PLANNING FOR A FUTURE THAT WILL NEVER COME: THE EFFECTS OF GAS PRICE SPIKES ON NEPA ANALYSIS

INTRODUCTION

The summer of 2008 was a turning point in Americans' travel habits and lifestyle. As auto fuel rose above $4.00 per gallon throughout the country, Americans were shocked to see their incomes being devoured by the commutes between the cities where they work and the suburbs where they have chosen to live.[1] By June, prospective home buyers were more inclined to live closer to the city so they could drive less. Other more basic lifestyle changes, like carpooling and public transportation, pulled even more drivers off the roads, especially on the longer commutes from suburbs and exurbs. The result is a population that is making more conscious decisions than ever before about where, when, and how far it drives each day. While this offers many environmental benefits, it has the interesting side effect of drastically undercutting transportation experts' ability to predict usage levels for transportation infrastructure projects. These studies are the cornerstone of the federal government's environmental assessment requirements under the National Environmental Protection Act (NEPA), but this sudden behavioral shift has made it nearly impossible to model and predict driving behavior, leaving these studies vulnerable to legal challenges.

This Note will show why these changed circumstances have fatally compromised the scientific integrity of the transportation models used to predict usage levels of proposed highway projects for environmental assessment purposes. Part I discusses the NEPA framework generally and emphasizes the requirement that environmental impact statements (EISs) reflect changing conditions and new information obtained during an EIS's preparation. Part II describes the process of modeling demand for proposed highway projects and explains the input choices and assumptions upon which these models rely. Part III explains the drastic changes in driving behavior that have occurred in the last year and explains why the traditional models cannot accurately reflect this change. Part IV shows why these flaws are fatal to pending highway EISs that rely on transportation models which no longer reflect society's behavior. This part presents analytical evidence to conclude that a court should demand an updated study of any highway proposal's EIS that does not satisfy NEPA's scientific integrity requirements.

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1. *See* Elizabeth Rhodes, *Will Gas Prices Drive Homebuyers Away from Suburbs?*, SEATTLE TIMES, July 7, 2008, at B1, *available at* http://seattletimes.nwsource.com/html/businesstechnology/2008036634_housegas07.html.

I. NEPA, EIS, AND THE ROLE OF MODELING

A. NEPA

Congress passed NEPA in 1969 as one of the earliest federal efforts to include environmental concerns in decision-making processes.[2] The Act declares that it is the "continuing policy of the Federal Government . . . to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans."[3] Section 102(C) requires the Federal Highway Administration (FHWA) to conduct a detailed analysis of the potential environmental impacts for any "major" project that will "significantly affect[] the quality of the human environment. . . ."[4] This seemingly simple requirement has become a powerful force in the field of environmental law. Although smaller projects may not require an exhaustive report, a large project in the transportation sector requires the FHWA to prepare a lengthy and detailed EIS setting forth FHWA's conclusions regarding the environmental impacts, possible alternatives, and an evaluation of the relative merits of the proposal.[5]

These requirements, however, pertain merely to what the EIS must contain; they do not require the agency to select the least environmentally harmful option.[6] The information in the EIS merely ensures that the public and the decision-makers with control over the project are fully informed and take all the possible consequences and alternatives into account.[7] After

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2. National Environmental Policy Act (NEPA) of 1969 § 101(a), 42 U.S.C. § 4331(a) (2008).

3. *Id.*

4. *Id.* § 102(2)(C), 42 U.S.C. § 4332(2)(C) (2008).

> For federally funded highway projects that FHWA determines will have a significant impact on the environment, FHWA must prepare a statement that describes the project, characterizes the surrounding environment, analyzes the environmental effects of all reasonable construction alternatives, and indicates plans for complying with applicable environmental laws and mitigating environmental damage.

Highway Infrastructure: Preliminary Information on the Timely Completion of Highway Construction Projects: Testimony Before the S. Comm. on Environment and Public Works, 107th Cong. 5 (2002) (Statement of Katherine Siggerud, Acting Director, Physical Infrastructure Issues), *available at* http://www.gao.gov/new.items/d021067t.pdf [hereinafter *Highway Testimony*].

5. *Highway Testimony*, *supra* note 4, at 6. "[I]t typically takes from 9 to 19 years to plan, gain approval for, and construct a new, major federally funded highway project that has significant environmental impacts. However, these projects constitute only about 3 percent of all federally funded projects." *Id*. at 2.

6. Robertson v. Methow Valley Citizens Council, 490 U.S. 332, 350 (1989) ("[I]t is now well settled that NEPA itself does not mandate particular results, but simply prescribes the necessary process.").

7. Lands Council v. Powell, 395 F.3d 1019, 1027 (9th Cir. 2005) ("Congress wanted each

the studies are conducted, the models perfected, and the information analyzed, the agency may nevertheless select whichever alternative it decides will best fulfill the purpose and need of the project proposal.[8]

Nevertheless, because an EIS must meet certain well-defined criteria, environmental plaintiffs who oppose a particular federal project may sue the responsible agency to force compliance with the criteria before the agency may carry out the project.[9] These plaintiffs cannot stop the projects or compel the agency to take the most environmentally responsible action through this kind of litigation,[10] but long delays and expensive legal battles may ultimately dissuade decision-makers in the agency from carrying out the project. Transportation projects, in particular, tend to generate both intense public debate and extensive EISs, so these impact statements are usually litigated *ad nauseum*.[11]

These battles can be waged purely on the contents of the EIS. Substantively, an EIS should be analytic,[12] and should give the agency and the public a complete understanding of the likely impacts of the proposed project.[13] Part of this "hard look requirement" is the need for the highest caliber of scientific accuracy and data available, lest the report present an inaccurate description of the project's potential consequences and be left vulnerable to a successful legal challenge.[14]

As part of this scientific integrity requirement, NEPA requires agencies to prepare a Supplemental EIS (SEIS) if new significant information becomes available or conditions change during the time the EIS is being prepared or litigated.[15] If an agency refuses to do so, environmental

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federal agency . . . to put on the table, for the deciding agency's and for the public's view, a sufficiently detailed statement of environmental impacts and alternatives so as to permit informed decision making.").

8. Robertson, 490 U.S. at 350 ("If the adverse environmental effects of the proposed action are adequately identified and evaluated, the agency is not constrained by NEPA from deciding that other values outweigh the environmental costs.").

9. *See* Kleppe v. Sierra Club, 427 U.S. 390, 415 (1976) (Marshall, J., concurring and dissenting) (discussing the injunctive remedies available for failure to comply with NEPA).

10. *See id*. at 415–16 (noting the courts' limited power to provide any other type of relief).

11. *See, e.g.*, Stop H-3 Ass'n v. Lewis, 538 F.Supp. 149, 154–56 (D. Haw. 1982) (discussing the lengthy litigation history of the H-3 highway project on the island of Oahu, which was delayed for over two decades due to various legal disputes, including multiple EIS challenges).

12. 40 C.F.R. § 1502.2(a) (2008) ("Environmental impact statements shall be analytic rather than encyclopedic.").

13. *Id.* § 1502.16.

14. *Id.* § 1500.1(b). "NEPA procedures must insure that environmental information is available to public officials and citizens before decisions are made and before actions are taken. The information must be of high quality. Accurate scientific analysis, expert agency comments, and public scrutiny are essential to implementing NEPA." *Id.*

15. *Id.* § 1502.9. The regulations do not state the exact threshold that triggers the preparation of an SEIS, but "[i]f there remains 'major Federal action' to occur, and if the new information is sufficient

plaintiffs may attempt to "compel the preparation of a SEIS . . . under [section] 706(1) of the [Administrative Procedures Act], which requires a court to 'compel agency action unlawfully withheld or unreasonably delayed.'"[16] Agencies generally will not be required to conduct a SEIS unless "'the new circumstance . . . present[s] a *seriously* different picture of the environmental impact of the proposed project from what was previously envisioned.'"[17]

A related issue arises when scientific information is incomplete or unavailable. In these cases, "the agency shall include the information in the [EIS]" whenever the incomplete information is "essential to a reasoned choice among alternatives and the overall costs of obtaining it are not exorbitant . . . ."[18] If the agency determines that it cannot reasonably obtain the missing information, then it must set forth its reasons for this conclusion and disclose what the impacts of this failure may be on the quality of the analysis.[19] Failure to disclose shortcomings in methodology or data can be

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to show that the remaining action will 'affect the quality of the human environment' in a significant manner or to a significant extent not already considered, a supplemental EIS must be prepared." Marsh v. Or. Natural Res. Council, 490 U.S. 360, 374 (1989) (quoting 42 U.S.C. § 4332(2)(C)).

16. Sierra Club v. U.S. Dep't of Transp. (*Sierra I*), 245 F. Supp. 2d 1109, 1119 (D. Nev. 2003) (quoting Administrative Procedure Act, 5 U.S.C. § 706(1) (2008)). It has often been noted, however, that agencies "need not supplement an EIS every time new information comes to light after the EIS is finalized. To require otherwise would render agency decisionmaking intractable, always awaiting updated information only to find the new information outdated by the time a decision is made." *Marsh*, 490 U.S. at 373; *see also* Vt. Yankee Nuclear Power Corp. v. Natural Res. Def. Council, Inc., 435 U.S. 519, 554–55 (1978) (discussing the limited nature of a court's review of the sufficiency of an agency's consideration of environmental factors).

