

A Literature Survey On Automobile Fuel System Technologies

SHREYAS G

Mechanical Engineering Student, JSSATE, Bangalore

shreyasg3004@gmail.com

Abstract: In this study, a survey of research papers on utilization of natural gas–hydrogen mixtures in internal combustion engines is carried out. The study addresses the issue of technological "lock-in" and the possibilities of escape from it. Earlier literature on technological lock-in has tended to focus on inter-industry sources of positive feedbacks that are at the core of the technological lock-in phenomena. This study draws attention to the importance of inter-industry sources in contributing to technological lock-in. Several possible avenues of escape from lock-in are discussed: crisis in existing technology, regulation, technological breakthroughs, changes in taste, emergence of niche markets, and new scientific results. The study includes a brief history of the competition among automobile technologies. This literature study will help any researcher to do further research easily by following all papers collected and listed under reference.

Key words: Automobile Fuel; Propulsion System; Gas Hydrogen Mixture; Internal Combustion;

I. INTRODUCTION

A survey of research papers on utilization of natural gas–hydrogen mixtures in internal combustion engines is carried out. There are a number of key areas surrounding this question, three of which are safety, economics and efficiency and emissions. Each of these issues was examined using the available literature. It can be seen that it is only with emissions that a clear difference appears and then hydrogen shows an advantage over methanol. The study addresses the issue of technological "lock-in" and the possibilities of escape from it. Earlier literature on technological lock-in has tended to focus on inter-industry sources of positive feedbacks that are at the core of the technological lock-in phenomena. This study draws attention to the importance of inter-industry sources in contributing to technological lock-in. Several possible avenues of escape from lock-in are discussed: crisis in existing technology, regulation, technological breakthroughs, changes in taste, emergence of niche markets, and new scientific results. The study includes a brief history of the competition among automobile technologies. Many people worry about the US dependence on imported petroleum, and people in both countries desire a switch from petroleum to a more sustainable fuel. Particular attention is given to strategies that would enhance the prospects that the hydrogen fuel cell car would eventually become the Car of the Future, while pursuing innovations relating to options based on internal combustion engines that would both assist a transition to hydrogen fuel cell cars and provide significant reductions of externality costs in the near term. This literature study will help any researcher to do further research easily by following all papers collected and listed under reference.

1. Atmospheric Chemistry Of Alternate Fuels And Reformulated Gasoline Components (Frank M. Bowman, John H. Seinfeld, 2000)

Recent air quality regulations have mandated the use of reformulated gasoline and alternate fuels in motor vehicles. Reformulated fuels are intended to reduce both ozone-forming volatile organic compound (VOC) emissions and air toxic emissions from vehicles. A method that allows the determination of the individual contributions of a single VOC to the ozone formation in a complex WC/NO_x mixture is outlined and applied to eight potential reformulated fuel components. In calculations using a current comprehensive atmospheric chemical reaction mechanism a wide variety of organics are shown to be responsible for ozone production. The incremental reactivities of the fuel components, which are defined as the additional amount of ozone formed per amount of organic compound added to a base mixture, include both the direct production of ozone by the oxygenate itself and additional ozone produced by the VOC mixture when the oxygenate is added. The enhancement of ozone production attributable to the organic mixture upon adding the oxygenates is shown to be a result of changes to the organic free radical pool. Most of the fuel oxygenates have relatively low incremental reactivity due to their slow reaction rates and to the formation of relatively unreactive formate and acetate products. The more reactive fuel oxygenates are those containing ethyl groups, which react faster than their counterparts containing only methyl and tetra-butyl groups.

2. Fuel cell system economics: comparing the costs of generating power with stationary and motor vehicle PEM fuel cell systems (Timothy E. Lipman, Jennifer L. Edwards, Daniel M. Kammen, 2002)

This investigation examines the economics of producing electricity from proton-exchange membrane (PEM) fuel cell systems under various conditions, including the possibility of using fuel cell vehicles (FCVs) to produce power when they are parked at office buildings and residences. The analysis shows that the economics of both stationary fuel cell and FCV-based power vary significantly with variations in key input variables such as the price of natural gas, electricity prices, fuel cell and reformer system costs, and fuel cell system durability levels. The “central case” results show that stationary PEM fuel cell systems can supply electricity for offices and homes in California at a net savings when fuel cell system costs reach about \$6000 for a 5 kW home system (\$1200/kW) and \$175,000 for a 250 kW commercial system (\$700/kW) and assuming somewhat favourable natural gas costs of \$6/GJ at residences and \$4/GJ at commercial buildings. Grid-connected FCVs in commercial settings can also potentially supply electricity at competitive rates, in some cases producing significant annual benefits. Particularly attractive is the combination of net metering along with time of-use electricity rates that allow power to be supplied to the utility grid at the avoided cost of central power plant generation. FCV based power at individual residences does not appear to be as attractive, at least where FCV power can only be used directly or banked with the utility for net metering and not sold in greater quantity, due to the low load levels at these locations that provide a poor match to automotive fuel cell operation, higher natural gas prices than are available at commercial settings, and other factors.

3. Techno-economic analysis of co-fired biomass integrated gasification/combined cycle systems with inclusion of economies of scale (Monica Rodrigues, Andre P.C. Faaij Arnaldo Walter, 2003)

This work focuses on short-term application of biomass integrated gasification/combined cycle (BIG/CC) technology with co-firing of natural gas and biomass derived gas. Co-firing leads to higher efficiency and lower costs of BIG/CC technology. A full technical and economic analysis was carried out by integrating performance modelling from co-fired CC and scale effects over a wide range of capacities (20–300 MW_e). The gasification technology is directly air-heated and the feedstock is sugar cane residue. Co-firing alleviates the need for de-rating gas turbines, which would reduce efficiency. It also allows combined cycles to be

scaled up beyond the limits imposed by single vessel gasifiers. Mixing of LCV gas and natural gas can greatly improve the cost-effectiveness of power generated by BIG/CC. The cost of electricity (COE) for biomass reaches a minimum with 50% proportion of natural gas in the mixture. For proportions of natural gas higher than 60%, the biomass-based power in a co-firing scheme may become less cost-effective than a BIG/CC. A sensitivity analysis shows that if the energy input consists of 50% biomass, the most sensitive parameters—in decreasing order—are the efficiency, the capital costs of the combined cycle, the gas clean-up equipment and the biomass fuel costs.

4. Escaping Lock-In: The Case Of The Electric Vehicle (Robin Cowan Staffan Hult en, 1996)

The study addresses the issue of technological “lock-in” and the possibilities of escape from it. Earlier literature on technological lock-in has tended to focus on inter-industry sources of positive feedbacks that are at the core of the technological lock-in phenomena. This study draws attention to the importance of inter-industry sources in contributing to technological lock-in. Several possible avenues of escape from lock-in are discussed: crisis in existing technology, regulation, technological breakthroughs, changes in taste, emergence of niche markets, and new scientific results. The study includes a brief history of the competition among automobile technologies. The analysis of the current state of the electric vehicle, its technology, and the surrounding supporting industries and infrastructures is relatively pessimistic about a rapid transition away from the internal combustion engine technological lock-in. However, regulation could create enough niche markets so that some self-reinforcing processes would become possible. In this way, the electric vehicle might emerge as a visible part of the automobile market.

5. A Survey of Processes for Producing Hydrogen Fuel from Different Sources for Automotive-Propulsion Fuel Cells (Lee F. Brown, 1996)

Seven common fuels are compared for their utility as hydrogen sources for proton-exchange membrane fuel cells used in automotive propulsion. Methanol, natural gas, gasoline, diesel fuel, aviation jet fuel, ethanol, and hydrogen are the fuels considered. Except for the steam reforming of methanol and using pure hydrogen, all processes for generating hydrogen from these fuels require temperatures over 1000 K at some point. With the same two exceptions, all processes require water-gas shift reactors of significant size. All processes require low-sulphur or zero-sulphur fuels, and this

may add cost to some of them. Fuels produced by steam reforming contain ~70-80% hydrogen, those by partial oxidation ~35-45%. The lower percentages may adversely affect cell performance. Theoretical input energies do not differ markedly among the various processes for generating hydrogen from organic chemical fuels. Pure hydrogen has severe distribution and storage problems. As a result, the steam reforming of methanol is the leading candidate process for on-board generation of hydrogen for automotive propulsion. If methanol unavailability or a high price demands an alternative process, steam reforming appears preferable to partial oxidation for this purpose.

6. *Harvesting Operations And Energetics Of Tall Grasses For Biomass Energy Production: A Case Study (P. Mislevy, R. C. Fluck, 1993)*

The U.S.A. imports about 50% of its energy needs while Florida imports about 85%. Among the renewable energy sources available, biomass appears promising especially in the southeast which includes Florida because of a favourable environment for production and the available methods to convert biomass to energy. Optimal production of biomass requires the identification and management of high yielding persistent perennial cultivars. Elephant grass (*Pennisetum purpureum* Schum.) and energy cane (*Saccharum spontaneum* L.) are two tall grasses that meet these requirements. To optimize the supply of convertible biomass, suitable methods of harvesting the crop must be available. The purpose of this research was to study the feasibility and energetics of harvesting, drying, and baling tall grasses with conventional farm machinery. A Mathews rotary scythe and a New Holland 849 Auto Wrap large round baler were determined to provide a practical harvesting system for baled biomass averaging 15-27 Mg ha⁻¹. The rotary scythe can be used for harvesting and fluffing or turning a windrow over to expedite drying. This harvesting system requires about 3 kg diesel fuel Mg⁻¹ dry biomass (DB), 25 min of time Mg⁻¹ DB, and a cost of about \$10 to 12 Mg⁻¹ DB. Energy requirements of harvesting operations would be about 300-375 MJ Mg⁻¹ DB, and primary energy requirements for production and harvesting are about 1100-1500 MJ Mg⁻¹ DB. For each unit of fossil fuel invested in the total production and harvesting system, 12-15 units would be returned in biomass

7. *Hydrogen Production From High-Temperature Steam Electrolysis Using Solar Energy (H. Arashi, H. Naito, H. Miura, 2003)*

Fundamental studies of hydrogen production by high-temperature steam electrolysis were made

using solar energy as a heat source. A sintered ZrO₂ + 8 mol% Y₂O₃ ceramic is used as an electrolyte. Both sides of this electrolyte were coated with platinum porous electrodes on the one side acting as a cathode and on the other as an anode. The electrolytic cell was inserted into a porous zirconia ceramic tube placed at the focal point of a solar concentrator and heated up to 1000~°C by concentrated solar radiation. Water vapor was introduced into a cathodic compartment using argon as a carrier gas. On supplying a direct current to this cell, the gas taken out from the cathodic compartment was analysed by gas chromatography and production of hydrogen was confirmed. The current efficiency in this high-temperature electrolysis was 98%. The electrochemical efficiency reached 71%. Combining our high-temperature electrolyser cell with a solar AMTEC or a solar thermoelectric conversion, hydrogen can be produced only using a solar energy as a primary energy. The overall energy efficiency was estimated as 20-28% for this hydrogen production system. This efficiency is twice that of photovoltaic electrolysis. From this fundamental research, it is concluded that high-temperature steam electrolysis using solar energy as a primary energy source is a promising technique to produce hydrogen cleanly

8. *Energy Pathway Analysis-A Hydrogen Fuel Cycle Framework For System Studies (J. S. Badin S. Tagore, 1998)*

An analytical framework has been developed that can be used to estimate a range of life-cycle costs and impacts that result from the incremental production, storage, transport, and use of different fuels or energy carriers, such as hydrogen, electricity, natural gas, and gasoline. This information is used in a comparative analysis of energy pathways. The pathways provide the U.S. Department of Energy (DOE) with an indication of near-, mid-, and long-term technologies that have the greatest potential for advancement and can meet the cost goals. The methodology and conceptual issues are discussed. Also presented are results for selected pathways from the E3 (Energy, Economics, Emissions) Pathway Analysis Model. This model will be expanded to consider networks of pathways and to be compatible with a linear programming optimization processor. Scenarios and sets of constraints (energy demands, sources, emissions) will be defined so the effects on energy transformation activities included in the solution and on the total optimized system cost can be investigated. This evaluation will be used as a guide to eliminate technically feasible pathways if they are not cost effective or do not meet the threshold requirements for the market acceptance

9. GHG mitigation in the transport sector (Laurie Michaelis, 1999)

This paper explores the potential for greenhouse gas mitigation in the transport sector to contribute to meeting the objective of the Framework Convention on Climate Change (FCCC). The technical potential for vehicle energy intensity reductions is found to be about 25-50%, but the economic ('no regrets') potential is much smaller. Renewable derived alternative fuels can reduce greenhouse gas emissions per unit of energy used by as much as 80%, but supplies are insufficient to meet current demand except at very high prices. Thus, energy intensity reductions should be the first priority. However, current trends suggest that energy intensity may not fall at all in the coming 30 years. Government policies, including feebates (a system of fuel economy related vehicle taxes and subsidies) and fuel taxes, could help to reduce transport energy intensity and traffic levels but, given available technology, current consumer preferences and lifestyles, policies that would reduce transport GHG emissions below 1990 levels would probably entail net economic costs. Governments pay much attention to developing new technology and this may be sufficient to bring about GHG emission reductions. However, technology might not provide the whole answer, and more research is needed into the possible role of developments in preference and lifestyle.

10. Fuel cells for transport: can the promise be fulfilled? Technical requirements and demands from customers (Thomas Klaiber, 1999)

The paper discusses the technical requirements and the customer demands for vehicles that have an on-board methanol reformer and fuel cells. The research concentrates on the technical developmental risks which include minimizing volume, reducing weight and, at the same time, improving efficiency and system dynamics. Fuel cell powered vehicles with methanol reformers are not only suitable for a niche market but also these vehicles will compete with conventional vehicles. The greatest hindrance will be the price of the fuel cell. A possible progressive development of the number of fuel cell powered vehicles in conjunction with a reduction in costs will be discussed in the paper. When fuel cell vehicles come to the market it is necessary that an infrastructure for the fuel methanol or hydrogen is installed. Therefore, it will only be possible to introduce fuel cell vehicles into special markets, e.g. California. Such a process will need to be subsidized by additional incentives like tax concessions. Today there are many technical risks and unsolved problems relating to production technologies, infrastructure, and costs. Nevertheless, among the alternative power units,

the fuel cell seems to be the only one that might be competitive to the conventional power unit, especially relating to emissions.

