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Articulating a Net Health Effects Challenge to Emissions Trading Markets

By Nicklas A. Akers✪

> *"[I]t is our judgment that the Clean Air Act of 1970 is based in important part on a policy of non-degradation."*
>
> *Sierra Club v. Ruckleshaus*, 344 F. Supp. 253, 256 (1972).

I. Introduction

Emissions trading markets generally measure their commodity — pollution — in total tons of emissions within an airshed. But when the contaminant traded causes localized adverse health effects, this approach can fail and allow trades that produce a net increase in pollution — attributable to illness and injury. The Clean Air Act ("CAA") and state environmental laws offer tools for environmentalists and environmental justice advocates to challenge such trades and the trading systems that produce them, particularly where they impact densely populated communities of color.

Market based solutions have become the method of choice for implementing environmental law and policy. From trading water pollution discharge rights under the Clean Water Act[1] to endangered species habitat trades,[2] many recent developments in environmental regulation have focused on taking market based approaches to increase flexibility in and reduce the cost of compliance with environmental statutes. The CAA regulation of air pollution sources has been no exception — incorporating both classic pollution credit trading systems[3] and requirements that new or

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1. *See* OFFICE OF WATER, U.S. E.P.A. Pub. No. E.P.A. 800-R-96-001, DRAFT FRAMEWORK FOR WATERSHED-BASED TRADING (1996).

2. *See, e.g., Sierra Club v. Babbit*, 15 F. Supp. 2d. 1274 (D. Ala. 1998).

3. 42 U.S.C. § 7651(b).

modified sources purchase offsetting[4] "emission reduction credits."[5] These approaches were integral to the 1990 CAA Amendments[6] and have been actively implemented by the Environmental Protection Agency ("EPA") and state and local agencies responsible for enforcing the CAA.

These trading programs have stimulated both active emissions markets and equally active criticism by environmental and environmental justice groups. Environmentalist critics have focused on the moral and symbolic implications of pollutant trading and on failures in implementation. Environmental justice critics have claimed that the trading markets produce "hot spots" of pollution centered in underrepresented communities.[7] These trades are also open to another critique because markets organized around the commodity of pollution measured in tons of emissions and blind to the local health effects caused by the migration of those emissions can allow trades that increase the aggregate risk of death and disease in a region.[8] This paper applies public health techniques to model and evaluate information about Volatile Organic Compound ("VOC") trading in one air market and considers two case studies. These models show the potential of VOC trading markets designed around tons of emissions, rather than health effects, to fail and allow trades that cause a net increased burden on human health. These failures can occur because of the differences in the communities between which emissions are moved and because of the differences in health effects produced by the family of chemicals classed as volatile organic compounds.

Emission credit trades allow the user to increase emissions or to forego a reduction that would otherwise be required by the baseline of command and control regulations in exchange for "excess" emissions reductions by another facility.[9] Excess emissions reductions are judged against the baseline of command and control emissions limits. Underlying such a market system is the assumption of no net negative effect — that a trade will not compromise efforts to achieve pollution reductions in providing flexibility to polluters. When the purchaser of a credit uses it in a manner that has more serious impacts on human health than the seller's prior use of the credit had, the transaction increases risk to human health. A trade that produces a net negative effect such as this betrays the promise that markets will achieve flexibility without cost to pollution reduction goals.[10]

In the legal arena, the CAA[11] and state environmental laws[12] provide doctrinal tools to challenge trades that produce a net negative health effect. Environmental and environmental justice advocates should add a health-based perspective, and the legal tools that compliment it, to their current tool kit of procedural and disparate impact based legal challenges. In the policy forum, environmental regulators should adopt two reforms to classic trading markets. First, data generation and distribution requirements should be instituted to enable the modeling of trading system health impact. Second, backstop requirements should block trades which result in an aggregate increased risk of morbidity and mortality.

4. 42 U.S.C. § 7503(a)(1)(A).

5. *See, e.g.*, CAL. HEALTH & SAFETY CODE § 39617 (Deering 2001).

6. *See, e.g.*, 42 U.S.C. § 7401(a)(2)(A) (2001) (amended 1990).

7. Complaint and Memorandum for Relief from Environmental Justice Violations, Cmtys. for a Better Env't. v. S. Coast Air Quality Mgmt. Dist. (E.P.A. No. 10R-97-R9) (filed July 23, 1997) (hereinafter "CBE Compl.").

8. *See* discussion *infra* § 5B1b.

9. *See supra* text accompanying notes 23-33.

10. *See* Richard B. Stewart & Jonathan B. Wiener, *The Comprehensive Approach to Global Climate Policy: Issues of Design and Practicality*, 9 ARIZ. J. INT'L & COMP. L. 83, 93 (1992) ("Under the acid rain provisions of the 1990 Clean Air Act, ambitious sulfur control requirements are extended to all utility sources. But sources are allowed the flexibility to achieve reductions in any way they choose — whether through use of scrubbers, low-sulfur coal, new combustion technologies, or reduced electricity generation due to conservation and demand-management techniques. Moreover, sources that reduce sulfur emissions further than they are required may sell their excess reductions to others who find it more difficult or costly to achieve reductions.") *Id.*

11. 42 U.S.C. §§ 7401-7671(q).

12. *See, e.g.*, CAL. HEALTH & SAFETY CODE §§ 39600-39617 (Deering 2001).

II. The Place of Emission Credit Trading Within the U.S. Clean Air Law

The United States system of air pollution law employs regulation at the federal, state and local levels implemented through a permitting system for continuing, modified and new emissions. The CAA[13] establishes a general framework for this system. It requires the EPA to set air quality standards — the National Ambient Air Quality Standards ("NAAQS") for a variety of pollutants.[14] These pollutants include oxides of Nitrogen (NO_X) and Sulfur (SO_X) and VOCs, (ozone precursors).[15] In areas where ambient air complies with NAAQS, the CAA and EPA regulations imposed thereunder require that local agencies mandate emissions limitation so as to prevent "significant deterioration" of air quality.[16]

In areas where ambient air does not comply with the EPA's NAAQS, the CAA requires that emissions controls and permitting systems be implemented to reduce the amount of pollution and bring air quality into compliance with the NAAQS.[17] These regulations reach many sources of pollutants. Subchapter I of the Act deals with fixed sources.[18] It establishes a requirement for the review of new sources of emissions,[19] which is implemented through the CAA Subchapter V source permitting system.[20] New facilities must offset any increase in their emissions through an equal or greater decrease in their own or another facility's emissions in the same area.[21] The EPA's 1976 interpretive guidelines first described the agency's approach to offsetting emissions reductions from the same or another plant in noncompliance areas.[22]

These offsets,[23] or "Emission Reduction Credits"[24] can come from a facility's own operations, or reductions at another facility. "Internal" trades are the most common. A facility can shut down or clean up one process and apply this reduction in emissions to offset against new emissions or foregone reductions from another process.[25] Conceptually, the EPA places a "bubble" around an industrial facility. Emissions of the plant as a whole, rather than individual operations, are subject to a permit so that an excess reduction in one process' emissions can compensate for an increase or failure to meet target emissions reductions in another process. For example, consider a printing plant with five presses. Instead of a separate permit covering the VOC emissions of each press, the entire plant is viewed as a whole. This approach provides facility managers with flexibility in designing compliance plans. They are able to select the processes that will receive technological "fixes" or those operations will be shifted to sufficiently reduce overall emissions. In the end, the quantity of emissions for each "bubble" is meant to be less than or equal to the amount of emissions that would have been produced if the plant had installed the level of control technology mandated by command and control regulations onto each individual operational unit.[26]

13. 42 U.S.C. §§ 7401-7671(q).

14. 42 U.S.C. § 7409.

15. *Id.* VOCs are alternately referred to as reactive organic gasses (ROGs), Volatile Organic Materials (VOMs), and hydrocarbons (HCs).

16. 42 U.S.C. § 7410(a)(2)(I) (adopting an approach first set forth by the D.C. District Court in *Sierra Club v. Ruckelshaus*, 344 F. Supp. 253 (D. D.C. 1972)).

17. 42 U.S.C. §§ 7501-7515.

18. 42 U.S.C. § 7411(a) (defining fixed sources).

19. 42 U.S.C. § 7410(a)(2)(C) (discussing New Source Review).

20. 42 U.S.C. §§ 7661-7661(e).

21. 42 U.S.C. §§ 7503(a)(1)(A), 7503(b).

22. Air Quality Standards, 41 Fed. Reg. 55,524-25 (1976) (interpretive ruling) (discussing offsets). *See also* Emissions Trading Policy Statement, General Principles for Creation, Banking, and Use of Emission Reduction Credits, 47 Fed. Reg. 15,076 (Jan. 4, 1982) (proposed policy) (discussing emissions reduction credit generation).

23. 42 U.S.C. § 7503(a)(1)(A).

24. *See, e.g.*, CAL. HEALTH & SAFETY CODE § 39617 (Deering 2001).

25. 42 U.S.C. § 7511(a)(g)(4)(A) (setting forth the CAA's provisions relating to trading oxides of nitrogen (NO_X) and VOCs).

26. Trading under this system may allow a company to make more cost effective reductions in emissions through flexibility in what technology is adopted. If that is the case, the flexibility may allow greater aggregate emissions reductions among all polluters because of a reduction in the average cost of an emissions reduction in comparison to a command and control system.

The EPA also allows trades between facilities.[27] These trades have been the subject of greater controversy than those within a single facility. A facility that reduces its emissions of a target substance by a greater amount than is required by current law can market those additional reductions to new or modified sources.[28] A hypothetical power plant that reduces its emissions of SO_X below the levels required by law can sell those reductions to a new source, such as a power plant just starting its operations. These external trades, like internal "bubble" transactions, are meant to give flexibility to business. Conceptually, they achieve the same amount of aggregate emissions in the basin as a classical command and control system would. But they allow reductions to be made where they cost the least.[29] As described within the EPA's emissions trading policy statement, both of these approaches focus on the total emissions from a process, the "smokestack" approach, rather than the environmental or human health impact of the emissions.[30]

The 1990 CAA Amendments required that the EPA expand its use of market based or economic incentive approaches.[31] This has prompted the expansion of programs that allow facilities to substitute other facilities' use of emissions controls above and beyond those required for their own reductions in emissions.[32] These incentives markets are largely created and administered by state and local air pollution control agencies.[33]

The CAA delegates primary authority to establish, implement, and enforce pollution control regimes to the states under EPA-approved State Implementation Plans ("SIPs").[34] This structure has been described as a "bold experiment in constitutional federalism."[35] As an example, in California, authority at the state level is held by the California Air Resources Board ("CARB"). In turn, it is delegated by the states to counties or special regional authorities, such as the South Coast Air Quality Management District ("SCAQMD"), which covers a multi-county area in the vicinity of Los Angeles[36] or the Bay Area Air Quality Management District ("BAAQMD"), which has jurisdiction over the counties of the San Francisco Bay Area. Both the state agency and the EPA must approve amendments to local plans before they become effective.[37]

A number of states have been active in constructing emissions trading markets. In the Northeast, a multi-state coalition is working on developing trading regimes in the Ozone Transport Region for Oxides of Nitrogen (NO_X).[38] Illinois operates a system for trading volatile organic material[39] in the Chicago area.[40] This program, the Emissions Reduction Market System,[41] is operated by the Illinois State EPA and allows the trading of excess reductions in

27. *Air Quality Standards*, 41 Fed. Reg. 55,524-25 (1976) (interpretive ruling).

28. *Id.*

29. Emissions trading markets should in theory provide signals to regulators about the actual cost of achieving reductions in emissions in various industries based upon the regulated community's willingness to purchase credits or reduce emissions, and the cost of those credits. Daniel C. Esty, *Toward Optimal Environmental Governance*, 74 N.Y.U. L. REV. 1495, 1531-74 (1999) ("By creating a market in pollution (and emission control), the 1990 Clean Air Act established incentives for the generation of information (particularly on the level of emissions and the costs of control) on a highly disaggregated basis, making possible a much more refined and cost-effective regulatory strategy and encouraging action by those in a position to reduce SO_2 and NO_X emissions at the lowest cost."). *Id.* at 1531.

30. National Emission Standards for Hazardous Air Pollutants for Source Categories, 57 Fed. Reg. 62,608, 62,683 (Dec. 21, 1992) (discussing the EPA's Emissions Trading Policy Statement of December 4, 1986 at 51 Fed. Reg. 43,814).

31. 42 U.S.C. § 7410(a)(2)(A).

32. *See, e.g.*, SCAQMD Reg. XX.

33. 42 U.S.C. § 7410(a)(2)(A).

34. 42 U.S.C. § 7407(a).

35. Bethlehem Steel v. Gorsuch, 742 F.2d 1028, 1036 (7th Cir. 1984).

36. SCAQMD has jurisdiction over urban portions of Los Angeles, Orange, San Bernardino and Riverside Counties. CAL. HEALTH & SAFETY CODE § 40400 (Deering 2001).

37. Cmtys. for a Better Env't v. Chevron, No. CV# 97-5412DT(BQR$_X$) (C.D. Cal. 1998); Maria Cone, *Judge Rules Smog Plan Cutbacks Illegal*, LA TIMES, Oct. 6, 1998, at A1.

38. EPA Open Market Trading Rule for Ozone Smog Precursors Proposed Policy Statement and Model Rule, 60 Fed. Reg. 39,668, 39,670 (Aug. 3, 1995).

39. Volatile Organic Compounds ("VOCs") are referred to as volatile organic materials ("VOMs") in the Illinois statutes and regulations.

40. EPA Open Market Trading Rule for Ozone Smog Precursors Proposed Policy Statement and Model Rule, 60 Fed. Reg. 39,668, 39,670 (Aug. 3, 1995).