> "Administrative consideration of evidence . . . always creates a gap between the time the record is closed and the time the administrative decision is promulgated. . . . If upon the coming down of the order litigants might demand rehearing as a matter of law because some new circumstance has arisen, some new trend has been observed, or some new fact discovered, there would be little hope that the administrative process could ever be consummated in an order that would not be subject to reopening."

Id. at 518–19 (quoting ICC v. Jersey City, 322 U.S. 503, 514 (1944)).

17. Hickory Neighborhood Def. League v. Skinner, 893 F.2d 58, 63 (4th Cir. 1990) (quoting Sierra Club v. Froehike, 816 F.2d 205, 210 (5th Cir. 1987)).

18. 40 C.F.R. § 1502.22(a).

19. 40 C.F.R. § 1502.22 (b). Specifically, this regulation requires:

> (1) A statement that such information is incomplete or unavailable; (2) a statement of the relevance of the incomplete or unavailable information to evaluating reasonably foreseeable significant adverse impacts on the human environment; (3) a summary of existing credible scientific evidence which is relevant to evaluating the reasonably foreseeable significant adverse impacts on the human environment, and (4) the agency's evaluation of such impacts based upon theoretical approaches or research methods generally accepted in the scientific community.

Id.

grounds for invalidating the EIS to the extent that these failures impact the EIS's conclusions.[20] Such failures may include neglecting to disclose the potential inadequacies of a particular model.[21] If the agency fails to explain the impacts that any potentially flawed data will have on the analysis, then a court may compel the agency to do so.[22]

B. Challenging the Science

This discussion has thus far described the required contents of an EIS. There are also substantive requirements regarding the accuracy of the document.[23] The scientific integrity of an EIS can become the subject of a legal challenge in a number of ways. First, a plaintiff may challenge the hard science, generally with regards to either the agency's choice of data collection methods or testing procedures.[24] This kind of challenge includes attacks on the accuracy, currentness, and reliability of the study, model, or methodology employed.[25] Alternatively, plaintiffs may challenge an agency's interpretation of the scientific data.[26] Agencies are charged with interpreting data to reach conclusions, and courts extend great deference to these determinations, as discussed below.[27] Nevertheless, a court may deem

20. Northwest Ecosystem Alliance v. Rey, 380 F. Supp. 2d 1175, 1195 (W.D. Wash. 2005) ("Relying on outdated data or not acknowledging the limitations in a methodology are grounds for setting aside an EIS.").

21. 40 C.F.R. § 1502.22; *see also* Lands Council v. Powell, 395 F.3d 1019, 1032 (9th Cir. 2005) (noting that withholding information regarding the inadequacies of a model violates NEPA).

22. *See* DANIEL R. MANDELKER, NEPA LAW AND LITIGATION § 10:22 (2d ed. 2009) (discussing disclosure requirements with regard to potentially flawed data).

23. *See, e.g.*, Sierra Club v. U.S. Army Corps of Eng'rs, 701 F.2d 1011, 1031 (2d Cir. 1983) (affirming lower court's decision to reject an EIS which contained information that had no "substantial basis in fact" because NEPA's goals cannot be achieved without accurate information).

24. In one case, for example, the industry plaintiffs alleged that EPA should have used a four-day study period rather than a sixty-day period to analyze toxic effects on trout. Dithiocarbamate Task Force v. EPA, 98 F.3d 1394, 1403 (D.C. Cir. 1996). The industry plaintiffs claimed that the shorter study period was considered "the preferred benchmark" among scientists. *Id.*

25. *See, e.g.*, Sierra Club v. Costle, 657 F.2d 298, 333 (D.C. Cir. 1981) (addressing plaintiff's argument that an inaccurate model amounts to a failure to provide substantial evidence upon which the agency can make an informed decision); Sierra Club v. EPA, No. 95-1562, slip op. at 2 (D.C. Cir. Oct. 22, 1996) (rejecting a challenge that EPA's eight-year-old data was too old).

26. *See Costle*, 657 F.2d at 328 ("Sierra Club challenges both EPA's findings about the relative national and regional impacts of alternative standards and the conclusions the agency drew from these findings."); *see also* Leather Indus. of Am., Inc. v. EPA, 40 F.3d 392, 406 (D.C. Cir. 1994) (acknowledging "genuine scientific debate" over the toxicity of trivalent chromium, but deferring to EPA's decision to regulate the substance as though it were toxic in order to fulfill its mandate of protecting human health).

27. *See infra* notes 28–31 and accompanying text.

an EIS inadequate if the agency does not "articulate a rational connection between the facts found and the conclusions reached."[28]

Any of these substantive attacks against the agency's science face a serious challenge under the existing legal framework. A reviewing court will grant substantial deference to an agency's methodology whenever it is reasonable to do so.[29] This principle has resulted in nearly unbreakable deference to agency science when there is a "battle of the experts."[30] Courts review the scientific data and conclusions in an EIS under the arbitrary and capricious standard of the Administrative Procedure Act.[31] A court will reverse under this standard

> only if the agency has relied on factors that Congress has not intended it to consider, has entirely failed to consider an important aspect of the problem, or has offered an explanation for that decision that runs counter to the evidence before the agency or is so implausible that it could not be ascribed to a difference in view or the product of agency expertise.[32]

For an agency's science to meet this standard, it only needs to be "reasonably thorough."[33] In fact, "NEPA does not require [the court] to decide whether an EIS is based on the best scientific methodology available or to resolve disagreements among various experts."[34] An agency's science must be legitimately defensible, but absent proof of a "clear error in judgment," a court will not strike down the agency's science simply because it finds a different study or opinion more persuasive.[35]

This standard applies equally to an agency's use of models.[36] Scientists often use system models to simulate "the dynamic mechanisms that control the internal state of an environmental system."[37] These are often the most

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28. Earth Island Inst. v. U.S. Forest Serv., 442 F.3d 1147, 1156–57 (9th Cir. 2006) (citing Midwater Trawlers Co-op v. Dep't of Commerce, 282 F.3d 710, 716 (9th Cir. 2002)).

29. *See* Marsh v. Or. Natural Res. Council, 490 U.S. 360, 378 (1989) ("When specialists express conflicting views, an agency must have discretion to rely on the reasonable opinions of its own qualified experts even if, as an original matter, a court might find contrary views more persuasive.").

30. *Id.*

31. 5 U.S.C § 706(2)(A) (2006); *Earth Island Inst.*, 442 F.3d at 1156.

32. *Earth Island Inst.*, 442 F.3d at 1157.

33. Laguna Greenbelt, Inc. v. U.S. Dept. of Transp., 42 F.3d 517, 526 (9th Cir. 1994).

34. *Id*.

35. Marsh v. Or. Natural Res. Council, 490 U.S. 360, 378 (1989) (quoting Citizens to Preserve Overton Park, Inc. v. Volpe, 401 U.S. 402, 416 (1971)).

36. Sierra Club v. Costle, 657 F.2d 298, 333 (D.C. Cir. 1981) (applying the "clear error of judgment" standard to an agency's use of a model).

37. MANDELKER, *supra* note 22, § 10:7; *see also* Am. Pub. Gas Ass'n v. Fed. Power Comm'n, 567 F.2d 1016, 1037 (D.C. Cir. 1977) (noting that "[i]n the world of today, model-building is not merely

efficient and accurate methods of predicting future impacts, particularly secondary impacts that are especially difficult to forecast without the use of computer models.[38] Environmental impact models in the transportation sector draw on historical data to represent the relationships among different factors.[39] "By operating the model under different assumptions, analysts can determine likely impacts resulting from the project . . . ."[40] Although there may be several different kinds of models that represent similar situations, professional forecasters can select whichever model they think is best for their situation and calibrate it to more closely resemble the circumstances of the area they are studying.[41] They can then run the models under a variety of possible conditions, which usually results in a comprehensive overview of the most likely future scenario and impacts.[42]

As noted, however, if a model is used in the preparation of an EIS, then it must be able to withstand attacks against its scientific integrity, and the EIS must disclose any shortcomings in the model.[43] If a model is indefensible or obviously out of date, then a court may order the responsible agency to supplement the EIS with a new study that demonstrates "a rational connection between the factual inputs, modeling assumptions, modeling results and conclusions drawn from these results."[44] Usually, this would occur because the agency's model relied on erroneous inputs or because it was unclear or misinterpreted as a final product.[45]

Other problems may arise when the original study did not anticipate some drastic change in circumstances. If conditions have changed so much

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a sport of youngsters and tiny planes.").

38. MANDELKER, *supra* note 22, § 10:7.

39. TRANSP. RESEARCH BD., SPECIAL REPORT 288: METROPOLITAN TRAVEL FORECASTING 24–25 (2007), *available at* http://onlinepubs.trb.org/onlinepubs/sr/sr288.pdf [hereinafter METROPOLITAN TRAVEL FORECASTING] (identifying several of the relevant factors and how they are used).

40. MANDELKER, *supra* note 22, § 10:7.

41. *See* Utahns for Better Transp. v. Dept. of Transp., 305 F.3d 1152, 1181–82 (10th Cir. 2002) (discussing one such adjustment that was made in order to increase the accuracy of the model of a particular highway proposal).