11. A Life-Cycle Model Of An Automobile (Heather L. Maclean Lester B. Lave)

The environmental and energy implications of a mid-sized automobile were assessed by performing a life-cycle inventory analysis that emphasized manufacture and use phases. An Economic Input-Output Life-Cycle Analysis model was used that produces a large array of indicators of the effects of a product or service on the economy and the environment. The analysis corroborates two previous studies that used the conventional life-cycle analysis model developed by the Society for Environmental Toxicology and Chemistry (SETAC) (1, 2) and EPA (3). The use phase is more important than the manufacture and disposal phases in terms of energy use and environmental discharges. Automobile service is comparable to the fuel cycle in terms of discharges of toxic substances. In contrast to a Volkswagen study, tailpipe exhaust and evaporative emissions of hydrocarbons (HC)/volatile organic compounds (VOCs), nitrogen oxides (NO_x), and particulate matter are greater than emissions upstream in the fuel cycle. This difference apparently arises from using on-road tailpipe emissions data, rather than emissions data from laboratory tests. The Economic Input-Output model is found useful for quantifying the range of implications of decisions concerning manufacture and use

12. An accident waiting to happen: a spatial approach to proactive pedestrian planning (Robert J. Schneider, Rhonda M. Ryznar Asad J. Khattak, 2002)

There are about 75,000 pedestrian crashes in the United States each year. Approximately 5000 of these crashes are fatal, accounting for 12% of all roadway deaths. On college campuses, pedestrian exposure and crash-risk can be quite high. Therefore, we analysed pedestrian crashes on the campus of the University of North Carolina at Chapel Hill (UNC) as a test case for our spatially-oriented prototype tool that combines perceived-risk (survey) data with police-reported crash data to obtain a more complete picture of pedestrian crash-risk. We use spatial analysis techniques combined with regression models to understand factors associated with risk. The spatial analysis is based on comparing two distributions, i.e. the locations of perceived-risk with police-reported crash locations. The differences between the two distributions are statistically significant, implying that certain locations on campus are perceived as dangerous, though pedestrian crashes have not yet occurred there, and there are actual locations of police-reported crashes that are not perceived to be

dangerous by pedestrians or drivers. Furthermore, we estimate negative binomial regression models to combine pedestrian and automobile exposure with roadway characteristics and spatial/land use information. The models show that high exposure, incomplete sidewalks and high crosswalk density are associated with greater observed and perceived pedestrian crash-risk. Additionally, we found that people perceive a lower risk near university libraries, stadiums, and academic buildings, despite the occurrence of crashes.

13. Supported Pd-perovskite catalyst for CNG engines' exhaust gas treatment (D. Fino, N. Russo, G. Saracco, V. Specchia, 2007)

Perovskite-type oxides of the series $La_{1-x}A_xMn_{1-y}ByO_3$ ($A \frac{1}{4} Sr$; $B \frac{1}{4} Fe$ or Co) were prepared by solution combustion synthesis and characterized by X-ray diffraction, specific surface analysis, transmission electron microscopy and field emission scanning electron microscopy techniques. Their activity towards the combustion of methane was evaluated in a temperature programmed combustion microreactor. The $LaMn_{0.9}Fe_{0.1}O_3$ catalyst was found to provide the best performance. The half-conversion temperature of methane over the $LaMn_{0.9}Fe_{0.1}O_3$ catalyst was 398 C with a W/F $\frac{1}{4}$ 0.12 g s/cm³ and a methane feed concentration of 0.4 vol% under oxygen excess. Via temperature programmed oxygen desorption (TPD) analysis as well as catalytic combustion runs, the prevalent activity of the $LaMn_{0.9}Fe_{0.1}O_3$ catalyst could be explained by its higher and increased capability to desorb superficial, weakly chemisorbed oxygen species. Further catalyst development allowed to maximise the catalytic activity of this compound by promoting it with CeO_2 (1:1 molar ratio) and with 1 wt% Pd. This promoted catalyst was lined on cordierite monoliths in a $\gamma-Al_2O_3$ -supported form (catalyst weight percentage: 15 wt%) and then tested in a lab-scale test rig under realistic conditions for compressed natural gas-vehicles' exhaust gas treatment. Half methane conversion was achieved at 340 C (gas high space velocity = 10 000 h⁻¹), nearly the same but with a fourfold lower amount of the expensive noble metal than that used in commercial 4wt%Pd- γ - Al_2O_3 catalysts.

14. Differentiated Regulation: The Case Of Auto Emissions Standards (Howard K. Gruenspecht)

Differentiated regulation occurs when a regulatory authority applies different regulatory criteria across subgroups of a regulated sector. An extreme form of differentiation, grandfathering, fixes the regulatory standard for each regulated unit as of its entry date. Grandfathering plays an important role in economic and social regulatory programs such as

occupational licensure, building codes, and most product safety standards. Other programs, notably the environmental and occupational safety programs of EPA and OSHA, incorporate some retroactive regulation but generally apply tougher standards for newer facilities. Despite the widespread use of differentiated regulatory tools, little attention has been paid to their effect on investment and scrapping decisions in the regulated sector. Neoclassical capital theory suggests that bias against new sources in regulation will reduce investment in new facilities and lengthen the economic lifetime of old ones. Once the effect of differentiation on the composition of the capital stock is taken into account, tighter new source standards may actually be counterproductive, increasing the aggregate level of the regulated externality rather than reducing it. This paper presents an analysis of automotive emissions regulation that explicitly considers the link between regulation and the composition of the vehicle stock. The adoption of more stringent emissions standards for new vehicles is shown to prolong the retention of old, high-emission-rate vehicles in the fleet. For this reason, tighter new source standards actually increase aggregate emissions in the short run. This result is of general as well as specific interest given the widespread use of differentiated regulatory tools incorporating a bias against new sources in many regulatory programs.

15. The nonpecuniary costs of automobile emissions standards (Timothy F. Bresnahan Dennis A. Yao)

An important component of the costs of automotive air-pollution control has been nonpecuniary. a decline in vehicle performance characteristics. This regulatory impact on what the auto industry calls "drivability" has never been quantified, although there is considerable reason to believe that it has been a major component of the costs of some of the auto emissions standards of the last decade. We develop a methodology for econometric assessment of such costs, and apply it to the automobile air pollution standards of 19 72-1981. We find that these costs are important. For the first standards implemented in the 1970s, they exceeded the costs of pollution control equipment installed on the car and the costs of decreased fuel efficiency. Since then, however, advances in compliance technology have allowed increases in automobile quality so that incremental costs of recent standards are much lower than previously believed

16. Strategic Responses To Automobile Emissions Control: A Game-Theoretic Analysis (Dennis A. Yao, 1987)

This paper examines the dynamics of standard-setting regulation under technological uncertainty and asymmetric information about technological

capability. A two-period model which allows fully strategic action is developed and applied to the regulation of automobile emissions, a situation in which standards have been used to “force” innovation. It is found that the initial level of R&D activity caused by regulation increases with the intrinsic technical capability of industry. This result does not depend on marginal productivities of research that favour high-capability types and implies that a poor-capability industry will not attempt to compensate for its inability to innovate with increased research activity. It is also found that the regulator’s ability to induce investment is greater when R&D is likely to be unsuccessful.

17. *The Contingent Valuation Debate: Why Economists Should Care (Paul R. Portney)*

The contingent valuation method involves the use of sample surveys (questionnaires) to elicit the willingness of respondents to pay for (generally) hypothetical projects or programs. The name of the method refers to the fact that the values revealed by respondents are contingent upon the constructed or simulated market presented in the survey. A spirited (and occasionally mean-spirited) battle over such methods is currently being waged, involving competing factions within the federal government, economists and lawyers representing business and environmental groups, and interested academics as well. At issue is a seemingly quite specific question: should environmental regulations currently under development at both the Department of the Interior and the Department of Commerce sanction the use of the contingent valuation method in estimating the damage done by spills of oil, chemicals, or other substances covered by federal law? More generally, the debate raises broad questions about what economists have to say about the values that individuals place on public or private goods. The two papers that follow this one make cases for and against the use of the contingent valuation method. My aim here is to provide an overview of the technique and the debate surrounding it. I also want to suggest why this debate should matter to economists, both professionally and in their roles as citizens and consumers.

18. *Applications Of Environmental Valuation For Determining Externality Costs (H. Scott Matthews Lester B. Lave, 2000)*

Analysing the effectiveness of environmental programs and regulations requires comparing the costs and benefits of reducing different pollutants or further abatement. To make useful comparisons, the various benefits from reduced pollution must be translated into dollars. Unfortunately, estimating the dollar value of environmental damages is complicated, controversial, and generally uncertain. Often these estimates have been misused. This

paper identifies the need for benefit estimates, shows how they are constructed, and demonstrates how they can be used to improve environmental policy analysis

19. *Economic Prescriptions for Environmental Problems: How the Patient Followed the Doctor's Orders (Robert W. Hahn)*

One of the dangers with ivory tower theorizing is that it is easy to lose sight of the actual set of problems which need to be solved, and the range of potential solutions. As one who frequently engages in this exercise, I can attest to this fact. In my view, this loss of sight has become increasingly evident in the theoretical structure underlying environmental economics, which often emphasizes elegance at the expense of realism. In this paper, I will argue that both normative and positive theorizing could greatly benefit from a careful examination of the results of recent innovative approaches to environmental management. The particular set of policies examined here involves two tools which have received widespread support from the economics community: marketable permits and emission charges (Pigou, 1932; Dales, 1968; Kneese and Schultze, 1975). Both tools represent ways to induce businesses to search for lower cost methods of achieving environmental standards. They stand in stark contrast to the predominant "command-and-control" approach in which a regulator specifies the technology a firm must use to comply with regulations. Under highly restrictive conditions, it can be shown that both of the economic approaches share the desirable feature that any gains in environmental quality will be obtained at the lowest possible cost (Baumol and Oates, 1975). Until the 1960s, these tools only existed on blackboards and in academic journals, as products of the fertile imaginations of academics. However, some countries have recently begun to explore using these tools as part of a broader strategy for managing environmental problems. This paper chronicles the experience with both marketable permits and emissions charges. It also provides a selective analysis of a variety of applications in Europe and the United States and shows how the actual use of these tools tends to depart from the role which economists have conceived for them.

20. *What Can We Learn from the Grand Policy Experiment? Lessons from SO2 Allowance Trading (Robert N. Stavins)*

Economists consistently have urged the use of "market-based" or "economic-incentive" instruments-principally pollution taxes and systems of tradeable permits-to address environmental problems, rather than so-called "command-and-control" instruments, such as design standards, which require the use of particular technologies, or

performance standards, which prescribe the maximum amount of pollution that individual sources can emit. At least in theory, a well-designed pollution tax (Pigou, 1920) or tradeable permit system (Crocker, 1966; Dales, 1968; Montgomery, 1972) will minimize the aggregate cost of achieving a given level of environmental protection (Baumol and Oates, 1988), and provide dynamic incentives for the adoption and diffusion of cheaper and better pollution control technologies (Milliman and Prince, 1989). Despite such advantages, market-based environmental instruments have been used far less frequently than command-and-control standards. In particular, while taxes have been imposed on certain products that are linked to pollution, like gasoline and chemicals, this has typically been done as a way of raising revenue, such as with gas taxes to fund highway construction or chemical taxes to fund cleanup of Superfund toxic waste sites, rather than as incentive devices intended to reduce externalities (Barthold, 1994). But over the past 25 years, the political process has gradually become more receptive to market-oriented environmental tools. Beginning in the 1970s, the Environmental Protection Agency (EPA) offered states the option of employing variants of tradeable permits for the control of localized air pollutants. Tradeable-permit systems were used in the 1980s to phase leaded gasoline out of the market and to phase out ozone-depleting chlorofluorocarbons (CFCs). But by far the most ambitious application of these instruments has been for the control of acid rain under Title IV of the Clean Air Act amendments of 1990, which established a sulfur dioxide (SO₂) allowance trading program intended to cut nationwide emissions of SO₂ by 50 percent below 1980 levels by the year 2000. This essay seeks to identify lessons that can be learned from this grand experiment in economically-oriented environmental policy. Since the SO₂ allowance trading program became binding only in 1995, it might seem premature to search for lessons for future policy. This would be true, were one to consider this policy experiment in isolation. But the SO₂ allowance trading program did not emerge into a policy vacuum; rather, it is but one step in the evolution of market-based environmental policies. Considered in this context, the time is ripe not only for an interim appraisal, but for reflection on what we have learned. I begin with a brief description of the SO₂ allowance trading system and its performance, relying on the accompanying article by Richard Schmalensee and his colleagues to provide details. I then address questions of positive political economy; for example, given the historical support for command-and-control environmental policy instruments, why was allowance trading adopted for acid-rain control in 1990? Subsequently, I consider normative lessons

for the design and implementation of market-oriented environmental policies, and offer some conclusions

21. *An Interim Evaluation of Sulfur Dioxide Emissions Trading (Richard Schmalensee, Paul L. Joskow, A. Denny Ellerman, Juan Pablo Montero, Elizabeth M. Bailey)*

Title IV of the 1990 Clean Air Act Amendments established the first large-scale, long-term environmental program to rely on tradable emissions permits called "allowances" in this program to control pollution. This program was designed to cut acid rain by reducing sulfur dioxide (SO₂) emissions from electric generating plants to about half their 1980 level, beginning in 1995. It is of interest both as a response to an important environmental issue and as a landmark experiment in environmental policy. This experiment comes at a particularly important time, since emission trading is under serious consideration, with strong U.S. backing, for use to deal with global climate change by curbing emissions of carbon dioxide (CO₂). The economic stakes in climate change surpass those in acid rain by several orders of magnitude (Intergovernmental Panel on Climate Change, 1996). This article summarizes the results to date of our ongoing empirical analysis of compliance costs and allowance market performance under the U.S. acid rain program

22. *Life-Cycle Assessment= Inventory Guidelines And Principles (B. W. Vigon, D.A. Tolle, B. W. Cornaby, H. C. Latham Battelle, 1 993)*

This document describes the three components of a life-cycle assessment (inventory analysis, impact analysis, and improvement analysis) as well as scoping activities, presents a brief overview of the development of the life-cycle assessment process, and develops guidelines and principles for implementation of a product life-cycle assessment. The major stages in a life cycle are raw materials acquisition, manufacturing, consumer use/reuse/maintenance, and recycle/ waste management. The basic steps of performing a life-cycle inventory (defining the goals and system boundaries, including scoping; gathering and developing data; presenting and reviewing data; and interpreting and communicating results) are presented along with the general issues to be addressed. The system boundaries, assumptions, and conventions to be addressed in each stage of the inventory are presented. Life-cycle impact analysis and life-cycle improvement analysis will be topics of forthcoming guidance document. This report was submitted by Battelle in fulfillment of Contract No. 68-CO-0003 under the sponsorship of the U.S. Environmental Protection Agency. Technical effort leading to this report covers a

period from August 1990 to May 1991. The draft report was completed in September 1991. Following a comment period, this final report was prepared between March and November 1992.

23. Using Input-Output Analysis to Estimate Economy-wide Discharges (Lester B. Lave, Elisa Cobas-Flore S Chri S T. Hendrickso N, Franci S C. Mcmichael, 1995)

Life-cycle assessment models attempt to quantify the environmental implications of alternative products and processes, tracing pollution discharges and resources use through the chain of producers and consumers. Present life-cycle assessments must draw boundaries that limit consideration to a few producers in the chain from raw materials to a finished product. We show that this limitation considers only a fraction of the environmental discharges associated with a product or process, thereby making current assessments unreliable. We propose an approach that uses economic input-output analysis and pollution discharge data and apply the model to automobiles, refrigerators, and computer purchases, and to a comparison of paper and plastic cups.

