations. *Id.* at 32:6-33:18. However, there currently are General Motors flexible-fuel vehicles certified to operate in California. Tr. vol. 11-B, 68:3-24 (Jackson, May 1, 2007); DX 2363.

An additional issue regarding E85's likely contribution to

[83] Evaporative emissions are hydrocarbons, which result from evaporation and permeation rather than from combustion. Certain blends of ethanol and gas have higher vapor pressure and a higher tendency to evaporate and to permeate the walls of rubber hoses or plastic fuel tanks. Tr. vol. 8-A, 35:23-38:13 (Austin, Apr. 24, 2007.)

compliance with the regulation is that while the regulation provides substantial credit for the use of E85, in order to obtain those credits manufacturers must demonstrate that each vehicle is not merely capable of using E85 but actually uses it. Witnesses for the manufacturer plaintiffs testified that this could be a barrier to obtaining credit for their production and sale of flexible fuel vehicles. *See* Tr. vol. 1-B 36:20-37:2 (Weverstad, Apr. 10, 2007); Tr vol. 3-A, 16:15-18:1 (Modlin, Apr. 12, 2007). Austin also testified that the regulation's requirement that a manufacturer demonstrate that vehicles are traveling miles on E85 rather than ordinary gasoline was problematic because it isn't possible to predict how much E85 vehicles in the general population will use. Tr. vol. 8-A, 27:1-29:2 (Austin, Apr. 24, 2007).

Duleep testified, however, that with current technology it should be possible to demonstrate that a consumer is actually running her vehicle on alternative fuel. Tr. vol. 12-B, 78:6-16 (Duleep, May 2, 2007). Most cars now are already equipped with fuel sensors, which tell the car's computer how much fuel in the tank is ethanol versus gasoline. The computer can keep track of that information in terms of the average amount of ethanol used per mile over a particular period of time. It would merely require a software change to keep track of the percent of ethanol, and then the information could be uploaded to a central

computer or downloaded when the vehicle appears for a state inspection. *Id.* at 78:17-79:10.

Weverstad confirmed on cross-examination that General Motors has an on-board diagnostics device known as OnStar, which measures the amount of fuel passing through the system and the numbers of miles the car travels, then sends the driver a monthly email with information regarding the vehicle's fuel economy. Weverstad wasn't aware of any reason why it wouldn't be possible for OnStar to monitor and report the alcohol content of the fuel. Tr. vol. 1-B, 104:18-107:13 (Weverstad, Apr. 10, 2007). He agreed that he supposed that some fleets could actually monitor and record ethanol usage to demonstrate that a vehicle is being operated on E85. *Id.* at 104:14-17. In light of the technology available and the strong incentives that the regulation offers to automakers to make serious efforts to develop this use of existing monitoring systems, it is difficult to believe that this requirement will impede the use of E85 if the obstacles of availability and cost are overcome.

(c) Hydrogen

Hydrogen-powered vehicles are not yet in production, but manufacturers are making progress toward fuel-cell vehicles. Fuel cell vehicles consist of a fuel stack driving an electric motor, and are powered by hydrogen. As with E85, a key challenge for public acceptance of hydrogen-powered cars is availability of

hydrogen at filling stations. Fuel cell vehicles require hydrogen fueling stations that can produce hydrogen at 700 bar or 10,000 psi; the only hydrogen station in Vermont has hydrogen available only at lower bar/psi, which would reduce the range of vehicles running on that fuel. Tr. vol. 1-B, 39:5-40:2 (Weverstad, Apr. 10, 2007). However, Patton testified that he believes that the infrastructure will follow once the right vehicle is developed. Tr. vol. 10-B, 54:24-55:10 (Patton, Apr. 30, 2007).

Duleep did not include fuel cell vehicles in his analysis, as they would currently be a very expensive option as a compliance tool, though they could be introduced independent of the regulation. Tr. vol. 13-A, 100:11-102:19 (Duleep, May 3, 2007).

Reginald Modlin testified that DaimlerChrysler believes that hydrogen-powered fuel cell electric vehicles are the future for transportation, but that they are still two or three decades away from production as they are limited by the manufacturing technology for fuel cells and the huge investment in infrastructure that will be necessary. Tr. vol. 2-A, 62:2-10 (Modlin, Apr. 11, 2007). Ford and DaimlerChrysler currently are in a joint project to develop fuel cells. *Id.* at 62:21-63:19. General Motors is working on a proprietary fuel stack, which it intends to have ready from an engineering standpoint prior to

2012. Tr. vol. 1-B, 11:18-12:6 (Weverstad, Apr. 10, 2007).

(d) Plug-in hybrids

Plug-in hybrid electric vehicles, like fuel cell vehicles, have no vehicle or tailpipe emissions of greenhouse gases. DX 2513 at 5. The battery in a plug-in hybrid can be recharged by plugging it into a normal electric outlet, and it can capture energy from braking. Tr. vol. 1-B, 125:4-8. Vehicles powered by electricity from renewable sources are essentially emissions-free in terms of both vehicle and upstream emissions. DX 2513; Tr. vol 5-A, 67:7-22 (Haskew, Apr. 19, 2007). Duleep found that plug-in hybrids would be a relatively high-cost way of trying to comply with the regulation, and did not include them in his analysis. Tr. vol. 13-A, 100:11-102:19 (Duleep, May 3, 2007).

Manufacturer witnesses testified that plug-in hybrids show potential for the future, but are not ready for the market. Tr. vol. 2-B, 67:7-62:1 (Modlin, Apr. 11, 2007). There are early prototype vehicles on the road, but the development of an adequate battery that would allow the widespread introduction of plug-in hybrids is yet to come. *Id.*

However, manufacturers remain committed to their development. General Motors recently made several statements reiterating its commitment to electrically driven vehicles. *See* DX 2513. Specifically, General Motors announced its development of two plug-in hybrid vehicles: the Chevrolet Volt and the

Saturn Vue. The Volt will be introduced when the battery technology is ready, predicted to be in 2010. Tr. vol. 1-B, 130:20-24 (Weverstad, Apr. 10, 2007). The Volt now exists only as a concept car, but General Motors is committed to making it into a real option. General Motors' Vice Chairman, Bob Lutz, stated that competitors who write it off as a public relations exercise will be "brutally surprised." Tr. vol. 2-A, 59:23-61:21 (Weverstad, Apr. 11, 2007). The Volt's projected fuel economy is around 150 miles per gallon. The Vue is currently sold as a hybrid, and an improved "two-mode" hybrid system will debut in that model in 2008. Tr. vol. 1-B, 117:1-118:1.

(3) Other technologies

Perhaps the most important factor affecting the different cost estimates that Austin and Duleep reached is their choice to include different technologies in their analyses. Both focused primarily on conventional technologies, and both found that there would be shortfalls in at least some vehicle categories if only those technologies were used, which they expected manufacturers to address through the use of hybrids. However, the percentages of hybrids which each predicted that manufacturers would have to include in their fleet mixes in order to comply were drastically different, and accounted for much of the difference in their evaluations of the cost of compliance with the regulation. Tr. vol. 12-B, 64:25-67:18 (Duleep, May 2, 2007). Hybrid

technologies are one of the most expensive means of reducing carbon dioxide emissions. Tr. vol. 4-A, 30:19-24 (Modlin, Apr. 13, 2007). In many cases, Austin's explanations for failing to include particular technologies in his analysis are contradicted by public statements of manufacturers and are not convincing.

Both Duleep and Austin outlined particular pathways resulting in some fleet of vehicles--in Austin's case, a fleet for each manufacturer, and in Duleep's, a representative set of vehicles for the industry overall--that are compliant with the regulation. Duleep was careful to note that the path that he outlined was only one among many of the possible strategies that a manufacturer could adopt, and that a manufacturer's choice to use a strategy that he didn't consider--for example, the use of alternative fuels--could allow a manufacturer latitude to apply fewer technologies in another category, due to the regulation's fleet-averaging and internal credit-trading provisions. Tr. vol. 12-A, 134:24-135:6 (Duleep, May 2, 2007); *Id.* at 136:3-8.

Austin agreed that manufacturers would look at the most cost-effective combination of technologies to apply to cars and trucks together, as it would be in manufacturers' interests to over-comply in one category to reduce the cost of compliance in the other. Tr. vol. 7-A, 73:19-74:9 (Austin, Apr. 23, 2007). He assumed that manufacturers would not use any technology that costs more per percent improvement in fuel economy and emissions

reductions than another available technology. *Id.* at 39:10-12. However, he eliminated several low-cost technologies from his analysis. In addition, some technologies excluded from his analysis as not cost-effective are nonetheless being used in increasing numbers independent of any attempt to comply with the regulation. This is true both of conventional technologies and of innovations such as the use of alternative fuels. This will enhance a manufacturer's ability to comply. Overall, a major flaw in Austin's analysis, and Plaintiffs' case, is his failure to justify the technologies and fuels that seem, according to Duleep and to manufacturers' actions, to offer the most viable means currently to achieve reductions in GHG emissions.

(a) GDI/turbo[84]

GDI/turbo is an attractive option, according to Duleep, because it allows a four-cylinder engine to replace a six-cylinder engine, without any significant sacrifice of power or torque. *Id.* at 135:4-14. This change improves fuel economy at a relatively low cost, since the costs of the technology are offset by the reduction in cost due to a smaller base engine. *Id.* at 135:15-136:4. GDI/turbo is already popular in Europe, where Volkswagen and Audi use it to meet the European Union's GHG

[84] GDI (gasoline direct injection) technology facilitates lean-burn engine operation for light-load conditions, resulting in lower carbon dioxide emissions. A turbocharged engine compresses air coming into the engine, which boosts engine power. The combination can result in lower carbon dioxide emissions with no loss of engine performance.

emissions standards. *Id.* at 134:3-11.