42. MANDELKER, *supra* note 22, § 10:7.

43. 40 C.F.R. § 1502.24 (2008); *see* Sierra Club v. U.S. Forest Serv., 878 F.Supp. 1295, 1308–09 (D. S.D. 1993) (discussing and upholding the Forest Service's use of a particular model by emphasizing that its shortcomings were fully disclosed in the EIS). EISs can also be challenged simply on the basis of failing to disclose shortcomings, incomplete, or inaccurate information. 40 C.F.R. § 1502.22; *Powell*, 395 F.3d at 1032.

44. Sierra Club v. Costle, 657 F.2d 298, 333 (D.C. Cir. 1981).

45. *See, e.g.*, Natural Res. Def. Council v. U.S. Forest Serv., 421 F.3d 797, 810 (9th Cir. 2005) (rejecting a model because it presented clearly erroneous demand figures); *see also* Hughes River Watershed Conservancy v. Glickman, 81 F.3d 437, 446–48 (4th Cir. 1996) (rejecting a model that inaccurately portrayed the economic benefits that would result from a proposed river recreation development because the figures could not be used to evaluate the real cost-benefit of the project and had the potential to mislead the public).

that a court believes that the EIS's model does not accurately portray the situation anymore, then the court may order an agency to take another "hard look" before NEPA's requirements are satisfied.[46] Of course, this is all judged under the same highly deferential standard afforded to all agency science, so a court will not usually weigh the relative merits of competing experts or choices of models.[47] Rather, "'it will consider whether the agency has taken account of all the relevant factors and whether there has been a clear error of judgment.'"[48]

II. MODELS IN TIMES OF FLUX

A. Transportation Modeling in a Nutshell

Models are useful tools for evaluating hypothetical or difficult-to-quantify impacts.[49] They have been particularly useful in transportation projects because they are one of the only ways to adequately predict what is likely to happen if a particular road is built in any location.[50] State and federal agencies, along with individual metropolitan planning organizations (MPOs), need to accurately forecast the level of demand for any new road in order to decide whether to build it.[51] Modelers use a travel demand forecasting model (TDFM) to predict the amount of use a potential road would receive, which allows a more complete analysis of a project's necessity, costs and benefits, appropriate size (a four-lane or a six-lane highway, for example), and secondary effects on the area where it is to be built.[52] Models can give planners and agencies a good prediction of the impacts that will result from various alternatives to the project and help them "determine which of those investments will best serve the public's

46. *See Hughes River*, 81 F.3d at 443 ("NEPA requires agencies to take a hard look at the environmental consequences of their proposed projects even after an EIS has been prepared.").

47. *See In re* Permian Basin Area Rate Cases, 390 U.S. 747, 790 (1968) (deferring to an agency's models and science as long as they produce no arbitrary result).

48. *Costle*, 657 F.2d at 333 n.124 (quoting United States v. Nova Scotia Food Products, 568 F.2d 240, 251 (2d Cir. 1977)).

49. *See* Costle, 657 F.2d at 333 ("Given the complexity and magnitude of the analyses EPA must perform[,] . . . computer modeling, for all its flaws, is invaluable.").

50. *See* MANDELKER, *supra* note 22, § 10:7 (outlining the benefits of models in forecasting the effects of transportation projects).

51. *See* Sierra Club v. Dept. of Transp. (*Sierra II*), 310 F. Supp. 2d 1168, 1189 (D. Nev. 2004) (discussing FHWA's use of the TRANPLAN model that was used by the Las Vegas MPO to project travel demand and impacts in the area).

52. METROPOLITAN TRAVEL FORECASTING, *supra* note 39, at 15–16. Development that occurs alongside major transportation arteries—such as suburban homes and commercial establishments outside the urban core—can cause what is known as "induced travel," because the development generates more traffic on that road that would not have otherwise existed. *Id*. at 26–27.

need for future travel and economic development."[53] They can also help determine the environmental impacts, such as air pollutant levels, that will result from drivers using a new roadway, which is a major factor in both NEPA and Clean Air Act (CAA) analysis.[54]

Nevertheless, modeling future human behavior is fraught with difficulty. Models of hypothetical travel patterns must anticipate the responses of large numbers of people to new travel options—responses which cannot be physically studied or verified until after the new roadway is built.[55] To address this, modelers have developed methods for approximating travel patterns based on other data that can be quantified during the planning stages.[56] Essentially, "where each person lives and works determines future system traffic."[57] In order to model a dynamic human society, TDFMs rely on "a sequential four-step process by which the number of daily trips is estimated, distributed among origin and destination zones, divided according to mode of travel, and finally assigned to highway and transit networks."[58]

A brief explanation of this process will help explain why these models cannot reflect the large-scale behavioral changes resulting from increased gas prices. In step 1, modelers calculate the approximate number of car trips in a particular zone they wish to study.[59] This calculation process has been in use for nearly half a century, since the Federal-Aid Highway Act of 1962 mandated urban transportation planning as a requirement for receiving federal transportation funds.[60] Early modelers utilized census data and home interviews to establish correlations between demographic categories and vehicle miles traveled (VMT, reported as a daily total).[61] Surveyors and modelers determined that travel choices—particularly the number of car trips—correlated with socioeconomic class.[62] These correlations became the foundation of the algorithms that use socioeconomic data of a neighborhood to calculate the number of car trips that occur within the neighborhood each

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53. *Id.* at 15.

54. *Id.* at 24. Models for the CAA are based on weather and chemical dispersion patterns, not usage statistics, so they are not relevant to this discussion. *See id*. at 53 (noting that EPA's air pollution models must be run after the TDFMs and rely on different data).

55. *Id*. at 24–26.

56. *Id.* at 23–26 (briefly outlining this process and the variables upon which it relies).

57. FED. HIGHWAY ADMIN., UTAH DEP'T OF TRANSP., SOUTHERN CORRIDOR DRAFT ENVIRONMENTAL IMPACT STATEMENT AND SECTION 4(F) EVALUATION app. F at F-1 (2003).

58. METROPOLITAN TRAVEL FORECASTING, *supra* note 39, at 2.

59. *Id*. at 50.

60. *Id*. at 20.

61. *Id*. at 21–23.

62. *Id*. at 48–49.

day.[63] To calculate the total number of car trips in a zone, modelers rely on relationships between the socioeconomic data and land use practices in each zone.[64] "The calculations take into account different trip purposes, which . . . are represented by land uses (e.g., the daily home-to-work commute is commonly represented by population or dwelling units at the home end and by the number of jobs at the work end)."[65]

In step 2, these trips are distributed among origin and destination zones based on each zone's land use composition.[66] For example, the destination point of the home-to-work commute trip—the number of which is attributed to each household based on the trip generation calculation of step 1—would not be assigned to a zone that has no employment sites.[67] The purpose of each trip is an important element in calculating how many total trips each household generates and what roadways drivers might use.[68]

For step 3, each trip is allocated among types of travel, typically either public transportation or private automobile.[69] Very few models give serious consideration to alternative modes of transportation, such as walking or biking.[70] The most common method for this step is the logit function, which predicts travel mode based on the utility considerations of each mode.[71] Common variables in this calculation include: out-of-pocket cost (including tolls and parking, but almost never gas costs, for reasons that will be explained below), door-to-door travel time, and other practical considerations to the extent they can be measured (such as trip distance, proximity of public transportation stops to home and workplace, number of transfers, etc.).[72] This step obviously can be quite complex, and may include

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63. *Id.* For example, the North Central Texas Council of Governments' (NCTCOG) TDFM uses the following trip generation inputs: population, households, median household income, basic employment, retail employment, and service employment. TRANSPORTATION DEPARTMENT, NORTH CENTRAL TEXAS COUNCIL OF GOVERNMENTS, DALLAS-FORT WORTH REGIONAL TRANSCAD TRAVEL MODEL: DESCRIPTION OF THE MULTIMODAL FORECASTING PROCESS 1 (2004), http://www.nctcog.org/trans/modeling/documentation/TransCADModel_ Documentation_Overview.pdf [hereinafter NCTCOG TRAVEL MODEL].

64. NCTCOG TRAVEL MODEL, *supra* note 63, at 1–2. Zones may also receive added trips based on "[s]pecial [g]enerators," such as shopping malls, colleges/universities, hospitals, and airports, because these facilities generate more driving traffic than would be reflected by population data alone. *Id*.

65. TRANSP. RESEARCH BD., ESTIMATING TOLL ROAD DEMAND AND REVENUE 11 (2006), *available at* http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_syn_364.pdf [hereinafter ESTIMATING DEMAND].

66. *Id*.

67. *Id*.

68. *Id*.

69. METROPOLITAN TRAVEL FORECASTING, *supra* note 39, at 51–52.

70. *See id*. at 51–52 (reporting that while more than half of large MPOs use models that reflect nonmotorized trips, few smaller MPOs model these trips); *see also id*. at 27–28 (noting that a model that does not include nonmotorized travel may fail to account for up to ten percent of a region's travel).