41. *See* 415 ILL. COMP. STAT. ANN. § 5/9.8 (West 2000); Ill. Reg. Tit. 35 § 205.1 (West 2000).

emissions within the Chicago ozone reduction region.[42]

In the Los Angeles air basin, SCAQMD has focused its attention on reducing particulates, NO_X, O_3, and O_3 precursor substances such as VOCs. The agency's "Regional Clean Air Incentives Market" ("RECLAIM")[43] allows stationary sources to trade among themselves reductions in emissions of oxides of nitrogen ("NO_X") and sulfur dioxide ("SO_2")[44] in order to comply with emissions limits. The agency has proposed an expansion of the RECLAIM program to include the trading of VOCs between stationary sources.[45]

SCAQMD allows stationary sources to use credits obtained from mobile sources — so-called Mobile Source Emission Reduction Credits ("MSERCS").[46] The District's "car scrapping" program allows stationary sources and credit brokers to purchase and scrap older, functional vehicles registered in the district.[47] The system operates under the assumption that the vehicles to be scrapped are being used in the air district, and that taking them off the road will result in their replacement by the use of lower polluting means of transit, either public transit or newer, cleaner vehicles. The program grants credits for these projected reductions of NO_X and VOC.[48] MSERCS may be earned directly by a stationary source operating its own scrapping program[49] or by independent scrappers, usually automotive junkyards, which sell the emissions reductions to brokers or directly to the stationary sources.[50] MSERCs are generated for reductions in NO_X, SO_2 and VOCs. The system does not allow inter-pollutant trading. A reduction in one substance, such as NO_X, count toward a reduction in emissions of VOCs.[51] This program appears to be unique in allowing the exchange of offsets between different types of sources — mobile and stationary — and allowing the credits generated to be applied to a number of different stationary source emissions regulations. Use of MSERCs has proved popular among the Los Angeles area's oil refineries and the associated marine terminals used to offload crude oil and transfer processed petroleum products to and from oil tankers moored near San Pedro and El Segundo.[52]

The RECLAIM and car scrapping programs are two examples of a general trend toward market-based programs and away from command and control systems of regulation.[53] Command and control regulations mandate specific emissions control technology or set specific emissions limits on process or facility emissions without allowing burden-shifting through trading. In addition to the classic trading programs discussed above, the SCAQMD and other air quality authorities, as part of the CAA required new source review — the permitting process for new or modified emitters of pollutants — require that new emissions be offset.[54] Any new emissions from a new or modified facility must be offset by a corresponding reduction in emissions from another facility in the air quality control region.[55] The offset may come from another

42. I*d*. *See also* http://epa.state.il.us/air/caapp/erms.html (last visited Feb. 25, 2000) (containing a description of the program).

43. SCAQMD Regulation XX. For a discussion of RECLAIM *see* SCAQMD, R*eclaim M*e*ans*, *at* http://www.aqmd.gov/reclaim/reclaim.html (last visited Jan. 30, 2000).

44. SCAQMD has abandoned, at least temporarily, plans to expand RECLAIM to encompass VOC trading, as many VOC trades are based on "fugitive" emissions and reductions therein are difficult to track. "Fugitive" emissions are those that do not come from a traditional source, such as the proverbial tail pipe, but come instead from leaks in a system, equipment servicing and cleaning, and the like. Proposed SCAQMD Regulation XX (1995) (including text of the proposed rules).

45. Proposed VOC Reclaim Report, SCAQMD Nov. 24, 1995, Proposed Revised Rule 2000 *et seq*. (RECLAIM is described at Regulation XX). The agency appears to have abandoned its attempts to expand RECLAIM. Marla Cone, A*nti-S*m*og P*l*an A*p*pears L*i*kely to B*e *S*helved*, L.A. TIMES, Jan. 12, 1996, at A1.

46. SCAQMD R. 1610.

47. SCAQMD R.1610(c).

48. SCAQMD R.1610(a), (j).

49. For a discussion of RECLAIM, see authorities collected *infra* notes 78, 81, 85.

50. I*d*.

51. SCAQMD R.1610(i).

52. CBE Compl., *supra* note 7.

53. S*ee, e.g.*, 42 U.S.C. § 7401(a)(2)(C) (amended 1990); OFFICE OF WATER, U.S. E.P.A., No. E.P.A. 800-R-96-001, DRAFT FRAMEWORK FOR WATERSHED-BASED TRADING (1996) (discussing watershed based trading under the Clean Water Act's NPDES system.).

54. SCAQMD R.1303(b)(2), 1309.

55. SCAQMD R.1303(b)(2), 1309(d).

facility adopting emissions controls, changing its operations to a process that pollutes less or shutting down all or part of its facility. The principal pollutants of interest in the SCAQMD include oxides of nitrogen, ozone, particulates, and ozone precursors — VOCs.[56] The District's offsetting program requires offsets — referred to by SCAQMD as Emissions Reduction Credits ("ERCs") for new sources of these substances.[57] The amount of VOCs traded within such systems is substantial. In 1998 alone, California's air districts reported emissions reduction credit transactions totaling 443 tons of VOC emissions.[58]

The emission reduction credit program also uses the bubble methodology (described *supra* section II). Bubbles can serve as a methodology for calculating "internal" offsets from reductions in existing process emissions that can allow increased emissions from new processes.[59] Generators of ERCs can also use the bubble methodology to determine their aggregate amount of "surplus" reduction that can be transferred to a new source.[60]

Generators of ERCs need not be stationary sources such as industrial facilities. SCAQMD has recently expanded its program to include emissions from non-SCAQMD-regulated small sources.[61] The Sacramento Air Quality Management District ("SMAQMD") has allowed the creation of ERCs from the replacement of small gasoline powered engines with electrical devices — such as for home gardening equipment.[62] The district also found that emission reduction credits had been created by a reduction in emissions from a non-SMAQMD regulated source — the stand down of B-52 Bomber operations at a local U.S. Air Force installation.[63]

Regardless of the source, these market or quasi-market programs allow the transfer of emissions from a shut down or reduced source to a new or expanded source of emissions. The programs allow these trades within the same air district or control region with the intent of providing flexibility in opening new facilities or operating old ones while maintaining a constant level of pollution in a region. In other terms, allowing no increased impact.[64]

The recent expansion of emissions credit trading programs is not limited to programs with substantial potential to create "hot spots" at the community level. The CAA has established a wide-scale interstate trading system for sulfur emissions among states with coal-burning electrical utilities that release SO2, contributing to the acid rain problem.[65] The CAA has also proposed additional study and research of inter-pollutant SO2-NO_X trading.[66] Pursuant to the Montreal Protocol[67] on depletion of stratospheric ozone, the CAA establishes transfer authority for emissions of ozone-depleting chlorofluorocarbons (CFCs), both between U.S. states[68] and among the countries that are parties to the Montreal Protocol.[69] The Kyoto Protocol,[70] which is focused on controlling global warming due to atmospheric carbon

56. SCAQMD 1997 AIR QUALITY MANAGEMENT PLAN, Ch. 2 (1997).

57. SCAQMD R. 1303(b)(2), 1309.

58. CAL. AIR RES. BD, EMISSIONS REDUCTION OFFSET TRANSACTION COST SUMMARY REPORT FOR 1998 16 (Apr. 1999).

59. For a discussion of bubble methodologies under RECLAIM, see SCAQMD, *Reclaim Means*, *supra* note 43; *see also* Chevron v. NRDC, 467 U.S. 837 (1984) (discussing bubble methodology generally).

60. *Reclaim Means*, *supra* note 43.

61. SCAQMD R. 2506 (regulating area source credits for NO_X and SO_X).

62. Mobile Source Emission Reduction Credits are regulated by Sacramento Metropolitan Air Quality Management District Rule 1005. *See also* Sacramento Metropolitan Air Quality Management District, *Mow Down Air Pollution* 2000 http://www.airquality.org/mobile/wrapup.htm (last visited Apr. 20, 2000).

63. John Cox, *Environmentalists Slam Smog Emission Credits*, SACRAMENTO BEE, Sept. 24, 1998, at B1 (describing the response of CBE and other environmental groups).

64. 42 U.S.C. § 7503(c) (limiting potential sources of offsets to those within the same non-attainment area as purchaser).

65. 42 U.S.C. §§ 7651b(b), 7651c(f)(2).

66. 42 U.S.C. § 7651b(c).

67. *Montreal Protocol on Substances That Deplete the Ozone Layer*, Sept. 16, 1987. S. Treaty Doc. No. 100-10, 26 I.L.M. 1541 (1987) (in force Jan. 1, 1989).

68. 42 U.S.C. § 7671(f).

69. 42 U.S.C. § 7671(o).

70. Kyoto Protocol to the 1992 U.N. Framework Convention on Climate Change (FCCC) U.N. Doc. FCCC/CP/1997/L.7/Add.1(1998), *reprinted in* 37 I.L.M. 22 (1998).

emissions, also has provisions allowing trades of carbon quotas.[71] Some commentators have proposed granting carbon emissions credits for the preservation of carbon dioxide sinks, such as tropical rainforest.[72]

III. Environmentalist and Environmental Justice Critiques of Local Programs

Emissions trading has provoked strong critiques from environmental and environmental justice organizations. Some critiques have focused on trading in general as a method to regulate the environment. Others have dealt with specific applications of emissions trading, including SCAQMD's car scrapping programs. Generally, the programs have been attacked: (1) based on principle — that emissions trading is morally wrong; (2) based on allegations of faulty or fraudulent implementation; and (3) based upon the disproportionate effect of some programs in creating pollution "hot spots" in poor communities of color.

Philosopher critics of emissions trading, such as Harvard's Michael J. Sandel, have argued that granting a property or quasi-property right to pollute by commodifying pollution undermines the goals of pollution prevention and reduction that underlie environmentalism and environmental law.[73] Sandel observes that "[i]f a company is fined. . . for spewing excessive pollutant into the air, the community conveys its judgment that the polluter has done something wrong. A fee, on the other hand, makes pollution just another cost of doing business."[74] He argues that society ought not to abandon a nonmarket approach to pollution.[75] In effect, a "right" to pollute justifies and legitimates the production of pollutants. It dilutes the moral undertones of environmentalism. If a polluter has purchased a legally constructed and recognized "right" to pollute, might it not undermine our commitment to treat pollution as a social evil needing to be controlled, albeit one linked with socially useful activities?

Other critics of emissions trading have focused on problems in program administration. The documentation of emission reductions is susceptible to easy manipulation and policing is very difficult. Academics have argued that emission credit markets lack the internal controls built into many systems of exchange.[76] For example, absent liability regimes and enforcement, purchasers of emission credits have no interest in the quality of the emissions reduction they purchase.[77] If one ton of well-documented reduction and one ton of marginally documented reduction give equal right to pollute, the only basis for competition in the credit market will be price.

SCAQMD's car scrapping program has been repeatedly attacked for overestimating the quantity of reductions for sale in the market. Communities for a Better Environment ("CBE"), a California-based environmental justice organization, has repeatedly attacked the program for allowing credit users such as marine terminals and oil refineries to overstate the air quality benefit from taking old vehicles off the road.[78] CBE argues that SCAQMD and credit users have overestimated the remaining usable life of the vehicles that were scrapped.[79] CBE has also argued that the agency overestimated the program's effectiveness by underestimating the age of the replacement vehicles purchased by motorists turning in their current vehicles for recycling.[80]

71. *Cost Free*, THE ECONOMIST, Jan. 22, 2000, at 64; *The Rise of the Sink*, THE ECONOMIST, Jan. 22, 2000, at 65 (noting that some propose expand trading under the Kyoto Protocol on global warming to include credits from the preservation of sinks of carbon, such as rainforest).

72. *The Rise of the Sink*, *supra* note 71.

73. Michael J. Sandel, *It's Immoral to Buy the Right to Pollute*, N.Y. TIMES, Dec. 15, 1997. *See also* Daniel C. Esty, *Revitalizing Environmental Federalism*, 95 MICH. L. REV. 570, 576 (1996) ("Our sense of justice and fairness thus is offended when pollution harms go uncompensated or uncontrolled.") *Id.*

74. Sandel, *supra* note 73.

75. *Id.*

76. *See, e.g.*, David Driesen, *Free Lunch Or Cheap Fix?: The Emissions Trading Idea And The Climate Change Convention*, 26 B.C. ENVTL. AFFAIRS L. REV. 1, 65 (1998) (arguing that a purchaser of an emissions credit has no real "interest" in the quality or "workmanship" behind the reduction).

77. *Id.*

78. Letter from Richard Drury, CBE, to Michael Kenny, California Air Resources Board, 2 (Feb. 13, 1998); CBE Compl., *supra* note 7.

79. CBE Compl., *supra* note 7.

80. *Id.*

Bruce Lohmann, a former SCAQMD employee charged with inspecting vehicles being scrapped has reported that many of the scrapped vehicles sat unused and therefore had not contributed to any actual emissions.[81] He noted that visual and functional inspections of vehicles submitted for scrap did not require that the vehicles be legally operable on a public way.[82] Lohmann also described a number of cases where a vehicle owner brought a nonfunctional car to a scrapper, who would remove parts from other vehicles to make the car pass the brief pre-acceptance inspection.[83] At least one owner re-used the same engine block from one vehicle in several different chassis to collect repeated scrapping payments of $600-700.[84] These critiques suggest that overestimation of emissions reductions may result in more credits for new emissions being "produced" than is warranted by the actual reductions.

Emissions trading programs have also drawn criticism from the environmental justice movement for their impact on poor communities and communities of color.[85] Environmental justice can be characterized as a fusing of the civil rights and environmental movements. The movement has maintained a concern with the distributional effects of pollution, and particularly its effects on low income communities and communities of color. Concerns about toxic substances and their effect on Latino communities were a constant element of Ceasar Chavez's work with the United Farm Workers.[86] Environmental justice issues were again brought to prominence by the United Church of Christ's 1982 involvement in a landfill siting conflict in Warren County, North Carolina.[87] The Church's Commission for Racial Justice studied the associations between racial and socioeconomic characteristics of communities that house hazardous waste sites.[88] The study found that poor and black communities had a greater number of hazardous waste sites than average.[89] Standardizing for income, the study found race more predictive than income for the location of high concentrations of hazardous waste sites.[90] The study drew criticism from some,[91] and served as a rallying cry for others. Academics such as Professor Robert Bullard have led efforts to connect activism and scholarship in the area.[92] Some have published work investigating the association between race, siting, and the probability of cleanup.[93] Organizations have grown up around this relatively newly developed issue, such as CBE in California.[94] Luke Cole, a practitioner at the Center for Race, Poverty and the Environment has described the development of a field of "environmental poverty law"[95] which draws on an integration of legal tactics, grassroots organizing, and working with technical and scientific information.[96] Environmental and civil rights groups, such as the Sierra Club and NAACP

81. Deposition testimony of Bruce Lohmann, discussed in *Id.* at 3 and attached to *Id.* as Exhibit "A" (hereinafter "Lohman Dep."; Marc Cooper, *Smoke Screen*, NEW YORK TIMES LOS ANGELES, Feb. 5-11, 1998, at 9.