Duleep testified that vehicles sold in the United States with GDI/turbo could get up to a twelve percent improvement in fuel economy, a conclusion that a website run by the United States government regarding federal government analyses of engine components, fueleconomy.gov, supports. The website also shows a twelve percent improvement in fuel economy resulting from GDI/turbo. DX 2597. Austin disagreed, stating that he believed that the fuel consumption benefit was only about six percent. Tr. vol. 15, 85:15-86:9 (Austin, May 7, 2007).

Austin argued that GDI/turbo was not commercially viable in most vehicles because it would be necessary to use premium fuel in order to get a "really significant fuel economy improvement." Tr. vol. 8-A, 53:14-16 (Austin, Apr. 24, 2007). He also asserted that a vehicle with a turbocharged engine which ran on ordinary, non-premium fuel would experience a drop in performance factors such as acceleration and gradeability. Tr. vol. 15, 86:13-87:4 (Austin, May 7, 2007). He concluded that although the use of GDI/turbo could result in some improvements in emissions, it was not the most cost-effective technology due to the above factors. Tr. Vol. 8-A, 53:18-25 (Austin, Apr. 24, 2007). Austin's testimony in this respect is contradicted by the actions of manufacturers, who certainly seem to believe that gasoline direct injection is a viable strategy. In the fall of last year,

General Motors brought vehicles into production with state-of-the-art GDI/turbo engines. Tr. vol. 10-B, 10:24-11:1 (Patton, Apr. 30, 2007). By 2010, it is projected that one of every six General Motors vehicles in North America will have a GDI engine. *Id.* at 46:18-21; DX 2650.

Duleep agreed that premium fuel optimizes performance for vehicles with GDI/turbo, but also noted that most consumers do not use their vehicles' full performance capacity or operate those vehicles with a wide-open throttle. Tr. vol. 12-A, 137:6-137:25 (Duleep, May 2, 2007).[85] Therefore, consumers are unlikely to notice any difference in performance when driving cars with GDI/turbo on regular fuel. *Id.* In addition, using regular fuel would not damage an engine equipped with GDI/turbo technology due to protective modern technology. *Id.* at 137:25-138:5. Finally, Duleep testified that manufacturers can correct for potential negative impacts on performance by changing the transmission gear ratios. While a turbo engine usually has some deficiency in low-speed torque, it is possible to compensate for that problem by making the torque converter slightly looser or increasing the first gear ratio. Tr. vol. 13-A, 130:13-131:13

[85] This issue relates purely to the vehicle's performance in the hands of consumers, not to the vehicle's performance on the certification test which is used for determining compliance with the regulation. The test uses a special gasoline called indolene, which has a fairly high level of octane, and so the full benefits of GDI/turbo show up on the test. Tr. vol. 12-A, 136:20-137:3 (Duleep, May 2, 2007).

(Duleep, May 3, 2007).

(b) Camless valve actuation[86]

Camless valve actuation is the only technology included in Duleep's analysis that is not in high-volume production. Camless valve actuation has been in the works for a long time; Duleep described it as the "Holy Grail of valve timing." Tr. vol. 12-A, 126:11-13 (Duleep, May 2, 2007). Duleep included the technology in his analysis regarding compliance with the 2016, but not the 2012 standard. DX 2689.

Austin did not include camless valve actuation in his analysis, contending that it is still too speculative. Tr. vol. 7-A, 85:20-23 (Austin, Apr. 23, 2007). However, his opinion is belied by manufacturers' pursuit of this technology. General Motors is investigating the technology, which it expects will provide a fuel economy benefit of up to twelve percent without requiring a special lean after-treatment system or electrical system. Tr. vol. 10-B, 47:14-48:11 (Patton, Apr. 30, 2007). Vallejo, a French supplier, has announced that it will produce camless valve actuation in high volume beginning in 2010. It has production contracts with several manufacturers. Tr. vol. 12-A, 126:20-22 (Duleep, May 2, 2007). It is therefore highly likely

[86] With camless valve actuation, valve motion is initiated and controlled through either electrical energy or hydraulic energy instead of a camshaft mechanism. Camless valve actuation enhances engine performance by allowing valve timing to vary based on engine RPMs.

that camless valve actuation will be in production in time to contribute to compliance with the mid-term standards.

(c) Rolling resistance improvements

Tires with low rolling resistance improve a vehicle's fuel economy at very low cost, but such improvements must be balanced with the need for traction for purposes of braking and cornering. Tr. vol. 7-A, 41:9-18 (Austin, Apr. 23, 2007). Austin asserted that manufacturers are already using tires with the maximum reductions in rolling resistance that consumers will accept. *Id.* Duleep disagreed, based on his work as a consultant to the NAS's tire committee in 2005. Tr. vol. 12-B, 72:5-12 (Duleep, May 2, 2007). The NAS concluded that "[c]ontinued advances in tire and wheel technologies are directed toward reducing rolling resistance without compromising handling, comfort, or braking. Improvements of about 1 to 15 percent are considered possible." DX 2007 at p. 39.

Based on his extensive experience working on the connections between tires and fuel efficiency, Duleep testified that tire manufacturers are continuing to improve tire technology, mitigating or rendering non-existent trade-offs between efficiency and durability, comfort, and wet braking. Tr. vol. 12-B, 71:23-73:1. Manufacturers are increasing tire diameter and decreasing the aspect ratio (sidewall height) of tires, which reduces the flex of the sidewall as the tire rolls, both changes

which will reduce rolling resistance. *Id.* at 73:2-19. Finally, manufacturers are improving their materials, including tread design and belts, resulting in improved rolling resistance. *Id.* at 73:12-15. Duleep has extensive expertise regarding tires and their relationship to fuel economy, which Austin does not;[87] as a result, Duleep's testimony is simply more credible on this point, as well as better supported with specific examples of actions manufacturers are taking to reduce rolling resistance.

(d) Reductions in aerodynamic drag

Austin identified reductions in a vehicle's aerodynamic drag as an "almost zero cost" means of reducing a vehicle's fuel consumption, but concluded that manufacturers had already made the maximum reductions practical. Tr vol. 7-B, 55:19-23 (Austin, Apr. 23, 2007). He stated that "the manufacturers have tried styling changes to lower aerodynamic drag and the market has rejected those changes . . . . We are kind of at the limit of what the market will accept with aerodynamic drag changes right now." *Id.* at 40:8-25. Austin did not specifically discuss what, exactly, would be objectionable to consumers about styling changes associated with lowered drag, beyond stating that "You end up affecting how upright people can sit in the vehicle. You end up affecting the styling of the vehicle." *Id.* He did not have examples of vehicles with lower versus higher aerodynamic

[87] Compare DX 2687 (Duleep's resume) to PX 1016 (Austin's resume).

drag that could illustrate his argument that very low aerodynamic drag would be unacceptable.

By contrast, Duleep testified that he believed that further improvements in aerodynamic drag were possible. Tr. vol. 12-B, 67:20-68:1 (Duleep, May 2, 2007). He explained that drag is due primarily to small details on a vehicle, and does not necessarily relate to the style or appearance of a vehicle in the way that laypeople might imagine. Many vehicles which appear extremely sleek and aerodynamic in fact have relatively high drag coefficients, while vehicles which are less rounded and have more "muscular stance[s]" actually have lower aerodynamic drag. *Id.* at 68:1-69:11. Duleep showed examples of vehicles with lower and higher drag coefficients in order to illustrate this point, including the Lexus LS 460, a large, square-looking vehicle with a big front grille and a very low drag coefficient of .26. *Id.* at 68:20-69:11; DX 2702; DX 2703. Duleep's well-illustrated and well-supported testimony convincingly demonstrated the potential for improvements in aerodynamic drag resulting in better fuel economy and reduced GHG emissions.

(e) Continuously variable transmission ("CVT")[88]

Austin did not include CVTs in his analysis, because in his opinion their fuel economy benefits were more expensive than

[88] CVT offers an infinite range of gear ratios, as opposed to the usual four to six, which improves engine operating conditions and power transmission efficiency.

other available technologies, namely six-speed automatic transmissions. Tr. vol. 7-B, 69:15-19 (Austin, Apr. 23, 2007). In addition, he contended that when a CVT is programed for maximum fuel economy, many people dislike the way that it feels and sounds. Tr. vol. 8-A, 54:4-55:2 (Austin, Apr. 24, 2007). But despite the negative experiences that some manufacturers have reported with the technology, it is used successfully in vehicles on the market now. Tr. vol. 12-B, 73:20-74:9 (Duleep, May 2, 2007).

Statements by manufacturers support Duleep's position. In particular, the president of Nissan has publicly stated that the use of CVT is one of the reasons that the 2007 Nissan Altima has both the highest horsepower and fuel economy for cars in its class. *Id.* In 2006 Nissan had CVT technology in the Murano, Versa and Maxima, and was planning to add it to the Altima, Sentra, Question, and two new vehicles between 2007 and 2010. Choe Dep. Tr. 39:16-41:15 (Aug. 31, 2006).