71. ESTIMATING DEMAND, *supra* note 65, at 12.

72. *Id*.; *see infra* text accompanying notes 98–99.

a huge number of variables depending on how much money and data the modelers have at their disposal.[73] Nevertheless, even the more basic models have traditionally provided reasonable estimates for each travel mode, which are then divided among the available roadways in step 4, yielding the final demand calculation for each roadway.[74]

The result is an algorithm model based primarily on land use patterns and demographic data that reflects with strong accuracy the actual usage of each roadway in a zone. Each model can then be used to predict what impacts an added or expanded roadway would have on the area. To study a proposed project, the model must first be calibrated to fit observed conditions at the time and place the study is undertaken.[75] Essentially, the modelers calibrate the model by using historical data to make the model "'predict' the known present."[76] This base year information serves as the standard for comparison in the analysis of future conditions and scenarios.[77] Once the model's outputs match the known reality, the model should be able to predict future developments using new assumptions of future conditions.[78] Modelers can usually approximate these conditions (as long as the variables are consistent and predictable) and enter them into the model as variables to forecast the future—they can literally predict the future socioeconomic composition, land use patterns, and infrastructure needs of the zone.[79] Because these variables (population growth, income increases, etc.) usually change slowly and consistently, modelers can make assumptions about them and incorporate the assumptions into the model.[80] While not an exact science, by using a range of reasonable estimates,

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73. *See* METROPOLITAN TRAVEL FORECASTING, *supra* note 39, at 57–58 (describing briefly the budget requirements for transportation modeling and its relationship to the accuracy of models).

74. ESTIMATING DEMAND, *supra* note 65, at 13 (describing several methods for this "trip assignment" step, where the final estimate of users for each travel mode and route is calculated).

75. *See, e.g.*, TRANSPORTATION DEPARTMENT, NORTH CENTRAL TEXAS COUNCIL OF GOVERNMENTS, DALLAS-FORT WORTH REGIONAL, FORT WORTH PARK-AND-RIDE DEVELOPMENT STUDY A.8 (2008), *available at* http://www.nctcog.org/trans/cmp/tdm/FWTAPNRStudy.pdf (identifying some of the sources of data used to calibrate the models, such as the 1994 workplace survey, 1999 Texas Department of Transportation traffic saturation counts, 1996 Dallas-Fort Worth household survey, 1996 Fort Worth Transportation Authority transit onboard survey, and 1999 SkyComp freeway density, speed, and volume study).

76. Keith C. Clarke et al., Methods and Techniques for Rigorous Calibration of a Cellular Automaton Model of Urban Growth (1996), *available at* http://www.ncgia.ucsb.edu/conf/SANTA_FE_CD-ROM/sf_papers/clarke_keith/clarkeetal.html.

77. METROPOLITAN TRAVEL FORECASTING, *supra* note 39, at 56.

78. *Id.*

79. *Id.* at 23 ("Forecasts of future travel are made by using forecasts of future demographics.").

80. *See id*. at 56 ("The model output is compared with observed travel data, and parameters are adjusted until the output falls within an acceptable range of error."); *see also* Sierra Club v. Costle, 657 F.2d 298, 326–27 (D.C. Cir. 1981) (explaining how parameters can be identified and adjusted throughout the modeling process to ensure accurate results).

modelers can usually illustrate what the future will look like with a high degree of certainty.[81]

B. The New Problem

None of this methodology has posed a problem historically in the NEPA context.[82] The models are generally reasonable enough to defend in court, so judges have little difficulty deferring to an agency's assurance that the models are sufficiently accurate.[83] In most cases, that poses no significant problem because the models probably are accurate enough to allow informed debate and decision-making.

However, recent events have created reason for concern regarding the accuracy of these travel demand models.[84] As noted, these models rely on socioeconomic factors and historical data to predict future driving behavior based on past trends.[85] From a legal perspective, the models have generally been defensible enough to stave off scientific-integrity challenges.[86] Thus, the transportation models themselves have rarely been the subject of successful litigation. On a more practical level, it would be difficult to challenge a model for inaccurately portraying the future when the future has not yet arrived to prove the model wrong.[87] Even if the future ultimately did prove the model inaccurate, it would be too late to affect the EIS or the decision-making, rendering any challenge moot.[88]

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81. Am. Pub. Gas Ass'n v. Fed. Power Comm'n, 567 F.2d 1016, 1037 (D.C. Cir. 1977). The court noted, "These economic models are . . . at base extrapolations from past experience, projections that must undergo continual examination and revision. They do not always have the reassuring concreteness of empirical observations, but they are the best we have to work with . . . ." *Id.*

82. METROPOLITAN TRAVEL FORECASTING, *supra* note 39, at 71 (pointing out that the presence of minor errors or uncertainty does not necessarily render the models useless or ineffective).

83. *See Costle*, 657 F.2d at 332 n.117 (citing the EPA Administrator's testimony that "[a]lthough the model 'produces precise numbers, it is not a precise model because of the uncertainties and inaccuracies of its assumptions'").

84. *See* CAMBRIDGE SYSTEMATICS, INC., TRANSP. RESEARCH BD., NAT'L COOP. HIGHWAY RESEARCH PROGRAM REPORT 462, QUANTIFYING AIR-QUALITY AND OTHER BENEFITS AND COSTS OF TRANSPORTATION CONTROL MEASURES 16 (2001), *available at* http://onlinepubs.trb.org/Onlinepubs/nchrp/nchrp_rpt_462-a.pdf [hereinafter TRANSPORTATION CONTROL] (expressing "serious reservations . . . concerning the accuracy of these results, the robustness of the underlying data, and even whether the correct set of variables are captured in these current model systems").

85. *See supra* notes 58–63 and accompanying text.

86. *See, e.g.*, Utahns for Better Transp. v. Dept. of Transp., 305 F.3d 1152, 1182 (10th Cir. 2002) (upholding various aspects of a challenged travel demand model even without evidence of absolute accuracy).

87. *See* Clark et al., *supra* note 76 ("Since a model predicting future patterns can only be validated after the fact (when the authors will be unavailable) the validation step is not feasible.").

88. METROPOLITAN TRAVEL FORECASTING, *supra* note 39, at 76 (pointing out that modelers cannot use actual data to verify their models of the future until several years after the model is developed)

But the future, it seems, has arrived. In the summer of 2008, the United States experienced its first bout with the future of transportation—a future that includes gas prices of four, five, or perhaps seven dollars per gallon.[89] Fueled by a media eagerly pumping the story, Americans were shocked at the prices they experienced at the pump, but they were also responsive: car trips were canceled or shortened, carpools organized, and public transit utilized by many for the first time.[90] Drivers were suddenly considering the cost of every car trip into their daily transportation plans.[91]

This conservation factor—the element of choosing not to drive even when that option is the most convenient—is not considered in the vast majority of widely used transportation models.[92] This variable has had little impact on TDFMs in the past because studies have shown that driving is fairly inelastic;[93] that is, people will not drastically change their driving habits based on the price of gas.[94] Historically this has been true because the price of gas changed incrementally and slowly, so people have tended not to alter their driving behavior except in the very long term.[95] Indeed, as the price of gas crept up throughout the 1990s and early 2000s, Americans drove more than ever and gasoline demand became even more inelastic.[96]

This history made it reasonable to assume that slightly increasing gas prices would not deter drivers, which justified the common practice of

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89. Bianna Golodryga & Robyn Kendler, *Is $7 Per Gallon Gas in Our Future?*, ABC NEWS, June 29, 2008, http://abcnews.go.com/GMA/story?id=5271315&page=1.

90. *See id*. (describing increases in public transportation ridership); Rich Miller & Matthew Benjamin, *Wealth Evaporates as Gas Prices Clobber McMansions*, BLOOMBERG.COM, June 9, 2008, http://www.bloomberg.com/apps/news?pid=20601109&refer=home&sid=a4kOXcpI3dQg (addressing commuting and housing shifts due to gas costs).

91. *See Rhodes*, *supra* note 1, at B1 (quoting an analyst who describes the ways people are "'recalibrating their thinking of how to deal with [expensive gas]'" by choosing alternative transportation).

92. Telephone interview with Stephen Lawe, Director of Forecasting, Resource Systems Group, Inc., in White River Junction, VT (Nov. 20, 2008) (notes on file with the author).

93. *See* ARUN KUPPAM ET AL., FUEL PRICES IN TRAVEL DEMAND MODELS 7 (Nov. 21, 2008), http://www.mwcog.org/uploads/committee-documents/Z15dWlhX20081121140356.pdf ("VMT is relatively insensitive to fuel prices.").

94. *See* Jonathan E. Hughes et al., *Evidence of a Shift in the Short-Run Price Elasticity of Gasoline Demand* §§ 2–4 (Univ. of Cal. at Davis, Dep't of Econ., Working Paper No. 06-25, 2006), *available at* http://www.econ.ucdavis.edu/faculty/knittel/papers/gas_demand_083006.pdf (citing studies to illustrate this traditionally accepted fact).

95. KUPPAM ET AL., *supra* note 93, at 4 ("Long-term elasticities are in general 2 to 3 times higher than short-term elasticities.").