82. Lohman Dep., *supra* note 81, at 4.

83. *Id.*

84. *Id.*

85. CBE Compl., *supra* note 7.

86. *Comments of the Chairman*, U.S. *Environmental Protection Agency Office Of Environmental Justice In The Matter Of The Fifth Meeting Of The National Environmental Justice Advisory Council*, 9 ADMIN. L.J. AM. U. 623, 625 (1995) (commenting on the absence of Chavez and others from the council).

87. COMMISSION FOR RACIAL JUSTICE, UNITED CHURCH OF CHRIST, TOXIC WASTES AND RACE IN THE UNITED STATES: A NATIONAL REPORT ON THE RACIAL AND SOCIO-ECONOMIC CHARACTERISTICS OF COMMUNITIES WITH HAZARDOUS WASTE SITES 13 (1987).

88. *Id.*

89. *Id.*

90. *Id.*

91. Daniel Kevin, *Environmental Racism and Locally Undesirable Land Uses: A Critique of Environmental Justice Theories and Remedies*, 8 VILL. ENVTL. L.J. 121 (1997); Vicki Been, *Locally Undesirable Land Uses in Minority Neighborhoods: Disproportionate Siting or Market Dynamics?*, 103 YALE L.J. 1383 (1994).

92. *See, e.g.*, Robert D. Bullard, *Anatomy of Environmental Racism and the Environmental Justice Movement*, *in* CONFRONTING ENVIRONMENTAL RACISM: VOICES FROM THE GRASSROOTS (Robert Bullard, Ed., 1993).

93. *See id*; *see, e.g.*, James T. Hamilton & W. Kip Viscusi, *The Benefits and Costs of Regulatory Reforms for Superfund*, 16 STAN ENVTL. L.J. 159, 180 (1997) (finding that minority communities are less likely to receive technical assistance grants under Superfund than other communities); B*ut see* studies cited *supra* note 91.

94. The organization's web site is located at http://www.cbela.org (last visited Mar. 20, 2000).

95. Luke Cole, *Practicing Environmental Policy Law*, 19 ECOLOGY L.Q. 619, 661 (1998).

96. Luke Cole & Christopher Edley, Comments as Panelists on Race at the Harvard Civil Rights-Civil Liberties Law Review Conference on Lawyering in the 21st Century, Harvard Law School (Mar. 4, 2000).

Legal Defense Fund have joined lawsuits aimed at achieving environmental justice goals.[97] President Clinton's Executive Order 12898 on Environmental Justice marked an official voicing of concern over the racial and poverty-related distributional effects of environmental hazards.[98] A number of agencies have responded by creating their own environmental justice programs.[99] The EPA in 1993 formed the National Advisory Committee on Environmental Justice[100] under the Federal Advisory Committee Act.[101] It has also established a review process for complaints that the EPA or EPA-funded programs violate the Civil Rights Act's Title VI prohibition against discrimination by federally funded programs.

As the environmental justice perspective has developed, environmental permitting and regulation programs have been attacked for producing localized "hot spots." These are areas of concentrated pollutants from single or multiple sources of emissions that create areas of high health hazard.[102] Environmental justice concerns are implicated when these hot spots fall in low-income communities or communities of color. Some campaigns have used the EPA administrative process to bring Title VI based complaints.[103] Others have relied on a mix of political action and conventional "NIMBY"[104] techniques such as complaints for procedural violation of the National Environmental Policy Act or analogous state statutes.[105] Some advocates have integrated racial and ethnic issues into claims grounded in traditional attacks on agency compliance with public participation requirements. Members of the Latino community in Kettleman City, California successfully challenged a county permit authorizing the construction of a waste treatment facility.[106] The permit was issued without holding public forums in Spanish or considering comments written in Spanish.[107]

Other campaigns have attempted to craft legal tools focused on race and disparate impact. The highest profile example of this has been an attack on permitting for treatment, storage, and disposal facilities in Chester County, Pennsylvania. In *Chester Residents v. Seif*, a coalition of community members and activists sued the Pennsylvania Department of Environmental Protection for consistently granting permits to facilities located in a predominantly low-income and black urban area of a majority white county.[108] The plaintiffs noted that the county in question had a number of treatment, storage, and disposal facilities for solid and hazardous waste, all of which were located in this small urban region.[109] They argued that the EPA's regulations promulgated pursuant to Title VI of the Civil Rights Act prohibiting discrimination in federally funded

97. *Id.*; Complaint and Memorandum of Points and Authorities for Relief from Environmental Justice Violations, CBE *v.* SCAQMD (Title VI Complaint before EPA) 26 (document signed by representatives of the NAACP Legal Defense Fund, Communities for a Better Environment, and the Center on Race, Poverty and the Environment).

98. Exec. Order No. 12,898, 59 Fed. Reg. 7629 (Feb. 11, 1994).

99. *See* Interagency Working Group on Environmental Justice; Notification of Availability of Federal Agency Environmental Justice Strategies for Comment, 60 Fed. Reg. 6710 (Feb. 3, 1995) and 30,871 (June 12, 1995) (discussing environmental justice strategies of various federal agencies.); *In the Matter of Louisiana Energy Services*, 1998 N.R.C. Lexis 7, 13 (1998) (discussing NRC environmental justice strategy).

100. For more information see the agency's Environmental Justice web site at <http://es.epa.gov/oeca/main/ej/nejac/index.html> (last visited Mar. 13, 2000).

101. 5 U.S.C. § 9(c) (current committee charter filed with Congress Sept. 28, 1999).

102. CAL. HEALTH & SAFETY CODE § 44301(d) (Deering 2001).

103. *See, e.g.*, CBE Compl., *supra* note 7.

104. NIMBY (Not in my Back Yard) tactics are those procedural and substantive legal and political approaches that have been generally employed by concerned residents to delay and prevent land development or environmental permitting proceedings.

105. Cole, *supra* note 95, at 674 (discussing the Kettleman City TSDF campaign and litigation).

106. *Id.*

107. *Id.*

108. 944 F. Supp. 413 (E.D. Pa.1996). Some of the success of the environmental justice movement is in changing the face of the environmental movement, and in encouraging a "lawyers on tap" instead of a "lawyers on top" view of the world. There have been some exceptions where community members have been highly involved in the prosecution of citizen suits. For example, Citizens for a Better Environment v. Chrome Crankshaft, VC028531 (Los Angeles County Superior Ct., Cal. 1998) has had substantial community involvement and support; *California Environmental Group Sues for Water Contamination at School*, MEALEY'S EMERGING TOXIC TORTS, (Feb. 19, 1999); *California: Neighbors Sue Chrome Plating Shop Over Water Contamination*, Cancer, BNA STATE ENVTL. DAILY, Feb. 2, 1999, at D3.

109. *Chester Residents v, Seif*, 944 F. Supp. 413 (Pa. D. 1996).

programs gave them a private cause of action for the discriminatory effect of the state's actions.[110] While this view was upheld by the Third Circuit in *Chester Residents v. Seif*,[111] the Supreme Court granted certiorari.[112] After plans to build the challenged facility were canceled and the case thereby rendered moot, the Court vacated the 3rd Circuit's decision.[113] The Court's action in vacating the decision calls into question the viability of Title VI disparate impact claims. The Third Circuit's holding in *Chester Residents* relied heavily on the Supreme Court's holding in *Guardians Association v. Civil Service Commission*[114] that regulations promulgated pursuant to Title VI prohibiting actions with a disparate impact creates a cause of action for private individuals suing for disparate impact.[115] The narrow holding in *Guardians* was the product of a majority which is no longer on the Court,[116] making unlikely an expansion of the Guardians holding into a right to sue in the environmental context for environmental justice related claims.

The limited viability of Title VI as a litigation tool suggests the need for other doctrinal hooks for the environmental justice advocate.

IV. A Different Approach — Market Blindness.

The current emission reduction credit trading system commodifies emissions, measured in amounts of substance emitted into the air basin. Underlying this commodification is an assumption that emissions are fungible — that a pound of VOCs emitted in, for example, a heavily populated mixed-use neighborhood, is the same as a pound of VOCs emitted in an industrial park away from a residential population. This view is not entirely irrational. VOCs play an important role in the production of ozone, and as a catalyst for the chemical reactions that lead to the creation of photochemical smog in the troposphere.[117] Limiting the aggregate amount of VOCs released in an air basin is important to any attempt to control this process. If the only outcome of interest for VOCs is their role in ozone and photochemical smog production, a market need not look further than aggregate emissions. This focus on aggregate emissions was an underlying assumption of the EPA's 1996 emissions trading policy statement.[118]

But many VOCs do cause localized health effects — carcinogenic and non-carcinogenic — in communities that surround sources of emissions.[119] Some, like Benzene, are known human carcinogens.[120] Others, like Toluene, are not classified as carcinogens, but have the potential to cause neurological and other non-cancer injuries and illness.[121] Aggregate emissions are but one of a number of potential bases for establishing a market, or for testing a market's performance in avoiding inefficient

110. *Id.*

111. 132 F.3d 925 (1997).

112. *Seif v. Chester Residents Concerned for Quality Living*, 524 U.S. 914 (1998).

113. *Seif v. Chester Residents Concerned for Quality Living*, 524 U.S. 974 (1998).

114. *Guardians Ass'n v. Civil Serv. Comm'n Of The City Of* N.Y., 463 U.S. 582 (1983).

115. *Chester Residents v. Seif*, 132 F.3d 925 (1997).

116. *Guardians*, 463 U.S. at 584, n.2 (1983). Justice White, noted, "I conclude, as do four other Justices, in separate opinions, that the Court of Appeals erred in requiring proof of discriminatory intent." *Id.* at 584. The Justice commented that "[t]he five of us reach the conclusion that the Court of Appeals erred by different routes. Justice Stevens, joined by Justice Brennan and Justice Blackmun, reasons that, although Title VI itself requires proof of discriminatory intent, the administrative regulations incorporating a disparate impact standard are valid. Justice Marshall would hold that, under Title VI itself, proof of disparate impact discrimination is all that is necessary. I agree with Justice Marshall that discriminatory animus is not an essential element of a violation of Title VI. I also believe that the regulations are valid, even assuming arguendo that Title VI, in and of itself, does not proscribe disparate impact discrimination." *Id.* at n.2.

117. Daniel L. Costa & Mary O. Amdur, *Air Pollution*, in CASARETT AND DOULL'S TOXICOLOGY, 5th Ed. (1996) 857, 860; *Id.* at 873.

118. U.S. EPA, Emissions Trading Policy Statement; General Principles for Creation, Banking and Use of Emission Reduction Credits, 51 Fed. Reg. 43,814 (Dec. 4 1986), discussed at U.S. EPA, National Emission Standards for Hazardous Air Pollutants for Source Categories; Organic Hazardous Air Pollutants from the Synthetic Organic Chemical Manufacturing Industry and Seven Other Processes, 57 Fed. Reg. 62,608, 62,683 (Dec. 31, 1992).

119. *Compare* EPA Integrated Risk Information System (IRIS) document for Benzene (CASRN 71-43-2, updated Jan. 19, 2000) §II.A.1 (Benzene a "Class A" or known human carcinogen) with IRIS Document for Toluene (CASRN 108-88-3, updated 4/1/94) §II.A.1 (Tuolene "Class D" or non classified as a carcinogen).

120. IRIS Document for Benzene, *supra* note 119.

121. IRIS Document for Tuolene, *supra* note 119.

outcomes. In analyzing these localized trades, a key outcome of interest from a public health or population perspective is total disease burden.[122] In other words, if a trade is allowed, will the net result be a greater risk of illness and injury? A simple criteria for measuring the "efficiency" of a trade is whether it makes the effects of pollution worse. Under this view, a trade on the margin of a trading system that increases morbidity and mortality over that without the trade is not efficient.

A trading system that commodifies tons of emissions may fail this test. Where the market trades in tons of contaminant coming out of the proverbial smokestack rather than the effect of that contaminant on the community, the market may be blind to the real health effects of the system.This paper does not propose a trading market for "rights" to produce chronic disorders and cancers in receptor populations.[123] But when theoretically applied, such a model is a useful benchmark to test the performance of our current system in avoiding trades that increase burdens to health. In contrast to the customary net emissions market, this health effects market focuses not on aggregate emissions at the smokestack, but rather on the effects of those emissions on the receptor population.

To develop such a hypothetical market, there must be a means to assess the health effects of the emissions being traded. Public health provides the tools to examine the health effects of exposures on populations. Two tools of public health analysis — risk assessment and toxicology — are useful in developing this theoretical model. Modeling the effects of a substance on a human population is made easier by the application of a conceptual tool — the "Source to Target Paradigm."[124] A tool of environmental health practice, the paradigm focuses on the causal pathway from emissions to individual exposures and then to resultant health effects in those individuals.[125] This target-focused view evaluates the impact of an action by its effect on the target individual or population's health. Its goal is to describe those actions that cause illness or injury or increase the risk of injury above baseline.[126]

These techniques may be illustrated though the example of a hypothetical industrial process emitting VOCs. The substances disperse by wind and diffusion across the surrounding area. If the area is inhabited, residents of the area would be exposed to the substances in question. Atmospheric models could predict the amount of substances reaching the receptor population.[127]

Toxicological assessments provide a model of how the receptor population will, on average, respond to the exposures.[128] This assessment relies on information relating to the identity and properties of the substance, the amount released, and the environmental fate and transport of the substance — what happens to it in the environment.[129] This data along with an understanding of how rapidly the human body absorbs chemicals goes into estimating the biological dose to the population exposed.[130] Toxicological dose-response data can then be applied to estimate the risk of disease to the population in question. These considerations of localized human health effects from particular exposures are absent from the traditional emissions credit trading system.