A web-site maintained by the Department of Energy and EPA, fueleconomy.gov, states that CVTs can increase fuel economy by six percent. *See* DX 2598. Given its success with the Altima and the improvements in fuel economy and emissions that it offers, it is likely that CVT technology is viable and will be increasingly used by Nissan and by other manufacturers.

(f) Electronic power steering

Austin did not include electronic power steering in his analysis. As explanation he merely stated that it would be impractical to install it only in vehicles being sold in California and other states adopting the regulation, and he therefore did not consider it cost-effective. Tr. vol. 8-A, 56:5-8 (Austin, Apr. 24, 2007). It is difficult to see why this problem, if it exists, is unique to electronic power steering. Austin did not explain why it would be cost-effective to install any of the technologies that he did include only in the vehicles to be sold in states adopting the regulation, or why any of the other technologies were different in that respect from electronic power steering. His bare assertion that it would be impractical to use electronic power steering as a component of a compliance strategy is unconvincing.

(g) A/C credits

In addition to providing credits for alternative fuels, the regulation provides credits for various improvements to vehicle's air conditioning systems, and allows credit trading.

Austin and Duleep each predicted that manufacturers would take advantage of the air conditioner credits available under the regulation. These credits could amount to about fifteen percent of the GHG reductions that the regulation requires for the PC/LDT1 category, according to Plaintiffs' expert Harold Haskew.

Tr. vol. 5-A, 62:13-63:17 (Haskew, Apr. 19, 2007). Austin assumed that all vehicles would have their air conditioning systems "completely changed." Tr. vol. 7-A, 42:1-21 (Austin, Apr. 23, 2007). Duleep was not certain that all manufacturers could immediately take advantage of the credits available; instead, he assumed that manufacturers would need some time to complete the conversions necessary to receive all of the credits, and estimated that they would get ten grams of credit in 2012 and twelve in 2016 in the PC/LDT1 category, and fourteen grams in 2016 in the LDT2 category. Tr. vol. 12-A, 107:11-110:14 (Duleep, May 2, 2007). Manufacturers likewise assumed that they would receive some or all of the air conditioner credits available. Modlin testified that although DaimlerChrysler doesn't have all of the technology systems developed now to implement the regulation's changes, it is possible to develop them within the time frame of the regulation. Tr. vol. 3-A, 27:17-28:23 (Modlin, Apr. 12, 2007).

(h) Credit trading

Austin dismissed the possibility that credit trading among companies could help some manufacturers to comply. He reasoned that a low-cost manufacturer who stands to gain market share if a higher-cost manufacturer leaves the market will not sell its credits. Additionally, he testified that the cost to buy credits from another manufacturer would be almost as great as compliance

with the regulation. Tr. vol. 7-A, 87:14-88:12. Manufacturer witnesses agreed with that conclusion, predicting that all companies will eventually find themselves out of compliance with the regulation, and will therefore save credits for themselves. Tr. vol. 3-A, 28:24-29:25 (Modlin, Apr. 12, 2007). Modlin also suggested that a company which did sell its credits would then have the resources to price its products much lower than those of the company purchasing the credits, so that DaimlerChrysler would not choose to engage in credit purchasing. *Id.* at 30:1-31:3; *see also* PX 956.

Duleep disagreed, noting the many ways in which manufacturers already collaborate with one another although they are competitors, including on the development of various technologies. Tr. vol. 12-B, 75:18-76:13 (Duleep, May 2, 2007). Examples include various partnerships noted above to develop technologies such as advanced hybrids or fuel cells. He also noted that trades have taken place under the ZEV mandate, which allows manufacturers to sell hybrid credits. *Id.* at 76:14-17. These examples suggest that manufacturers are likely, if not certain, to trade credits to some extent.

While there is debate as to the utility of credit sharing between companies, it is clear that credits are available to be shared within a manufacturer’s fleet. That is, a manufacturer who overcomplies in the LDT2 category will then be able to use

credits from that overcompliance to offset shortfalls in the PC/LDT1 category.

(i) Efforts to promote technology generally

Evidence that manufacturers are actively pursuing initiatives and attempts to promote technologies that will reduce GHG emissions further undermines Austin's assertion that some manufacturers will simply leave the market rather than attempt to comply. DaimlerChrysler is undertaking a set of new initiatives designed to assist it in meeting customer desire for increased fuel economy as a significant part of its new business model. Tr. vol. 3-B, 16:14-18:8 (Modlin, Apr. 12, 2007). The new plan includes significant investments in technology, including 3 billion dollars dedicated to new engines, transmissions, and axles meant to improve fuel economy. *Id.* at 18:23-20:4. DaimlerChrysler plans to use the money for dual-clutch transmission technology, which can provide up to a ten percent fuel efficiency improvement; the first two-mode full hybrid, to be introduced in the 2008 Dodge Durango; and on diesel vehicles, including BLUETEC-label vehicles, planned to meet all emission requirements including AB 1493. *Id.* at 20:6-22:23. In addition, it plans to double the production capacity of its thirty-plus miles per gallon engine facility. Tr. vol. 4-A, 40:6-20 (Modlin, Apr. 13, 2007); DX 2510. Right now, DaimlerChrysler is phasing in six-speed automatic transmissions, and is at the front end of

phasing in electronically-shifted manual transmissions, which will be the next step beyond six-speed automatics. *Id.* at 39:12-22; DX 2510. Beyond five to eight years from now, it plans to improve fuel economy by introducing plug-in hybrids, then eventually fuel cell vehicles. Tr. vol. 2-B, 61:7-62:1 (Modlin, Apr. 11, 2007).

DaimlerChrysler's Vice President of Powertrain Engineering, Robert Lee, testified that concern about fuel economy drives much of what happens in his department, to the extent that it spends forty to fifty percent of its time examining fuel economy opportunities. Tr. vol. 4-A, 84:18-86:7 (Lee, Apr. 13, 2007). These improvements are in addition to the investments in E85 and other alternative fuels discussed previously.

Thomas LaSorda, the CEO of DaimlerChrylser, stated that DaimlerChrysler is capable of four percent annual increases in fuel economy over the next ten years, which would result in a fifty percent increase in fuel economy. DX 2510. DaimlerChrysler's witnesses at trial emphasized that this statement was not intended to apply to current United States market conditions. Tr. vol. 4B 60:23-62:8 (Lee, Apr. 13, 2007). However, as discussed above, consumer preferences and market conditions are changing rapidly.

General Motors is also undertaking many initiatives to improve the fuel economy and GHG emissions of its vehicles.

No one can predict exactly when technologies will overcome the challenges for which they are designed. *See, e.g.,* Tr. vol. 10-B, 92:19-94:17 (Patton, Apr. 30, 2007). However, Patton believes that General Motors has addressed a lot of challenges over the years and is optimistic that General Motors will keep making progress on these technologies. *Id.* at 44:1-24. Thousands of engineers work at General Motors Powertrain, all enthusiastic about improving General Motors products and working hard on making them better; Patton believes that, given enough time, many of these technologies will be successful. *Id.* at 68:7-69:10. Like DaimlerChrysler, General Motors prioritizes fuel economy in its development of new vehicles. Tr. vol. 1-A, 115:5-8 (Weverstad, Apr. 10, 2007). General Motors has an "extraordinary ability to innovate technologically" and is competitive with all other manufacturers on a segment-by-segment basis. Tr. vol. 1-C, 19:16-20:9 (Weverstad, Apr. 10, 2007).

As for specific technologies, General Motors will introduce a demonstration vehicle with HCCI next year and is moving closer to placing vehicles with HCCI on the market. Tr. vol. 10-B, 20:3-21:25 (Patton, Apr. 30, 2007). HCCI offers a fuel economy benefit which is eighty percent of that provided by diesel, for as little as fifty percent of the cost. *Id.* at 22:1-22. General Motors now has two different hybrid technologies on the market, and will add a third, improved hybrid technology next year. Tr.

vol. 1-B, 113:11-25 (Weverstad, Apr. 10, 2007). General Motors is competitive with Toyota with regard to hybrid technology. *Id.* at 121:9-12.

Witnesses for Ford, testifying in this case by deposition, testified that Ford's business strategy includes the lowering of GHG emissions, and a shift in its investments away from larger SUVs and toward smaller cars, SUVs, and crossovers. Brown Dep. Tr. 77:4-22, 56:3-11 (Sep. 20, 2006). In addition, Ford plans to expand its hybrid lineup, increase its use of ethanol fuels and of diesel engines, and shift to more fuel-efficient vehicles. *Id.* at 86:5-87:5.

Plaintiffs have failed to carry their burden to demonstrate that the regulation is not technologically feasible or economically practicable. Austin's conclusions, on which the testimony of many Plaintiffs' witnesses hinges, fail to demonstrate that the regulation is not feasible, given the flawed assumptions and overly conservative selection of technologies documented above. Duleep's analysis demonstrated that with respect to the industry as a whole, compliance is possible in the time period provided at a relatively reasonable cost. In addition, the evidence showed that alternative fuels, which were not included in Duleep's analysis, will become increasingly viable compliance options in the next few years. Manufacturers are already introducing vehicles that use diesel fuel or that are

capable of running on E85, which will undoubtedly contribute to the feasibility of compliance with the regulation. So will air conditioner credits and the ability to trade credits between companies.

The idea that the regulation will force manufacturers to simply leave the market in some or all vehicle categories in all of the states enforcing the regulation is highly unlikely in light of the evidence presented at trial. It is improbable that an industry that prides itself on its modernity, flexibility and innovativeness will be unable to meet the requirements of the regulation, especially with the range of technological possibilities and alternatives currently before it.