96. Hughes et al., *supra* note 94, § 4. In 2006, before the price spikes, "the short-run price elasticity of gasoline demand [was] significantly more inelastic . . . than in previous decades. In the short-run, consumers appear significantly less responsive to gasoline price increases." *Id.*. § 1; *see also* Brad Foss, *We Keep On Pumping, Despite Gas-Cost Pains*, AZSTARNET.COM, Aug. 16, 2005, http://www.azstarnet.com/sn/related/88801 (describing steady increases in demand when gas was about $2.55 in the summer of 2005, and opining that habits might change if prices hit $3 per gallon).

minimizing or ignoring gas price as a factor in predicting future VMT.[97] "Cost of fuel" is still not a major factor in any widely used model.[98] There are two primary ways of using (or not using) the cost of fuel as a factor in TDFMs. First, most models include fuel cost as part of the "cost of auto use" factor that is incorporated into the model.[99] Automobile operating costs also include the other costs associated with driving one's personal vehicle, such as wear-and-tear and maintenance costs.[100] Because fuel costs are only a fraction of this already small component in the model, fuel price spikes do not significantly affect the overall behavioral model.[101] Although innovations in this field can make this factor somewhat more responsive to changes, it is common practice to use a fixed figure for this component of the model.[102] As noted above, even when the figure can be manipulated, its relevance is often minimized so much that changing it will not significantly affect the outcome of the model.[103] A recent report called the "fixed auto operating cost . . . a big simplifying assumption in the wake of highly unstable fuel prices."[104]

Alternatively, some models use a fixed figure based on estimates of future gas prices. For example, the ASSIGN model, a commonly used model for assigning traffic onto the roadway network (Step 4), was used by the North Central Texas Council of Governments in its most recent traffic modeling studies.[105] It used estimates for fuel cost that decreased over time, from $0.07 per mile in 1984 when the study was initiated, to $0.05 per mile for intervals between 1995 and 2007, and then settling at $0.04 per mile for intervals between 2010 and 2025.[106] If the real world prices fall somewhere close to these estimates, the models may perform adequately. But those estimates are seriously flawed now that gas prices and fuel efficiency have combined to make driving a car much more expensive than a nickel per

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97. KUPPAM ET AL., *supra* note 93, at 8 ("Fuel price is a small component of auto operating costs and hence, a spike in fuel price does not change auto operating costs significantly.").

98. *Id.*

99. *Id.* (outlining this methodology in basic terms).

100. *Id*.

101. *Id*.

102. *See id*. (noting that the standard Transportation Planning Board "model uses a fixed 10 cents per mile (1994 dollars) value as auto operating cost"); *see also* TRANSPORTATION DEPARTMENT, NORTH CENTRAL TEXAS COUNCIL OF GOVERNMENTS, DALLAS-FORT WORTH REGIONAL, NCTCOG MODE CHOICE MODEL ESTIMATION 6 (2008), http://www.nctcog.org/trans/modeling/documentation/DFWRTMModelDescription.pdf (setting this figure at 7.3 cents per mile in 1999 dollars).

103. KUPPAM ET AL., *supra* note 93, at 9.

104. *Id*. at 8.

105. NCTCOG TRAVEL MODEL, *supra* note 63, Description of the Multimodal Forecasting Process, at 121.

106. *Id*.

mile.[107] How much this will affect the models is far too speculative to generalize about; nevertheless, the discrepancy helps illustrate the vast difference between current conditions and the world that modelers anticipated until recently.

Another reason why modelers deemphasized the effects of price on consumption is simply because those effects are extremely difficult to portray in behavioral models.[108] This is not a criticism, but rather an accepted limit of the ability of current models to capture the range of human behavior.[109] In fact, this lack of sensitivity to pricing has been identified as one of the primary "inherent weaknesses of current models" by the Transportation Research Board's recent report on the state of the modeling practice.[110]

In spite of this limitation, models have historically performed adequately enough to serve their purpose. They provide a valuable service by giving planners, decision-makers, and the public a general idea of what the future will look like, at least within a certain margin of error.[111] The models were defensible because they relied on historical data—the best data we have for human behavior, population growth, and transportation patterns—and reasonable assumptions of slow and predictable changes in population and trends.[112]

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107. Here is a quick calculation simply to put this in perspective: EPA projects that the Fleet Year 2008 models will average 20.8 miles per gallon. ENVTL. PROT. AGENCY, LIGHT-DUTY AUTOMOTIVE TECHNOLOGY AND FUEL ECONOMY TRENDS: 1975 THROUGH 2008: EXECUTIVE SUMMARY 1 (2008), *available at* http://www.epa.gov/OTAQ/cert/mpg/fetrends/420s08003.pdf. If the cost of gas is assumed to be $4.00 for the sake of argument, this would yield a $0.19 per mile cost. Even $3.00 per gallon would result in a cost of $0.14 per mile, substantially more than projected in this particular model. Using these same figures, gas would need to cost $1.04 per gallon in 2007 to achieve the nickel per mile estimate of the 1984 model still in use in Dallas.

108. METROPOLITAN TRAVEL FORECASTING, *supra* note 39, at 76 ("[F]actors are omitted because the agency did not anticipate the need to consider how variations in those factors might affect travel demand or because the agency did not have a way to forecast those factors.").

109. *Id*. at 68 (noting that "'the four-step modeling system does not capture behavioral responses to pricing options because pricing has dynamic, interactive effects that cannot be accommodated in a linear, static modeling system'") (quoting J.L. SCHOFER, EXPERT FORUM ON ROAD PRICING AND TRAVEL DEMAND MODELING 8 (2006), http://www.civil.northwestern.edu/docs/Schofer/road_pricing_forum_summary_statement_sch.pdf).

110. *Id*. at 67–68.

111. *Id.* at 71–72 (encouraging modelers to use ranges of results with a reasonable margin of error, rather than a single value).

112. KUPPAM ET AL., *supra* note 93, at 7 ("Total highway travel has grown steadily at an average of 3.2 percent annually during 1970 – 1995 and at 2.1 percent during 1995 – 2005[.]").

III. MODEL FAILURE

Nevertheless, it is also true that "[m]odels can be responsive only to factors that have been included in their specification."[113] If the assumptions that underlie the models are not consistent with human behavior, then we cannot rely on the models.[114] Whenever circumstances change drastically and suddenly while a model is being constructed, the model may lose relevance to the transportation decision at hand.[115] A model that is clearly out of sync with both the underlying assumptions and the reality on the ground is not defensible. Thus, if the traditional TDFMs are no longer representative of society's behavior, then they should be rejected. This, in fact, is the result when modelers try to apply traditional models to a world that includes gas prices of five or six dollars because no model can predict the effect this change will have on our transportation habits. For this reason, environmental plaintiffs will be able to challenge the reliability of the EIS for any major infrastructure project that relies on traditional travel demand forecast models.

A. Facts on the Ground: Summer of 2008 Brings a Change to Society

No challenge to the science underlying an EIS will be successful unless it is clear to a reviewing court that an agency's reliance on that science is arbitrary and capricious.[116] This means the court will defer to the agency as long as the agency can provide a "complete analytic defense of its model . . . ."[117] Though this is a highly technical exercise, it is sufficient for the

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113. METROPOLITAN TRAVEL FORECASTING, *supra* note 39, at 75.

114. *See* Sierra Club v. Costle, 657 F.2d 298, 332 n.118 (D.C. Cir. 1981). During the court's proceedings in *Costle*, the EPA Administrator testified: "Those models are terribly sensitive to the assumptions that you make. For example, they assume that, when utility managers must manage these investments and make a decision, they choose the most economically efficient alternative. This is a modeling assumption; it may not be true in real life." *Id.* (citation omitted).

115. Sriram Krishnamurthy & Kara Maria Kockelman, *Propagation of Uncertainty in Transportation-Land Use Models*, 1831 TRANSP. RES. REC. 219, 228 (2003) *available at* http://www.caee.utexas.edu/prof/kockelman/public_html/TRB03ITLUP.pdf. Krishnamurthy and Kockelman describe two different kinds of problems in TDF modeling: "The first, and most difficult to represent, is uncertainty arising from major political upheavals or unexpected technological breakthroughs. The second class arises from political, economic, or social events and variables relatively independent of the transportation system being evaluated, but affecting the environment in which it operates." *Id.*

116. *See, e.g.*, Sierra Club v. U.S. Army Corps of Eng'rs, 701 F.2d 1011, 1032 (2d Cir. 1983) (applying the arbitrary and capricious standard to the Corps' decision to rely on particular science when issuing a Clean Water Act permit).

117. *Costle*, 657 F.2d at 333 (quoting Am. Pub. Gas Ass'n v. Fed. Power Comm'n, 567 F.2d 1016, 1039 (D.C. Cir. 1977)).

agency to show "a rational connection between the factual inputs, modeling assumptions, modeling results and conclusions drawn from these results."[118]

It should be relatively clear by now that the travel demand forecasts are not responsive to changes in gas prices to any significant degree. Even large changes in gas prices will not affect the results of most models currently in use.[119] Therefore, if an environmental plaintiff conclusively demonstrates that real-world behavior responds to gas prices in ways that the model cannot reflect, serious doubt should be cast on the validity of the model itself. A model that produces estimates that are clearly erroneous beyond some reasonable margin of error cannot meet the scientific integrity requirement.[120] Proving this would require evidence that people are reacting to gas-price increases in radically different ways than they have in the past—ways that make the current models inaccurate to a statistically significant degree.

How have people responded to four and five dollar gas prices? First, it is helpful to compare the raw data from the previous year (2008) to years past—keeping in mind that no predictive model has anticipated long-term *decreases* in driving.[121] However, after just one year of the new age of high-cost gas, driving has decreased nationwide.[122] As the price of gas peaked in the summer of 2008, "Americans drove 15 *billion* fewer miles . . . than they did in August 2007[—]the largest ever year-to-year decline recorded in a single month . . . ."[123] This decline represented a decrease of 5.6% and capped off a ten-month period in which Americans drove "78 billion fewer miles than they did in the same 10 months the previous year."[124] These figures represent the nation-wide aggregate; parts of the country experienced even more drastic reductions.[125]

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118. *Id*.