24. Toxic Emissions Indices For Green Design And Inventory (Arpad Horvath, Chri S T. Hendrickso N, Lester B. Lave Franci S C. Mcmichael, Tse-Sun G Wu, 1995)

The Toxics Release Inventory (TRI) is the most comprehensive and widely reported information on hazardous discharges to the environment in the United States. Unfortunately, the fledgling nature of the TRI may lead to simplistic interpretations of the results. In particular, TRI summaries typically report total releases of toxic chemicals by weight, implicitly assuming that a discharge of substance A is equivalent to an equal weight discharge of substance B. In contrast, various indices of the toxicity to humans of the chemicals reported in the Inventory indicate that the most harmful are more than 1,000,000 times more toxic than the least harmful. Thus, the simple rankings and time trends of facilities, industries, counties, and states as sources of toxic releases can be misleading because they have neglected relevant toxicological data. We contrast the one-to-one ranking of the TRI data with a ranking based on relative toxicity, using "threshold limit value" (TLV) indices. The weighting scheme presented here is a useful first step for correcting the TRI but is certainly not definitive. Additional study is needed of uncertainties and limitations of this proposed approach. Future applications may be found in green engineering design and manufacturing changes

25. Product Environmental Life-Cycle Assessment Using Input-Output Techniques (Satish Joshi. 1999)

Life-cycle assessment (LCA) facilitates a systems view in environmental evaluation of products, materials, and processes. Life-cycle assessment attempts to quantify environmental burdens over the entire life-cycle of a product from raw material extraction, manufacturing, and use to ultimate disposal. However, current methods for LCA suffer from problems of subjective boundary definition, inflexibility, high cost, data confidentiality, and aggregation. This paper proposes alternative models to conduct quick, cost effective, and yet comprehensive life-cycle assessments. The core of the analytical model consists of the 498 sector economic input-output tables for the U.S. economy augmented with various sector-level environmental impact vectors. The environmental impacts covered include global warming, acidification, energy use, non-renewable ores consumption, eutrophication, conventional pollutant emissions and toxic releases to the environment. Alternative models are proposed for environmental assessment of individual products, processes, and life-cycle stages by selective disaggregation of aggregate input-output data or by creation of hypothetical new commodity sectors. To demonstrate the method, a case study comparing the life-cycle environmental performance of steel and plastic automobile fuel tank systems is presented.

26. Economic Input—Output Models For Environmental Life-Cycle Assessment (Chris Hendrickson, Arpad Horvath, Satish Joshi, Lester Lave, 2011)

Process and product models are commonly used for performing life-cycle assessments (LCAs) of the environmental impacts of materials and products through different stages of fabrication, use, and end-of-life options. In this article, we show that these models can be represented as process flow diagrams or as matrices of process interactions. In either representation, the inventory of environmental emissions and resources used is comparable, provided the process models are proportional in nature (any increase in product output produces a corresponding environmental burden). Matrix representations are advantageous if application cost, feedback flow, or speed of analysis is important. They are also useful in conjunction with comprehensive, general equilibrium models in which the system boundary of the problem (e.g., an LCA of a product) being analyzed is on the level of the national economy.

II. ACKNOWLEDGEMENT

The Author is highly thankful to Dr. S. Sridhar, Professor and Director, RV Cognitive Technologies, RV College of Engineering, Bangalore for helping me to present my literature work in the form of paper and for communicating it to this journal for publication.

III. REFERENCES

- [1]. "1991 Toxics Release Inventory Public Data Release, State Fact Sheets"; U.S. Environmental Protection Agency. Office of Pollution Prevention and Toxics (TS-799): Washington, DC, May 1993; EPA 745-F-93-002.
- [2]. "1992 Toxics Release Inventory Public Data Release"; U.S. Environmental Protection Agency. Office of Pollution Prevention and Toxics (7408), Washington, DC, April 1994; EPA 745-R-94-001.
- [3]. "Green Products by Design, Choices for a Cleaner Environment"; Office of Technology Assessment, Technical Report OTA-E-541, U.S. Government Printing Office: Washington, DC, 1992.
- [4]. "Guide to Occupational Exposure Values-1993"; American Conference of Governmental Industrial Hygienists (ACGIH): Cincinnati, 1993.
- [5]. "Standard Industrial Classification Manual: SIC 2 + 2"; Dun & Bradstreet Information Resources: Murray Hill, NJ, 1989.
- [6]. "Toxic Release Inventory, 1987-1990 Inventories and Chemical Substance Fact Sheets"; U.S. Environmental Protection Agency. Office of Pollution Prevention and Toxics: Washington, DC, September 1992; compact disc, EPA 700/C-92-002.
- [7]. "Toxicity Testing: Strategies to Determine Needs and Priorities"; National Academy of Sciences; National Academy Press: Washington, DC, 1984.
- [8]. "Tracking Toxic Substances at Industrial Facilities, Engineering Mass Balance Versus Materials Accounting"; National Research Council: Washington, DC, 1990.
- [9]. "U.S. Bureau of the Census, 1988 Annual Survey of Manufacturers: Statistics for Industry Groups and Industries"; Technical Report; U.S. Department of Commerce: Washington, DC, October 1990; M88(AS)-1.
- [10]. 1987-1993 Toxics Release Inventory [CD-ROM]; EPA-749/ C-95-004; U.S. Environmental Protection Agency, Office of Pollution Prevention, U.S. Government Printing Office: Washington, DC, June 1995.
- [11]. 1988 Annual Survey of Manufacturers: Statistics for Industry Groups and Industries; Technical Report M88(AS)-1; U.S. Bureau of the Census, U.S. Department of Commerce, U.S. Government Printing Office: Washington, DC, October 1990.
- [12]. 1992 Toxics Release Inventory; Technical Report; Office of Pollution Prevention and Toxics. U.S. Environmental Protection Agency: Washington, DC, April 1994; EPA 745- R-94-001.
- [13]. 1993 RCRA Facility Reports (Oil Refineries, public data release); U.S. Environmental Protection Agency, U.S. Government Printing Office: Washington, DC, 1997.
- [14]. 1993 Toxics Release Inventory Public Data Release; EPA 745-R-95-010; Office of Pollution Prevention and Toxics, U.S. Environmental Protection Agency, U.S. Government Printing Office: Washington, DC, 1995
- [15]. IPCC (Intergovernmental Panel on Climate Change) (1995a) Climate Change 1994 Cambridge University Press, Cambridge
- [16]. 3. D. P. Baron and B. R. Myerson, Regulating a monopolist with unknowns cost, *Econometrica* 59, 911-930 (1982).
- [17]. A Technical Framework for Life-Cycle Assessments; Society of Environmental Toxicology and Chemistry, SETAC Foundation: Washington, DC, 1991.
- [18]. A. D. Little, "Multi-Fuel Reformers for Fuel Cells Used in Transportation--Multi-Fuel Reformers. Phase I. Final Report," Report #DOE/CE/50343-2, prepared for U.S. Department of Energy, Office of Transportation Technologies. Arthur D. Little, Inc., Cambridge, MA, May, 1994.
- [19]. A. Kaufman, DOE-PAFC-Rus. Int. Conf. on Fuel Cells. Long Beach. FL USA. Nov/Dec. 1994.
- [20]. Ackerman, Bruce A., and William T. Hassler, *Clean Coal/Dirty Air*. New Haven: Yale University Press, 1981.

- [21]. Acton, Jan, "Evaluating Public Progress to Save Lives: The Case of Heart Attacks," RAND Research Report R-73-02. Santa Monica: RAND Corporation, 1973.
- [22]. Adler, U. (ed.-in-chief), Automotive Handbook, p. 216. Robert Bosch, Stuttgart, 1986
- [23]. Adriaanse, A. 1993. Environmental policy performance indicators. The Hague: Sdu Publishers
- [24]. Adriaanse, A. Environmental Policy Performance Indicators-A Study on the Development of Indicators for Environmental Policy in The Netherlands; Sdu Uitgeverij Koninginnegracht: 1993.
- [25]. Ainsworth, S. J., "U.S. Petrochemical Producers Anticipate Strong, More Stable 1995," Chem. & Eng. News, 73(11), 15-23, esp. 20-21 (March 13, 1995)
- [26]. AIRS Database. U.S. Environmental Protection Agency, <http://www.epa.gov/airsweb/>.
- [27]. Amphlett, J. C., M. J. Evans, R. A. Jones, R. F. Mann and R. D. Weir, "Hydrogen Production by the Catalytic Steam Reforming of Methanol--Part I: Thermodynamics," Can. J. Chem. Engr., 59, 720- 727 (1981).
- [28]. Amphlett, J. C., M. J. Evans, R. F. Mann and R. D. Weir, "Hydrogen Production by the Catalytic Steam Reforming of Methanol--Part II: Kinetics of Methanol Decomposition Using Girdler G66B Catalyst," Can. J. Chem. Engr., 63, 605-611 (1985).
- [29]. An, E; Barth, M.; Ross, M. Proceedings of the 1995 Total Life Cycle Conference; Society of Automotive Engineers, Inc.: Warrendale, PA, October 1995; pp. 147-157.
- [30]. Andersson-Skald, Y., Grennfelt, P. and Pleijel, K., J. Air & Waste Manage. Assoc. 42, I I52 (1992).
- [31]. Ang, B W (1993) 'An energy and environmentally sound urban transport system: the case of Singapore' International Journal of Vehicle Design 14 (4)
- [32]. Ang, B W, Fwa, T F and Poh, C K (1991) 'A statistical study of automobile fuel consumption' Energy: The International Journal 16 (8) 1067-1077
- [33]. Ang, BW 1992: 'Restraining automobile ownership and usage and the transportation energy demand: the case of Singapore' The Journal of Energy and Development 12 (2) pp 263-290
- [34]. Angrist, S. W., Direct Energy Conversion, 3rd ed., pp. 374-378. Allyn and Bacon, Boston, 1976
- [35]. Appeals Court ruling that EPA exceeded its authority in setting the 1998 PM2.5 and Ozone Standards.
- [36]. Appleby, A. J., "Characteristics of Fuel Cell Systems," in Fuel Cell Systems (L. J. M. J. Blomen and M. N. Mugerwa, eds.), pp. 157-199, esp. pp. 159-160. Plenum Press, New York, 1993
- [37]. Armstrong, D M (1993) 'Transport infrastructure, urban form and mode usage: an econometric analysis based on aggregate comparative data' in Regional Science Association Thirty Third European Congress, Moscow, 24-27 August 1993 Northern Ireland Economic Research Centre, Belfast
- [38]. Arnold, F. 1993. Life-cycle design doesn't work. Environmental Forum. Sept/Oct: 19-23.
- [39]. Arnold, F. Environmental Forum 1993, Sept./Oct., 19-23.
- [40]. Arthur D. Little, 1994. Fuel Cells for Building Applications: Market Analysis, Technology Status, and Program Plan Overview, Vol. 2. Arthur D Little, Cambridge, MA.
- [41]. ASAE Standards 1990, Am. Soc. Agric. Eng. St. Joseph, MI (1990).
- [42]. Aschmann, S. M. and Atkinson, R., Environ. Sri. Tech. 28, 1539 (1994).
- [43]. Atkeson, Erica, "Joint Implementation: Lessons from Title IV's Voluntary Compliance Programs," Working Paper 97-003, MIT Center for Energy and Environmental Policy Research, May 1997
- [44]. Atkinson, R., Atmbs. Environ. 24, I (1990).
- [45]. Atkinson, R., Baulch. D. L., Cox, R. A., Hampson, R. F., Kerr, J. A. and Troe, J. J. Phys. Chem. Ref Data 21, I I25 (1992).
- [46]. Austin, K.P., Tight, M.R., Kirby, H.R., 1995. An Advanced System for the Study of Children's Safety on the Journeys To and From School, vol. 2A, No. 3. VTI Conference No. 4A
- [47]. AUTOMOTIVE NEWS. Annual Market Data Book. Annual, 1965-1983.

- [48]. Averch, Harvey, and Leland L. Johnson, "Behavior of the Firm under Regulatory Constraint," *American Economic Review*, 1962, 52, 1053-69.
- [49]. Ayres, R. U. and A. V. Kneese. 1969. Production, consumption and externalities. *The American Economic Review*, LIX(June): 282–297.
- [50]. Ayres, R. U. *Resources, Environment and Economics*; Wiley Inter-science: New York, 1978.
- [51]. B. Holmstrom, Design of incentive schemes and the new Soviet incentive model, *European Econom. Rev.* 127-148 (1982).
- [52]. Bailey, Elizabeth M., "Allowance Trading Activity and State Regulatory Rulings: Evidence from the US Acid Rain Program," Working Paper 96-002, MIT Center for Energy and Environmental Policy Research, March 1996.
- [53]. Bailey, Elizabeth M., "Prices and Pricing in the Market for Sulfur Dioxide Emissions," Mimeo, MIT Department of Economics, February 1998
- [54]. Bailey, T., Gatrell, A., 1995. *Interactive Spatial Data Analysis*. Wiley, New York.
- [55]. Bakemeier, H., T. Huberich, R. Krabetz, W. Kiebe, and M. Schunck, "Ammonia," in *Ullmann's Encyclopaedia of Industrial Chemistry*, 5th ed. (B. Elvers, S. Hawkins, M. Ravenscroft, J. F. Rousaville and G. Schulz, eds.), vol. A2, pp. 143-242, esp. pp. 178-179, 213-216. VCH Verlagsgesellschaft, Weinheim, Germany, 1989.
- [56]. Balch W, Evans R, Brown J, Feldman G, McClain C, Esaias W. The remote sensing of ocean primary productivity: use of a new data compilation to test satellite algorithms. *J Geophys Res* 1992; 97:2279-2293.
- [57]. Banister, D (1992) 'Energy use, transport and settlement patterns' in Breheny, M J (ed) *Sustainable Development and Urban Form* Pision, London
- [58]. Barde, J., "Use of Economic Instruments for Environmental Protection: Discussion Paper," ENV/ECO/86.16, Organization for Economic Cooperation and Development, September 9, 1986.
- [59]. Barin, I., F. Sauert, E. Schultze-Rhonhof, S.-S. Wang, *Thermochemical Data of Pure Substances*. VCH Verlagsgesellschaft, Weinheim, Germany, 1993.
- [60]. Barlow, A., D. Contos, M. Holdren, P. Garrison, L. Harris, and B. Janke. 1996. Development of emission factors for polyethylene processing. *Journal of the Air and Waste Management Association* 46: 569–580.
- [61]. Barthold, Thomas A., "Issues in the Design of Environmental Excise Taxes," *Journal of Economic Perspectives*, Winter 1994, 8:1, 133-51.
- [62]. Basalla, G., *The Evolution of Technology*, Cambridge University Press, Cambridge, MA, 1988.
- [63]. Baumol, W. and Oates, W. *The Theory of Environmental Policy*. Englewood Cliffs, NJ: PrenticeHall, 1985
- [64]. Baumol, William J., and Wallace E. Oates, *The Theory of Environmental Policy*. Second edition. New York: Cambridge University Press, 1988.
- [65]. Becker, G., "A Theory of Competition Among Pressure Groups for Political Influence," *Quarterly Journal of Economics*, 1983, XCVII, 371-400.
- [66]. Bell, S. R.; M. Gupta, M.; Greening, L. A. *Energy Sources* 1995, 17, 535-551.
- [67]. Bennett, P. J. and Kerr, J. A., *J. Atmos. Chem. IO*, (1990).
- [68]. Bergin, M. S., Russell, A. G., Yang, Y., Das, M., Milford, J. B., Kirchner, F. and Stockwell, W. R., Uncertainty analysis of rate constants and product yields and the effects on quantification of the reactivity of emissions from alternatively-fueled vehicles, Report to the National Renewable Energy Laboratory of the Department of Energy. Contracts 13013-1, April (1995).
- [69]. Berkowitz, M K, Gallini, N T, Miller, E J and Wolfe, R A (1990) 'Disaggregate analysis of the demand for gasoline' *Canadian Journal of Economics* 23 (2) 253-275
- [70]. BERNDT, E.R. "Integration of Modern Demand Analysis with Hedonic Procedures: Towards an Empirical Implementation." Unpublished Manuscript, Massachusetts Institute of Technology, August 1982.
- [71]. BioCycle, 1991. *The Art and Science of Composting*. Edited by the staff of BioCycle, *Journal of Waste Recycling*. J.G. Press, Inc., Emmaus, PA.