In addition, political changes on the federal level are likely to make withdrawal from specific markets less likely. The likelihood that the federal CAFE standards will increase significantly--at a rate of four percent per year under President Bush's announced goal--makes it still less likely that manufacturers will withdraw their products from some states at the same time they work to meet more stringent standards in all fifty states.[89]

[89] Obviously if more states apply stringent GHG emissions standards, withdrawal from those states' markets becomes a less viable strategy. While it is possible to imagine a manufacturer deciding to withdraw significant product from Vermont alone, given that Vermont is a relatively small market, it is hard to believe that a manufacturer would choose to withdraw a significant number of products from numerous states, including populous states such as New York and California, rather than

(4) Consumer choice

The primary evidence presented to suggest that consumers will suffer from a reduction in choice when purchasing new vehicles is the testimony of Austin, Modlin, and Weverstad, who suggest that the regulation will cause manufacturers including Ford, General Motors, and DaimlerChrysler to withdraw their products from the market in states enforcing the regulation. Their predictions differ slightly, as Austin predicts merely that these manufacturers will all become truck companies in those states, while Weverstad and Modlin predict that their companies will withdraw from those markets almost entirely. As discussed, it is not credible that the regulation will actually drive auto manufacturers to take such drastic steps.

A more tenable concern regarding consumer choice is that as costs to manufacturers rise due to the regulation's requirements, costs to consumers will rise also, making it more difficult for customers to purchase new cars. Duleep found that costs would be increased by around $1,500 per vehicle. Duleep's costs, like Austin's, are retail price equivalents: that is, they represent the amount that the price of a new vehicle would rise due to enforcement of the regulation.

The effect of emissions regulation on the prices of new vehicles is the subject of Daniel Sperling's extensive research.

---

comply with a regulation.

Sperling testified for the Defendants as an expert on the regulation of the automobile industry, the industry's response to regulation, and consumer behavior as to vehicle purchases. *See* Tr. vol. 12-A, 14:7-19 (Sperling, May 2, 2007). Sperling managed a study exploring how government regulation regarding emissions and safety is historically accounted for in vehicle cost increases. The study found that regulatory costs overall accounted for between a fifth and a third of cost increases during the period from the late 1960s until recently. *Id.* at 14:21-15:8. During that time period, costs due to emissions regulation changed drastically, beginning at around zero dollars until around 1970, peaking at around one thousand dollars in about 1981, and then decreasing over time. *Id.* at 16:19-18:19. This decrease is due to innovation; the automobile industry has historically been very effective at improving the quality of necessary technology while decreasing its cost. *Id.* at 18:20-19:1.

Sperling found that historically no statistical relationship exists between emission control costs and vehicle pricing, even during periods of large increases in the costs of compliance with emissions regulations. *Id.* at 22:20-22; 23:5-17. He concluded that although significant costs were imposed on the industry in those periods, the automobile industry still has targets and needs to sell vehicles and meet production targets. Companies

have therefore used a variety of strategies to ensure that their cars sell, including advertising and financing such as large rebates, favorable loan terms, or "decontenting" (some standard features are made optional to keep a vehicle affordable). *Id.* at 23:21-24:24.

Although this history cannot conclusively predict the future behavior of automakers, their ability to respond successfully to the momentous changes required of them when EPCA was first enacted suggests that they are hardly likely to flee the markets when once again they face more stringent regulations. More importantly, the study casts doubt upon the assumption that higher costs for automakers will mean higher costs for consumers. Historically, it appears, first, that higher costs for automakers due to emissions regulation were temporary due to the automakers' ability to reduce costs of new technology over time, and second, that automakers were able to weather high-cost periods without making vehicles prohibitively expensive for consumers.

Even assuming, however, that prices for new cars do rise as Duleep predicted, increased prices will be offset by increased fuel savings. The regulation will reduce the operating cost of a vehicle over its lifetime, resulting in a net financial gain to consumers. Tr. vol. 12-A, 113:3-8 (Duleep, May 2, 2007). Duleep calculated the benefit to the owner of a typical mid-size passenger car, which would be EPA-rated at about twenty-eight or

twenty-nine miles per gallon but would likely get closer to twenty-four miles per gallon in practice. *Id.* at 113:9-14. Duleep looked at savings over the car's lifetime, approximately 120,000 miles. *Id.* at 113:14-18. At the three dollar per gallon price for gasoline that Vermonters were paying at the time of trial, savings over the lifetime of the car would be around five thousand dollars, about equal to Austin's estimated vehicle cost increase and far exceeding Duleep's. *Id.* at 113:19-114:11.

Dr. Peter Berck testified for the Defendants as an expert in environmental and natural resource economics.[90] Tr. vol. 14-B, 7:18-24 (Berck, May 4, 2007). Berck used the Environmental Dynamic Revenue Analysis Model ("EDRAM") to describe the economic impacts of the regulations based on inputs submitted to him by CARB. *Id.* at 8:23-9:2; 11:11-13. In particular, Berck used CARB's estimated operating cost savings, based on an estimated gasoline price of $1.74 per gallon, but noted that savings to consumers would increase proportionally to any increase in the cost of fuel, so that savings could be much larger given the cost of gasoline at the time of trial. *Id.* at 11:14-12:2. Berck found that Californians will have $170 million worth of

[90] Berck is a professor of agricultural and resource economics and is the S.J. Hall Professor at the University of California at Berkeley. He has a bachelor's degree in economics and mathematics from the University of California at Berkeley and a Ph.D. in mathematics from MIT, and has authored fifty or sixty peer-reviewed publications in the field of economics, as well as several books and book chapters. Tr. vol. 14-B, 4:21-5:24 (Berck, May 4, 2007); DX 2718.

additional income in 2010 due to the fuel that the regulation will save; $4.76 billion in 2020; and $7.32 billion in 2030. *Id.* at 12:5-12. EDRAM is a California-specific model, but Berck predicted that benefits for individual consumers would be greater in Vermont than in California. First, Vermonters drive more, and savings increase with the amount driven. Second, the largest downside to the regulation for California is that its refinery industry could be harmed if consumers are purchasing less gasoline, an issue that would not affect Vermont. *Id.* at 122:22-13:5.

In light of all of the evidence, it does not appear that the regulation will significantly harm consumers.

(5) Product withdrawal and job loss

As with consumer choice, much of the evidence that supports the hypothesis that the regulation will lead to hardship for the automobile industry is testimony suggesting that automakers will be forced to choose between an impossible attempt to comply with the regulation and partial or total withdrawal from states that have adopted the regulation. This testimony is unconvincing.

Also relevant is Sperling's testimony that automakers do drastically reduce costs over time, allowing them to be resilient even when faced with the dramatic regulatory cost increases that they experienced in the 1970s. Tr. vol. 12-A, 18:20-19:1 (Sperling, May 2, 2007).

Dr. David Harrison testified for Plaintiffs as an expert in environmental and transportation economics.[91] Tr. vol. 5-A, 89:1-5 (Harrison, Apr. 19, 2007). Harrison testified that the regulation will reduce vehicle sales in the states that enforce the regulation. *Id.* at 90:3-6. This conclusion was based on data that Harrison received from Austin, including Austin's predictions that some models would be withdrawn; that there would be fuel economy improvements in vehicles still offered; and that there would be cost increases. *Id.* at 92:2-25. Harrison used Austin's costs for each vehicle and manufacturer, and his predictions regarding which models would be withdrawn and when, as the basis for his analysis. *Id.* at 98:20-100:6. Using these inputs in his new vehicle market model, Harrison calculated that new vehicle sales would decline by about eighteen percent overall in Vermont in 2016, and by similar percentages in New York and California.[92] *Id.* at 97:17-98:19.

These predictions are obviously questionable, given the Court's conclusion that Austin's analysis overstated both technological difficulty and cost of compliance, and that manufacturers are unlikely to withdraw products to the extent

[91] Dr. Harrison is an economist and the Senior Vice President of National Economic Research Associates ("NERA"), where he chairs the firm's global environmental economics program. Tr. vol. 5-A, 82:23-83:11 (Harrison, Apr. 19, 2007).

[92] Harrison's model is a "nested logit model," based essentially on the steps in customers' decision-making process. *Id.* at 94:3-95:13.

that Austin predicted. Harrison himself agreed on cross examination that if the inputs he received from Austin were revised, the results of his modeling would be different. Tr. vol. 5-B, 36:15-39:4 (Harrison, Apr. 19, 2007).

Berck reviewed Harrison's testimony on behalf of the Defendants. Tr. vol. 14-B, 14:17-20 (Berck, May 4, 2007). Berck noted that as an economist, he would expect that if fuel prices were to rise then sales of fuel efficient vehicles would rise also, a possibility that is not accounted for in Harrison's model. *Id.* at 14:25-15:11. Berck also believed that Harrison's nested logit model misrepresents the auto market. *Id.* at 17:2-18:3. Harrison's model is based on a classic model in which cars are separated by category as foreign or domestic, due to empirical evidence that people tend to buy either foreign or domestic cars and that it is difficult to convince them to switch categories. *Id.* at 17:10-14. Harrison's model however eliminated the distinction between foreign and domestic categories. He didn't explain the elimination. *Id.* at 17:14-18:3. Since Harrison's analysis assumes, based on Austin's conclusions, that domestic cars would have a larger cost increase than foreign cars, it is important to know whether people who previously bought domestic cars will switch to foreign cars in evaluating the effect on the domestic automotive industry. *Id.* These criticisms of course do not invalidate Harrison's analysis,

but do weaken the reliability of his model results.