119. *See supra* notes 90–106 and accompanying text.

120. *Costle*, 657 F.2d at 333.

121. *See, e.g.*, FORT COLLINS LUTRAQ TEAM, VMT REDUCTION PROJECT, ESTIMATION OF VMT AND VMT GROWTH RATE (2001), *available at* http://fcgov.com/climateprotection/pdf/ctf-res-lutraq.pdf (forecasting 4.9% VMT increase annually); OHIO DEP'T OF TRANSP., ODOT'S HPMS VMT FORECASTING PROCEDURE (2002), *available at* http://www.dot.state.oh.us/Divisions/TransSysDev/Innovation/Prod_Services/ModelingDwnlds/Pages/default.aspx (follow "VMT.DOC" hyperlink) (recommending adherence to the previous growth rate, in spite of a slight drop in VMT in the previous year, because using other figures would be too speculative).

122. Press Release, U.S. Dep't of Transp., Office of Pub. Affairs, DOT 157-08: New August Data Show Americans Drove 15 Billion Fewer Miles than a Year Ago, U.S. Transportation Secretary Mary Peters Announces (Oct. 24, 2008), http://www.dot.gov/affairs/dot15708.htm.

123. *Id.* (emphasis added). September posted a decrease of 11 billion miles driven. Lena H. Sun, *As Gas Prices Fall, Transit Still Popular; Economic Woes, Low Cost Help Push Up Ridership*, WASH. POST, Dec. 2, 2008, at B1.

124. Press Release, U.S. Dep't of Transp., *supra* note 122.

125. Kleeman Blog, http://kleemanblog.blogspot.com/2008/10/significant-decreases-in-

There are a myriad of statistics demonstrating this radical change in behavior, but a few are especially relevant. In addition to a lower number of cars and fewer VMT, use of public transit increased 6.2% nationally during the summer of 2008,[126] with higher spikes around the country.[127] The trend is also reflected in major roads throughout the country: compared to a year ago, daily traffic on the Indiana Toll Road decreased 22.2% (approximately 27,800 vehicles per day), while traffic on the Chicago Skyway dropped 14.6% (7,500 vehicles per day) over the same period.[128]

Secondary effects are already being felt as well, as the cost of commuting has made "three-fourths of prospective homebuyers . . . more inclined to live in an urban area because of fuel prices, according to a recent survey of 903 real estate agents with Coldwell Banker, the national brokerage firm."[129] This, too, is a nationwide trend: "A Portland economist predicts that buyers soon will choose where to live based on what they would spend for gasoline."[130] The gas price increases, of course, are just one factor in the tumultuous housing market, so it is impossible to predict what the future of suburbia will hold. But even a slowdown or slight drop in suburban sprawl would be a drastic departure from the decades of outward expansion around American cities.[131] This trend showed no signs of stopping until recently, but it is impossible to deny that it has slowed significantly or stopped altogether.[132] Whatever the future holds, it is

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automobile.html (Oct. 29, 2008 10:32 EST) (pointing out "that in the Southeastern states the decrease was 7.4 percent"). For more information, visit FHWA's Traffic Volume Trends website for monthly state by state data regarding traffic trends, measured by percentage of change. FED. HIGHWAY ADMIN., TRAFFIC VOLUME TRENDS, http://www.fhwa.dot.gov/ohim/tvtw/tvtpage.cfm (last visited Oct. 2, 2009).

126. Press Release, U.S. Dep't of Transp., *supra* note 122.

127. The Dallas Area Rapid Transit system (DART), for example, experienced a 15% increase in ridership over the summer. *Id.*

128. *Traffic Hit Hard by Fuel Prices - Average Down Over 5%, but Some Way Worse*, TOLLROADSNEWS, Aug. 24, 2008, http://www.tollroadsnews.com/node/3697. Tollroadsnews further explains:

> Traffic on tax roads in the US seems to have dropped on average by 4 to 5% and on toll roads by 5 to 6% over the past year. The reduced travel is attributable almost entirely to the big run-up in gasoline prices . . . .
>
> Toll road traffic may be down marginally more than tax roads traffic because tollroads are somewhat skewed to discretionary travel.

Id.

129. Peter S. Goodman, *Fuel Prices Shift Math for Life in Far Suburbs*, N.Y. TIMES, June 25, 2008, at A18.

130. Rhodes, *supra* note 1, at B1.

131. *See* Rich Miller & Matthew Benjamin, *Wealth Evaporates as Gas Prices Clobber McMansions (Update1)*, BLOOMBERG.COM, June 9, 2008, http://www.bloomberg.com/apps/news?pid=20601109&refer=home&sid=a4kOXcpI3dQg ("Emerging suburbs and exurbs—commuter towns that lie beyond cities and their traditional suburbs—grew about 15 percent from 2000 to 2006, nearly three times as fast as the U.S. population . . . .").

132. Goodman, *supra* note 129, at A18 (citing numerous studies and statistics demonstrating the

unlikely to fit within the models that we once believed were accurate and upon which planners still rely.

It might be tempting to disregard these figures in the wake of 2009's drastic decline in gas prices. By March 2009, the national average retail price of gas hovered around $1.90 per gallon or less, a decrease of well over a dollar since the previous year.[133] Critics might argue that last summer's price increases were a fluke, which the market has now corrected.[134] If this were true, then the models that assume the availability of low-cost fuel would continue to perform adequately.

However, there is no reason to think that low prices will continue in the long term. Prices will almost certainly rise again in the medium to long term.[135] The current low prices are inextricably linked to two relatively short-term variables: the worldwide economic recession (decreasing demand), and the excess supply of cheap crude oil.[136] While the impact of these factors on the price of fuel has been significant, neither is likely to depress the price for more than a few years.[137] In fact, when posed with the hypothetical question of whether prices at the pump last summer were a fluke, the Associated Press's Energy Writer recently remarked:

> Actually, most experts say you're in for a nasty surprise if you believe that. . . . The economy will eventually recover, and experts say the same demand issues that helped drive prices sharply higher at the pump are not that far removed. And the ability to find new oil? That hasn't changed either: It's getting more difficult.[138]

For all these reasons, it is safe to assume that prices will return to and exceed 2008 levels in the long term. Even if that were not the case, one might hope and expect that the changes in behavior resulting from last year's high prices will persist even without the economic incentive.[139]

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slow growth of suburbs in the previous year).

133. Energy Info. Admin., Retail Gasoline Historical Prices, http://www.eia.doe.gov/oil_gas/petroleum/data_publications/wrgp/mogas_history.html (last visited March 15, 2008) (follow "United States" hyperlink).

134. Chris Kahn, *Will Gas Prices Stay Put for Long?*, S.F. CHRON., Mar. 17, 2009, http://www.sfgate.com/cgi-bin/article.cgi?f=/n/a/2009/03/17/national/a133847D67.DTL.

135. *Id.*

136. *Id.* (describing the "huge surplus of cheap oil" on the market and the decreased demand in both private and commercial sectors).

137. *See id*. (noting in particular that the excess supply will only keep prices down for the short term, but that Americans can expect "$150 to $200 oil" three to five years from now).

138. *Id*.

139. *See* Sun, *supra* note 123, at B1 (reporting that public transit use has remained high even since the decrease in gas prices).

Regardless, the general volatility of fuel prices demonstrates the problems facing modelers in this uncertain era. The problem is relevant even if gas prices remain depressed for the near future because it illustrates the large margin for error in modeling. These uncertainties are only acceptable within certain limits. The legal strategies discussed below will be available whenever radical changes occur in the world that are not accurately reflected in EIS models.

B. Impacts

Behavior is drastically changing in ways that we could not have anticipated before the summer of 2008. More importantly, it is changing because of factors that the current transportation demand forecasting models are not (and cannot) reflect or quantify.[140] The models simply cannot cope with changes that they were not built to measure or respond to, especially when those changes are as drastic as the ones Americans have made in the past year.[141] Nevertheless, planners will continue to use the models until improvements are made,[142] so it is important to analyze how these flawed models will impact the NEPA process in the immediate future.

Initially and most obviously, models that are not sensitive to the behavioral shift resulting from price increases will overestimate the number of vehicles on America's roads. The variables in the models—socioeconomic status, job locations, etc.—may not have changed significantly, so the model will continue to generate outputs that reflect the old assumptions. However, the number of trips actually generated has decreased significantly.[143] We do not know how much these figures will decrease, nor do we know of any way to estimate or model them because the data is not yet available.[144] Worse, we may never be able to model these behavioral changes adequately because of

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140. METROPOLITAN TRAVEL FORECASTING, *supra* note 39, at 67–72 (outlining some of the variables that TDFMs cannot respond to adequately).

141. *See* Sierra Club v. Costle, 657 F.2d 298, 332 n.116 (D.C. Cir. 1981). The EPA Administrator commented:

> The truth of the matter is that the model that we are using is a reasonably good model, but you can alter the outcome from that model dramatically by just simply changing a few key initial assumptions that you crank into the model. I think those assumptions need to be tested, frankly, in a public debate and in a formal rulemaking proceeding, where people comment for the record, set out their alternative assumptions, saying, "We think this is really more realistic."

Id.

142. *See* METROPOLITAN TRAVEL FORECASTING, *supra* note 39, at 115 (proposing several methods for improving the quality of TDFMs).

143. *See supra* text accompanying notes 121–28.