- [72]. Birdsell, S. E., and N. E. Vanderborgh, "Kinetic Analysis of Carbon Monoxide Oxidation during Methanol Steam Reforming Clean-up," Paper #94-4077, AIAA 29th Intersociety Energy Conversion Engineering Conference, Monterey, CA, August 8-12, 1994.
- [73]. Birdsell, S. E., N. E. Vanderborgh and M. A. Inbody, "Preferential Oxidation of Methanol and Carbon Monoxide for Gas Cleanup during Methanol Fuel Processing," Proceedings of the 27th Intersociety Energy Conversion Engineering Conference, Atlanta, GA, August 23-27, 1993.
- [74]. Bishop, Richard, and Thomas Heberlein, "Measuring Values of Extramarket Goods: Are Indirect Measures Biased?" American Journal of Agricultural Economics, December 1979, 61, 926-30.
- [75]. Bleijenberg, A, 1994: 'The art of internalising' in Internalising the Social Costs of Transport European Conference of Ministers of Transport, OECD, Paris
- [76]. Bleiviss, D L (1988) The New Oil Crisis and Fuel Economy Technologies Quantum Books
- [77]. Bohi, Douglas R., "Utilities and State Regulators Are Failing to Take Advantage of Emissions Allowance Trading," The Electricity journal, March 1994, 7:2, 20-27.
- [78]. Bohi, Douglas R., and Dallas Burtraw, "SO₂ Allowance Trading: How Do Expectations and Experience Measure Up?" Electricity Journal, August/September 1997, 67-75.
- [79]. Bohi, Douglas R., and Dallas Burtraw, "Utility Investment Behavior and the Emission Trading Market," Resources and Energy, April 1992, 14:1/2, 129-53.
- [80]. Boland, J., "Economic Instruments for Environmental Protection in the United States," ENV/ECO/86.14, Organization for Economic Cooperation and Development, September 11, 1986
- [81]. Bose, R K and Mackenzie, G A (1993) 'Transport in Delhi: energy and environmental consequences' Industry and Environment 16 (1-2)
- [82]. Boustead, I. 1993. Eco-profiles of European plastics industry—polyethylene and polypropylene: Report 3. Brussels: The European Center for Plastics in the Environment
- [83]. Boustead, I. 1994. Eco-profiles of European plastics industry—polyvinyl chloride: Report 6. Brussels: The European Center for Plastics in the Environment
- [84]. Boustead, I. and G. F. Hancock, 1979. Handbook of Industrial Enewv Analysis. Chichester: Ellis Horwood and New York: John Wiley, ISBN 0-470-26492-6, Chapter 3, "Real Industrial Systems," p. 76
- [85]. Boustead, I., undated. "The Relevance of Re-Use and Recycling Activities for the LCA Profile of Products," 10 p.
- [86]. Bower, B. et al., Incentives in Water Quality Management: France and the Ruhr Area. Washington, D.C.: Resources for the Future, 1981.
- [87]. Bowman, F. M. and Seinfeld, J. H. Geophys. Res. 99, 5309 (1994).
- [88]. Bowman, F. M. and Seinfeld, J. H., Fundamental basis of incremental reactivities, Atmos. Environ. 28, 3359 (1994).
- [89]. Bowman, F. M., Pilinis, C. and Seinfeld, J. H., Atmos. Environ. 29, 579 (1995).
- [90]. Braddock, M., Lapidus, G., Cromley, E., Cromley, R., Burke, G., Banco, L., 1994. Using a geographic information system to understand child pedestrian injury. Am. J. Publ. Health 84 (7), 1158–1161
- [91]. Braumbeck O, Bauen A, Rosillo Calle F, Cortez L. Prospects for green cane harvesting and cane residues use in Brazil. Biomass Bioenergy 1999; 17:495–506.
- [92]. Brejc, M., and E. Supp, "Noncatalytic Partial Oxidation and Special Processes for Higher-Boiling Hydrocarbons," a chapter in "Gas Production," in Ullmann's Encyclopedia of Industrial Chemistry (B. Elvers, S. Hawkins, M. Ravenscroft, J. F. Rousaville and G. Schulz, eds.), vol. A12, pp. 204-14, esp. p. 206. VCH Verlagsgesellschaft, Weinheim, Germany, 1989.
- [93]. Bressers, J., "The Effectiveness of Dutch Water Quality Policy," Twente University of Technology, Netherlands, mimeo, 1983.
- [94]. Breuil, J. M. "Input-Output Analysis and Pollutants Emissions in France"; Energy Journal; Energy Economics Educational Foundation, Inc.: Cleveland, OH, 1992.
- [95]. Brög, W (1993) 'Behaviour begins in the mind: possibilities and limits of marketing activities in urban public transport' in

- European Conference of Ministers of Transport Round Table 92 on Marketing and Service Quality in Public Transport European Conference of Ministers of Transport, OECD, Paris
- [96]. Brooks, A., 2001. Electric drive vehicles: a huge new distributed energy resource. EVAA Electric Transportation Industry Conference, Sacramento, CA
- [97]. Brown, G., Jr. and J. Bresser, "Evidence Supporting Effluent Charges," Twente University of Technology, The Netherlands, mimeo, September 1986.
- [98]. Brown, G., Jr. and R. Johnson, " Pollution Control by Effluent Charges: It Works in the Federal Republic of Germany, Why Not in the U.S.," Natural Resources Journal, 1984, 24, 929-966.
- [99]. Brown, G., Jr., "Economic Instruments: Alternatives or Supplements to Regulations?" Environment and Economics, Issue Paper, Environment Directorate OECD, June 1984, 103-120.
- [100]. Brown, H.L., B.B. Hamel, B.A. Hedman, et al., 1985. Energy Analysis of 108 Industrial Processes, Drexel University, Philadelphia, PA. Prepared for U.S. Department of Energy. Fairmont Press, 314 p
- [101]. BTS, 1999. Transportation Statistics Annual Report 1999, BTS99-03. U.S. Department of Transportation, Bureau of Transportation Statistics, Washington, DC
- [102]. Buchanan, J. and G. Tullock, "Polluters' Profits and Political Response: Direct Controls Versus Taxes," American Economic Review, 1975 65, 139-147.
- [103]. Bunch, D S, Bradley, M A, Golob, T F, Kitamura, R and Occhiuzzo, G P (1993) 'Demand for clean-fuel vehicles in California: a discrete choice stated preference approach' Transportation Research A 27A (3) 237-253
- [104]. Burtraw, Dallas, "The SO₂ Emissions Trading Program: Cost Savings Without Allowance Trades," Contemporary Economic Polity, April 1996, 14, 79-94.
- [105]. Burtraw, Dallas, Alan Krupnick, Erin Mansur, David Austin, and Deirdre Farrell, "The Costs and Benefits of Reducing Acid Rain," Discussion Paper 97-31-REV, Resources for the Future, Washington, D.C., September 1997
- [106]. Burtraw, Dallas, and Byron Swift, "A New Standard of Performance: An Analysis of the Clean Air Act's Acid Rain Program," Environmental Law Reporter News & Analysis, August 1996, 26:8, 10411-10423.
- [107]. Butchart, A., Kruger, J., Lekoba, R., 2000. Perceptions of injury causes and solutions in a Johannesburg township: implications for prevention. Social Sci. Med. 50, 331–344
- [108]. Butchart, A., Kruger, J., Lekoba, R., 2000. Perceptions of injury causes and solutions in a Johannesburg township: implications for prevention. Social Sci. Med. 50, 331–344
- [109]. Button, K (1990) 'Environmental externalities and transport policy' OxJord Review of Economic Policy 6 (2)
- [110]. Button, K (1994) 'Overview of internalising the social costs of transport' in Internalising the Social Costs of Transport European Conference of Ministers of Transport, OECD, Paris
- [111]. CAGAN, P. "Measuring Quality Changes and the Purchasing Power of Money: An Exploratory Study of Automobiles" in Z. Griliches, ed., Price Indexes and Quality Change: Studies in New Methods of Measurement, Cambridge: Harvard University Press, 1971.
- [112]. California Air Resources Board (CARB), Development and Evaluation of Ozone Reactivity Scale for Low-Emission Vehicles and Clean Fuels Regulations, Sacramento, CA, 2 April (1992).
- [113]. California Air Resources Board, 2001. ARB Fact Sheet: Zero Emission Vehicle Program Changes. Sacramento, CA.
- [114]. Callon, M., The Sociology of an Actor-Network: The Case of the Electric Vehicle, in Mapping the Dynamics of Science and Technology. M. Callon, J. Law, and A. Rip, eds., Macmillan, London, 1986.
- [115]. Calvert, J. G.; Heywood, J. B.; Sawyer, R. E; Seinfeld, J. H. Science 1993, 261, 37-45.
- [116]. Cameron, C., Trivedi, P., 1998. Regression Analysis of Count Data. Econometric Society Monograph No. 30, Cambridge University Press, Cambridge.
- [117]. Campos, J., "Toward a Theory of Instrument Choice in the Regulation of

- Markets," California Institute of Technology, Pasadena, California, mimeo, January 26, 1987
- [118]. Canadian Electric Utilities and National Energy Board, 1992. Personal Communication between Raffaele DiGirolamo, Energy, Mines, and Resources Canada, and Illa Amerson, Battelle.
- [119]. Cansier, Dieter, and Raimund Krumm, "Air Pollutant Taxation: An Empirical Survey," *Ecological Economics*, 1997, 23:1, 59-70
- [120]. Carroll, W.F., Jr., 1988. TVC and Incineration." *J. Vinyl Technol.* 10(2):90-94.
- [121]. Carson, Richard, et al., A Bibliography of Contingent Valuation Studies and Papers. La Jolla, California: Natural Resources Damage Assessment, Inc., 1994
- [122]. Carson, Richard, et al., A Contingent Valuation Study of Lost Passive Use Values Resulting From the Exxon Valdez Oil Spill, Report to the Attorney General of the State of Alaska, prepared by Natural Resource Damage Assessment, Inc., La Jolla, California, 1992.
- [123]. Carter, W. P. i. and 'Atkinson, R. J., *Environ. Sci. Tech.* 23,864 (1989).
- [124]. Carter, W. P. L. and Atkinson, R. J., *Environ. Sci. Tech.* 21, 670 (1987).
- [125]. Carter, W. P. L. and Lurmann, F. W., *Atmos. Environ.* 25A, 2771 (1991).
- [126]. Carter, W. P. L., Appendix C. Documentation for the SAPRC atmospheric photochemical mechanism preparation and emissions processing programs for implementation in airshed models, Report, Contract No: A5-122- 32. California Air Resources Board. Sacramento. CA. October (1988)
- [127]. Carter, W. P. L., *Atmos. Environ.* 24A, 481 (1990).
- [128]. Carter, W. P. L., Development of Ozone Reactivity Scales for Volatile Organic Compounds. EPA 600/3- 91/050, Environmental Protection Agency, Research Triangle Park, NC (1991).
- [129]. Carter, W. P. L., *J. Air & Waste Manage. Assoc.* 44, 881 (1994).
- [130]. Cason, T.N., "An Experimental Investigation of the Seller Incentives in EPA's Emissions Trading Auction, *American Economic Review*, September 1995, 85, 905-22.
- [131]. Cason, T.N., "Seller Incentive Properties of EPA's Emissions Trading Auction, " *Journal of Environmental Economics and Management*, September 1993, 25,177-95.
- [132]. Cason, T.N., and Charles R. Plott, "EPA's New Emissions Trading Mechanism: A Laboratory Evaluation," *Journal of Environmental Economics and Management*, March 1996, 30, 133-60.
- [133]. Caveney, R. *Science* 1991, 252(5011), 1362.
- [134]. CEC (Commission of the European Communities) (1992) Research and Technology Strategy" to Help Overcome the Environmental Problems in Relation to Transport (SAST Project No 3) Global Pollution Study Report EUR- 14713 -EN, Commission of the European Communities Directorate-General for Science, Research and Development, CEC, Brussels and Luxembourg
- [135]. Census of Manufacturers 1987; Bureau of the Census, U.S. Department of Commerce, U.S. Government Printing Office: Washington, DC, 1987.
- [136]. Cerri I, Pavese M, Saracco G, Specchia V. *Catal Today* 2003;83:19.
- [137]. Chameides, W. L., Fehsenfeld, F., Rodgers, M. O., Cardelino, C., Martinez, J., Parrish, D., Lonneman, W., Lawson, D. R., Rasmussen, R. A., Zimmerman, P., Greenberg, J., Middleton, P. and Wang, T., *J. Geophys. Res.* 91.6037 (1992).
- [138]. Chian, E.S.K., S.B. Ghosh, B. Kahn, M. Giabbi, and F.G. Pohland, 1986. Codisposd of Low Level Radioactive Waste and Sanitary Waste, SCEGIT Report No. 86-01.
- [139]. Choudhary TV, Banerjee S, Choudhary VR. *Appl Catal A* 2002; 234:1.
- [140]. Chu, Y., Azer, M., Catalanotto, F., Ungar, H., Goodman, L., 1999. Safety/GIS models reviewed and related to long island arterial needs study. In: Proceedings of the ITE International Conference on Enhancing Transportation Safety in the 21st Century.
- [141]. Cicchetti, Charles J., and V. Kerry Smith, "Congestion, Quality Deterioration, and Optimal Use: Wilderness Recreation in the Spanish Peaks Primitive Area," *Social Science Research*, 1973, 2, 15-30.

- [142]. Cifuentes, L.; Lave, L. B. *Annu. Rev. Energy Environ.* 1993, 18, 319.
- [143]. Ciriacy-Wantrup, S. V., "Capital Returns from Soil Conservation Practices," *Journal of Farm Economics*, November 1947, 29, 1181-96.
- [144]. Civera A, Negro G, Specchia S, Saracco G, Specchia V. *Catal Today* 2005;100:275.
- [145]. Civera A, Pavese M, Saracco G, Specchia V. *Catal Today* 2003;83:199.
- [146]. Clawson, Marion, "Methods of Measuring the Demand for and Value of Outdoor Recreations," Reprint no. 10, Resources for the Future, Washington, D.C., 1959.
- [147]. CMP (Center for Metals Production). 1987. Techno-economic assessment of electric steelmaking through the year 2000 (Report EPRI EM-5445). Pittsburgh, PA: CMP.
- [148]. Coale KH et al. A massive phytoplankton bloom induced by an ecosystem-scale iron fertilization experiment in the equatorial Pacific Ocean. *Nature* 1996; 383:495-501.
- [149]. Cobas, E. Life-Cycle Assessment Using Input-Output Analysis. Doctoral Dissertation, Carnegie Mellon University, Department of Civil and Environmental Engineering, Pittsburgh, PA, 1996.
- [150]. Cobas-Flores, E. 1996. Life-cycle assessment using input-output analysis. Ph.D. dissertation, Carnegie Mellon University.
- [151]. Cobas-Flores, E.; Hendrickson, C. T.; Lave, L. B.; McMichael, F. C. Proceedings of the 1995 IEEE Symposium on Electronics and the Environment, Institute of Electrical and Electronics Engineers Inc.: Piscataway, NJ, May 1995; pp 273-278.
- [152]. Cobb, C.; Halstead, T.; Rowe, J. *The Genuine Progress Indicator: Summary of Data and Methodology*; Redefining Progress Publication: San Francisco, 1995.
- [153]. Coelho, P., "Polluters' and Political Response: Direct Control Versus Taxes: Comment," *American Economic Review*, 1976, 66, 976-978.
- [154]. Coggins, Jay S., and John R. Swinton, "The Price of Pollution: A Dual Approach to Valuing SO₂ Allowances," *Journal of Environmental Economics and Management*, January 1996, 30:1, 58-72.
- [155]. Cohen H, Rogers GFC, Saravanamuttoo H. *Gas turbine theory*. 4th ed. Addison Wesley/Longman Limited, 1996
- [156]. Cohen, J. P., Yarwood, G., Noda, A. M., Pollack, A. K. and Morris, R. E., *Auto/Oil Air Quality Improvement Research Program: Development of Emissions Reactivity Values for Phase II Results*. SYSAPP94- 94/053, Systems Applications International, San Rafael, CA, July (1994).
- [157]. Commission of the European Communities. *Externalities of the Fuel Cycle: Externe Project; Working Documents 1, 2, 5, and 9*; European Commission: Brussels, 1993.
- [158]. Conrad, Klaus, and Robert E. Kohn, "The US Market for SO₂ Permits: Policy Implications of the Low Price and Trading Volume," *Energy Policy*, 1996, 24:12, 1051-59.
- [159]. Consonni S, Larson ED. Biomass-gasifier/aero derivative gas turbine combined cycles. Part A—technologies and performance modelling. *J Eng Gas Turbines Power* 1996; 118:507–15
- [160]. Consonni S, Larson ED. Biomass-gasifier/aero derivative gas turbine combined cycles. Part B—performance calculations and economic assessment. *J Eng Gas Turbines Power* 1996; 118:516–25.
- [161]. Copersucar. *Gerac¸ao de energia por biomassa bagac¸o da cana-de-ac¸ucar e residuos*. Projeto BRA/96/G3, Summary of Baling Tests Report no RLT-015, Piracicaba. SP, Brazil: Centro de Tecnologia Copersucar; January 1998.
- [162]. Cordi, I., *What Is Today's Status of Electric Cars? A Brief International Look*, Report written for Association of Swedish Automobile Manufacturers and Wholesalers and the Swedish Petroleum Institute, Danderyd, 1994.
- [163]. Cowan, g., and Gunby, P., *Sprayed to Death: Pest Control Strategies and Technological Lock-In*, *Economic Journal* (in press).
- [164]. Cowan, R., *Nuclear Power Reactors: A Study in Technological Lock-In*, *Journal of Economic History* 50(3), 541-568 (1990).
- [165]. CRANDALL, R.W., KEELER, T.E., AND LAVE, L.B. "The Cost of Automobile Safety and Emissions Regulation to the Consumer: Some