Finally, it is possible--even likely--that economic models do not fully capture the motivations of today's customers. Sperling testified, based on a statistical study, that he believes that this may be the first time in history where consumers are choosing their cars on the basis of a desire to do good. Tr. vol. 12-A, 31:7-32:7 (Sperling, May 2, 2007). Sperling completed a study of households that had purchased hybrid vehicles, and found that almost none of the purchasers had gone through an actual calculation regarding how much fuel or how much money they would save by buying a hybrid. *Id.* at 28:23-29:7. Rather, people were buying hybrids for a variety of reasons--including reducing fuel consumption, promoting energy security, avoiding climate change or pollution--that could be summarized as a desire to do good. People bought hybrids because they fit with their values or projected who they were. *Id.* at 29:8-30:2.

There is evidence that consumers want to buy hybrids. In California last year about three percent of people bought hybrids, although doing so meant paying a premium of four to eight thousand dollars. Sperling calculated that eight or ten percent would purchase hybrids if more models were available. *Id.* at 30:13-21. Toyota has forecast that the premium will be reduced to below two thousand dollars, which is likely to inspire

more customers to consider hybrid vehicles. *Id.* at 30:22-31:6. Toyota sold approximately 150,000 hybrids in 2005, was on track to sell 250,000 hybrids in 2006, and expects that its hybrid sales volume will continue to grow. Love Dep. Tr. 40:17-25 (Aug. 3, 2007). These facts suggest that although the regulation will push automakers to invest in hybrid and other low-emission vehicles, such an investment may be rewarded because it addresses customer interest.

If Plaintiffs' contentions regarding the effects of the regulation--including assertions that domestic manufacturers will withdraw entirely or in part from the market in the states enforcing the regulation, and that car sales will decline dramatically--are correct, then it is a fair inference that employment in the domestic automobile industry will decline. If, however, these contentions fail to convince, the regulation's effect on employment is less certain.

Plaintiffs presented the testimony of Ron Harbour, an expert in automotive engineering, about the effect that the regulation will have on domestic employment.[93] Tr. vol. 6-A, 20:21-25 (Harbour, Apr. 20, 2007). Harbour testified about all of the jobs that are involved in the production of an automobile,

[93] Ronald Harbour is the President of Harbour Consulting, which works with companies on improving productivity, quality, and cost, as well as doing competitive benchmarking and performance analysis. Tr. vol. 6-A, 5:20-7:6 (Harbour, Apr. 20, 2007).

including jobs with suppliers to the automobile industry, jobs with vehicle manufacturers (also known as original equipment manufacturers ("OEMs")), jobs involved in the transportation of vehicles from factories to dealerships, and jobs at dealerships. *Id.* at 15:9-16:3.[94] He testified that in his opinion, the regulation will have a significant impact on jobs in the United States. *Id.* at 21:5-8.

Harbour reached this conclusion through the use of a statistical job model to examine how jobs would be affected due to the regulation. *Id.* at 26:22-27:2. Inputs into the model included total sales in affected states for the 2006 model; the number of those vehicles that were produced domestically; the costs of compliance with the regulation, provided by Austin and Sierra Research; and Austin's prediction that five companies would have to essentially withdraw from the PC/LDT1 market in the affected states. *Id.* at 28:9-33:8. Based on Austin's cost estimates, Harbour predicted that the percent decrease in sales in the market overall would be an average of 11.8 percent, assuming a price elasticity of minus one. *Id.* at 33:18-34:15. Taking into account that overall decrease, Harbour assumed for

[94] Vehicle manufacturers have four major businesses: they make "stampings," coils of steel used to stamp the shape for doors, roofs, and other structural portions of a vehicle; they have plants that make engines; they typically make the vehicle's gear box or transmission; and they assemble the vehicles. *Id.* at 16:4-17:10. Suppliers provide items like steel, paint, carpeting, seats, and equipment for use in OEMs' plants. *Id.* at 18:17-19:7.

his analysis that companies remaining in the market would take up the sales of the companies that withdrew, in proportion to their market share, to meet remaining customer demand.[95] *Id.* at 34:24-35:3. Harbour also assumed that the remaining automakers would continue to sell the same percentages of domestic and foreign-made vehicles regardless of this increased production. *Id.* at 37:8-22.[96] These inputs allowed him to calculate the number fewer units that would be sold, and he then used a "job loss ratio" to determine how the loss in volume would translate into a loss of jobs, based on his own knowledge and experience of past changes. *Id.* at 38:18-39:3; 46:7-11.

Harbour concluded that 65,000 jobs would be lost in the United States as a result of the regulation, taking into consideration both PC/LDT1 and LDT2 fleets and all levels of the automobile industry, including OEMs, suppliers, and transporters and dealers. *Id.* at 76:18-20.[97] Of course, like Harrison's, the

---

[95] Harbour testified that the assumption that remaining automakers would pick up the slack was conservative, since to do so each would have to increase its production by almost sixty-eight percent in a very short time, which would be difficult. *Id.* at 33:9-35:21.

[96] The description of Harbour's procedure is taken from his analysis of the PC/LDT1 fleet. However, his analysis of the LDT2 fleet was identical except that there was no need for any adjustment because there was no prediction that manufacturers would withdraw from the LDT2 market. *Id.* at 71:20-75:15.

[97] Harbour predicted that there would be about 7,000 direct job losses at OEMs, about 20,000 jobs lost in vehicle sales and distribution, and about 37,000 jobs lost in supporting industries such as suppliers. *See* PX 1000.

value of Harbour's analysis is entirely dependent on the validity of the inputs Austin provided to him. Given the Court's conclusion that Austin's analysis overstated the costs that will result from the regulation, Harbour's predictions lose much of their force.

However, Harbour also did an analysis using costs that CARB estimated in support of the AB 1493 rulemaking. CARB predicted that the regulation would cause a 4.7 percent decrease in sales in the eleven states adopting the regulation, and that the cost of compliance with the regulation would be around one thousand dollars per vehicle. *Id.* at 82:3-11; PX 1012. Using CARB's predictions, Harbour found that about 14,000 jobs would be lost. *Id.* at 82:18-22.

While any job loss is obviously cause for concern, it is appropriate to put Harbour's numbers into context. General Motors has announced that it intends to close twelve manufacturing plants by 2008. *Id.* at 122:3-18. While it is difficult to calculate the exact effect that this will have on the company's North American capacity, closing six plants and opening one recently will cause a loss of fifteen percent of its capacity, or 775,000 vehicles, by the end of 2008, and it is fair to estimate that closing six additional plants will cause a similar decrease. *Id.* at 122:18-125:1. General Motors is planning to reduce its work force by 30,000 employees, and is

relieving about 2500 of its salaried workers. *Id.* at 125:2-126:1. Ford plans on closing fourteen manufacturing plants by 2012, which will reduce its production capacity by one-third, and plans to cut 34,000 jobs by 2012. *Id.* at 126:2-11. DaimlerChrysler announced in February that it will reduce its capacity by 400,000 units, and reduce its work force by 11,000 employees. *Id.* at 126:12-22.

These numbers are important in evaluating Harbour's analysis, because he assumed that sales would remain constant between 2006 and 2016 absent the regulation. *Id.* at 107:5-108:13. If, in fact, sales would decline regardless of the regulation, the number of lost jobs which can be attributed solely to AB 1493 becomes questionable. *Id.* at 120:23-121:11. While the manufacturers' announcements of plant closings and firings are not proof that their sales will be lower, it does appear that Ford, DaimlerChrysler and General Motors contemplate lowering their United States production capacity and reducing their workforces, which suggests that they will sell fewer vehicles independent of the regulation. It is unknown whether any of the jobs eliminated will be outsourced to other employers within the United States. *Id.* at 139:4-140:3.

Finally, it is worth noting that the numbers of jobs that these automakers already plan to eliminate dwarf the number of jobs that would be eliminated at OEMs under any of Harbour's

predictions. *See* PX 1000 (predicting just 7,000 direct jobs lost, assuming that inputs provided by Austin are correct). Overall, Plaintiffs have failed to prove that the regulation will cause significant domestic job loss.

(6) Safety

Plaintiffs have alleged that the regulation will have negative safety consequences due to increased vehicle miles traveled (VMT) and aging of the fleet as a result of the regulation. Harrison predicted that, due to projected increases in new vehicle prices, scrappage rates will decline. Tr. vol. 5-A, 115:17-23 (Harrison, Apr. 19, 2007). The "scrappage rate" is the fraction of a particular vehicle type scrapped over the course of a given time period. *See id.* at 113:5-9. Harrison's modeling of scrappage rates suggests that by 2020 there would be fewer vehicles from model years after 2012 or 2013 on the road than there would be absent the regulation, and more vehicles from previous years; in other words, the net effect of the regulation is that the vehicles on the road would be older on average. *Id.* at 122:10-124:1.[98] Since vehicles have become safer over time, the implication is that the increase in older vehicles on the

[98] Harrison's analyses for the PC/LDT1 and LDT2 fleets were identical. Citations above are to his explanation of his analysis of the PC/LDT1 fleet, because he explained that analysis in detail while merely noting that his analysis for the LDT2 category is identical and similarly shows an increase in older vehicles and decrease in newer vehicles on the roads. *See* Tr. vol. 5-A, 136:2-16 (Harrison, Apr. 19, 2007).

roads would have negative safety consequences. *See* Tr. vol. 9-A, 60:2-8 (M.L. Marais, Apr. 25, 2007) (stating that to the extent that an aging fleet is more expensive to maintain, and to the extent that higher maintenance costs could lead to a lower amount of maintenance applied, aging of the fleet would increase the magnitude of any decrease in safety).