144. KUPPAM ET AL., *supra* note 93, at 9.

both the unpredictability of the modern fuel market[145] and the fundamental difficulties in modeling dynamic human responses to price stimuli.[146] It is clear, however, that the models underlying infrastructure EISs have significantly overestimated the number of vehicles that will use these roadways. Furthermore, because the majority of models do not consider alternative transportation to any significant degree, they underestimate the amount of people that are walking or biking—a factor that is likely to become even more significant over time.[147]

IV. LEGAL ISSUES

The most fundamental problem with relying on these erroneous models involves the scientific integrity requirement, which may provide the best opportunity for environmental plaintiffs to challenge an EIS. Few people would have ever expected driving to decrease in America over the course of a year.[148] Accordingly, modelers throughout the last decade have (quite reasonably) used estimates of increasing VMT each year to forecast travel demand.[149] However, now analysts must learn to cope with a significant decrease in highway use in order to build models that satisfy the scientific integrity requirement.[150]

A. A Courtroom Hypothetical[151]

Imagine how this problem might manifest itself in a hypothetical EIS that commenced about five years ago—the average amount of time an EIS

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145. *Id.*

146. METROPOLITAN TRAVEL FORECASTING, *supra* note 39, at 68 (discussing the difficulties in modeling "the full range of choices available to individuals").

147. *See id.* at 27–28 (suggesting that this underestimate could be by as much as 10% in some cities).

148. The National Energy Education Development (NEED) Project reports:

> The average American uses 500 gallons of gasoline every year. The average vehicle is driven more than 12,000 miles per year. That number is expected to increase about 40 percent during the next 20 years if Americans don't change their driving habits by using public transportation, carpooling, walking or bicycling.

NAT'L ENERGY EDUC. DEV. PROJECT, INTERMEDIATE ENERGY INFOBOOK 51, http://www.need.org/needpdf/infobook_activities/IntInfo/EfficiencyI.pdf (2008).

149. *See* Joseph B. White, *Home & Family – Eyes on the Road: The Next Car Debate: Total Miles Driven*, WALL ST. J., Feb. 5, 2008, at D2 ("From 1977 to 2001, the number of miles driven every year by Americans rose by 151%—about five times as fast as the growth in the population . . . .").

150. *See supra*, text accompanying notes 121–28.

151. I am indebted to Stephen Lawe, Director of Forecasting at Resource Systems Group, Inc., White River Junction, VT, for helping me craft this simplified hypothetical situation.

takes to complete.[152] In 2002, the interested parties propose to widen a circumferential highway around an American city from four to six lanes. To prepare the EIS, modelers must determine how many people could be expected to use this proposed road. First, they establish a baseline for comparison and calibration purposes. They determine through surveys and traffic counts that approximately 10,000 vehicles use the road each day during 2002. Based on the city's composition and its suburbs' growth rate and characteristics, they expect this number to increase by approximately 3% to 5% annually for the next 20 years. They model several different points along a timeline: a short-range projection of the year they anticipate building to begin (2007, about five years from the baseline), another increment about five years beyond that, and a long-range estimate of 20 years.

The process that has been summed up here in a few sentences in fact takes several years to do accurately. Assuming the EIS is compiled and submitted in six years—which is not uncommon—it is now 2008. A local environmental group files a lawsuit challenging the scientific integrity of the EIS. The best way for the agency to defend the model is to show that the 2007 short-term prediction matches actual traffic counts conducted during that same year. If the model is otherwise well constructed and its forecasts for 2007 are close to the real numbers for 2007, then the model should be defensible.

In the constant growth scenario the modelers predicted, the highway is expected to carry 11,592 vehicles daily (at 3% growth) in 2007. But as a result of high fuel prices, driving is down nearly 6% in the last year, rather than growing by the modest estimate of 3% per year. Public transit use is up about 6% as well, and the suburbs are not growing as expected, if at all. Instead of the steady 3% to 5% increase in VMT projected in the model for the years between 2003 and 2007, VMT followed this pattern: A 3% growth for the first two years when prices were still relatively stable; then about 1.5% for the next two years as prices made their first jump in the summer of 2005; and finally a 6% drop in the last year as prices spiked to record highs. This scenario would leave the circumferential highway carrying 9,991 vehicles per day in 2007. This is less than the 10,000 vehicles that used it when the study began, and 13.8% lower than the model's estimate for 2007.

There would be no way to defend the model in this scenario. The four-lane highway already exists and cars are using it, so the environmental plaintiff could conduct counts and present the court with figures showing that the model's prediction for 2007 to 2008 is clearly erroneous by a

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152. LINDA G. LUTHER & DAVID M. BEARDEN, CRS REPORT FOR CONGRESS: ENVIRONMENTAL STREAMLINING PROVISIONS IN THE TRANSPORTATION EQUITY ACT FOR THE 21ST CENTURY: STATUS OF IMPLEMENTATION 3 (2003), *available at* http://ncseonline.org/nle/crsreports/03Jun/RS20841.pdf.

statistically significant margin—nearly 14%. This would cast significant doubt on the reliability of the studies generally,[153] and make it hard to justify expanding the highway when the evidence shows that ridership has decreased since the project was proposed.

B. Scientific Integrity

Agency science can withstand general attacks on methodology, data collection, and even interpretation. It cannot survive when it is fundamentally wrong.[154] A plaintiff challenging a model in this context would need to demonstrate that the agency abused its discretion by relying on science that is so inaccurate it "preclude[s] informed decision-making and informed public participation . . . ."[155] Specifically, in order to force an agency to conduct a SEIS in this particular case, a plaintiff would need to show that new driving patterns constitute "significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts."[156]

1. Significant New Circumstances or Information

The decrease in driving in this country has been swift and undeniable. The numbers presented in Part III.A show that a major behavioral shift occurred in 2008 and indicate that TDFMs are unlikely to reflect this change. The models' lack of sensitivity to these behavioral changes and gas price spikes mean they will not be able to accurately forecast traffic patterns in the future until the methodology finds a way to cope with these issues.[157] It is also not reasonable to assume that traffic patterns will return to their

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153. As one professional modeler stated recently, it would be easy for the plaintiff to argue "If you're wrong about that, what else are you wrong about?" Telephone interview with Stephen Lawe, *supra* note 92.

154. *See* Nat'l Wildlife Found. v. Nat'l Marine Fisheries Serv., 422 F.3d 782, 798 (9th Cir. 2005) ("[T]he deference accorded an agency's scientific or technical expertise is not unlimited"); Am. Pub. Gas Ass'n v. Fed. Power Comm'n, 567 F.2d 1016, 1037 (D.C. Cir. 1977) (stating that the key question when a court is examining the legitimacy of a model is "not the extent to which the Commission methodology consisted of empirical observations, but whether its premises were supported by substantial evidence and whether its reasoning was sound").

155. Sierra Club v. Dept. of Transp. (*Sierra II*), 310 F. Supp. 2d 1168, 1187 (D. Nev. 2004).

156. 40 C.F.R. § 1502.9(c)(1)(ii) (2004).

157. *See* TRANSPORTATION CONTROL, *supra* note 84, at 1 ("[Existing methodologies prompt] serious reservations . . . concerning the accuracy of their results, the robustness of the underlying data, and whether the correct set of variables are captured in these current model systems."); *see also* TRANSP. RESEARCH BD., SPECIAL REPORT 245: EXPANDING METROPOLITAN HIGHWAYS: IMPLICATIONS FOR AIR QUALITY AND ENERGY USE 224 (1995) ("[T]he state of knowledge and modeling practice are not adequate for predicting with certainty the impacts of highway capacity additions.").

historical patterns, even if gas prices unexpectedly drop back to the lower levels seen in the 1990s and early 2000s.[158] For the reasons explored so far, it should be clear that circumstances have changed significantly, and the models do not reflect this change.

The environmental plaintiff from Part IV.A, for example, can clearly demonstrate that circumstances have changed drastically since the model was constructed. There are nearly 14% fewer cars on the highway than the model predicted. In fact, there are fewer cars than when the study began. In the hypothetical, this is only about 1,500 vehicles, but there are likely to be hundreds of thousands of vehicles on any major American highway each day.[159] Miscalculating the traffic demand on these highways by 14% would result in a tremendously inaccurate portrayal of the situation on the ground. Accordingly, a court should find that the EIS does not "make a reasonably adequate compilation of relevant information . . . and sets forth statements that are materially false or inaccurate . . . ."[160] At the very least, failure to incorporate these new findings into an EIS should constitute "ignor[ing] pertinent data . . . ."[161] Finding either of these, a court "may properly find that the EIS does not satisfy the requirements of NEPA, in that it cannot provide the basis for an informed evaluation or a reasoned decision."[162]

2. Relevance of Information to Environmental Concerns and its Bearing on the Proposed Action or its Impacts

Changed circumstances or new information alone are not enough to force an agency to conduct a SEIS. The new information must also bear directly on environmental concerns associated with the proposed project.[163] A court will not order an agency to conduct a SEIS unless the correct information would allow decision-makers and the public to engage in a

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158. *See* Haya El Nasser & Paul Overberg, *Cheaper Gas Not Shifting Road Habits, Driving Still Down in Uncertain Economy*, USA TODAY, Nov. 20, 2008, at 3A (quoting Transportation Secretary Mary Peters: "(T)his isn't just a phenomenon that quickly bounces back when fuel prices drop . . . ."); *see also* Sun, *supra* note 120, at B1 (describing and predicting a continued increase in public transit use). *But see* Clifford Krauss, *Drivers Take to the Road Again as Gas Prices Fall*, N.Y. TIMES, Oct. 30, 2008, at B1 (expressing contrary view, but relying mostly on anecdotal evidence and personal stories rather than statistics).