- Preliminary Results." American Economic Review, Vol. 72 (May 1982), pp. 324-327.
- [166]. Crocker, Thomas D., "The Structuring of Atmospheric Pollution Control Systems." In Harold Wolozin, ed. The Economics of Air Pollution. New York: Norton, 1966
- [167]. CSPE. 1999—Comissão de Public Services on Power (Comissão de serviços públicos de energia, Tarifas de gas canalizado) 1999. Available from: <http://www.CSPE.sp.gov.br>.
- [168]. Cumberland, J. H. and B. Stram. 1976. Empirical applications of input-output models to environmental protection. In Advances in input-output analysis: Proceedings of the sixth international conference on input-output techniques, Vienna, April 22–26, 1974, edited by K. R. Polenske and J. V. Skolka, pp. 365–382. Cambridge: Ballinger
- [169]. Curlee, T. R. The Economic Feasibility of Recycling; Praeger: New York, 1986; pp 127-128.
- [170]. Curlee, T. R.; Das, S.; Rizey, C. G.; Schexnayder, S. M. Recent Trends in Automobile Recycling: An Energy and Economic Assessment, ORNL/TM-12628; Oak Ridge National Laboratory: Oak Ridge, TN, 1994.
- [171]. Curran, M. A. 1996. Environmental life-cycle assessment. New York: McGraw Hill.
- [172]. Curran, M. A. Environ. Sci. Technol. 1993, 27(3), 430-36.
- [173]. Curran, M. A. Life-Cycle Analysis; Island Press: New York, 1996.
- [174]. Current Business Reports BS/93, Service Annual Survey: 1993. U.S. Bureau of the Census, U.S. Department of Commerce, U.S. Government Printing Office: Washington, DC, 1995.
- [175]. Czuppon, T. A., S. A. Knez and D. A. Newsome, "Hydrogen," in Kirk-Othmer Encyclopedia of Chemical Technology, 4th ed. (J. I. Kroschwitz and M. Howe-Grant, eds.), vol. 13, pp. 838-894, esp. pp. 852-865. Wiley, New York, 1995.
- [176]. D. A. Yao, "Three Essays on Regulation with Application to the Automobile Industry," unpublished doctoral dissertation, Stanford University (1984).
- [177]. D. Ginsburg, Making automobile regulation work: Policy options and a proposal, in "Government, Technology, and the Future of the Automobile" (D. Ginsburg and W. Abernathy, Fds.), McGraw-Hill, New York (1980).
- [178]. D. M. Kreps and R. Wilson, Sequential equilibria, *Econometrica* SO, 863-894 (July 1982).
- [179]. D. P. Baron and B. R. Myerson, Regulating a monopolist with unknown cost, *Econometrica* 59, 911-930 (1982).
- [180]. D. P. Baron and D. Besanko, Regulation and information in a continuing relationship, *Zfnonn. Econom. Policy* 1, 261-302 (1984).
- [181]. D. Sappington, Optimal regulation of research and development under imperfect information, *Be//J. Econom.* 13, 354-368 (Autumn 1982).
- [182]. Dabels, J., Environmental Requirements and the Impact Prototype Vehicle, OECD, Paris, 1992.
- [183]. Dahmén, E., Development Blocks in Industrial Economics, in *Industrial Dynamics*. B. Carisson, ed., Kluwer, Boston, 1989.
- [184]. Dahmén, E., Research on Railways in a Historical Perspective, in *High Speed Trains, Fast Tracks to the Future*. J. Whitelagg, S. Hult~n, and T. Flink, eds., Leading Edge, Worcester, MA, 1993.
- [185]. Dahmén, E., Svensk Industriell Företagarverksamhet, Kausalanalys av den Industriella Utvecklingen 1919- 39, 2 vols., IUI, Stockholm. English edition of Vol. 1, *Entrepreneurial Activity on the Development of Swedish Industry 1919-39*, Irwin, Homewood, IL, 1970.
- [186]. Dales, John H., Pollution, Property, and Prices. Toronto: University of Toronto Press, 1968.
- [187]. Daly, H. E.; Cobb, J. B. For the Common Good: redirecting the economy toward community, the environment, and a sustainable future; Beacon Press: Boston, MA, 1989.
- [188]. Darrow, K. G. Light Duty Vehicle Full Fuel Cycle Emissions Analysis; Gas Research Institute Topical Report April 1993-April 1994, No. 9333R440; Energy International, Inc.: Bellvue, WA, 1994.
- [189]. Daubert, T. E., Chemical Engineering Thermodynamics, pp.365-366. McGraw-Hill, New York, 1985

- [190]. David, M. and E. Joeres, "Is a Viable Implementation of TDPs Transferable?" In Joeres, E. and M. David, eds., *Buying a Better Environment: Cost-Effective Regulation Through Permit Trading*. Madison: University of Wisconsin Press, 1983, 233-248.
- [191]. David, P., *Clio and the Economics of QWERTY*, *American Economic Review* 75(2), 332-337 (1985).
- [192]. Davidson, O R (1992) *Transport Energy in Sub-Saharan Africa: Options for a Low-Emissions Future Report No 267*, Princeton University Center for Energy and Environmental Studies Princeton, NJ
- [193]. Davis, G. A. 1993. *The use of life-cycle assessment in environmental labeling programs*, EPA/742-R-93-003. Washington, DC: U.S. Environmental Protection Agency.
- [194]. Davis, G. A.; Kincaid, L. E.; Bartmess, J.; Schultz, T; Griffith, B.; Jones, S. "Chemical Ranking for Potential Health and Environmental Impacts"; Draft Report, University of Tennessee, Center for Clean Products and Clean Technologies: Knoxville, TN, July 1993; EPA Cooperative Agreement No. CR 816735.
- [195]. Davis, Robert, *The Value of Outdoor Recreation: An Economic Study of the Maine Woods*, doctoral dissertation in economics, Harvard University, 1963.
- [196]. de Kant HF, Bodegom M. 2000 *Studie voorschakeling vergassers voor aardgas gestookte energie-installaties*, report prepared for NOVEM by HOST. Hengelo: The Netherlands; January 2000. p. 102 + appendices [In Dutch]
- [197]. De Souza MR, Walter A, Faaij A. *Co-firing of natural gas and syngas in biomass integrated gasification/combined cycle systems*, Department of Mechanical Engineering College, State University of Campinas—Brazil & Department of Science, Technology & Society—Utrecht University, The Netherlands. *Energy* 2003; 28:1115–31.
- [198]. De Souza MR, Walter A, Faaij A. *Possibilities and constraints for co-fired (sugar cane residues + natural gas) CHP plants in the state of São Paulo, Brazil*. In: *The First World Conference and Exhibition on Biomass for Energy and Industry*, 5–9 June, 2000, Seville, Spain, Proceedings vol. 1. London: James & James; 2001. p. 817–20.
- [199]. Dean, J. A., *Lange's Handbook of Chemistry*, 14th ed.. McGraw-Hill, New York, 1992.
- [200]. DeCicco, J and Gordon, D (1995) 'Steering with prices: fuel and vehicle taxation as market incentives for higher fuel economy' in Sperling, D and Shaheen, S (eds) *Transportation and Energy: Strategies for a Sustainable Transportation System* American Council for an Energy-Efficient Economy, Washington, DC and Berkeley, CA
- [201]. DeCicco, J and Ross, M (1993) *An Updated Assessment of the Near-Term Potential for Improving Automotive Fuel Economy* American Council for an Energy-Efficient Economy, Washington, DC and Berkeley, CA
- [202]. DeLucchi, M A, McCubbin, D, Kim, J, Hsu, S-L and Murphy, J (1994) *The Annualised Social Cost of Motor-Vehicle Use, Based on 1990-1991 Data* Institute of Transportation Studies, University of California, Davis, CA
- [203]. Delucchi, M. A. *Air Waste Manage. Assoc.* 1993,43,1486- 1495.
- [204]. Delucchi, M. A. *Emissions of Greenhouse Gases from the Use of Transportation Fuels and Electricity, Vol. 2: Appendices A-S*; ANL/ESD/TM-22; Center for Transportation Research, Energy Systems Division, Argonne National Laboratory: Argonne, IL, November 1993.
- [205]. Delucchi, M. A. *Emissions of Greenhouse Gases from the Use of Transportation Fuels and Electricity, Vol. 1, Main Text*, ANL/ESD/TM-22; Center for Transportation Research, Energy Systems Division, Argonne National Laboratory: Argonne, IL, November 1991.
- [206]. Delucchi, M. A.; McCubbin, D. R. *The Contribution of Motor Vehicles and Other Sources to Ambient Air Pollution*; UCD-ITS-RR-96-3 (16); Report # 16 in the Series: *The Annualized Social Cost of Motor-Vehicle Use in the United States*; Institute of Transportation Studies, University of California, Davis; August 1996.
- [207]. Delucchi, M.; Wang, Q.; Greene, D. L. *Motor Vehicle Fuel Economy: The Forgotten HC Control Strategy?* ORNL-

- 6715; Oak Ridge National Laboratory: Oak Ridge, TN, June 1992.
- [208]. DeLuchi, M A (1991) Emissions of Greenhouse Gases from the Use of Transportation Fuels and Electricity Volume 1: Main Text ANL/ESD/TM-22, Vol 1 Center for Transportation Research, Argonne National Laboratory, Argonne, IL
- [209]. DeLuchi, M A (1993) Emissions of Greenhouse Gases from the Use of Transportation Fuels and Electricity Volume 2: Appendixes A-S ANL/ESD/TM-22, Center for Transportation Research, Argonne National Laboratory, Argonne, IL
- [210]. Derwent, R. G. and Jenkin, M. E., Atmos. Environ. 25, 1661 (1991).
- [211]. Desvousges, W. H.; Johnson, F. R.; Banzhaf, H. S. Assessing Environmental Costs for Electricity Generation; Triangle Economic Research General Working Paper No. G-9402; 1994.
- [212]. Devine, D. Grant, and Bruce Marion, "The Influence of Consumer Price Information on Retail Pricing and Consumer Behavior, American Journal of Agricultural Economics, May 1979, 61, 228-37.
- [213]. Dewees, D., "Instrument Choice in Environmental Policy," Economic Inquiry, 1983, XXI, 53-71.
- [214]. DEWEES, D.N. Economics and Public Policy: The Automobile Pollution Case. Cambridge: MIT Press, 1974.
- [215]. Diekstra, R F W and Kroon, M C (1996) 'Cars and behaviour: psychological barriers to fuel efficiency and sustainable transport' in Towards a Clean and Fuel Efficient Vehicle Conference proceedings, OECD, Paris (forthcoming)
- [216]. Dietz, T and Stem, P C (1993) Individual Preferences, Contingent Valuation, and the Legitimation of Social Choice Draft report, Paul C Stem, National Research Council, Washington, DC
- [217]. Difiglio, C, Duleep, K G and Greene, D L (1990) 'Cost effectiveness of future fuel economy improvements' The Energy Journal 11 (1)
- [218]. Dimitriou, H Y (1992) Urban Transport Planning: A Developmental Approach Routledge, London
- [219]. DOE (Department of Energy) (1994) The Climate Change Action Plan: Technical Supplement DOE/PO-0022, United States Department of Energy, Washington, DC
- [220]. DOE (Department of Energy) (1995) Effects of Feebates on Vehicle Fuel Economy. Carbon Dioxide Emissions, and Consumer Surplus Energy Efficiency in the US Economy. Technical Report Two DOE/PO-0031 United States Department of Energy, Washington, DC
- [221]. DOE (Department of Energy, USA). Selected national average natural gas price in 2000. Energy Online 2001. Available from: <http://www.energyonline.com/products/avgngsel.asp>.
- [222]. DOE (U.S. Department of Energy), 1992, "Monthly Power Plant Report," Energy Information Administration, EIA-759.
- [223]. Doherty, D. The Shaw Group Limited, Lantz, Nova Scotia, Canada. Personal communication, October 1996.
- [224]. Dornburg A, Faaij A. Efficiency and economy of wood-fired biomass energy systems in relation to scale regarding heat and power generation using combustion and gasification technologies. Biomass Bioenergy 2001;21(2):91-108.
- [225]. Dosi, G., Technological Paradigms and Technological Trajectories, Research Policy, 11, 147-162 (1984).
- [226]. Doucet, Joseph A., and Todd Strauss, "On the Bundling of Coal and Sulphur Dioxide Emissions Allowances," Energy Polity, September 1994, 22.9, 764-70.
- [227]. DRI/McGraw-Hill (1994) Transportation Sector Subsidies: US Case Study Consultants' report for the OECD project on Environmental Implications of Energy and Transport Subsidies, OECD, Paris (forthcoming)
- [228]. DRI/McGraw-Hill (1991) An Analysis of Public Policy Measures to Reduce Carbon Dioxide Emissions from the US Transportation Sector DRI/McGraw-Hill, Lexington, MA
- [229]. Duchin, E; Lange, G. M.; Johnsen, T. Strategies for Environmentally Sound Development: Progress Report 5; Institute of Economic Analysis: New York, 1990.
- [230]. Duchin, F. In Industrial Input/Output Analysis: Implications for Industrial Ecology. The Greening of Industrial Ecosystems; Allenby, B. R., Richards, D. R., Eds.; National Academy of