V. Critiquing Fungibility from a Health Perspective

A. The Method — Toxicology and Risk Assessment

Toxicology and Risk Assessment can be applied to individual trades to model the health

122. *See, e.g.*, Frank Speizer, *Occupational and Environmental Lung Diseases: An Overview*, ENVTL. HEALTH PERSP. (Aug. 2000); *Global Disease Elimination and Eradication as Public Health Strategies*, MORBIDITY AND MORTALITY WEEKLY REPORT, Dec. 31, 1999, at 6.

123. Such a trading system might be even more problematic than the current formulation of emission credit trading under Dr. Sandel's approach. *See supra* note 63.

124. DADE W. MOELLER, ENVIRONMENTAL HEALTH 40 (1997) (illustrating the pathway approach to hazard evaluation).

125. *Id.*

126. *Id.*

127. *See, e.g., id.* at 39.

128. *Id.* at 30; David L. Eaton & Curtis D., *Principles of Toxicology*, CASARETT & DOULL'S TOXICOLOGY, (1996) at 18.

129. MOELLER, *supra* note 124 at 39.

130. *Id.*

impacts of the prior and proposed use of the emissions credit and thereby to assess its net effect on the human health of local communities.

Risk assessment can be conceived of as a three-part process.[131] First, a hazard is identified. Then, data on the health effects of exposure is analyzed to describe the level of risk posed to an exposed person or population at various levels of exposure. The population or individuals of interest are then studied to estimate the actual exposure of those individuals to the substance in question.

To paraphrase the early physician and toxicologist Paracleus, the poison is in the dose.[132] This states a conceptually simple proposition that can be difficult to model with useful precision. The effect of exposure to a substance is linked to the dose. Toxicology attempts to describe the general relationship between dose and response and to characterize the risk posed to those individuals by the exposure in question.[133]

These models are by their nature imperfect, but they provide a useful best estimate of the action of toxins on the human body. The EPA and National Academy of Sciences have recently commented on the deficiencies in the state of the art of toxicological risk modeling for cancer effects.[134] While offering aspirational goals for the field, their conclusions leave substantially unchanged the current methodology pending the development of additional tools of analysis.[135]

The goal of cancer and non-cancer health effects models is to establish a dose-response relationship — ascertaining the health effects associated with various biological doses of the substances in question.[136] Usually, the relationship is represented as a line on a graph with dose and response on the *x* and *y* axes ("dose-response curve").[137] The curve is often assumed to have a constant slope[138] (the "linearity assumption") and thus is often expressed as a rather simple linear equation. The effects of other substances may require more complex equation modelings.

Models of cancer health effects use risk of cancer as their measure of response.[139] EPA models rely on a no-threshold assumption.[140] Working from the thesis that cancers can begin with a single mutation, the no-threshold approach assumes that there is no dose of a carcinogen that poses no risk of cancer.[141] This means that a graphed carcinogenic dose-response curve would pass through the graph's point of origin, where both dose and biological response are zero.[142]

131. For a general discussion of risk assessment *see generally* Elaine M. Faustman & Gilbert S. Omenn, *Risk Assessment*, CASSARETT & DOULL'S TOXICOLOGY, 5th Ed. (1996) 75.

132. Phillipus Aureolus Theophrastus Bombastus VonHoenheif, *quoted in*, CASSARETT & DOULL'S TOXICOLOGY, 5th Ed. (1996), i. ("Solely the dose determines that a thing is not a poison").

133. Virginia Steward Houk & Michael D. Waters, *Genetic Toxicity of Complex Mixtures*, TOXICOLOGY & RISK ASSESSMENT PRINCIPLES, METHODS & APPLICATIONS, 370 (Anna M. Fan & Couis W. Chang, Eds., 1996).; *See also* Welford C. Roberts & Charles O. Abernathy, *Basic Elements and Approaches in Risk Assessment*, TOXICOLOGY & RISK ASSESSMENT PRINCIPLES, METHODS & APPLICATIONS, 245, 250 (Anna M. Fan & Louis W. Chang, Eds., 1996).

134. *See* Proposed Guidelines for Carcinogen Risk Assessment, 61 Fed. Reg. 17,960 (April 23, 1996).

135. *Id.*

136. MOELLER, *supra* note 124 at 14.

137. Eaton & Klassen, *supra* note 169 at 19-23; MOELLER, *supra* note 124 at 21.

138. The FDA, for example, uses a "nonthreshold, linear-at-low-dose extrapolation procedure that determines the upper level of risk." This Gaylor-Kodell model set forth in 50 Fed. Reg. 45,530-45,556 (1985) is discussed in Appendix 2 to William Hallenbeck, QUANTITATIVE RISK ASSESSMENT FOR ENVIRONMENTAL AND OCCUPATIONAL HEALTH, 157 (1993), and generally means that from the lowest data point, you draw a straight line to the origin (0,0).

139. MOELLER, *supra* note 124 at 21.

140. Generally, cancer causing agents are treated as zero-threshold substances — the assumption is made that no level of chemical exposure is without risk and thereby "safe", but that any exposure poses some risk. Roberts & Abernathy, *supra* note 133 at 218, 263 .

141. *Id.* at 226 (noting that the basis for this assumption is the presumed method of carcinogenesis - that the smallest component of a carcinogen could cause a cancer-inducing mutation - and that higher concentrations only increase the probability of an interaction with DNA that could cause such a mutation). B*ut see* Proposed Guidelines for Carcinogen Risk Assessment, 61 Fed. Reg. 17,960 (Apr. 23, 1996) (suggesting that as knowledge about the mechanisms of carcinogenesis develops this zero-threshold assumption may need to be refined).

The zero-threshold assumption for risk has focused regulators on limiting risk to acceptable levels, as California's Proposition 65 did at $1x10^{-5}$. *See* Brian K. Davis & A.K. Klein, *Medium-Specific and Multimedia Risk Assessment*, TOXICOLOGY & RISK ASSESSMENT PRINCIPLES, METHODS & APPLICATIONS 290 (Anna M. Fan & Louis W. Chang, Eds., 1996).

142. WILLIAM HALLENBECK, QUANTITATIVE RISK ASSESSMENT FOR ENVIRONMENTAL AND OCCUPATIONAL HEALTH 157 (1993) (appendix 2).

A cancer dose-response[143] curve such as that discussed above can be used to estimate the risk of cancer from a particular biological dose.[144] Exposure modeling allows the estimation of actual biological dose from an environmental concentration. In other words, it allows the estimation of the amount of a substance in air, food, or water that is actually taken in by and able to act on the body. If the exposure is from a gas or other airborne substance, mathematical models can estimate total exposure from the volume of air inhaled, the rate of absorption through lung tissue and skin area, and other such factors.[145] A composite model can then approximate the individual's increased risk of cancer attributable to that exposure.[146] Spatial analysis of population and emissions through a computerized geographic information system ("GIS") allows estimates of individual expopsure. Fundamentally, a GIS system allows the study of data that includes information on geographic location. Population and ground-level exposure data can be related geographically to estimate the population exposed to an emission and their level of exposure.[147] Estimates of risk from exposure can in turn estimate the population's cancer risk attributable to the exposure(s). GIS-based demographic analysis of communities surrounding permit applicants, including race and population density, is a key step in the EPA's methodology for testing for disparate impact under Title VI.[148]

The non-cancer health effects of a substance can also be described through dose-response curves. Initially, the curve is based on identifying a "no observed adverse effects level" ("NOAEL"): a dosage where the investigator is unable to identify any adverse effects on the subject.[149] A "no observed effects level" ("NOEL") and associated reference dose ("RfD") is derived from the NOAEL to determine an acceptable level of exposure, which includes an adequate margin of safety.[150] A "Hazard Index" of one ("HI=1") exists where the dose to an individual is equal to the RfD.

Conceptually, a hazard index of one denotes an exposure at the highest level where there has been no observed effect on biological processes.[151] A hazard index greater than one reflects exposure at a multiple of the RfD. As an example, a dose at five times of the NOEL would produce a HI of five. While some substances have no measurable threshold as regards chronic non-carcinogenic health effects, most have a threshold. In such a case, exposure below the NOEL is not expected to

143. National Academy of Sciences (1983) defines dose-response assessment as "The process of characterizing the relationship between the dose of an agent administered or received and the incidence of an adverse health effect in exposed populations and estimating the incidence as a function of human exposure to the agent." Roberts & Abernathy, *supra* note 140 at 254.

144. For a discussion of NOAEL, LOAEL, RfD *see* Roberts & Abernathy, *supra* note 140, at 256.

145. MOELLER, *supra* note 124 at 15.

146. B*ut see* discussion of synergistic and antagonistic interactions between substances, *infra* § V(A).

147. S*ee supra* text accompanying notes 180-185 for an illustration; Also OCR Methodologies, *infra* note 148.

148. The USEPA Office of Civil Rights ("OCR") methodology includes:

> "Step 2: Determining the Demographics of the Affected Population
>
> The second step is to determine the racial and/or ethnic composition of the affected population for the permitted facility at issue in the complaint. *To do so*, OCR *uses demographic mapping technology, such as Geographic Information Systems* (GIS). *In conducting a typical analysis to determine the affected population*, OCR *generates data estimating the race and/or ethnicity and density of populations within a certain proximity from a facility or within the distribution pattern for a release/impact based on scientific models*. OCR then identifies and characterizes the affected population for the facility at issue. If the affected population for the permit at issue is of the alleged racial or ethnic group(s) named in the complaint, then the demographic analysis is repeated for each facility in the chosen universe(s) of facilities discussed below."

U.S. E.P.A., INTERIM GUIDELINES FOR INVESTIGATING TITLE VI ADMINISTRATIVE COMPLAINTS CHALLENGING PERMITS (1998) 10 <http://es.epa.gov/oeca/oej/titlevi.html> (emphasis added).

149. Faustman & Omenn, *supra* note 131.

150. I*d.*

151. SCAQMD R.1401(c)(7); Davis & Klein, *supra* note 141 at 282-85.

have any known biological effect, or at least, no observed biological effect.[152] The NOEL can be disaggregated into a set of partial NOEL's for various organ systems — i.e. neurological, renal, etc. — to show the level of zero effect for various systems.[153] The substance NOEL is set at the partial NOEL for which there is the lowest threshold of effect.

Just as the carcinogenic dose-response relationship may be extrapolated from to derive an airborne concentration-response relationship for a respiratory exposure pathway, the Reference Dose ("RfD"), or dose equal to the NOEL, can be extrapolated from to estimate the airborne environmental concentration that will deliver the RfD to a person breathing that air.[154] This measure is the Reference Concentration ("RfC"), and it allows HI calculations to be made based on environmental exposure.[155] It should be noted that each level of abstraction adds uncertainty to these calculations.[156]

Generally, cancer risk or HI assessments are assessments based on the reference concentrations for a variety of organ systems affected by the substance. Cancer risk estimates are produced by a summing of the effects on a variety of organ systems.[157] In contrast, RfD is set with reference to the lowest level that will trigger any biological response in any organ system.[158] Determining the health effects of multiple chemical exposures is more complex, but the modeling techniques applied to the problem have produced a rough but workable solution.[159] Where substances have non-cancer effects on the same organ systems — for example, the nervous system — the substance-attributable hazard indices may be combined through addition.[160] Some chemicals interact in more complex ways. Some interact synergistically — producing a greater effect than would be expected from the two exposures were their effects added. A classic example of this is the devastating synergistic effect of combining smoking and asbestos exposure.[161] Other substances in combination can interact antagonistically. In other words, they have a subtractive effect, resulting in less biological effect than if taken individually.[162] Non-additive interactions are in general poorly studied, and additive models are usually applied to combining risks.

Modeling non-cancer effects is less straightforward. Any exposure to a carcinogen is assumed to pose a risk of cancer.[163] The risk increases as the level of exposure increases. Non-cancer effects may require exposure to a threshold level of a substance.[164] These effects are not generally expressed as risks of one outcome, like cancer, associated with particular exposure levels. Instead, they are expressed as exposure thresholds — minimum levels of

152. Some studies have suggested that the current NAAQS are inadequate, as some chronic conditions may be caused or exacerbated by exposure below the standards. *See, e.g.*, Costa & Amdur, *Air Pollution*, *supra* note 117; Schwartz, et al., *Harvesting and Long Term Exposure Effects in the Relations Between Air Pollution and Mortality*, AM. J. OF EPIDEMIOLOGY (Mar. 1, 2000). Some commentators have noted the general inadequacies in toxicological data regarding toxicants. *See* MOELLER, *supra* note 124, at 30. *See also* <www.chemicalindustryarchives.com.> (noting the inadequate communication of existing data).

153. Faustman & Omenn, *supra* note 131.

154. The concept of a RfC is a relatively recent approach to modeling the effects of inhaled substances. *See* Roberts & Abernathy, *supra* note 140 at 262.

155. *Id.*

156. *Id.*

157. Faustman & Omenn, *supra* note 131 at 81.

158. *Id.*

159. If individuals are exposed to different compounds then an additive model is applied if it is assumed that the substances have the same mode of action and act on the same target organ. Davis & Klein, *supra* note 141 at 286 (noting that regulatory agencies generally add risks from all carcinogens because the agents' underlying means of action are poorly understood).

160. *Id.*

161. Henry C. Pitot III & Yvonne P. Dragan, *Chemical Carcinogenesis*, CURTIS KLAASEN, ED., CASSARETT & DOULL'S TOXICOLOGY 201, 244 (5th Ed. 1996).

162. Subtractive effect can be conceived of through analogy to the interaction of a poison and its antidote. Where risks are non-additive, a ratio of joint effect (S) for any substances A and B comparing their interaction can be produced through the following method:

$$S = \frac{R_{11} - R_{00}}{R_{10} + R_{01} - 2R_{00}}$$

where R_{11} = risk with exposure to A and B, R00 = risk with exposure to neither A nor B, R_{10} = risk posed by exposure to A alone, and R_{01} = risk posed by exposure to B alone.