159. *See, e.g.*, CAL. DEP'T OF TRANS., TRAFFIC AND VEHICLE DATA SYSTEMS UNIT: 2007 ALL TRAFFIC VOLUMES ON CSHS, http://traffic-counts.dot.ca.gov/2007all.htm (last visited Oct. 3, 2009) (listing traffic counts for every highway in California).

160. Sierra Club v. U.S. Army Corps of Eng'rs, 701 F.2d 1011, 1030 (2d Cir. 1983).

161. *Id*. at 1029.

162. *Id*. at 1030; *see also* MANDELKER, *supra* note 22, § 10:50 n.12 (citing many examples of courts ordering SEISs based on new information and circumstances).

163. 40 C.F.R. § 1502.9(c)(1)(ii) (2004) (requiring a supplemental EIS where new and relevant information is present).

more informed decision-making process.[164] Continuing the hypothetical from the previous section, the data from the model is 14% percent too high. The more accurate traffic counts would call into question the necessity of expanding the roadway at all since there are fewer people using it in 2007 than when the project was conceived. This would severely affect the purpose-and-need and cost-benefit evaluations of the project.[165] When confronted with evidence of declining traffic counts, the city or state could easily decide that a larger highway is simply not needed. The no-build alternative would arguably fit the facts on the ground best. While a judge is unlikely to engage in this kind of second-guessing,[166] better information might well lead the public and the decision-makers to decide that a light rail, increased public transit, or a smaller road expansion would be more cost-effective and appropriate. Any of these decisions would have significantly different environmental implications from the proposed roadway expansion, but none would be addressed adequately without relying on better data than the current TDFMs can provide.

In addition to undercutting the purpose-and-need statement for the project, changed circumstances could render the rationale supporting a decision to build or expand a road "arbitrary and capricious."[167] NEPA's purposes are not served if incorrect information prevents decision-makers from balancing all the important factors that influence whether to build a major infrastructure project.[168] The errors in the current models should provide grounds to force the agency to reevaluate its estimates and methodology. The agency must be able to articulate a reasonable connection

164. Sierra Club v. Dept. of Transp. (*Sierra II*), 310 F. Supp. 2d 1168, 1187 (D. Nev. 2004). (declining to order a SEIS in spite of a minor flaw in the TDFM because the error would not have precluded informed decision-making and public participation).

165. *See, e.g.*, Earth Island Inst. v. U.S. Forest Serv., 442 F.3d 1147, 1160–67, 1160 (9th Cir. 2006) (addressing and agreeing with plaintiff's allegation that a Forest Service's EIS "substantially overpredict[s] tree mortality, with the result that many more trees will be cut than are necessary to meet the legitimate objectives" of the proposed project).

166. *See* Vt. Yankee Nuclear Power Corp. v. Natural Res. Def. Council, Inc., 435 U.S. 519, 549–53 (1978) (applying the arbitrary and capricious standard to the alternatives analysis of an EIS, severely restricting the realm of alternatives that an agency must consider and extending great deference to the agency's justification of whichever alternative it selects).

167. *See* Sierra Club v. Costle, 657 F.2d 298, 333 (D.C. Cir. 1981) (explaining that agencies must articulate a rational connection between the processes, assumptions, and results of their models in order to gain court approval).

168. *See* Calvert Cliffs Coordinating Comm. v. U.S. Atomic Energy Comm'n, 449 F.2d 1109, 1113 (D.C. Cir. 1971) ("[A]gencies must 'identify and develop methods and procedures . . . which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decisionmaking along with economic and technical considerations.") (quoting 42 U.S.C. § 4332(2)(B)).

between the facts found in the study and the selected alternative.[169] If the numbers do not demonstrate a need for a large project because of changed conditions, then any articulated rationale for building the large project should be rejected. A cost-benefit statement that claims the risk to the environment is acceptable due to high demand would be arbitrary and capricious because such a determination would not be supported by the facts confronting the agency—particularly, the decreasing numbers of drivers.

Several other problems are immediately apparent. First, an EIS's alternatives analysis would be inadequate because no alternative relies on an accurate demand forecast.[170] Second, models dealing with land use patterns will need to be recalibrated to account for the slowed pace of urban sprawl that most cities are experiencing.[171] This adjustment is particularly important in accurately gauging demand for circumferential highways and secondary roads that provide access from the suburbs into the cities.[172] Third, assessments of likely environmental impacts generally—and air pollution estimates in particular—will be exaggerated if they rely on inflated estimates of future road use. Although it is tempting to disregard this problem since it arguably leads to overestimates of environmental harm, changes that result in lower impacts than originally predicted can nevertheless be grounds for conducting a SEIS.[173] A correct evaluation of impacts would also need to account for the increases in public and alternative transportation. Without accurate information on all these issues in an EIS, decision-makers and the public cannot make a fully informed choice. Thus, the EIS would have to be rejected until the new information could be analyzed and included.

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169. *Id*.

170. *See* Natural Res. Def. Council v. U.S. Forest Serv., 421 F.3d 797, 810 (9th Cir. 2005) (finding that a model that did not reflect the true demand for timber could not reasonably be used to make an informed decision regarding how much timber to cut because there was no way to articulate a rational connection between the model's erroneous data and the decision reached).

171. *See* Goodman, *supra* note 129, at A18. A recent study showed that "house prices in the urban centers of Chicago, Los Angeles, Pittsburgh, Portland and Tampa have fared significantly better than those in the suburbs. So-called exurbs—communities sprouting on the distant edges of metropolitan areas—have suffered worst of all . . . ." *Id.*

172. METROPOLITAN TRAVEL FORECASTING, *supra* note 39, at 27–28 (discussing the role of land use patterns in trip generation models).

173. *See* MANDELKER, *supra* note 22, § 10:49 n.5 (listing examples of courts so finding). *Contra id.* § 10:51 n.10 (listing cases where no new study was ordered). Those courts that have ordered an agency to prepare a supplemental impact statement even if new information or new circumstances are beneficial to the environment reasoned that "the key issue is the significance of the new information or circumstance, not whether it has an adverse effect." *Id*. at § 10:49.

C. Going Forward

It is clear that current TDFMs are not accurate. However, even if a court determines that an EIS based on flawed traffic models is unreliable, an agency will try to avoid conducting new studies by simply incorporating a disclaimer into the EIS.[174] The agency will argue that even if its science is inadequate, better information "cannot be obtained because the overall costs of obtaining it are exorbitant or the means to obtain it are not known."[175] This argument will pose a problem since no model currently in use was designed to handle five or six dollar gas prices. It is very likely that none of the current models can handle those prices with sufficient accuracy. If an agency concludes that the means to achieve the desired level of accuracy are unknown, then they will have to set forth the reasons and implications of this conclusion.[176] Given the great uncertainty and challenges in the modeling field right now, this conclusion may be fair. However, decision-makers still need to know about this uncertainty in order to weigh it along with all the other factors surrounding the decision to build a major infrastructure project.[177] Therefore, the agencies should be forced to address uncertainties in the analysis.

There are better models available than the traditional four-step TDFMs currently in use by most planning agencies,[178] and the costs of adapting them to reflect the changing travel patterns may not be "exorbitant."[179] It would be expensive and would require a serious commitment by the agency, but a plaintiff may be able to convince a court that the increased reliability justifies the expense. Many planning organizations have already recognized the flaws that exist in these models, and they are attempting to address them.[180] As the better models become more commonly used, the problems identified in this paper will begin to dissipate. Nonetheless, there are already models that do a significantly better job of incorporating these issues into their calculations, so environmental plaintiffs should try to force agencies to use these models for major projects. This will serve the usual

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174. 40 C.F.R. § 1502.22 (2004).

175. *Id.*

176. *Id.* § 1502.22(b).

177. METROPOLITAN TRAVEL FORECASTING, *supra* note 39, at 71–72 (urging modelers to include range estimates or discussions of the limitations of their models in their reports).

178. *Id.* at 90–100 (listing several alternative, state of the art models that more accurately reflect the discrete choices people make).

179. 40 C.F.R. § 1502.22(b). The regulations do not define "exorbitant."

180. *See* METROPOLITAN TRAVEL FORECASTING, *supra* note 39, at 61–64 (listing the problems with a few of the "[c]ommon practice[s]" in modeling and some of the alternatives that may achieve better results).

goals of delaying a project and forcing the responsible agency to present environmental issues honestly and accurately. This candor will allow for more reasoned decision-making on the best ways to improve America's infrastructure in an environmentally responsible way.

CONCLUSION

Including inaccurate data in an EIS does nothing to further NEPA's twin aims of informing both policy makers and the public about the environmental implications of proposed projects. In fact, when presented with grossly inflated traffic estimates, decision-makers might believe they need to invest in roadway expansions when, in fact, real traffic counts are declining. Challenging these clearly erroneous traffic demand models would be an effective and worthwhile method of forcing the government to be honest about the usefulness and impacts of new infrastructure projects, thereby helping federal agencies catch up with the American citizenry, who have already shown they are ready to move beyond the sprawl-and-drive mentality of the previous half century.

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