- Engineering: Washington, DC, 1994; pp 61- 68.
- [231]. Duchin, F., G. M. Lange, and T. Johnsen. 1990. Strategies for environmentally sound development: Progress: Report 5. New York: Institute of Economic Analysis.
- [232]. Duchin, Faye. 1994. Industrial input/output analysis: Implications for industrial ecology. In *The greening of industrial ecosystems*, edited by B. R. Allenby and D. R. Richards, pp. 61–68. Washington, DC: National Academy of Engineering
- [233]. Dudek, Daniel J., and Joseph Goffman, "The Clean Air Act Acid Rain Program: Lessons for Success in Creating a New Paradigm," 85th Annual Meeting of the Air & Waste Management Association, 95-RA120.06, San Antonio, Texas, 1995.
- [234]. Dukek, W. G., "Aviation and Other Gas Turbine Fuels," in *Kirk-Othmer Encyclopedia of Chemical Technology*, 4th ed. (J. I. Kroschwitz and M. Howe-Grant, eds.), vol. 3, pp. 788-812. Wiley, New York, 1992
- [235]. Duncan, C., Khattak, A., Hughes, R., 1999. The perceived effectiveness of sidewalks and other pedestrian safety treatments as countermeasures for hit-along-roadway crashes. Presented at 81st Annual Transportation Research Board Meeting, on TRB CD-ROM, Washington, DC, 2002.
- [236]. EIA (Energy Information Administration) (1995) *International Energy Outlook*, 1995 EIA, DOE, Washington, DC
- [237]. EC (European Commission) (1995) *A Community Strategy to Reduce CO₂ Emissions from Passenger Cars and Improve Fuel Economy* Communication from the Commission to the Council and the European Parliament COM (95)689 European Commission, Directorate General XI: Environment, Nuclear Safety and Civil Protection, Brussels
- [238]. ECMT/OECD (European Conference of Ministers of Transport and Organisation for Economic Co-Operation and Development) (1995) *Urban Travel and Sustainable Development* OECD, Paris
- [239]. ECN (Energieonderzoek Centrum Nederland/Netherlands Energy Research Foundation) (1995) *Prospects for Energy Technologies in the Netherlands*, Volume 2: Technology Characterisations and Technology Results ECN, Petten
- [240]. EEA (Energy and Environmental Analysis) (1995) *Fuel Economy Potential of Light Duty Vehicles in 2015+ Draft final report*, EEA, Arlington, VA
- [241]. *Electric Cars, Will They Work and Who Will Buy Them?* Woodruff, D., Armstrong, L., and Cary, J., *Business Week*, May 30, pp. 36-42 (1994).
- [242]. Ellerman, A. Denny, and Juan Pablo Montero, "Why Are Allowance Prices So Low? An Analysis of the SO₂ Emissions Trading Program," Working Paper 96-001, MIT Center for Energy and Environmental Policy Research, February 1996.
- [243]. Ellerman, A. Denny, Richard Schmalensee, Paul L. Joskow, Juan Pablo Montero, and Elizabeth M. Bailey, *Emissions Trading Under the U.S. Acid Rain Program: Evaluation of Compliance Costs and Allowance Market Performance*. Cambridge: MIT Center for Energy and Environmental Policy Research, October 1997
- [244]. Elliot P. Biomass—energy overview in the context of Brazilian biomass—power demonstration. *Bioresour Technol* 1993; 46:13–22.
- [245]. Elmore, T. et al., "Trading Between Point and Nonpoint Sources: A Cost Effective Method for Improving Water Quality," paper presented at the 57th annual Conference/Exposition of the Water Pollution Control Federation, New Orleans, Louisiana, 1984.
- [246]. *Emissions of Greenhouse Gases in the United States 1987- 1994*; DOE/EIA-0573(87-94); Energy Information Administration, U.S. Department of Energy, Government Printing Office: Washington, DC, 1995.
- [247]. Energy Information Administration, 2001 [accessed August 23, 2001]; *Electric power industry generation by energy source; 1998*. *Electric power annual*, vol. II; 1998. p. 12 [Table 1].
- [248]. Environmental Law Institute, "Implementing an Emissions Cap and Allowance Trading System for Greenhouse Gases: Lessons from the Acid Rain Program," Research Report, Washington, D.C., September 1997.
- [249]. Environmental Protection Agency, *Environmental Investments: The Cost of a*

- Clean Environment, Report no. EPA-230-12-90-084, 1990.
- [250]. EPA, U. series manual for OZIPM-4 Volume I, EPA- 45014-84-005, July (1989).
- [251]. ETSU (Energy Technology Support Unit) (1994) Appraisal of UK Energy Research, Development, Demonstration and Dissemination Volume 7 Transport HMSO, London
- [252]. Eyre, N J and Michaelis, L A (1991) The Impact of UK Electricity, Gas and Oil Use on Global Warming Report AEA-EE-0211 Energy Technology Support Unit, Harwell
- [253]. F. J. Salzano, G. Skaperdas and A. Mezzina, Water vapor electrolysis at high temperature. *Int. J. Hydrogen Energy* 10, 801-809 (1985).
- [254]. Faaij A, Meuleman B, Van Ree R. Long term perspectives of BIG/CC technology, performance and costs, report no. EWAB 9840. Utrecht Netherlands: November–December 1998.
- [255]. Faaij A, van Ree R, Waldheim L, Olsson E, Oudhuis A, Van Wijk A, Daey Ouwens C, Turkenburg W. Gasification of biomass wastes and residues for electricity production. *Biomass Bioenergy* 1997;12(6):387–407.
- [256]. Fabri, J., W. Dabelstein and A. Reglitzky, "Motor Fuels," in *Ullmann's Encyclopedia of Industrial Chemistry*, 5th ed. (B. Elvers, S. Hawkins, M. Ravenscroft, J. F. Rousaville and G. Schulz, eds.), vol. A16, pp. 719-753, esp. pp. 743-744. VCH Verlagsgesellschaft, Weinheim, Germany, 1990.
- [257]. Fathi-Afshar, S.; Yang, J-C. *Chem. Eng. Sci.* 1985, 40(5), 781-97.
- [258]. Fava, J.A., R. Denison, B. Jones, M.A. Curran, B. Vigon, S. Selke, and J. Barnum (Editors), 1991. *A Technical Framework for Life-Cycle Assessments*. Society of Environmental Toxicology and Chemistry and SETAC Foundation for Environmental Education, Inc., Washington, D.C.
- [259]. Fava, J.A., R. Denison, T. Mohin, and R. Parrish, 1992. "Life-Cycle Assessment Peer Review Framework." Society of Environmental Toxicology and Chemistry, Life-Cycle Assessment Advisory Group, 4 p.
- [260]. *Fed. Regist.* 1985, 50(6), 1170-76.
- [261]. Fiedler, E., G. Grossman, B. Kersebohm, G. Weiss and C. Witte, "Methanol," in *Ullmann's Encyclopaedia of Industrial Chemistry*, 5th ed. (B. Elvers, S. Hawkins, and G. Schulz, eds.), vol. A16, pp. 465-486. VCH Verlagsgesellschaft, Weinheim, Germany, 1990.
- [262]. Fino D, Russo N, Saracco G, Specchia V. *J Catal* 2003;217:367.
- [263]. FISHER, F. AND SHELL, K. "Taste and Quality Change in the Pure Theory of the True Cost-of-Living Index" in Z. Griliches, ed., *Price Indexes and Quality Change: Studies in New Methods of Measurement*, Cambridge: Harvard University Press, 1971.
- [264]. Flink, J. J., *America Adopts the Automobile: 1895-1910*, Cambridge University Press, Cambridge, MA, 1970.
- [265]. FOEFL (Federal Office of Environment, Forests and Landscape, Switzerland). 1991. *Eco-balance of packaging materials: State of 1990*. Berne, Switzerland: FOEFL.
- [266]. Forman, D. L. *Proceedings of the Toxics Release Inventory (TRI) Data Use Conference*, March 29-31, 1993, Chicago, IL; U.S. Environmental Protection Agency: Washington, DC, July 1993; EPA/745-R-93-004.
- [267]. Forsund, F. R. 1985. Input-output models, national economic models and the environment. In *Handbook of natural resource and energy economics*, vol. I, edited by A. V. Kneese and J. L. Sweeney, pp. 325–394. Amsterdam: North Holland
- [268]. Forsund, F. R. In *Handbook of Natural Resource and Energy Economics*; Elsevier: Amsterdam, 1985.
- [269]. Forzatti P, Groppi G. *Catal Today* 1999;54:165
- [270]. Friedman, D.J., Lipman, T.E., Eggert, A.R., Ramaswamy, S., Hauer, K.-H., 2000. Hybridization: cost and efficiency comparisons for PEM fuel cell vehicles. SAE Future Transportation Technology Conference, Costa Mesa, CA, August 21–23, 2000, DOFTT-54
- [271]. Fullerton, Don, and Gilbert Metcalf, "Environmental Controls, Scarcity Rents, and Pre-Existing Distortions," NBER Working Paper 6091, July 1997.
- [272]. G. J. Gascho and S. H. Elawad, Biomass production from herbaceous plants in

- Florida. Proc. Conf on Alternative Energy Sources for Florida. Univ. of Florida, Inst. Food and Agric. Sci. Ctr. Environ. Natural Res., Gainesville, FL (1979)
- [273]. G. M. Prine and P. Mislevy, Grass and herbaceous plants for biomass. Soil Crop Sci. Soc. Fla. Proc. 42, 8-12 (1983).
- [274]. G. M. Prine, L. S. Dunavin, B. J. Brecke, R. L. Stanley, Jr, P. Mislevy, R. S. Kalmbacher and D. R. Hensel, Model Crop Systems: sorghum, napier grass. In Methane from Biomass: A Systems Approach (W. H. Smith and J. R. Frank, Eds), pp. 833-102. Elsevier Applied Science, New York (1987).
- [275]. Gaines, L.; Singh, M. Total Life Cycle Conference and Exposition; Vienna, Austria, October 16-19, 1995.
- [276]. Garcia, E. Y., and M. A. Laborde, "Hydrogen Production by the Steam Reforming of Ethanol: Thermodynamic Analysis," Int. J. Hydrogen Energy, 16, 307-312 (1991).
- [277]. Gas turbine world handbook. 1999–2000. Fairfield, CT: Pequot Publishing Inc; 1999.
- [278]. Gavalas, G. R, G. E. Voecks, N. R. Moore, J. F. Ferrall, and P. R. Prokopius, "Fuel Cell Locomotive Development and Demonstration Program; Phase One: Systems Definition." Report # JPL D-12087. Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, February, 1995.
- [279]. Getis, A., Boots, B., 1978. Models of Spatial Processes: An Approach to the Study of Point, Line, and Area Patterns. Cambridge University Press, Cambridge.
- [280]. Ginley, D. M. Resources Policy 1994, 20(3), 169-181.
- [281]. Gnabler, A (1993) 'Transportation sector: growing demand and emissions' Pacific and Asian Journal of Energy 3 (2) 179-199
- [282]. Gold, L. S.; Manley, N. B.; Sloane, T. H.; Garfinkel, G. B.; Rohrbach, L. R.; Ames, B. N. Environ. Health Perspect. 1993, 100, 65-135.
- [283]. Goodwin, P B (1985) Changes in Transport Users' Motivations Jbr Modal Choice: Passenger Transport European Conference of Ministers of Transport Round Table 68 OECD, Paris
- [284]. Goodwin, P B (1992) 'A review of new demand elasticities with special reference to short and long run effects of price changes' Journal of Transport Economics and Policy 26 (2) 155-170
- [285]. Goodwin, P, Hallett, S, Kenoy, F and Stokes, G (1991) Transport: The New Realism Rees Jeffreys Road Fund Report 624 Transport Studies Unit, University of Oxford
- [286]. Goulder, Lawrence H., Ian W. H. Parry, and Dallas Burtraw, "Revenue-Raising vs. Other Approaches to Environmental Protection: The Critical Significance of Pre-Existing Tax Distortions," RAAD Journal of Economics, Winter 1997, 28:4, 708-31.
- [287]. Graedel, T. E.; Allenby, B. R. Industrial Ecology and the Automobile; Bell Laboratories, Lucent Technologies; PrenticeHall Inc.: Saddle River, NJ, 1997.
- [288]. Graedel, T. E.; Allenby, B. R.; Comrie, E R. Environ. Sci. Technol. 1995, 29(3), 134A-139A.
- [289]. Greene, D L (1990) 'CAFE or price? An analysis of the effects of federal fuel economy regulations and gasoline price on new car MPG, 1978-89' The Energy Journal 11 (3) 37-57
- [290]. Greene, D L (1992) 'Vehicle use and fuel economy: how big is the "rebound" effect?' The Energy Journal 13 (1) 117-143
- [291]. Greene, D L and Duleep, K G (1993) 'Costs and benefits of automotive fuel economy improvement: a partial analysis' Transportation Research-A 27A (3) 217-235
- [292]. Greene, W., 1997. Econometric Analysis, second ed. MacMillan, New York
- [293]. Greene, W., 1997. Econometric Analysis, second ed. MacMillan, New York
- [294]. Greene, W., 1998. LIMDEP. Econometric Software Inc.
- [295]. Grègoire, J. A., 50 Ans d'Automobile-- Tome 2: la Voiture Electrique. Flammarion, Paris, 1981.
- [296]. Grieb, H and Simon, B (1990) 'Pollutant emissions of existing and future engines for commercial aircraft' in Schumann, U (ed) Air Traffic and the Environment: Background, Tendencies and Potential Global Atmospheric Effects Springer Verlag, Berlin

- [297]. GRILICHES, Z. "Hedonic Price, Indexes for Automobiles: An Econometric Analysis of Quality Change" in Z. Griliches, ed., Price Indexes and Quality Change: Studies in New Methods of Measurement, Cambridge: Harvard University Press, 1971.
- [298]. Grosjean, D., Grosjean, E. and Williams, E. L., Abstr. Papers Am. Chem. Soc. 207, 187-ENVR (1994)
- [299]. Grosjean, D., Williams, E. L. and Grosjean, E., Environ. Sci. Tech. 27,830 (1993)
- [300]. Gruenspecht, Howard K., "Differentiated Social Regulation in Theory and Practice," doctoral dissertation draft, Yale University, 1981.
- [301]. Guides to Pollution Prevention: The Automotive Refinishing Industry, EPA/625/7-91/016; U.S. Environmental Protection Agency, U.S. Government Printing Office: Washington, DC, October 1991.
- [302]. Guides to Pollution Prevention: The Automotive Repair Industry, EPA/625/7-91/013; U.S. Environmental Protection Agency, U.S. Government Printing Office: Washington, DC, October 1991.
- [303]. H. Ingram, The political rationality of innovation: The clean air act amendments of 1970, in "Approaches to Controlling Air Pollution" (A. F. Friedlaender, Ed.), MIT Press, Cambridge, MA (1978).
- [304]. H. S. Spacil and C. S. Tedmon, Electrochemical dissociation of water vapor in solid oxide electrolyte cells. J. Electrochem. Soc. 116, 1618 1633 (1969).
- [305]. H. Weule, Neue Antriebe und Energieträger -- Chancen flit den Auwomobilbau. 16. Int. Wiener Motorensymp., Vienna. Austria. May 1995.
- [306]. Hahn, R. and A. McGartland, "The Political Economy of Instrument Choice: An Examination of the U.S. Role in Implementing the Montreal Protocol," Working Paper 88-34, School of Urban and Public Affairs, Carnegie Mellon University, Pittsburgh, Pennsylvania, 1988.
- [307]. Hahn, R. and G. Hester, "Marketable Permits: Lessons for Theory and Practice," Ecology Law Quarterly, forthcoming.
- [308]. Hahn, R. and G. Hester, "Where Did All the Markets Go?: An Analysis of EPA's Emission Trading Program," Working Paper 87-3, School of Urban and Public Affairs, Carnegie Mellon University, Pittsburgh, Pennsylvania, 1986. Forthcoming in the Yale Journal on Regulation
- [309]. Hahn, R. and Noll, R., " Barriers to Implementing Tradable Air Pollution Permits: Problems of Regulatory Interaction," Yale Journal on Regulation, 1983, 1, 63-91.
- [310]. Hahn, R. and Noll, R., "Designing a Market for Tradable Emissions Permits." In Magat, W. ed., Reform of Environmental Regulation. Cambridge, MA: Ballinger, 1982, 119-146.
- [311]. Hahn, R., "Designing Markets in Transferable Property Rights: A Practitioner's Guide." In Joeres, E. and M. David, eds., Buying a Better Environment: Cost Effective Regulation Through Permit Trading. Madison: University of Wisconsin Press, 1983, 83-97
- [312]. Hahn, R., "Rules, Equality and Efficiency: An Evaluation of Two Regulatory Reforms," Working Paper 87-7, School of Urban and Public Affairs, Carnegie Mellon University, Pittsburgh, Pennsylvania, 1987.
- [313]. Hahn, Robert W., "Economic Prescriptions for Environmental Problems: How the Patient Followed the Doctor's Orders," Journal of Economic Perspectives, Spring 1989, 3:2, 95-114.
- [314]. Hahn, Robert W., and Carol A. May, "The Behavior of the Allowance Market: Theory and Evidence," The Electricity Journal, March 1994, 7:2, 28-37
- [315]. Hahn, Robert W., and Gordon L. Hester, "Marketable Permits: Lessons for Theory and Practice," Ecology Law Quarterly, 1989a, 16, 361-406.
- [316]. Hahn, Robert W., and Gordon L. Hester, "Where Did All the Markets Go?" Yale journal on Regulation, Winter 1989b, 6, 109-53.
- [317]. Hahn, Robert W., and Robert N. Stavins, "Economic Incentives for Environmental Protection: Integrating Theory and Practice," American Economic Review, 1992, 82, 464-68.
- [318]. HALL, R.E. "The Measurement of Quality Change from Vintage Price Data" in Z.