Harrison also testified about the "rebound effect," which is the change in vehicle miles traveled due to a percentage change in fuel economy. VMT typically increases when fuel economy improves, because the improvement in fuel economy lowers the cost of travel.[99] Tr. vol. 5-B, 7:19-8:20 (Harrison, Apr. 19, 2007). Harrison concluded that there would be an increasing rebound effect over time in Vermont resulting from the regulation. *Id.* at 17:17-24; 23:11-14.

All of Harrison's opinions are based on predictions provided to him by Austin, including his scrappage and VMT predictions. *Id.* at 24:10-25:8. As previously stated, this reduces the certainty of his conclusions. In addition, as with his prediction that new car sales will decline, his scrappage model fails to take into account any impact from increasing fuel prices. Tr. vol. 14-B, 15:19-22 (Berck, May 4, 2007).

[99] Harrison calculated that for Vermont, a one percent increase in vehicles' average fuel economy measured in miles per gallon would cause a percent change in vehicle miles traveled of -0.069 in the short term, and -0.335 in the long term. PX 0994. Harrison prepared similar calculations for New York and California.

Berck criticized Harrison's conclusions regarding the rebound effect. The regulation is likely to make vehicles more expensive and to make driving less expensive. However, Harrison has taken into account the lower cost of driving in calculating the rebound effect, but not the higher price of purchasing a vehicle, even though higher vehicle prices will reduce the amount of money that consumers who purchase the new vehicles with higher fuel economy will have left over to buy fuel. *Id.* at 16:4-19.

Austin's estimates and Harrison's predictions that the regulation will cause new vehicle sales to decline, scrappage rates to increase, and VMT to increase, are the basis for a statistical analysis by Dr. M. Laurentius Marais, Plaintiffs' expert in statistics and statistical analysis.[100] *See* Tr. vol. 8-B, 60:17-22 (Marais, Apr. 24, 2007). Marais used inputs provided by the other experts and data on the observed rate of fatalities in Vermont and New York to calculate likely rates of fatalities and serious injuries in highway accidents without and then with the regulation.[101] *Id.* at 60:24-61:23.

---

[100] Marais is a professional statistics and applied mathematician in private practice as a consultant with William E. Wecker Associates, Inc., where he is a vice president and principal consultant. Tr. vol. 8-B, 57:14-23 (Marais, Apr. 24, 2007).

[101] Marais applied an adjustment to his results to account for safety improvements, because fatality and injury rates have declined over time due to improvements in vehicle safety. *Id.* at 69:13-17. Another Plaintiffs' expert, Mr. Robert Shelton, testified that in his opinion based on his professional experience, which included several positions at NHTSA including

Marais predicts that in Vermont, the regulation will cause a 4.7 percent increase in fatalities and serious injuries in 2020, or about fifteen additional serious injuries and about two additional fatalities. For 2030 Marais predicts an eight percent increase, or twenty-two serious injuries and three fatalities. *See id.* at 88:5-16; PX 1073. Marais also prepared predictions for New York, where the percentage change in injuries and fatalities would be lower than in Vermont, but the additional injuries and fatalities would be far higher in number due to the higher population. *Id.* at 87:17-88:5; PX 1073.

These predictions rest on Harrison's results, and on Austin's, for their validity; therefore, the sources of inaccuracy earlier noted with regard to those experts apply equally to Marais.

Plaintiffs did not offer expert testimony suggesting that the regulation will lead to smaller vehicles or that smaller vehicles are less safe. However, witnesses for Plaintiffs on topics other than safety did suggest that there was a correlation between vehicle size and safety and that these factors might be affected by the regulation. *See* Tr. vol. 2-B, 60:14-61:6 (R. Modlin, Apr. 11, 2007) (stating that "[y]ou get more protection with greater size of a vehicle").

Executive Director, Marais had correctly accounted for safety improvements over time. Tr. vol. 8-B, 8:3-13:18 (Shelton, Apr. 24, 2007) (describing Shelton's career at NHTSA); *id.* at 26:13-19.

Defendants presented the testimony of Dr. David Greene on the subject of connections between fuel economy, vehicle weight and size, and safety. Dr. Greene is an expert on transportation energy policy, including the impact of fuel economy on traffic safety.[102] Tr. vol. 15, 18:5-9 (Greene, May 7, 2007). Greene testified that the hypothesis that there is a causal link or correlation between fuel economy standards and highway traffic safety because manufacturers will make smaller and lighter cars to be more fuel efficient and those cars will be less safe is mistaken. *Id.* at 18:11-22. Based on the physics of collision between two objects, if two vehicles of different sizes crash, the occupants of the lighter vehicle are more likely to be injured.[103] *Id.* at 24:10-16. However, if both vehicles' weight were reduced by the same amount, there would be no change in the likelihood of injury based on that principal of physics, so it would be possible to down-weight a whole fleet without any impact on safety. *Id.* at 25:3-19. New studies also show that it is

[102] Dr. Greene is employed by Oak Ridge National Laboratory of the Department of Energy, where he specializes in studying transportation energy policy research, including work on fuel economy standards and their relationship to safety. Tr. vol. 15, 10:17-11:19 (Greene, May 7, 2007).

[103] The reason that passengers of the lighter vehicle will be at a disadvantage is that the ratio of changes in velocity of the two vehicles will be inversely proportional to their masses, so the lighter vehicle will experience the greater change in velocity due to the crash. The probability of an injury or fatality is highly correlated with the change in the vehicle's velocity. *Id.* at 24:17-25:2.

possible to study the effects of reducing vehicle mass and the effects of reducing vehicle size (measured by track and wheel-base) separately, and that when those changes are studied separately, it appears that reductions in mass may have a positive effect on safety if size is maintained. *Id.* at 32:7-16. This result is relevant to the likely effect of this regulation, since Austin and Duleep's analyses included down-weighting as one potential method of compliance.

Greene also notes that historically, fuel economy changes have not been correlated with decreases in vehicle safety, even when fuel economy improvements of about eighty percent for passenger cars and fifty percent for light trucks were mandated between 1975 and 1985. *Id.* at 19:1-11. Greene conducted a study looking at the historical record from 1966 to 2002, and found that there was no correlation between fuel economy, weight, and safety. *Id.* at 31:8-18.

Greene concluded that the fuel economy levels that would result from the enforcement of AB 1493's emission standards should be possible to achieve without a negative effect on highway safety. *Id.* at 22:19-23:4.

Taking into account all of this testimony, it appears clear that any negative safety impact arising from the regulation will result from changes in consumer behavior, not from any flaw in technology or design likely to be used to reduce GHG emissions.

It also appears likely that any decrease in safety will be relatively minor, and will be outweighed by increases in safety taking place over time. Under these circumstances, Plaintiffs have not shown that the regulation has a significant negative impact on safety.

The Court's examination of the factors that NHTSA considers in its analysis of technological feasibility and economic practicability does not change the conclusion that it reached based on the testimony of the parties' expert witnesses. Plaintiffs have not carried their burden to show that compliance with the regulation is not feasible; nor have they demonstrated that it will limit consumer choice, create economic hardship for the automobile industry, cause significant job loss, or undermine safety.

II. Foreign Policy Preemption

The '302 plaintiffs also allege that Vermont's GHG regulation "intrude[s] upon the foreign policy of the United States and the foreign affairs prerogatives of the President and Congress of the United States." '302 Compl. ¶ 120. Specifically they claim that the regulation conflicts with the United States' pursuit of multilateral agreements to reduce international GHG emissions, diminishes its bargaining power, and "interferes with the ability of the United States to speak with one voice upon matters of global climate change." *Id.* ¶ 121.

In *American Insurance Ass'n v. Garamendi*, the United States Supreme Court articulated a rule of executive preemption, based upon the premises that "at some point an exercise of state power that touches on foreign relations must yield to the National Government's policy," and "there is executive authority to decide what that policy should be." 539 U.S. 396, 413-14 (2003). In the absence of a federal statute or treaty, a state law may be preempted if it "impair[s] the effective exercise of the Nation's foreign policy." *Zschernig v. Miller*, 389 U.S. 442, 440 (1968); *accord Garamendi*, 539 U.S. at 419. In *Garamendi*, the Supreme Court suggested that when a state's enactment comes within its traditional realm of competence, but affects foreign relations, the clarity or substantiality of the required conflict might vary with the strength or importance of the state concern. 539 U.S. at 419-20 & n.11.

The plaintiffs make two arguments: one, that Vermont's regulation is preempted in the absence of any conflict with national foreign policy, by virtue of its intrusion into the field of foreign affairs, citing *Zschernig,* 389 U.S. at 432; and two, that the regulation is preempted because there is a "sufficiently clear conflict" with an "express foreign policy of the National Government," citing *Garamendi*, 539 U.S at 420.