163. Roberts & Abernathy, *supra* note 133 at 226.

164. Faustman & Omenn, *supra* 131 at 81.

exposure that produce a range of effects.[165] Exposure effects can range from upper respiratory irritation to breathing difficulties, chemical intoxication, neuro-toxicity and death.[166]

The existence of sub-threshold exposures that do not cause health effects, and the broad range of those health effects, make it more difficult to apply a no-harm requirement for trades involving non-carcinogenic rather than carcinogenic health effects. Of these two issues, the former is less problematic. Where a trade involves the migration of emissions that will cause or contribute to a HI greater than or equal to one, the trade results in a net increase in health burden if the previous use of the credits was in a sub-threshold area or if a smaller population was exposed to a threshold level of exposure. Exposure-related health effects more serious than those at the NOAEL are triggered when exposure levels reach the RfD.[167] These can be expressed as a multiple of the RfD, and thus as a particular HI>1.[168] But the numerical expression of these effects as a hazard index would not necessarily make the HI over 1.0 a linear, appropriate, or even useful way to equate the health effects associated with exposure to two different substances. An accurate assessment of comparative disease burden of two exposures where each HI>1, would require assessing and comparing the health effects of each exposure for which a LOAEL has been reached, and the size of the population impacted.[169] These inter-disease comparisons are difficult in the same way comparisons between cancer and noncancer health effects are. They rely heavily on aggregating personal beliefs about whether one illness or injury is worse than another, and upon underdeveloped understandings of the various health effects of toxicants at exposure levels greater than a HI of 1.[170] The difficulty in establishing a common numerical currency of analysis may call for a more descriptive and discretionary balancing based upon common social beliefs about the risk trade-off involved, supported by scientific and medical information about the effects of the substances in question.

But a rudimentary model for determining if trades increase localized health effects is achievable. Absent a standard for comparing health effects at above HI=1 exposure levels, a test could apply a simplified comparison of exposure hazard indices for exposures where HI>1.[171] Combined with a prohibition on trades that increase exposure over threshold where the prior use of the credit was sub-threshold, this analysis would offer an imperfect but administrable system. The analysis would also be a substantial improvement over present emissions credit trading schemes that lack internal checks on trades that increase health burden.

The models usually applied to estimate both cancer and noncancer human health risk from airborne and other exposures of environmental toxicants have become more readily available and user-accessible given the advent of widely available computer software and internet distribution.[172] Again, applying these models involves using a very limited understanding of the effects of toxic substances provided by scientific research in order to try to block trades that increase risks to human health. The quality of the decisions made will improve as modeling techniques improve. But they remain preferable to conventional markets, which ignore local health effects. These methods allow us to take a first step into systematic analysis of the real health effects of emissions trading.

165. *Id*. at 80.

166. *See generally* NATIONAL INSTITUTES OF OCCUPATIONAL SAFETY AND HEALTH, POCKET GUIDE TO CHEMICAL HAZARDS, 1994 (DHHS Pub. No. 94-116).

167. Faustman & Omenn, *supra* note 131 at 80.

168. Davis & Klein, *supra* note 141 at 282-85.

169. David L. Eaton & Curtis D. Klassen, P*rinciples of Toxicology*, in Casarett & Doull's Toxicology (1996) at 16-17; Roberts & Abernathy, *supra* note 133 at 226.

170. S*ee supra* text accompanying note 251 (relating to QUALY and DALY concepts).

171. S*ee, e.g.*, SCAQMD R. 1402.

172. S*ee, e.g.*, California Department of Toxic Substance Control Lead Spread spreadsheet for Excel, California Department of Toxic Substance Control CalTOX spreadsheet, and EPA SCREEN III aerial dispersion modeling software. The EPA has developed CAMEO — an integrated suite of dispersion modeling, exposure assessment, and mapping software for emergency response and planning. <http://www.epa.gov/ceppo/cameo/> (last visited Apr. 15, 2000).

B. Increased Cancer Morbidity and Mortality Resulting from "Efficient" Trades in Current "Aggregate Emissions" Markets.

1. Excess Cancer Burden Based on Exposure — the Impact of Population Density

Population disease burden is the aggregation of the disease burden of each individual in a population.[173] If one exposes a community of one million to a chemical hazard posing a one in a million risk of death, it is expected that one death will result. If the exposed population doubles, the expected number of deaths would also double. Here, using the source to target paradigm discussed earlier, the size of the population exposed changes the expected cost of emissions in human lives. Conceptually, there is nothing unique about the idea that the population affected by something matters in determining the total effect. Environmental Impact Statement/Review ("EIS/R") processes routinely incorporate data on the size of human populations.[174]

In the case of airborne emissions, the models described previously in the discussion of risk assessment and toxicology can approximate the distribution of the substances into the air surrounding a facility. Uncertainties in modeling are reduced by the availability in some areas of detailed micro-meteorological data.[175] To summarize, in the case of airborne contaminants, an increase in population living within an area impacted by an emission that can cause adverse health effects will increase the total amount of morbidity and mortality within that population.

a. A Hypothetical Application:

This principle applies most directly to trades of carcinogens. Assume a hypothetical firm — SOURCECO — that has reduced its emissions of a carcinogenic VOC — "substance" — by one ton more than that required by command and control regulations.[176] SOURCECO sells this one ton of emissions of substance to a second firm — USERCO — that finds it less expensive to purchase SOURCECO's one ton reduction than to reduce its own emissions of VOCs by a ton.

Under conventional emissions trading markets are concerned, this is an efficient transaction. The commodity sold is a ton of emitted substance. The total cost of complying with the aggregate emissions reduction is reduced with no perceived negative impact on the environment. But this failure to perceive is a function of the system's blindness to local health effects — not of their benign nature or insignificance. The market as described is blind to the local health and environmental effects of the substance in question. If the substance is carcinogenic and as the cancer risk posed by VOCs is primarily localized about the source of emissions, the characteristics of the local community will determine the real health risk posed by these exposures.

Returning to the hypothetical, assume that SOURCECO is a machine shop located in a mixed-use densely populated community. Also assume that USERCO is an industrial facility in a primarily industrial area with little residential population.[177] The trade of one ton of substance to USERCO causes a net reduction in health risk. Conversely, if USERCO's emission of the one ton exposed a larger population than SOURCECO had, this "efficient" trade may

173. *See* Speizer, *supra* note 122.

174. *See, e.g.*, Environmental Impact Statement and Environmental Impact Report for Continued Operation of Lawrence Livermore National Laboratory and Sandia National Laboratories, Livermore (DOE/EIS-0157) (1992) at § 4.3 .

175. *See, e.g.*, Decl. of Schulyer Beth Fishman in Opp. to Deft's. Mot. to Dismiss, *Communities for a Better Environment v. Chevron*, CV# 97-5412DT (BQR_X), (C.D. Cal. 1998) (for an application of such data).

176. In this context, "command and control" refers to those regulations that place an absolute cap on emissions at a particular plant or from a particular process without allowing flexibility to shift pollution rights (or reduction responsibility) among various polluters.

177. The real health effects of toxic substance use fall heavily on the backs of workers in facilities using the substances. The focus of this analysis, and of the markets analyzed, is limited to EPA-regulated sources rather than taking a more holistic view because of the segregation of responsibility for occupational toxics exposure into the state workers compensation and state/federal Occupational Safety and Health Administration ("OSHA") systems. The OSHA Act is set forth at 29 U.S.C. §§ 651-667. It is a fair critique that approaches designed to reduce the effects of pollution, including models of the effects of emissions trades, ought to include estimates of the burden of occupational injury and illness.

cause an increase in morbidity and mortality. If the buyer and seller of emissions engaged in a transaction produce emissions of the same substances which cover a geographic area about the plants of roughly the same radius, the number of people in that radius — the population density — provides a very rough but conceptually useful standard of comparing the impact of their emissions.

b. Analysis of VOC Trades in One Air Quality District

The hypothetical above illustrates the potential for an "inefficient" trade, but leaves unresolved the question of whether trades like this occur. Comparison of the population living within small radii of source and user facilities would provide a useful, albeit imprecise answer to this question. Analysis of one air district's VOC ERC trading program answers the question in the affirmative.

A number of regulatory agencies operate substantial VOC emission credit trading systems.[178] The performance of a system might be evaluated for its ability to block trades that increase health burden. Such an evaluation might be based on district-provided data on the geographic location of the source and user of the credits traded, and the quantity and type of material traded. By integrating census tract population data with the geographic location of trades in a geographic information system, the population densities of areas surrounding sources and users of credits may be compared. Using historical trading data provided by San Francisco's Bay Area Air Quality Management District ("BAAQMD"),[179] an analysis was conducted to describe the population densities of source and user communities.

In 1999 there were 83 active VOC emission credit trades between facilities within California's Bay Area Air Quality Management District. The data provided by the district included the geographic location of the sources and users of ERCs.[180] Using ArcView GIS software, the geographic location of the source and receptor sites was plotted and population density calculated.[181] Census tract boundary and population data was imported into ArcView,[182] enabling the gathering of population and area data for all census tracts within one half and two mile radii of the sources and receptors.[183] The raw population data was converted into density data by dividing it by the area of the census tracts wholly or partially enclosed within the radius of interest of the site in question.[184] This in turn accomplished a standardization by area, as the radii from sources and users enclosed census tracts of varying sizes and shapes. The importation of the data into STATA facilitated data analysis.[185]

The data analysis had two functions. The first function was to describe the overall differences in population density between aggregated source and user communities. The second function was to describe the quantity and magnitude of any trades that moved VOCs to communities with higher population densities.

In the aggregate, communities within a half-mile radius of BAAQMD sources are 3.81 times more densely populated than its similarly defined user communities. As noted in Table 1,

178. S*ee supra* text accompanying notes 40-46.

179. BAAQMD was cooperative in aiding this analysis by providing data on the location of trades and amount traded. The dataset from their district is the only set used because of their ability and willingness to produce a large set of paired location data. Other districts were unable or unwilling to provide such data.

180. The data in question was mapped on a NAD72 datum UTM protection. UTM or Universal Transverse Mercator is a grid system used to express the longitude and latitude of a specific point on the earth, and employs a series of regions of the earth with grid overlays based on their own datum points.

181. Societal disease burden is heavily affected by occupational exposure — as occupational exposures are likely to be much higher than community exposures. S*upra* note 177.

182. ArcView 3.1 GIS Software, (c) 1992-1998 by Environmental System Research Inc., licensed to the Harvard University Library Map Collection. A*vailable at* <http://www.esri.com> (last visited Jan. 14, 2000).

183. This is an original study completed for the purposes of this paper. Inter-facility emission reduction credit data provided by the BAAQMD was mapped using a 1972 datum UTM Area projection in ArcView, and population density in census tracts within 0.5 and 2 mile radii of the UTM coordinates provided by BAAQMD for credit source and receiver calculated using 1999 US Census estimated population, as well as persons older than 65 and younger than 18. After standardization for the differing area of the tracts by converting from population counts to densities, the results were compared and tabulated using the STATA statistical analysis program.

184. For a discussion of methodology *see supra* note 183.

185. STATA software package, v. 5.0 for Win. 95, produced by STATA Corporation, *at* <http://www.stata.com>.

infra, this difference is statistically significant.[186] A number of the trades in the market were made between pairs of trading partners who engaged in multiple transactions. In a second analysis, repeat trades by the same partners were combined.[187] One summary record was generated to take the place of each set of trades. As is reflected in Table 1, the direction of the difference between communities with high and low densities holds, but the magnitude of the difference is significantly reduced. Source communities have roughly 2.09 times the population density of user communities.

Table 1 — Density (total population) per Square Kilometer.

	All Trades	Grouped trades
source density	1499	1190
user density	393	569
multiplier	3.81x	2.09x

Note: For both pairs of user and source data, one-sided t test $\alpha<0.05$)

While the BAAQMD's trading system does not in the aggregate appear to have caused a mass movement of credits from less densely to more densely populated communities, this aggregate perspective is insensitive to the quantity and magnitude of individual trades that have resulted in movement of emissions to more densely populated areas. In STATA, data from the 83 transactions was analyzed to generate a count and description of those trades. These results are presented in Table 2.

This data shows that trades accounting for 98.4 tons of VOC move pollutants to users surrounded in a ½ mile radius by more densely populated areas than those around the source. Among trades from lower to higher density communities, the user communities at a ½ mile radius were on average 8.7 times more densely populated than the sources. The magnitude of the size of trades decreases when communities in a 2.0-mile radius are compared. While in this air district these trades only constitute roughly 15% of total trades, this number is unstable when the trades between two partners are aggregated. In that case, while the number of trades to more highly populated areas remains constant, they account for roughly 42% of all trades. Density is a very rough estimate of health risk and the methods used to calculate density in this example were imprecise. This data suggests that there are trades taking place, even in what is perhaps one of the districts most highly attuned to this issue, where in the guise of an "efficient" program emissions are being moved to areas where they may be resulting in the exposure of larger numbers of people and thereby increasing the total risk and burden to human health.[189]

Table 2 — Distribution of trades to higher density communities.

	All Trades ½ Mi. Radius (n=83)	All Trades 2 Mi. Radius	Grouped trades ½ Mi. Radius (n=31)	Grouped trades 2 Mi. Radius
Trades to higher density	12	13	12	13
As % of total	14.5%	15.6%	38.7%	41.9%
Avg. tons of trade	8.2	5.3	8.2	5.3
Max. tons of trade	50.6	50.6	50.6	50.6
Min. tons of trade	0.03	0.03	0.03	0.03
Total tons	98.4	68.9	98.4	68.9
Avg. increase in pop.	8.7x	1.94x	8.7x	1.94x
Max. increase in pop.	39.3x	4.4x	39.3x	4.4x

c. Two Cases — When Environmental Justice and Health Burden Coincide

Two recent cases show that opportunities exist to apply the health risk analysis approach described above as an advocacy tool in the environmental justice context.

186. $\alpha<0.05$.

187. This aggregation reduced the BIAs in trade counts toward trading partners who engaged in repreated trades between the same facilities.