- Griliches, Price Indexes and Quality Change: Studies in New Methods of Measurement, Cambridge: Harvard University Press, 1971.
- [319]. Hammack, Judd, and Gardner Brown, Waterfowl and Wetlands: Toward Bioeconomic Analysis. Baltimore: Johns Hopkins University Press, 1974.
- [320]. Hanemann, W. Michael, "Preface: Notes on the History of Environmental Valuation in the U.S." In Navrud, Stale, ed., Pricing the Environment: The European Experience. London: Oxford University Press, 1992, 9-35.
- [321]. Hanemann, W. Michael, "Willingness to Pay and Willingness to Accept: How Much Can They Differ?" American Economic Review, June 1991, 81, 635-47.
- [322]. Hank Mohle and Associates, 1996. GIS for Small Municipalities. Presentation Materials, OTS Summit
- [323]. Härd, M., and Knie, A., The Ruler of the Game: The Defining Power of the Standard Automobile, WZB Publ., Berlin, 1993.
- [324]. Harrell, A., 1991. Factors influencing pedestrian cautiousness in crossing streets. J. Social Psychol. 131 (3), 367–372
- [325]. Hartman, L., Cairns, J., and Hietbrink, H., Electric Vehicles Challenge Battery Technology, 5th Conference on Energy, Washington, DC, February 27, 1978.
- [326]. Hausberger et al (1994) KEMIS: A Computer Program for the Simulation of on-Road Emissions Based on the Characteristical Driving Behaviour Institute for Internal Combustion Engines and Thermodynamics, Technical University, Graz, Austria
- [327]. HAUSMAN, J. "Specification Tests in Econometrics." Econometrica, Vol. 46 (November 1978), pp. 1251-1272.
- [328]. Häussinger, P., R. Lohmüller, and A. M. Watson, "Hydrogen," in Ullmann's Encyclopaedia of Industrial Chemistry, 5th ed. (B. Elvers, S. Hawkins, M. Ravenscroft, and G. Schulz, eds.), vol. A13, pp. 297- 442, esp. p. 319, 376-377. VCH Verlagsgesellschaft, Weinheim, Germany, 1989.
- [329]. Haynes, H. W., Jr., "Multiple-Reaction Equilibria by Reactors-in-Series Method," a computer code distributed by ChemE Computations, Laramie, WY. It is a portion of the code package Thermopak (1990).
- [330]. Hazilla, Michael, and Raymond Kopp, "Social Cost of Environmental Quality Regulations: A General Equilibrium Analysis," Journal of Political Economy, August 1990, 98, 853-73.
- [331]. Hendrickson, C. T.; Horvath, A.; Joshi, S.; Lave, L. B. Environ. Sci. Technol. 1998, 32, 184A.
- [332]. Hendrickson, C., A. Horvath, S. Joshi, and L. Lave. 1998. Economic input-output models for lifecycle assessment. Environmental Science and Technology: 13(4): 184A–191A.
- [333]. Hendrickson, C; Horvath, A.; Joshi, S.; Klausner, M.; Lave, L.; McMichael, F. C. In Comparing Two Life-Cycle Assessment Approaches: A Process Model vs. Economic Input-Output Based Assessment, Proceedings of the 1997 International Symposium on Electronics and the Environment; Institute of Electrical and Electronics Engineers: Piscataway, NJ, May 1997.
- [334]. Hendrickson, C; Horvath, A.; Joshi, S.; Lave, L. Environ. Sci. Technol. 1998, 3(4), 184A-191A.
- [335]. Herms, B., 1972. Pedestrian Crosswalk Study: Accidents in Painted and Unpainted Crosswalks. Record No. 406, Transportation Research Board, Washington, DC
- [336]. HESS, A.C. "A Comparison of Automobile Demand Equations." Econometrica, Vol. 45 (April 1977), pp. 683- 701.
- [337]. Hiller, H., and R. Reimert, "Introduction," a chapter in "Gas Production," in Ullmann's Encyclopaedia of Industrial Chemistry, 5th ed. (B. Elvers, S. Hawkins, M. Ravenscroft, J. F. Rounsaville and G. Schulz, eds.), vol. A12, pp. 171-186, esp. p. 179. VCH Verlagsgesellschaft, Weinheim, Germany, 1989.
- [338]. Hino, A., van der Molen, H.H., Wilde, G.J.S., 1996. Risk perception, risk taking, accident involvement and the need for stimulation. Safety Sci. 22 (1–3), 35–48
- [339]. Hochhauser, A. M., "Gasoline and Other Motor Fuels," in Kirk-Othmer Encyclopaedia of Chemical Technology, 4th ed. (J. I. Kroschwitz and M. Howe-Grant, eds.), vol. 12, pp. 341-388, esp. p. 361. Wiley, New York, 1994.

- [340]. Hocking, M. B. Science 1991, 25i (4993), 504-05.
- [341]. Holloway S. An overview of the underground disposal of carbon dioxide. Energy Convers Manage 1997;38S:193-198.
- [342]. Hopkins, Thomas, "The Costs of Federal Regulation," Journal of Regulation and Social Costs, March 1992, 2, 5-31.
- [343]. Horvath, A. Estimation of Environmental Implications of Construction Materials and Designs Using Life-Cycle Assessment Techniques. Doctoral Dissertation, Carnegie Mellon University, Department of Civil and Environmental Engineering, Pittsburgh, PA, 1997.
- [344]. Horvath, A. et al. Environ. Sci. Technol. 1995,29(2), 86A- 90A.
- [345]. Horvath, A. Master's Thesis, Department of Civil and Environmental Engineering, Carnegie Mellon University, 1994.
- [346]. Horvath, A., C. Hendrickson, L. Lave, F. C. McMichael, and T. S. Wu. 1995. Toxic emission indices for green design and inventory. Environmental Science and Technology 29(2): 86–90.
- [347]. Houah, A. M. and Derwent. R. G.. Atmos. Environ. 21. 2015-(1987).
- [348]. Household Vehicle Energy Consumption. Energy Information Administration, U.S. Department of Energy, U.S. Government Printing Office: Washington, DC, 1991.
- [349]. Howarth RW. Nutrient limitation of net primary production in marine ecosystems. Annu Rev Ecol 1988; 19:89-110.
- [350]. Huisman W, Jenkins BM, Summers MD. Comparison of bale storage systems for biomass. In: The First World Conference and Exhibition on Biomass for Energy and Industry, 5–9 June, 2000, Seville, Spain, Proceedings vol. 1. London: James & James; 2001. p. 241–4.
- [351]. Hult6n, S., and S6derhind, M., Elbilar-Tekniska M6jlisheter och Marknadsspridning (in Swedish), EFI Research Paper, Stockholm School of Economics, Stockholm, Sweden, 1994.
- [352]. I EA (International Energy Agency) (1994b) Biofuels OECD, Paris
- [353]. ICAO (international Civil Aviation Organisation) (1992) OutlookJbr Air Transport to the Year 2001 Circular 237-AT/96 Montreal, ICAO
- [354]. ICAO (International Civil Aviation Organisation) (1994) The World of Civil Aviation, 1993-1996 Circular 250-AT/102 Montreal, ICAO
- [355]. ICF, Inc., "Economic Analysis of Title V (Acid Rain Provisions) of the Administration's Proposed Clean Air Act Amendments (H.R. 3030/S. 1490)." Prepared for the U.S. Environmental Protection Agency, Washington, D.C., 1989
- [356]. IDEA, Indicadores de Desempenho da Agroindustria Canavieira na Safra 97–98. Report from IDEA: Instituto de Agro industrial Development (Instituto de Desenvolvimento Agroindustrial). Ribeirao, Preto São Paulo: Brazil; 1999.
- [357]. IEA (International Energy Agency) (1993a) Cars and Climate Change OECD, Paris
- [358]. IEA (International Energy Agency) (1993b) Energy Statistics and Balances of Non-OECD Countries, 1990-1991 OECD, Paris
- [359]. IEA (International Energy Agency) (1994a) World Energy Outlook, 1994 Edition OECD, Paris
- [360]. IEA (International Energy Agency) (1995a) Energy Prices and Taxes Second Quarter, 1995 OECD, Paris
- [361]. Input-Output Accounts of the U.S. Economy, 1987 Benchmark (computer diskettes); U.S. Department of Commerce, Inter-industry Economics Division, U.S. Government Printing Office: Washington, DC, 1994.
- [362]. Input-Output Accounts of the U.S. Economy, 1992 Benchmark; U.S. Department of Commerce, Interindustry Economics Division, Computer Diskettes: Washington, DC, 1997.
- [363]. Input-Output Accounts of the US. Economy, 1987 Benchmark; Interindustry Economics Division. U.S. Department of Commerce: Washington, DC, 1994.
- [364]. Intergovernmental Panel on Climate Change (IPCC), Climate Change 1995. Economic and Social Dimensions of Climate Change: Contribution of Working Group III to the Second Assessment Report of the Intergovernmental Panel on Climate Change. In J. Bruce, H.P. Lee, and E.F. Haites, eds. Cambridge: Cambridge University Press, 1996

- [365]. IPCC (Intergovernmental Panel on Climate Change). 1995. IPCC guidelines for national greenhouse gas inventories, vol. 1–3. UNEP, OECD and IPCC.
- [366]. IPCC (Inter-governmental Panel on Climate Change) (1995b) IPCC Second Assessment Synthesis of Scientific-Technical Information Relevant to Interpreting Article 2 of the UN Framework Convention on Climate Change, 1995 and Summaries for Policymakers of Working Groups 1, 11 and 111 of the IPCC 1995 Approved texts subject to minor editing prior to publication IPCC Secretariat, World Meteorological Organisation, Geneva
- [367]. Isacower, K. American Petroleum Institute, Washington, DC. Personal communication, November 1996.
- [368]. J. Alvarez and T. J. Schueneman, Costs and returns for sugarcane production on muck soils in Florida: 1990-91. In Economic Information Report EI 91-3. Food and Resource Econ. Dep. Inst. Food and Agric. Sci., Univ. of Florida, Gainesville (1991).
- [369]. J. M. Ogden and R. H. Williams, Electrolytic hydrogen from thin-film solar cells. *Int. J. Hydrogen Energy* 15, 155--169 (1990).
- [370]. J. S. Badin and G. Kervitsky, Recommendations of Emission Values for the E3 pathway Analysis Modeling System, October (1993).
- [371]. J. S. Badin and R. Eaton, Hydrogen Energy Pathways: A Federal Plan for a Sustainable Energy Economy, Intersociety Energy Conversion Engineering Conference, August (1993).
- [372]. J. S. Badin, S. Mack and G. Kervitsky. E3 Pathway Analysis Modeling System Users Guide, Version I.O. June (1993)
- [373]. J. V. Uspensky, "Theory of Equations," McGraw-Hill, New York (1948).
- [374]. Jacobs, M (1994) 'The limits to neo-classicism: towards an institutional environmental economics' in Redclift, M and Benton, T (eds) *Social Theory and the Global Environment* Routledge, London
- [375]. Jaffe, Adam B., and Robert N. Stavins, "Dynamic Incentives of Environmental Regulations: The Effects of Alternative Policy Instruments on Technological Diffusion," *Journal of Environmental Economics and Management*, November 1995, 29:3, S43-S63
- [376]. Jamal, Y., and M. L. Wyszynski, "On-Board Generation of Hydrogen-Rich Gaseous Fuels--a Review," *Int. J. Hydrogen Energy*, 19, 557-572 (1994).
- [377]. Jamison, A., *The Steam-Powered Automobile: An Answer to Air Pollution.* Indiana University Press, London, 1974
- [378]. Janbey A, Clark W, Noordally E, Grimes S, Thair S. *Chemosphere* 2003;52:1041.
- [379]. Japar, S. M., Wallington, T. J., Richert, J. F. O. and Ball, J. C., *Int. J. Chem. Kin.* 22, 1257 (1990).
- [380]. Japar, S. M., Wallington, T. J., Rudy, S. J. and Chang. T. Y., *Environ., Sci. Tech.* 25,415 (1991)
- [381]. Jeffries, H. E. and Crouse, R., Scientific and technical issues related to the application of incremental reactivity, Report, University of North Carolina, Chapel Hill, NC (1990).
- [382]. Jeffries, H. E. and Tonnesen. S., *Atmos. Environ.* 28, 299 I (1994).
- [383]. Jen HW, Graham GW, Chun W, McCabe RW, Cuif JP, Deutsch SE, et al. *Catal Today* 1999;50:309.
- [384]. JOHNSON, T.R. "Aggregation and the Demand for New and Used Automobiles." *Review of Economic Studies*, Vol. 45 (July 1978), pp. 311-327.
- [385]. Jones ISF, Cappelen-Smith C. Lowering the cost of carbon sequestration by ocean nourishment. In: Eliasson B, Riemer P, Wokaun A, editors. *Greenhouse Gas Control Technologies; Proceedings of the Fourth International Conference on Greenhouse Gas Control Technologies.* Pergamon, 1999:255-259.
- [386]. Jones ISF, Otaegui D. Photosynthetic greenhouse gas mitigation by ocean nourishment. *Energy Convers Manage* 1997; 38S:379-384.
- [387]. Jones ISF, Sugimori Y, Stewart RW. Satellite remote sensing of the oceanic environment. Tokyo: Seibutsu Kenkyusha, 1993:528.
- [388]. Jones ISF, Young HE. Engineering a large sustainable world fishery. *Environ Conserv* 1997; 24:99-104.
- [389]. Jones ISF, Young HE. Enhanced oceanic uptake of carbon dioxide an AIJ candidate. In: Riemer PW, Smith AY, Thambimuthu