A. National Foreign Policy on GHG Emissions

For at least twenty years, Congress has recognized that GHG

emissions may be contributing to global warming that may alter global weather patterns and cause sea levels to rise, and that international cooperation is required to respond to this global threat. *See* The Global Climate Protection Act of 1987, Pub. L. 100-204, tit. XI, 101 Stat. 1331, 1407 (printed in notes to 15 U.S.C. § 2901). Since 1992 the United States has been a party to the United Nations Framework Convention on Climate Change ("UNFCCC"), to consider international responses to global warming. Member nations of the UNFCCC negotiated the Kyoto Protocol, adopted in Kyoto, Japan on December 11, 1997, which called for mandatory limits or reductions in GHG emissions for developed countries. The Protocol entered into force on February 16, 2005. As of June 2007, 174 countries had ratified the Protocol. *See* UNFCCC, Kyoto Protocol, Status of Ratification (2007), http://unfccc.int/kyoto_protocol/background/status_of_ratification/items/2613.php.

The United States has not ratified the Protocol. In 1997 the Senate adopted the Byrd-Hagel Resolution, recording its objection to any protocol that exempted developing countries from GHG limits or reductions or that would result in serious harm to the United States economy. S. Res. 98, 105th Cong. (1997); S. Rep. No. 105-54 (1997).

On May 31, 2007, President Bush announced United States support for the development of a framework for international

policy on climate change after the expiration of the Kyoto Protocol in 2012. The United States remains committed to the UNFCCC, expects the framework to complement United Nations activity, and seeks to include both developed countries and emerging economies. Fact Sheet: a New International Climate Change Framework, May 31, 2007, http://www.whitehouse.gov/news/ releases/2007/05/print/20070531-13.html.

On June 7, 2007, at the annual G-8 Summit, the United States agreed to a summit declaration entitled "Growth and Responsibility in the World Economy." G-8, Summit Declaration, June 7, 2007, http://www.g-8.de/Content/EN/Artikel/__g8-summit/ anlagen/2007-06-07-gipfeldokument-wirtschaft-eng,property=publica tionFile.pdf. In the declaration's section on climate change, the G-8 leaders committed themselves "to taking strong and early action to tackle climate change in order to stabilize greenhouse gas concentrations at a level that would prevent dangerous anthropogenic interference with the climate system." *Id.* ¶ 49. "As climate change is a global problem, the response to it needs to be international. We welcome the wide range of existing activities both in industrialized and developing countries." *Id.* ¶ 50. "We acknowledge that the UN climate process is the appropriate forum for negotiating future global action on climate change. We are committed to moving forward in that forum . . . with a view to achieving a comprehensive post 2012 agreement . .

. that should include all major emitters." *Id.* ¶ 52.

Article 12 of the UNFCCC requires parties to report on the steps they are taking to implement the Convention. The United States Department of State has submitted four U.S. Climate Action Reports ("USCAR") to date; the Fourth USCAR was submitted to the UNFCCC on July 27, 2007. According to the Fourth USCAR, "the United States is pursuing a comprehensive strategy to address global climate change that is science-based, fosters breakthroughs in clean energy technologies, and encourages coordinated global action in support of the [UNFCCC]." U.S. Dept. of State, U.S. Climate Action Report--2006 at 2 (2007), http://www.state.gov/documents/organization/89646.pdf. The Administration has announced plans to reduce GHG emissions per unit of economic activity. *Id.* "Dozens of federal programs, . . . combined with state and local efforts, contribute to the ultimate objective of the UNFCCC: stabilizing atmospheric GHG concentrations at a level that would prevent dangerous human interference with the climate system." *Id.* At the same time, the United States is pursuing bilateral and multilateral climate change initiatives with nations around the world. *Id.*

The report applauds nonfederal policies and measures that limit GHG emissions: "In addition to the national effort, state and local governments and private and nonprofit organizations are taking a variety of steps that contribute to the overall GHG

intensity reduction goal. These nonfederal climate change activities can be an important factor in the success of emission reduction policies." *Id.* at 50-51. The report goes on to specify that "[m]any state governments have made . . . climate change initiatives high priorities . . . . These states are implementing a wide range of policies and measures to achieve the multiple benefits of minimizing their GHG emissions, encouraging the development of cleaner energy sources, and achieving air quality goals." *Id.* at 51. A table of "State Actions on Climate Change" accompanying the narrative specifically includes California's vehicle GHG emission standards, adopted by eleven states including Vermont. *Id.* at 52, tbl. 4-1.

The United States' review of a draft report of the Intergovernmental Panel on Climate Change ("IPCC"), the body that provides scientific and economic advice to the parties to the UNFCCC, to the Fourth Assessment Report expressed similar approval for the standards:

> California has led the nation and the world in setting stringent emissions standards for motor vehicles. The U.S. Clean Air Act recognizes California's ability to set more stringent standards, and allows other U.S. States to set standards that mirror California's. . . . In this sense, actions by sub-national governments have indeed led to nationally significant emissions reduction for criteria air pollutants (NOx, volatile organic compounds, etc.). There is no reason to believe that this approach would not also prove effective for GHG emissions abatement.
>
> Beyond the dynamic by which state standards can induce national action, state standards themselves can have a

> measurable impact. California's GHG emissions standards for motor vehicles have been adopted now by 10 other states, together comprising nearly 30% of the U.S. auto market. These standards would require a 30% reduction in new vehicle GHG emissions by 2016. If these standards survive a lawsuit recently filed by the auto manufacturers and dealers, they could ultimately force a significant reduction in the GHG emissions of new motor vehicles sold in the U.S. Ultimately, this would also be globally significant, given that U.S. light duty vehicles are responsible for about 4 to 5% of global carbon emissions [citation omitted].

U.S. Government Review of the Second Order Draft IPCC Working Group III Contribution to the Fourth Assessment Report (Sept. 14, 2006) (DX 3008) at 299-300.

It is evident from these sources that national foreign policy on global warming encourages the development of international support for reducing GHG emissions, and that garnering international support depends in part on informing other nations of this country's commitment to this task on the national, state and local level. The United States remains committed to the UNFCCC, the UNFCCC requires parties to report on their countries' strategies for addressing GHG emissions, and the United States considers that state and local efforts in concert with federal programs contribute to the UNFCCC's ultimate objective.

B. *Zschernig* Preemption

Zschernig involved an Oregon statute that provided for the escheat of an estate claimed by a nonresident alien unless the

heir could prove that a United States heir would have a reciprocal right to take property in the foreign country, and that the foreign heir could receive the proceeds of the Oregon estate without confiscation. In striking down the law, the Court held that "as applied" the statute had "more than some incidental or indirect effect in foreign countries, and . . . great potential for disruption or embarrassment," 389 U.S. at 434-35, and "seem[ed] to make unavoidable judicial criticism of nations established on a more authoritarian basis than our own." *Id.* at 440.

Justice Stewart, in a concurring opinion, concluded that the statute was unconstitutional on its face. For Justice Stewart, the statute "necessarily involve[d] Oregon courts in an evaluation, either express or implied, of the administration of foreign law, the credibility of foreign diplomatic statements, and the policies of foreign governments." *Id.* at 442 (Stewart, J., concurring). The Oregon legislature had impermissibly "framed its inheritance laws to the prejudice of nations whose policies it disapproves and thus ha[d] trespassed upon an area where the Constitution contemplates that only the National Government shall operate." *Id.*

The '302 plaintiffs contend that state regulation of GHG emissions "fall[s] squarely within this test," because international cooperation and coordination are necessary to

combat global warming, and because plans for limiting GHG emissions are the subject of international dialogue. '302 Pls. Proposed Concl. of Law 56 (Doc. 493). The '302 plaintiffs believe that state legislation regulating greenhouse gases will "necessarily implicate foreign policy and foreign relations," and there will be great potential for disruption or embarrassment if the federal government and individual states follow different policy choices. *Id.* at 56-57. Quite apart from the highly speculative nature of this potential for disruption or embarrassment,[104] the facts do not support the plaintiffs' argument. According to the recent release from the Department of State to the UNFCCC, California's GHG regulation, far from charting a divergent, potentially disruptive or embarrassing course, fits squarely within the nation's emission reduction policies. Far from representing an intrusion into the "field" of foreign affairs entrusted exclusively to the national government, Vermont's regulation stands out as exemplifying a cooperative federal state approach to the global issues of climate change.

C. *Garamendi* Preemption.

Garamendi involved a challenge to California's Holocaust

[104] In *Massachusetts v. EPA*, the Supreme Court rejected the contention that regulating greenhouse gases domestically might impair the President's ability to negotiate with developing nations to reduce emissions: "[w]hile the President has broad authority in foreign affairs, that authority does not extend to the refusal to execute domestic laws." 127 S. Ct. at 1463.

Victim Insurance Relief Act of 1999 ("HVIRA"), which required any insurer doing business in the state to disclose information about all policies sold in Europe between 1920 and 1945. 539 U.S. at 401. The statute was designed to force insurance companies that issued policies to Holocaust victims to pay on those policies.

The United States government had succeeded in obtaining an agreement from a newly-unified Germany to establish a foundation funded with ten billion deutsch marks to be used to compensate Holocaust victims. In return the government would submit a statement in any Holocaust-era claim in an American court that "it would be in the foreign policy interests of the United States for the Foundation to be the exclusive forum and remedy for the resolution of all asserted claims against German companies arising from their involvement in the National Socialist Era and World War II." *Id.* at 406. The German Foundation agreement served as the model for similar agreements with Austria and France.

After HVIRA was enacted, administrative subpoenas issued against several subsidiaries of European insurance companies. The Deputy Treasury Secretary wrote to the insurance commissioner and the governor of California objecting to interference with the cooperative arrangement for compensating Holocaust survivors, but the state commissioner announced that he would enforce HVIRA to its fullest extent. *Id.* at 411-12. The insurance companies

filed suit, challenging HVIRA's constitutionality.