188. While this emissions model provides only a very rough estimate of one element of the health effects of these trades, this study suggests that some real world emissions trades allow the migration of credits to areas where they place a larger population at risk through exposure than had there been no trade. A lack of speciation data precluded analysis of the health effects of the type of VOC involved.

189. An analogous paired analytical method was employed in Vicki Been & Francis Gupta, *Coming to the Nuisance or Going to the Barrios? A Longitudinal Analysis Of Environmental Justice Claims*, 24 ECOL. L. Q 1 (1997).

Los Angeles area oil refineries and marine terminals[190] have made use of emissions credits from air district authorized car scrapping programs. The refineries have been sued under the CAA's citizen suit provisions for these actions,[191] and the SCAQMD has been the subject of complaints before the EPA under Title VI of the Civil Rights Act.[192] CBE and the NAACP have alleged that SCAQMD violated Title VI by allowing the migration and concentration of emissions from the district's car scrapping system assumedly draws vehicles from the entire county, to a small number of refineries and terminals near communities of color.[193]

The credits at issue were used in lieu of outfitting the petroleum transfer facilities with vapor recovery technology to reduce emissions during loading operations.[194] Roughly 660 tons of VOC emission reductions had been foregone because of credit use.[195] Under a disparate impact analysis, complainants argued that the South Coast Air Basin as a whole has only 37% people of color, but that the San Pedro community most affected by one refinery is composed of more than 90% people of color.[196] The CBE complaint presents a variety of data on the communities impacted by these relatively large trades.

Health-based population density analysis can act as a proxy for racial disparate impact analysis where high population density is correlated with high minority population. Population density data on communities within a 1.5 mile radius of the marine terminals is presented in Table 3, along with estimated population density based on an assumed 7.06 square miles area within the 1.5 mile radius.

The results in Table 3 show that the communities in question have both a larger minority population than average for Los Angeles County, and a greater population density than the County's average of 2308 people per square mile.[197] The mobile sources of emission credits — scrapped vehicles — come from throughout the county. CBE alleges that these trades have produced local concentrations of pollutants, distributionally unequal toxic "hot spots", in low-income communities of color.[198] The data in Table 3 suggest that the trades may have, in addition, caused a movement of pollutants to more densely populated areas, and thereby increased the net health burden from air pollution in Los Angeles County.[199]

Table 3 — Communities Impacted by Refinery Emissions at 1.5 Mile Radius.

Refinery	Population	Pop/Mi^2	% people of color
1	23,831	3371	89.9
2	17,348	2454	85.9
3	23,956	3389	74.8
total	65,135	3075	-

Note: Totals assume non-overlapping refinery emission radii.

Elsewhere in the County, Southeast Los Angeles ("SELA") residents have become

190. Marine terminals are those facilities used for loading and offloading of petroleum from oil tankers, and are used in the Los Angeles area to transfer oil from tankers to area refineries for processing and distribution.

191. *See, e.g., Communities for a Better Env't v. Unocal Corp.*, No. 97-5414 (C.D. Cal. filed July 23, 1997); *Communities for a Better Env't v. Ultramar Corp.*, No. 97-5413 (C.D. Cal. filed July 23, 1997); *Communities for a Better Env't v. Chevron Corp.*, No. 97-5412 (C.D. Cal. filed July 23, 1997); *Communities for a Better Env't v. Tosco Corp.*, No. 97-5411 (C.D. Cal. filed July 23, 1997); *Communities for a Better Env't v.* GATX *Capital Corp.*, No. 97-5410 (C.D. Cal. filed July 23, 1997).

192. Title VI of the Civil Rights Act of 1964, 42 USC § 2000d et seq. EPA's Title VI implementing regulations are located at 40 CFR § 7.35. *See Communities for a Better Environment v. South Coast Air Quality Management District*, Complaint And Memorandum Of Points And Authorities For Relief From Environmental Justice Violations (July 23, 1997).

193. *Id.*

194. *Id.*

195. *California Group Files Civil Rights Claim Against California Pollution Transfer Program*, BNA STATE ENVIR. DAILY (July 28, 1997).

196. CBE Compl., *supra* note 7.

197. *Id.* (population counts are taken from the Complaint. Extrapolations to density were based on dividing the 1.5 mile radius population count by the surface area within a 1.5 mile radius, 7.06 square miles).

198. Complainants also alleged that the program constituted intentional discrimination. *See* CBE Compl., *supra* note 7 at 23.

199. Some advocates have proposed incentive systems for old vehicle scrapping which do not employ inter-source (i.e. vehicular to stationary source) trading. Steven Allan, *Begg Targets Old Bangers to End Pollution*, THE SCOTSMAN, March 3, 2000. (Discussing a trade-in system for old vehicles that compensated owners with transit passes).

involved in environmental justice issues.[200] Residents of this principally low income Latino community have organized the LA/CAUSA organization in coordination with CBE.[201] While LA/CAUSA's activism has not been focused on emissions trading, the organization's reports on local concentrations of industry in this mostly minority community documents a case where a health effects mode of analysis may be useful. In making equity arguments about multi-source exposures, CBE and LA/CAUSA have described the population density of the area, as noted in Table 4.

Table 4 — Population Densitites in SELA, selected SELA municipalities, and Los Angeles County Generally.[202]

Region	*Density (people/sqm.)*
Los Angeles County	2308
SELA	10,163
Maywood	24,291
Cudahy	22,182
Huntington Park	19,419

CBE reports have made allegations of disparate impact on communities of color in SELA by focusing on the density of people of color in the impacted communities.[203] But their reports also include information on general population density. This data indicates that the region and in particular certain municipalities within it have between 4.4 and 10.5 times the population density of the county as a whole.[204] The correlation between relatively high concentrations of low-income minority individuals and high concentrations of population within an urban/suburban metropolis seems intuitively unsurprising.[205] It also provides another case study for the potential usefulness of a health-burden based method of analysis in advancing environmental justice.[206]

C. Excess Disease Burden Where There are Sensitive Populations

A more nuanced model of total health effects would disaggregate the population impacted by an exposure. Pollutants may have a more pronounced effect on sensitive populations, particularly children and the elderly.[207] Research is developing on the effects of carcinogens on children. Respiratory irritants may have a more pronounced effect on mortality in

200. *See, e.g.*, CBE *v. Chrome Crankshaft*, VCO28531 (Los Angeles Co. Superior Ct., Cal. 1998)

201. The organization's web site is <http://www.cbela.org>.

202. COMMUNITIES FOR A BETTER ENVIRONMENT, HOLDING OUR BREATH: ENVIRONMENTAL INJUSTICE EXPOSED IN SOUTHEAST LOS ANGELES 17 (1998).

203. *Id.*

204. *See* density counts at Table 3.

205. *See generally* Daniel S. Shah, *Lawyering For Empowerment: Community Development And Social Change*, 6 CLINICAL L. REV. 217, 225 (1990) ("Suburban municipalities had no obligation to accept responsibility for inner city deterioration; they refused to build public housing, and their zoning restrictions excluded high density, low income housing in suburbs. All this kept cities segregated by race and income." *Quoting* Kenneth Jackson, THE CRABGRASS FRONTEIR, 277-78 (1985).); *Compare* research relating to southern rural areas, e.g. Regina Austin & Michael Schill, *Black, Brown, Poor, and Poisoned: Minority Grassroots Environmentalism and the Quest for Eco-Justice*, 1 KAN. J.L. & PUB. POL'Y, 69, 70 (1991) ("[I]n the South, a sparse concentration of inhabitants is correlated with poverty which is in turn correlated with race. [']It follows that criteria for siting hazardous waste facilities which include density of population will have the effect of targeting rural black communities that have high rates of poverty.[']" *Id.* (quoting Conner Bailey & Charles E. Faupel, Environmentalism and Civil Rights in Sumter County, Alabama, in PROCEEDINGS OF THE MICHIGAN CONFERENCE ON RACE AND THE INCIDENCE OF ENVIRONMENTAL HAZARDS, 159, 171 (1990)). The emissions trading cases described arise in a major metropolis. The observations of Bailey and Faupel suggest that the methods proposed may not be transferable to some more rural areas.

206. Another example from Southeast Los Angeles shows how a health-focused view of emissions can help select against the adverse effects of zoning balkanization. A portion of Huntington Park, a heavily populated (19,419 pers/sqm) is surrounded by Vernon, a heavily industrialized city with little population (16 pers/sqm). Residents of Huntington Park have come to call this area, plagued by high asthma rates among their children, "Asthmatown". This zoning mismatch between residential and industrial is produced by the municipal border running through the area. An emissions trading market that included considerations of the effects of emissions on the local population would, like the emissions in question, extend across city lines. Such a view would both force new sources in densely populated areas to purchase "more" credits than in a lightly populated area, and increase the "market value" of credits derived from the community in question, encouraging emissions reductions in this as opposed to less densely populated areas. *See* <www.cbela.org/atn.htm>; Scott Collins, Deborah Sullivan, *Emission Impossible?*, LA TIMES, Apr. 30, 1995, at 12.

207. *See generally* Schwartz, et al., *Harvesting and Long Term Exposure Effects in the Relations Between Air Pollution and Mortality*, AM. J. OF EPIDEMIOLOGY (Mar. 1, 2000).

older individuals, particularly those with preexisting emphysema or chronic obstructive pulmonary disorder ("COPD").[208] The CAA recognizes these differences in effect. The Act requires that the EPA set the national ambient air quality standards with sensitive populations in mind.[209] Presidential orders have also recognized the importance of taking special care to protect children from environmental hazards.[210]

To describe impacts on sensitive populations, the BAAQMD data previously discussed was re-analyzed. The re-analysis calculated the density of populations older than 65 and younger than 18 within the same radii of sources and users of VOC emission reduction credits. Data on sensitive populations was also obtained through plotting GIS source and user locations against census tract population and area data.

Table 5 — Density of Sensitive Populations in Source and User Communities (Persons per km^2).

		Unpaired, ½ Mi. Radius	Unpaired, 2 Mi. Radius	Paired, ½ Mi. Radius
Over 65	Users	37	49	49
	Sources	114	61	116
Under 18	Users	91	119	156
	Sources	371	169	298

As in the aggregate total population analysis, sensitive populations were not more heavily impacted by the trading system taken as a whole. However, the data showed that similar numbers of trades resulted in the "inefficient" movement of pollutants from lower to higher density communities of sensitive populations as it had in the total population analysis. These results are set forth in Table 6 and show a substantial number of trades to areas more densely populated by sensitive populations.

The sensitive population data maps closely the aggregate population data previously analyzed. Total population density was predictive of the population density of sensitive populations in the areas studied.[211]

Table 6 — Count of Trades Moving Credits to Communities More Heavily Populated by Sensitive Populations.

	Total Count	Avg. increase	Min. increase	Max. increase
Trades from lower to higher density (Pop. >65 yrs)	12 (14.45%)	28.13x	1.074x	285x
Trades from lower to higher density (Pop. >65 yrs)	12 (14.45%)	10.11x	1.113x	44.933x

D. Excess Disease Burden Based on Speciation

Air pollutants are not monolithic. Different chemicals act on the human body in a variety of ways and with widely varying degrees of potency.[212] VOCs are all carbon-based substances that tend to evaporate.[213] But different types — or species — of VOCs may act in very different ways on the human body.[214] VOCs tend to be lumped as a single commodity in trading systems, and are traded as a group rather than as amounts of individual substances.[215] This makes these systems blind to differences in VOC health effects. A model of trade health effects must take into account these differences.

VOCs of a variety of sorts are traded in the SCAQMD credit trading system. Refinery marine terminals in San Pedro emit benzene, toluene, hexane, xylenes, ethylbenzene, and other substances.[216] Benzene is a known (Class "A") carcinogen.[217] There is no threshold for its carcinogenic effects.[218] Toluene is not classified

208. *Id.*

209. 42 USC § 7408(f)(1)(c).

210. Executive Order 13045, 62 Fed. Reg. 19,885 (Apr. 23, 1997).

211. For population over 65, regressing total population density against population density over 65, the linear model: (density) = 10.57(density over 65) + 97.917 produces an α for density over 65 of 0.000 and an R^2 of 0.807. Model generated and evaluated using STATA software package, described *supra* note 136.

212. Richard Toshiyuki Drury, *Pollution Trading And Environmental Injustice: Los Angeles' Failed Experiment In Air Quality Policy*, 9 DUKE ENV. L. & POL'Y J. 231, 285 (1999).

213. *Compare* definition at SCAQMD R.102.

214. Drury, *supra* note 212.

215. *See infra* note 224.

216. Letter from Henry Hogo, SCAQMD, to USEPA Region IX regarding Rule 1610 Environmental Justice Task Force Information Request, at Table 2-2.

217. EPA IRIS document for Benzene (CASRN 71-43-2, updated Jan. 19, 2000).

218. *Id.*

as a carcinogen, but it does produce chronic health effects.[219] With no identified NOAEL, exposure can damage the neurological system and other organ systems. Phenols, another group of VOCs, are not classed as human carcinogens.[220] The effects of other substances are uncertain. Formaldehyde is classed as a "B1," or possible human carcinogen.[221] Among the carcinogens alone, the risk of cancer posed by a unit of exposure varies tremendously depending on the substance involved.[222] The substances — carcinogens and non-carcinogens — produce a wide range of effects on the human body. For example, while 0.8 µg/m3 of formaldehyde is associated with a 1 in 100,000 risk of cancer, the same risk is associated with between 1.3 to 4.5 µg/m3 of Benzene.[223] Clearly, the substance traded makes a difference for localized health risk. In the emissions trading context, this means that differences in the VOCs emitted between source and user facilities may change health risk. Again, trades on the margin of command and control regulations based on aggregate VOC emissions that ignore the health effect differences from different substances can produce net-adverse outcomes from a morbidity and mortality perspective.