The Supreme Court, in a five to four decision, determined that HVIRA was preempted because it interfered with the national government's conduct of foreign relations. *Id.* at 401. The government's foreign policy was expressed principally in executive agreements with Germany, Austria and France. *Id.* at 413. The Court found evidence of a clear conflict between the two policies: a consistent government foreign policy to encourage European governments and companies to volunteer settlement funds in preference to litigation or coercive sanctions versus the state's use of regulatory sanctions to compel disclosure and payment. *Id.* at 421, 423.

Preemption thus is required under *Garamendi* if the plaintiffs have demonstrated a clear conflict between the state law and an express national foreign policy. *Id.* at 420, 425. The '302 plaintiffs contend that there is an express national foreign policy against adopting unilateral binding limitations on GHG emissions in favor of a comprehensive international response to the issue. The Court has searched in vain for this policy.

Although the United States has consistently called for international consensus and a comprehensive approach to global warming, it has never disapproved of domestic regulation of domestic GHG emissions. To the contrary. The United States has praised such efforts to the international community. That the

United States also encourages voluntary efforts to reduce GHG emissions is not evidence that domestic regulatory programs are antithetical to the country's foreign policy. That the United States did not ratify the Kyoto Protocol may be evidence that the United States disapproved of international solutions that exempted developing countries, and was concerned that such a plan would unfairly tax the United States economy; it is not evidence of an express policy against domestic regulation of greenhouse gases.

In *Massachusetts v. EPA*, the Supreme Court dismissed EPA's contention that regulating greenhouse gases domestically might impair the President's ability to negotiate with developing nations to reduce emissions, noting that Congress authorized the State Department, not EPA, to coordinate the formulation of United States foreign policy concerning global climate change. 127 S. Ct. at 1463; *see also* Global Climate Protection Act of 1987, § 1103(c), Pub. L. 100-204, 101 Stat. 1331, 1407. As noted above, the State Department has recently singled out this regulatory scheme as an important factor in the success of GHG emission reduction policies. U.S. Dept. of State, U.S. Climate Action Report--2006 at 51.

The '302 plaintiffs have failed to demonstrate that Vermont's GHG regulation represents an insufferable intrusion upon the field of foreign affairs, or that it constitutes a

conflict with a national foreign policy. Accordingly, judgment for the Defendants is ordered on Count IV of the '302 Complaint.

Conclusion

In *Massachusetts v. EPA*, the Supreme Court recognized for the first time the phenomenon of global warming and its potentially catastrophic effects upon our environment. The Supreme Court described human-generated contributions to global warming, including carbon dioxide emissions from motor vehicles, and concluded that EPA has the authority to monitor and regulate such emissions under Section 202 of the CAA. That authority derives from EPA's responsibility to protect the public health and welfare, a responsibility it shares with each of the states. NHTSA has the authority to regulate fuel economy standards under EPCA. The Supreme Court concluded that EPA's authority to regulate GHG emissions and NHTSA's authority to set fuel economy standards overlap but do not conflict, and that the agencies have the duty to work together, particularly with regard to emissions standards that affect fuel economy.

This case presents a separate question involving the application of Section 209(b) of the CAA. California adopted AB 1493 and corresponding regulations setting emissions standards to regulate the discharge of greenhouse gases from motor vehicles in its effort to contribute to the fight against global warming. Section 209(b) permits California to adopt its own emissions

standards, and EPA to grant waivers from preemption under the CAA's Section 209(a).

Assuming such a waiver is granted, do the California regulations become "other motor vehicle standards of the Government" under Section 502 of EPCA? If so, Congress intended NHTSA to take such regulations into consideration when setting CAFE standards, and the question of federal preemption of a state statute does not arise. If EPA-approved California GHG regulations do not enjoy the status of other motor vehicle standards of the Government, or are not shielded from preemption analysis, are those standards preempted, either expressly or by implication, by EPCA's Section 509(a)?

The parties agreed that, for purposes of this litigation, EPA would be deemed to have granted California's application for waiver from federal preemption under the CAA, leaving open only the questions whether EPCA preempted the GHG regulations, or the regulations were preempted as an intrusion upon United States' foreign policy. The Court is therefore presented with a provision adopted by the states of California and Vermont, and approved by EPA. When courts venture into judicial review of federal and state statutes and regulations, they do so with the issues and burdens of proof of the particular case firmly in mind, aware that the legislative and executive branches are better suited to make policy decisions and technological choices.

These bodies have greater access to experts and their expertise to assist them in evaluating scientific theories, models and predictions. More important, it is they who bear the public charge to resolve issues of critical concern to the nation, such as the proper balance between a small step toward averting potential environmental disaster and its potential effects on the automobile industry. Many years ago, Justice Felix Frankfurter wrote: "[i]f the function of this Court is to be essentially no different from that of a legislature, if the considerations governing constitutional construction are to be substantially those that underlie legislation, then indeed judges should not have life tenure and they should be made directly responsible to the electorate." *W. Va. State Bd. of Educ. v. Barnette*, 319 U.S. 624, 652 (1943) (Frankfurter, J., dissenting). This Court's task is to determine whether the plaintiffs have carried their burden to show that Vermont's GHG regulation stands as an obstacle to the objectives of Congress. Many of the techical, political and even moral issues raised by this case are not, and should not be, resolved here, but may remain the subject of debate and policy-making in Congress, in state legislatures, and in federal and state agencies.

State action is foreclosed as preempted if Congress has expressly prohibited such action (express preemption), or has impliedly prohibited such action by occupying the entire field

(field preemption) or by enacting a statute with which it conflicts (conflict preemption). Congressional intent is the heart of preemption analysis, and the burden of proof rests on the parties asserting that state action is preempted.

Having reviewed the legislative history of the CAA and EPCA for evidence of Congress's intent, the Court concluded that Congress intended California emissions standards for which EPA granted a waiver pursuant to Section 209(b) of the CAA to constitute "other motor vehicle standards of the Government," under Section 502 of EPCA. Such a finding is entirely consistent with the language of the statutes, the House and Senate reports that accompanied the legislation, and NHTSA's practice of taking California standards into consideration when setting CAFE standards. Because this case involves potential conflict between "federal" provisions, preemption analysis does not apply.

Alternatively, the Court applied principles of express, field and conflict preemption to the regulations, finding in each case that the plaintiffs failed to prove the regulations were preempted. Congress did not intend that regulations adopted by California for which EPA granted a waiver under Section 209(b) of the CAA be preempted. The regulations set GHG emissions standards and are sufficiently unrelated to fuel economy standards not to be expressly preempted. Further, Congress did not intend EPCA's CAFE standards to occupy the field of fuel

economy exclusively, given that NHTSA must coordinate with other federal agencies and take into consideration other federal standards which may affect fuel economy.

The bulk of the evidence at trial addressed conflict preemption. Plaintiffs bore the burden of proving that the GHG regulations are sufficiently draconian that they essentially usurp NHTSA's prerogative to set fuel economy standards. The Court had to determine the practical impact of the GHG regulations to decide if they constituted an obstacle to the full purposes and objectives of Congress.

The GHG regulations are technology-forcing provisions designed to reduce emissions from new motor vehicles. Through amendments to the CAA, Congress has essentially designated California as a proving ground for innovation in emission control regulations. Policy-makers have used the regulatory process to prompt automakers to develop and employ new, state-of-the-art technologies, more often than not over the industry's objections. The introduction of catalytic converters in the 1970s is just one example. In each case the industry responded with technological advancements designed to meet the challenges.

On this issue, the automotive industry bears the burden of proving the regulations are beyond their ability to meet. There is no question that the GHG regulations present great challenges to automakers. Likewise, President Bush's plans for a dramatic

increase in CAFE standards by as much as four percent per annum, if adopted, provide substantial challenges to the industry. At the same time, two factors suggest the industry can meet these challenges. First, EPA clearly has the authority and flexibility to address lead time concerns in the waiver process. Second, automakers describe intensive efforts to develop and utilize new technologies to increase fuel efficiency and reduce emissions. American automakers are in the vanguard of utilizing hybrid technology to dramatically improve fuel economy. Clean diesel technology is being offered in a growing number of vehicles. Dramatic improvements to powertrain technologies are under study and may be available in the not-too-distant future. Alternative fuels such as ethanol provide another strategy for reducing GHG emissions. The manufacturers have become fully engaged in developing these technologies to address emissions concerns, and those efforts are front-and-center in the public record. History suggests that the ingenuity of the industry, once put in gear, responds admirably to most technological challenges. In light of the public statements of industry representatives, history of compliance with previous technological challenges, and the state of the record, the Court remains unconvinced automakers cannot meet the challenges of Vermont and California’s GHG regulations.

ORDER

For the reasons given above, judgment is ordered for Defendants on Count I (express and implied preemption under the federal fuel economy laws) and Count IV (preemption under the foreign policy of the United States and the foreign affairs powers of the federal government) of the Complaint in Docket No. 2:05-cv-302. Count II (preemption under the CAA) is dismissed as moot. Counts III, V, and VI were dismissed by Plaintiffs before trial. Judgment is ordered for Defendants on the First Claim (preemption under the federal EPCA) of the Complaint in Docket No. 2:05-cv-304. The Second Claim (preemption under the Clean Air Act) is dismissed as moot.

Dated at Burlington, Vermont this 12th day of September, 2007.

/s/ William K. Sessions III
William K. Sessions III
Chief Judge U.S. District Court