In the controversy surrounding SCAQMD's car scrapping program, environmentalists raised this issue of inter-VOC differences in the context of a Title VI complaint.[224] Their analysis focused on the health effect differences between the VOCs emitted by the scrapped vehicles and the VOCs allegedly emitted by the oil refineries and marine terminals forgoing technologically produced emissions limitations.[225]

E. Excess Disease Burden From Non-Carcinogenic Effects

The same basic approach applies to non-carcinogenic as to carcinogenic health effects analysis. Dose and response information is used to derive a curve that shows the level at which an exposure will on average cause a risk of certain adverse human health effects. But in the non-carcinogen case, dose and response often exhibit a threshold effect.[226] In other words, there is a level of exposure tolerated by the human body that will not produce any effect on biological processes. Increases in exposure above that threshold level produce biologically measurable effects. As noted, exposure at the threshold level can be described as a HI of 1. For this reason, the first effect of interest for a non-carcinogen emission is whether it causes the population impacted to reach a HI=1 threshold dose. Evaluating this question requires knowledge of both the emission in question, and of the background level of exposure for a community. For example, if a new source of emissions will add a HI of 0.2, this new emission is not in and of itself enough to trigger a biological response.[227] But if the new emission comes in a community with a baseline HI of 0.9 for the same organ system, the new emissions will create an environmental exposure level likely to cause injury or illness.

VOCs are not the only pollutants that can cause localized non-carcinogenic health effects. Research indicates that oxides of nitrogen can also cause such effects.[228] Recent studies suggested that NO_X can have adverse impacts at levels below the current EPA NAAQS, particularly in sensitive populations.[229]

219. EPA IRIS Document for Toluene. (CASRN 108-88-3, updated April 1, 1994).

220. EPA IRIS Document for Phenol (CASRN 108-95-2, updated Mar. 1, 1991).

221. EPA IRIS Document for Formaldehyde (CASRN 50-00-0, updated May 1, 1991).

222. S*upra* note 217.

223. I*d*.

224. Letter from Henry Hogo, *supra* note 216 at Att. 7.

225. I*d*.

226. S*ee* Discussion of threshold concept at notes 140-41.

227. Threshold analysis relies on our scientific knowledge about low-level effects. If the threshold level is based on an underestimation of low-level effects, the HI will similarly underestimate the harm to exposed individuals.

228. Costa & Amdur, *supra* note 117 at 857, 876.

229. Schwartz, et al., *supra* note 207 (arguing that the health effects of air pollution in causing chronic illness are underestimated).

Assessing the net effect on health burden from a trade between a source and user is more complicated for non-carcinogens than it is for carcinogens. These trades may be grouped into three classes. The first involves credit migrations from either threshold or non-threshold[230] areas to non-threshold areas. Such trades yield a reduction or steady level of local health burden and do not create inefficiencies because of market failures. The second group is composed of trades from non-threshold to threshold areas. By their nature, these trades involve an increased burden on local health. They imposed no burden at the source, because of the non-threshold nature of that exposure, but cause a breach of threshold exposure and therefore impose a health burden upon the user community. Such trades are inefficient. A third class of trades, from threshold to threshold, is more problematic. Comparing trades above the threshold is difficult. Where the type of health effect is the same in both the source and user communities, the comparative burden on health may be determined by comparing the number of individuals exposed at each location. But where the substance or amount of the substance varies between source and user, as might be the case in a trade of two different VOCs, the comparison becomes a balance between the health effects of the above-threshold exposures[231] and the size of the populations involved. Comparing the hazard indices can provide a useful if inexact proxy for health effects where the effects of exposure over a hazard index are unknown.[232] This balance may or may not present a clear result, as it can involve weighing the burden posed by various classes of illness and injury.

F. Existing Safety Valves Within the System

The market failures produced by the blindness of emissions trading programs may be partially mitigated by a jurisdiction's other rules relating to trading or health risk. Some jurisdictions have responded to concerns about "hot spots". SCAQMD prohibits trades that would forego the achievement of a $1x10^{-5}$ reduction in cancer risk from a facility.[233] Other district rules prohibit facilities from emitting "hazardous air pollutants"[234] which create exposures at a Hazard Index of 5 or carcinogenic health risk of $100x10^{-9}$.[235] Other approaches require risk assessments and allow discretionary denial of new source approval.[236] SCAQMD may deny a permit to a facility that imposes an increased cancer risk of $1x10^{-5}$ or causes a 0.5 risk that it will produce one cancer within an exposed population.[237] These discretionary safety valves are the result of state level regulation of local air quality authorities.[238] Other similar requirements mandate public notification where emissions of "toxic air contaminants" exceed certain levels.[239]

Rules governing emissions trading markets may also reduce the number of trades producing a net negative effect. Some jurisdictions have imposed "ratio" requirements upon trades — requiring that purchase of a unit of foregone emissions only allows the new emission of a fraction of the amount of foregone emissions. SMAQMD requires ratios of 1.2 for trades within 15 miles and 2 for trades from a greater distance.[240] Again, while reducing any likely increased health effect from "inefficient" trades, the blindness of the system to health effects may still allow trades across greater population density gradients or for emissions of substances posing a greater risk than that

230. For the purposes of this discussion the classification that a source or user area as threshold or non-threshold is made by including the credits to be the subject of the proposed trade.

231. S*ee* discussion of the LOAEL — the trigger dosage levels for health effect above the NOAEL, *supra* text accompanying note 114.

232. S*ee* SCAQMD Regulation XIV, Rule 1402, using a HI=5 standard to evaluate emissions of certain hazardous substances.

233. SCAQMD R. 2501(E)(1)(a)(i).

234. 189 hazardous air pollutants ("HAP") were designated in the CAA.

235. SCAQMD Regulation XIV (AQMD, 1999).

236. I*d*.

237. I*d*.

238. 17 Cal. Code Regs. § 91506 (Barclay's 2000).

239. 17 Cal. Code Regs. § 91506(l) (Barclay's 2000).

240. S*ee*, *e.g.*, Sacramento Air Quality Management District Rule 303.1; SCAQMD Regulation XIII (AQMD 1999).

cured by this imprecise tool, the ratio requirement. The BAAQMD study results are instructive. They show that "inefficient" trades went to areas with, on average, 8.7 times the population density as the source communities. While only a very rough model of the market, this suggests that current ratio levels[241] may be wholly inadequate to the task of preventing trades from producing an increase in morbidity and mortality.

As trading regimes proliferate, a variety of background regulations may mitigate the health inefficiencies in aggregate credit trading systems. They offer important ways to deal with the distributional inequities of concentrating pollution in "hot spots" that the single-minded adoption of a health effects critique may not recognize. But such approaches run the risk, as in the case of rations, of allowing some trades that produce a net increase in morbidity and mortality.

VI. Building a Model to Address Health Risk — Creating a Health Backstop.

The dominant model for emissions trading — aggregate emissions trading — is blind to the local health effects of trades. As discussed, its assumption that stack emissions are fungible is incorrect. VOCs can have localized health effects — both carcinogenic and non-carcinogenic — upon surrounding communities. As the BAAQMD data shows, trades in such systems run the risk of producing net increases in morbidity and mortality. In other words, the current system addresses only one of three axes along which the impacts of current emissions trades can be measured — the effects of emissions on total pollution in an air district. It ignores the other two axes — local carcinogenic and non-carcinogenic health effects. The purpose of this analysis is not to disparage the importance of aggregate pollution and contributions of VOCs to photochemical smog; or to understate the deficiencies in our knowledge of toxic substances,[242] but rather to advocate an aspirational no-harm standard for trades that operate on these three axes simultaneously.

A model arranged along these three axes would integrate the total emissions model currently applied with the methods of carcinogenic and non-carcinogenic health risk analysis, set forth at section V. If a conventionally structured emissions trading system produces trading outcomes different from those of this proposed model, it tolerates trades on the margin of a command and control structure that place an increased burden on human health without a reduction in aggregate emissions. Integrating health effects concerns into a conventional market in the manner described would create a health backstop, preventing trades that produce a net increase in adverse health effects.

This proposed three-axis model is also subject to fair criticism. The model is administratively more complex than the current system. At the same time, the principal cost created by that added complexity would be in the generation of information modeling the effects of trades on communities. If effectively promulgated, the information produced may both motivate communities to become involved in siting questions, and provide a tool for community advocacy. The information gathering processes involved in this health backstop model can also be used to produce information on the distributional effects of pollution trading from an environmental justice perspective.[243]

The proposed system relies on estimating heath effects. Such estimates are bounded by uncertainty and vary widely.[244] Risk assessment methods continue to evolve.[245] While important, this uncertainty in the effects of hazardous substances on human populations should not block implementation of a health backstop. The alternative to addressing this issue using the limited information we do have is to ignore it entirely. This latter approach is

241. SCAQMD Regulation XIII (AQMD 1999).

242. Costa & Amdur, *supra* note 117 at 857-60.

243. *See* Proposed Guidelines for Carcinogen Risk Assessment, 61 Fed. Reg. 17,960 (Apr. 23, 1996).

244. Sidney A. Shapiro & Thomas McGarity, *Not so Paradoxical: The Rationale for Technology-Based Regulation*, 1991 DUKE L.J. 729, 731 (1991).

245. *See, e.g.*, USEPA, Proposed Guidelines for Carcinogen Risk Assessment, 61 Fed. Reg. 17960 (Apr. 23, 1996).

taken by market systems blind to local health effects.[246] The answer to the problem of inadequate information is not to refrain from action. Rather, trading markets should adopt health backstop policies consistent with the precautionary principal and sensitive to advances in risk assessment and toxicology.[247] The three-dimensional backstop model may also be criticized for lumping all cancer and non-cancer health effects into its "no harm" focus, rather than adopting a more nuanced view of the degree of burden imposed by various illnesses and injuries. This concern is most evident in the context of threshold area to threshold area trades of non-carcinogens. The problem posed by these analyses is determining which illness or risk of illness is less desirable and therefore more important to avoid. Risk trade-offs are less amenable to bright line rules, but this type of decision is still made on a regularized basis. The classic example is the patient attempting to balance the risks of a medical treatment against the effects of a disease without treatment.[248] Some theorists have developed indices which attempt to aggregate and model the decisions of individuals. Quality Adjusted Life Years ("QUALYs")[249] and Disability Adjusted Life Years ("DALYs")[250] are two such indices. They attempt to create a common "currency" to enable risk-risk comparisons between injury and illness health outcomes. But there are substantial uncertainties in the QUALY and DALY models that counsel against adopting a common market for assessing carcinogen and non-carcinogen effects. Rather, such indices should be a helpful but non-exclusive input for discretionary balancing based upon societal beliefs about risk and guided by public participation.[251]

This model need not and should not displace current initiatives to avoid hot spots and assist overburdened communities for reasons of equity and fairness. It is intended to force the model to consider health effects on local communities as part of a utilitarian check on the impact of trading on aggregate health risk, and to force data production regarding those effects. This data production element allows it to compliment rather than displace Title VI and other disparate impact analyses, which provide backstops for important equity-based considerations.

246. The precautionary principle provides guidance on this issue. Choosing not to act in the face of scientific uncertainty because of that uncertainty conflicts with the principle.

247. *See generally* USEPA, *Proposed Guidelines for Carcinogen Risk Assessment*, 61 Fed. Reg. 17960 (Apr. 23, 1996);

The impact of erroneous risk measurements on a health backstop model is easily over-stated. This paper has described two principal methods by which trades can cause a net increase in disease burden — allowing increases in the size of the community exposed and in the health risk of the substance to which they are exposed. Errors in estimating toxicity should only impact those trades where there is a change in the substance emitted between source and user. Where the same substance is traded, and similarly cautious protocols used in estimating the population exposed, the paired nature of the comparison should reduce some errors in estimating the population exposed and the level of exposure.

To offer a more concrete example, assume two fishermen are engaged in an exchange of fish — Halibut for Cod. Each is required by regulation to under-count the number of fish, which is counted by estimating the number of fish in a fully packed crate. If both Halibut and Cod are under counted, the actual amount exchanged may have been mis-estimated, but the constant mis-counting should have still yielded an equal exchange. If our goal is avoiding health risk increases produced by a trade, accurate measurement of risk is less important than having equal error in measuring sources and users. This critique would, however, be applicable to attempts to integrate the three axis of the proposed model into a single index. Just as EPA has (cautiously) proposed initiatives for interpollutant trading, an index might be developed to allow trading between locally induced health risks and aggregate pollutant emission regional health and natural resources effects.

248. *See generally* discussions throughout MICHAEL DRUMMOND ET AL., METHODS FOR THE ECONOMIC ANALYSIS OF HEALTH CARE PROGRAMMES, 2D ED. (1997); GOLD ET AL. EDS, COST EFFECTIVENESS IN HEALTH AND MEDICINE (1996).

249. *See, e.g.*, MICHAEL DRUMMOND ET AL., METHODS FOR THE ECONOMIC ANALYSIS OF HEALTH CARE PROGRAMMES, 2D ED. (1997) 165 (discussing the development of the QUALY to compare the utility associated by patients with life with dialysis in comparison with life after a successful kidney transplant); *American Trucking Association v.* EPA, 175 F.3d 1027 (D.C. Cir .1999) (discussing the use of QUALYS in the public health care financing context).

250. Lipscomb, et al., *Time Preference*, in GOLD ET AL. EDS, COST EFFECTIVENESS IN HEALTH AND MEDICINE 231 (1996).

251. Some commentators have noted the importance of structuring pollution trading markets in ways that enable public participation. *See* Lisa Heinzerling, *Selling Pollution, Forcing Democracy*, 14 STAN. ENVTL. L.J. 300, 343 (1995) ("However, if pollution trading programs do not assure meaningful citizen participation in decisions about the environment, then the distributional objection goes unmet: some unconsenting citizens must endure greater pollution, in the service of reducing the overall costs of environmental compliance.") *Id.*

VII. Implications for Action — Legal Tactics for Bringing Health Effects Based Challenges to Trading Markets.

A health-based perspective on market outcomes provides a reason for challenging trades and trading systems that produce a net increase in adverse health effects. It also provides an additional reason for challenging specific trades that burden low-income communities of color where those trades also increase morbidity and mortality. But this approach is not simply a policy-analytical tool.

The CAA and analogous state statutes and implementing regulations provide opportunities to make legal challenges to emissions trades and trading programs that increase net health risk.[252] Such challenges can be applied in the environmental justice context, supplementing the legal tool kit of advocates, along with procedural challenges and disparate impact analyses. In addition to litigation strategies, shared jurisdiction over air quality regulation between federal, state, and local authorities provides multiple loci for legislative and administrative advocacy supporting the introduction of data production and health backstop requirements into emissions credit programs.

1. Challenges to Permitting Decisions and Programs

a. Federal Tactics

Trades that increase net health risk also increase the adverse effects of air pollution, and therefore violate the CAA. The Act allows citizen suits against the EPA and other parties for violation of air quality standards, implementation plans, or emission requirements,[253] or to require the EPA to perform a non-discretionary duty.[254] In *Sierra Club v. Ruckleshaus*,[255] the Sierra Club sued the EPA for its failure to prohibit pollution increases in "attainment areas" — areas that complied with the National Ambient Air Quality Standards ("NAAQS").[256] Prior to the enactment of the EPA's "prevention of significant deterioration" ("PSD") regulations,[257] the EPA had held that the CAA did not reach emissions-based deterioration in air quality that did not cause a violation of the NAAQS.[258] Overruling the EPA, the court in *Sierra Club* observed that:

> In Section 101(b) of the Clean Air Act, Congress states four basic purposes of the Act, the first of which is "to protect and enhance the quality of the Nation's air resources so as to promote the public health and welfare and the productive capacity of its population." 42 U.S.C. S 1857(b) (1). On its face, this language would appear to declare Congress' intent to improve the quality of the nation's air and to prevent deterioration of that air quality, no matter how presently pure that quality in some sections of the country happens to be.[259]

The court concluded that:

> "[h]aving considered the stated purpose of the Clean Air Act of 1970, the legislative history of the Act and its predecessor, and the past and present administrative interpretation of the Act, it is our judgment that the Clean Air Act of 1970 is based in important part on a policy of non-degradation of existing clean air."[260]

Just as in *Sierra Club*, emissions credit trades on the margin of command and control regulations that produce a net increase in health effects produce an effective increase in the adverse effects of air pollution.

252. 42 U.S.C. § 7604.

253. *Id.*

254. 42 U.S.C. § 7604(c).

255. 344 F. Supp. 253 (D.D.C. 1972) *aff'd* 1972 WL 2725, 2 Envtl. L. Rep. 20,656 (C.A.D.C.).

256. The NAAQS are discussed *supra*, text accompanying notes 12.

257. Later adopted into the CAA through regulation, 40 CFR 50.2, and in 1977 through an amendment to Title I, 42 U.S.C. § 7401.

258. *Sierra Club v. Ruckleshaus*, 344 F. Supp. 253, 255 (D.D.C. 1972).

259. *Id.*

260. *Id.* at 256.

The Act's language shows a clear intent to prevent increases in the adverse effects air pollution has on human health. As noted by the court in *Sierra Club*, the Act contains a variety of references to the importance of protecting human health. It is intended to "...promote the public health."[261] Primary standards under the Act are based upon human health considerations,[262] and must consider the effects of pollution on the health of sensitive or susceptible groups or individuals.[263] Other portions of the Act focus on research into the human health effects of pollutants[264] and the development of specific programs to control locally hazardous air pollutants. Actions that increase the adverse health effects of pollution conflict with the basic policy of the CAA found in its text and described by the court in *Sierra Club v. Ruckleshaus*.[265] As such, the Act should be interpreted to prohibit emissions credit trades that produce net negative health effects. A contrary position by the EPA would be sufficiently in conflict with the Act's clearly stated intent to fall outside the appropriate scope of *Chevron's*[266] deference to an agency's interpretation of a statute.

b. State Law Approaches

The delegation of authority under the CAA to state and local agencies provides additional venues and sources of law for litigating challenges to local agency approval of emissions credit trades which increase aggregate health risk.

California provides an illustration of the tools that may be available within state law. Like its federal analog, California's Clean Air Act provides a strong statement that it is intended to maintain and improve air quality[267] and to produce "healthful air."[268] The parallel purpose guiding the two texts supports a reading of the California Act to prohibit actions that reduce air quality, as was described in *Sierra Club*[269] interpreting the CAA.

Unique state statutory provisions can also be used to support net health effects-based challenges to trades. As an example, the California statute requires that market-based incentives may not delay, postpone, or hinder compliance with the California Clean Air Act.[270] It requires that trades produce a net air quality benefit,[271] and that market-based reductions in emissions must be at least as effective as those that would have been produced by a command and control system.[272] Emissions reduction credits can only offset new emissions if the credit source's reduction in emissions is "comparable" to reductions under a command and control system.[273] Statutory language mandating equally effective or comparable emissions reductions, when read in the context of legislative provisions focused on reducing the adverse health effects of pollution,[274] is sufficiently broad to encompass and support claims based on net health effects analysis.[275]

2. Reform Via Legislation and Administrative Action

Legislative and administrative fora also provide opportunities to institute net health effects backstops. Legislative advocacy may prompt the adoption of health backstop requirements directly, as well as standards requiring data generation that enable or

261. 42 U.S.C. § 1857(b)(1).

262. 42 U.S.C.§§ 7408(a)(1)(A), 7409.

263. 42 USC § 7408(f)(1)(C).

264. 42 U.S.C. §§ 7403(d); (f)(1).

265. *See* 344 F. Supp. 253; *supra* text accompanying note 201.

266. *See Chevron v.* NRDC, 467 U.S. 837 (1984) (requiring judicial deference to administrative agency interpretations of the statutes implemented by the agency in question absent a conflict with clear legislative intent).

267. CAL. HEALTH & SAFETY CODE § 39607.5(A) (Deering 2001).

268. CAL. HEALTH & SAFETY CODE § 40910 (Deering 2001).

269. *Sierra Club*, 344 F. Supp. at 253.

270. CAL. HEALTH & SAFETY CODE § 39616(c) (Deering 2001).

271. CAL. HEALTH & SAFETY CODE § 40440.10-11 (Deering 2001).

272. CAL. HEALTH & SAFETY CODE § 39616(c)(1) (Deering 2001).

273. CAL. HEALTH & SAFETY CODE § 40713 (Deering 2001).

274. CAL. HEALTH & SAFETY CODE § 40910; § 41700 (Deering 2001).

275. Such provisions are not limited to California. Illinois, home to the Chicago VOC emissions trading market has a Clean Air Act designed to "restore, maintain, and enhance the purity of the air." 415 Ill.Code 5/8 (West Supp. 1999).

require the modeling of localized health effects.

a. Part One: Facilitate Data Gathering

Both Title VI disparate impact analysis and net-disease-burden analysis rely on accurate information about transactions in an emissions market. They require data on the location of sources and users of credits, as well as information on the magnitude of the trades that will be used to derive dispersion models.[276] Net disease burden analysis also requires information on population distribution and chemical speciation — information on exactly what types of chemicals are involved. Disparate impact analysis focuses instead on the location of minority populations. Mechanisms currently in place to collect, assemble, and distribute this information are inadequate. Of three major California air quality districts contacted to developing the data presented in this paper, none were readily able to provide credit trade information linked with VOC speciation.[277] Another was unable to assemble data on the pairing of sources and users for each transaction without a lengthy, manual sorting of sources and users.[278] The existence of this data and its availability in a usable form to regulators, permit applicants, environmental justice advocates, and the communities impacted by trades, is essential to provoke dialogue on the effects of the system, and to facilitate Title VI and net health effects inquiries.[279]

The current state-level emissions trading data collection and reporting system in California requires that agencies report data from each completed emissions reduction credit trade.[280] But the only information gathered relates to the class of substance traded, the size of the trade and the price paid per ton.[281] The system neither collects nor reports data on the identity or location of the parties involved in the trade.[282] Like the market itself, this data gathering system is blind to health effects. Its only focus is on the price of the credits in the market. Illinois regulations governing emissions credit trading require the reporting of more extensive data, as well as the development of a computerized bulletin board to provide data on emissions credits.[283] The test of the Illinois system will be in implementation — what data will be collected, how will it be presented, and will it be presented in a forum useful to communities? A model for state initiatives in making such data available already exists in the form of the EPA's "envirofacts" database integrating site and facility data from a variety of environmental data sources into a relatively user-friendly interface.[284]

Data collection has been an issue of growing prominence in the context of racial profiling and of disproportionate use of *Terry*[285] stops against members of minority communities. Critics of racial profiling have intensified efforts to force data collection and distribution.[286] The data is not an end, but a means to describe the problem and provoke discourse and action in legal, administrative, and legislative fora. For the same reasons, data collection is an important step in developing attacks on emissions trading grounded in disparate impact and aggregate health effects analyses.

b. Part Two: A No-Harm Requirement

If trades exist to provide flexibility in complying with command and control emissions limits, those trades should not increase the

276. *See* Tit. 6 Guidance Document, *supra* note 148.

277. Personal communication with author.

278. *Id.*

279. Such a public-notification approach is typified by the Emergency Planning and Community Right-To-Know Act. 42 U.S.C. § 11001 (2001).

280. CAL. HEALTH & SAFETY CODE § 10709.5 (Deering 2001).

281. *See, e.g.*, CALIFORNIA AIR RESOURCES BOARD, EMISSION REDUCTION OFFFSET TRANSACTION COST SUMMARY REPORT FOR 1998 (Apr. 1999).

282. CAL. HEALTH & SAFETY CODE § 40709.5(e) (Deering 2001).

283. 35 ILL. REGS. 205.6 (West 1999).

284. EPA Envirofacts Database <http://www.epa.gov/enviro/index_java.html>

285. Terry v. Ohio, 392 U.S. 1 (1968).

286. *See, e.g.*, Lisa Walter, *Eradicating Racial Stereotyping From Terry Stops: The Case for an Equal Protection Exclusionary Rule*, 71 COLO. L. REV. 255, 274 (1999) (discussing litigation by Atty. Robert Wilkins against the Maryland State Police).

aggregate burden of morbidity and mortality above that produced under a purely command and control system. In other terms, a trade should not produce a net increase in adverse health effects. This can be described as a "no harm" standard. The multi-factor analysis (described *supra*) is designed to ensure that trades are efficient on three axes — airshed, cancer, and non-cancer health effects. By blocking trades that increase aggregate burden on human health, a no-harm standard would create a backstop requirement for the protection of health.

This inquiry would require data on the speciation of the substances emitted, their health risks, geographic distribution of population, and modeling data to describe the dispersion of emissions in a local community. Where threshold non-carcinogens are involved, information on background levels of substances that produce non-carcinogenic effects would also be required. The decision rules set forth previously in this paper would be applied to assess whether a trade increased aggregate health risk. Trades from non-carcinogenic threshold to threshold areas should apply hazard index comparisons as part of a mixed qualitative and quantitative risk assessment process.

Such a model is admittedly aspirational. But creating the infrastructure required to evaluate trades would not require the development of any new technologies. Population, dispersion and substance health effects data are publicly available, but should be integrated and presented so as to be usable for such analyses. Speciation data should also be reported and made readily available as part of the permitting process. Modeling and geographic relation of emissions to populations is achievable through current computer modeling systems.[287] Regulatory guidance defining the emissions model and assumptions to be used in modeling would reduce compliance costs and promote equivalency in credit valuation, and reduce incentives and opportunities for strategic negative behavior by market participants.[288]

A health backstop could prove a useful tool to challenge trades and trading systems both generally, and as they impact communities of color.[289]

VIII. Conclusion

Public health's population perspective provides a useful approach for evaluating emissions credit trading systems. Health based efficiency critiques offer advocates for environmental justice another tool to add to process and equity based challenges. The BAAQMD data analysis suggests that emissions credit systems can cause the migration of emissions in ways that increase net adverse health effects. Currently formulated pollution markets are blind to these effects, and differences in toxicant and community characteristics that underlie them. The net negative effect of these trades runs afoul of the promise of emissions trading as a source of flexibility for polluters that will not hamper efforts to reduce the adverse effects of air pollution.

The failures of the current market to address the health effects of trading provides opportunities for environmental justice advocates when these "inefficient" trades occur in low income communities of color. Challenges to such trades and systems may be formulated under both the federal CAA and state law.

287. Leon R. Leonard, AIR QUALITY PERMITTING, CRC/Lewis Publishers (1997) 100 (discussing models such as the EPA's "Industrial Source Complex 3/ISC3" and SCREEN models).

288. The growth of an industry of brokers who are repeat players in the trading markets, as well as repeat large purchasers provides a constituency with an interest in developing and funding developments in this needed infrastructure.

289. Adding a backstop requirement also avoids an outright commodification of rights to injure and cause illness. Such a commodification might prove even more troubling than the current system from the perspective of critics such as Sandel. *See* discussion of moral attacks upon emissions trading, *supra* note 73.

290. *See, e.g.*, Marla Cone, *Judge Rules Smog Cutbacks Illegal*, LA TIMES, Oct. 6 1998 A1 (Discussing Clean Air Act SIP approval-based challenge to local emissions trading rule.); *Communities for a Better Env't v. Unocal Corp.*, No. 97-5414 (C.D. Cal. filed July 23, 1997); *Communities for a Better Env't v. Ultramar Corp.*, No. 97-5413 (C.D. Cal. filed July 23, 1997); *Communities for a Better Env't v. Chevron Corp.*, No. 97-5412 (C.D. Cal. filed July 23, 1997); *Communities for a Better Env't v. Tosco Corp.*, No. 97-5411 (C.D. Cal. filed July 23, 1997); *Communities for a Better Env't v.* GATX *Capital Corp.*, No. 97-5410 (C.D. Cal. filed July 23, 1997).

Trades that result in harm to human health violate the Act's goal of prevention deterioration when read in the context of its focus on the human health effects of pollution. Given the weakness of Title VI as a tool for environmental justice litigation, a net-health-effects based approach should be added to more traditional process based arguments under the CAA and other statutes.[290]

A health effects based approach may also serve as the basis for legislative action at state and federal levels. Such actions might include (1) the adoption of data gathering requirements to facilitate both disparate impact and health effects analysis, and (2) the adoption of statutory net health effects requirements to support litigation-based approaches.

As the number of emissions credit systems grows, net health effects based approaches provide an additional opportunity for activism and litigation ready to be harnessed by the environmental justice movement.