- KV, editors. Greenhouse gas mitigation: technologies for activities implemented jointly. Pergamon, 1998:267-272.
- [390]. Jones, C T (1993) 'Another look at US passenger vehicle use and the "rebound" effect from improved fuel efficiency' The Energy Journal 14 (4) 99-143
- [391]. Jones, C.J., P.J., McGugan, and P.F. Lawrence, 1977. "An Investigation of the Degradation of Some Dry Cell Batteries Under Domestic Waste Landfill Conditions." J. Hazard. Mater., 2~259-289.
- [392]. Jorgensen, M.S. and B. Pedersen, 1990. "Quality Concepts for Processed Organic Food." Letter Attachment to Timothy Mohin, U.S. Environmental Protection Agency from Bo Pedersen, Interdisciplinary Centre, Technical University of Denmark, Lyngby, Denmark, October 17,1990
- [393]. Jorgenson, Dale, and Peter Wilcoxon, "Environmental Regulation and U.S. Economic Growth," RAND Journal of Economics, Summer 1990, 21, 314-40.
- [394]. Joshi, S. Comprehensive Product Life-Cycle Analysis Using Input-Output Techniques. Doctoral Dissertation, Carnegie Mellon University, Heinz School of Public Policy and Management, Pittsburgh, PA, 1997.
- [395]. Joshi, S. Ph.D. Dissertation, Carnegie Mellon University, Pittsburgh, PA, 1997.
- [396]. Joshi, S. V. 1998. Comprehensive product life-cycle analysis using input-output techniques. Ph.D. dissertation, Carnegie Mellon University
- [397]. JOSKOW, A. "A Welfare Analysis of Industry Product Variety." Unpublished, U.S. Department of Justice, 1984.
- [398]. Joskow, Paul L., and Richard Schmalensee, "The Political Economy of Market-Based Environmental Policy: The U.S. Acid Rain Program," Journal of Law and Economics, April 1998, 41, 89- 135.
- [399]. Joskow, Paul L., and Richard Schmalensee, "The Political Economy of Market-Based Environmental Policy: The U.S. Acid Rain Program," Journal of Law and Economics, forthcoming.
- [400]. Joskow, Paul L., Richard Schmalensee, and Elizabeth M. Bailey, "Auction Design and the Market for Sulfur Dioxide Emissions," National Bureau of Economic Research Working Paper No. 5745, Cambridge, September 1996
- [401]. Joskow, Paul L., Richard Schmalensee, and Elizabeth M. Bailey, "The Market for Sulfur Dioxide Emissions," American Economic Review, forthcoming.
- [402]. Joumard, R, Paturel, L, Vidon, R, Guitton, J-P, Saber, A-I and Combet, E (1990) Emissions unitaires de polluants des v~hicules l~gers INRETS Report no 116 Institut National de Recherche sur les Transports et leur Scuritr, Bron, France
- [403]. K. H. Quand and R. Streicher, Concept and design of a 3.5 MW pilot plant for high temperature electrolysis of water vapor. Int. J. Hydrogen Energy 11, 309 315 (1986).
- [404]. K. Hanson, The effect of fuel-economy standards on corporate strategy in the automobile industry, in "Government, Technology, and the Future of the Automobile" (D. Ginsburg and W. Abernathy, Eds.), McGraw-Hill, New York (1980).
- [405]. K. Mund and M. Waidhas. Research and Development of Low Temperature Fuel Cells at Siemens, Fuel Cell Seminar. San Diego, USA, Nov. 1994.
- [406]. Kageson, P (1994) 'Effects of internalisation on transport demand and modal split' in Internalising the Social Costs of Transport European Conference of Ministers of Transport, OECD, Paris
- [407]. Karim, M.R., 1992. Traffic accidents in a university environment. ITE J. 62 (7), 30–34.
- [408]. Karna, A. and J. Engstrom. 1994. Life-cycle analysis of newsprint: European scenarios. Paperi ja Puu 76(4): 232–237
- [409]. Kashmanian, R. et al., "Beyond Categorical Limits: The Case for Pollution Reduction Through Trading," paper presented at the 59th Annual Water Pollution Control Federation Conference, Los Angeles, CA, October 6-9, 1986.
- [410]. Kazimi, C. Ph.D. Dissertation, University of California, Irvine, 1995.
- [411]. Kelman, Steven P., What Price Incentives? Boston: Auburn House, 1981.
- [412]. Kempton, W., Letendre, S.E., 1996. Electric vehicles as a new power source for electric utilities. Transport Research-D 2 (3), 157–175

- [413]. Kempton, W., Tomic, J., Letendre, S., Brooks, A., Lipman, T., 2001. Vehicle-to-GridPower: Battery, Hybrid, andFuel Cell Vehicles as Resources for DistributedElectric Power in California. Inst. of Transportation Studies, University of California, Davis, UCDITS-RR-01-03.
- [414]. Kennedy, David M., ControllingAcidRain, 1986. Case Study C15-86-699.0. Cambridge: John F. Kennedy School of Government, Harvard University, 1986
- [415]. Keohane, Nathaniel O., Richard L. Revesz, and Robert N. Stavins, "The Positive Political Economy of Instrument Choice in Environmental Policy." In Paul Portney and Robert Schwab, eds. Environmental Economics and Public Policy. London: Edward Elgar, Ltd., 1997
- [416]. Keoleian, G. A. and D. Menerey. 1993. Life-cycle design manual (EPA 600/R-92/226). Washington, DC: U.S. Environmental Protection Agency
- [417]. Keoleian, G. A. Industrial Ecology of the Automobile: A LifeCycle Perspective, Society of Author's Representatives Inc.: New York, 1997.
- [418]. Keoleian, G. A., S. Spatari, and R. Beal. 1997. Lifecycle design of a fuel tank system (draft report). Ann Arbor, MI: National Pollution Prevention Center, University of Michigan.
- [419]. Keoleian, G. A.; Meneray, D. Life Cycle Design Guidance Manual: Environmental Requirements and the Product System; EPA 600-R-92-226; U.S. Environmental Protection Agency, U.S. Government Printing Office: Washington, DC, 1993.
- [420]. Keoleian, G. A.; Menerey, D. "Life Cycle Design Guidance Manual"; Report to U.S. Environmental Protection Agency: Washington, DC, January 1993; EPA600/R-92/226.
- [421]. Kerr, Suzi, and David Mare, "Efficient Regulation Through Tradeable Permit Markets: The United States Lead Phasedown," Department of Agricultural and Resource Economics, University of Maryland, College Park, Working Paper 96- 06, January 1997.
- [422]. Kim, K., Takeyama, D., Nitz, L., 1995. Moped safety in Honolulu Hawaii. J. Safety Res. 26 (3), 177–185.
- [423]. Kinoshita, K., F. R. McLarnon, and E. J. Cairns, "Fuel Cells--A Handbook," Report #DOE/METC-88- 6096, p. 48. U.S. Department of Energy, Office of Fossil Energy, Morgantown Energy Technology Center, Morgantown, WV, 1988.
- [424]. Kirsch, D. A., Flexibility and Stabilization of Technological Systems: The Case of the Second Battle of the Automobile Engine, Proceedings EUNETIC Conference on Evolutionary Economics of Technological Change, Strasbourg, 1994.
- [425]. Kissock, J.K., 1998. Combinedheat andpower for buildings using fuel-cell cars. ASME International Solar Energy Conference, Albuquerque, NM.
- [426]. Kneese, A. and Schultze, C., Pollution, Prices, and Public Policy. Washington, D.C.: The Brookings Institution, 1975.
- [427]. Koomey, J. Comparative Analysis of Monetary Estimates of External Environmental Costs Associated with Combustion of Fossil Fuels; Electric Power Research Institute and Lawrence Berkeley Laboratory: Berkeley: CA, 1990.
- [428]. Koop et al. www.rff.org/featuresfeature060.html, 1999.
- [429]. Koopman, G J (1995) 'Policies to reduce CO 2 emissions from cars in Europe' Journal of Transport Economics and Policy 153-70
- [430]. Kosaric, N, A. Farkas, H. Sahm, O. Geobel, and D. Mayer, "Ethanol," in Ullmann's Encyclopaedia of Industrial Chemistry, 5th ed. (W. Gerhartz, Y. S. Yamamoto, F. G. Campbell, L. Kaudy, J. F. Rounsaville, and G. Schulz eds.), vol. A9, pp. 588-653. VCH Verlagsgesellschaft, Weinheim, Germany, 1987.
- [431]. Kreutz, T.G., Ogden, J.M., 2000. Assessment of hydrogen-fueled proton exchange Membrane fuel cells for distributed generation and cogeneration. Proceedings of the 2000 US DOE Hydrogen Program Review, NREL/CP-570-28890.
- [432]. Krupnick, Alan, and Maureen Cropper, "The Effect of Information on Health Risk Valuation," Journal of Risk and Uncertainty, February 1992, 2, 29-48.
- [433]. Krutilla, John, "Conservation Reconsidered," American Economic Review, September 1967, 56, 777-86.
- [434]. Kumar, R., H. K. Geyer, R. Ahluwalia, and M. Krumpelt, "Polymer Electrolyte

- Fuel Cell Systems for Fuels and Fuel Processing Options,” Proceedings of the 1994 Annual Automotive Technology Development Contractors’ Coordination Meeting, Warren MI, October 24-27, 1994.
- [435]. Kumar, R., R. Ahluwalia, H. K. Geyer, and M. Krumpelt, “Modeling of Polymer Electrolyte Fuel Cell Systems,” Proceedings of the 1993 Automotive Technology Development Contractors’ Coordination Meeting, Warren, MI, October, 1993
- [436]. L. J. Lundqvist, “The Hare and the Tortoise: Clean Air Policies in the United States and Sweden,” Univ. of Michigan Press, Ann Arbor (1980).
- [437]. L. K. Matthews, R. Viskanta and F. P. Incropera, Combined conduction and radiation heat transfer in porous materials heated by intense solar radiation. *J. Solar Energy Engng* 107, 29 34 (1984).
- [438]. Laffitte, P., Rapport sur l'Intérêt du Véhicule Électrique au Regard de la Protection de l'Environnement, Assemblée Nationale, Paris, No. 680 (1993).
- [439]. Lampert JK, Kazi MS, Ferrauto RJ. *Appl Catal B* 1997; 14:211.
- [440]. Landis, B.W., Vattikuti, V.R., Ottenberg, R.M., McLeod, D.S., Guttenplan, M., 2001. Modeling the roadside walking environment: a pedestrian level of service. In: Proceedings of the Papers Presented at Transportation Research Board 80th Annual Meeting.
- [441]. Landis, B.W., Vattikuti, V.R., Ottenberg, R.M., McLeod, D.S., Guttenplan, M., 2001. Modeling the roadside walking environment: a pedestrian level of service. In: Proceedings of the Papers Presented at Transportation Research Board 80th Annual Meeting.
- [442]. Landsfeld, J. S.; Carson, C. S. *Surv. Curr. Business* 1994, 74 (4).
- [443]. LANGENFELD, J.A. Federal Automobile Regulations. Ph.D. Thesis, Washington University, 1983.
- [444]. Larson ED, Marrison CI. Economic scales for first-generation biomass-gasifier/gas turbine combined cycles fueled from energy plantations. *J Eng Gas Turbines Power* 1997; 119:285–90.
- [445]. Lave, L. B., E. Cobas-Flores, C. T. Hendrickson, and F. C. McMichael. 1995. Using input-output analysis to estimate economy-wide discharges. *Environmental Science and Technology* 29(9): 420A–426A
- [446]. Lave, L. B.; Russell, A. G.; Hendrickson, C. T.; McMichael, F. C. *Environ. Sci. Technol.* 1996, 30, 402-407.
- [447]. Lave, L.; Cobas, E.; Hendrickson, C. T.; McMichael, F. *Environ. Sci. Technol.* 1995, 29, 420A.
- [448]. Lave, Lester, "Conflicting Objectives in Regulating the Automobile," *Science*, May 22, 1981, 893-99.
- [449]. Lawson, A. M.; Teske, D. A. 1994 Benchmark Input Output Accounts for the U.S. Economy, 1987; Survey of Current Business, U.S. Department of Commerce, U.S. Government Printing Office: Washington, DC, April 1994; pp 73-114.
- [450]. Lawson, A. M.; Teske, D. A. *Survey of Current Business* 1994, April, 73-114.
- [451]. IEA (International Energy Agency) (1995b) Oil, Gas and Coal Supply Outlook OECD, Paris
- [452]. Leontief, W *Input-Output Economics*; Oxford University Press: New York, 1986.
- [453]. Leontief, W *Rev. Econ. Stat.* 1970,1/7(3), 262-71.
- [454]. Leontief, W. 1966. *Input-output economics*. New York: Oxford University Press
- [455]. Leontief, W. *Input-Output Economics*, 2nd ed.; Oxford University Press: New York, 1986.
- [456]. Levine, N., 1999. CrimeStat: A Spatial Statistics Program for the Analysis of Crime Incident Locations. Ned Levine & Associates, Annandale, VA and the National Institute of Justice, Washington, DC, August 1999
- [457]. Levine, N., Kim, K., Nitz, L., 1995. Spatial analysis of Honolulu motor vehicle crashes. I. Spatial patterns. *Accid. Anal. Prev.* 27 (5), 663–674.
- [458]. Levy, E *The Complete Car Cost Guide* 1994 Edition; Gross, S., Ed.; IntelliChoice: San Jose, CA, 1994.
- [459]. Levy, J. I.; Hammitt, J. K.; Yangisawa, Y.; Spengler, J. D. *Environ. Sci. Technol.* 1999, 33, 4364.

- [460]. Liebowitz, S. J., and Margolis, S. E. The Fable of the Keys. *Journal of Law and Economics* XXXIII, 1-25 (1990).
- [461]. Life Cycle Assessment: Inventory Guidelines and Principles; U.S. Environmental Protection Agency; Cincinnati, OH, 1993; EPA- 600-R-92-245.
- [462]. Liley, P. E., R. C. Reid and E. Buck, "Physical and Chemical Data," Section 3 in Perry's Chemical Engineer's Handbook, 6th ed. (D. W. Green, ed.). McGraw-Hill, New York, 1984.
- [463]. Logsdon, J. E., "Ethanol," in Kirk-Othmer Encyclopedia of Chemical Technology, 4th ed. (J. I. Kroschwitz and M. Howe-Grant, eds.), vol. 9, pp. 812-860. Wiley, New York, 1994
- [464]. Lomax, F.D., James, B.D., Baum, G.N., Thomas, C.E., 1997. Detailed Manufacturing Cost Estimates for Polymer Electrolyte Membrane (PEM) Fuel Cells for Light Duty Vehicles. Directed Technologies, Inc., Arlington.
- [465]. IOO (Instituut voor Onderzoek van Overheidsuitgaven/Institute for Research on Public Expenditure) (1995) The Price of Mobility in the Netherlands IOO, the Hague
- [466]. Lovins, A B, Barnett, J W and Lovins, L H (1993) Supercars: The Coming Light-Vehicle Revolution Rocky Mountain Institute, Snowmass, CO
- [467]. Lowry, Robert C., "The Political Economy of Environmental Citizen Groups," unpublished Ph.D. thesis, Harvard University, 1993
- [468]. Lucas, A.; Roberts, M. *Chemical Week* 1994, 29(2), 33-34.
- [469]. Lundholm, M.P. and G. Sundstrom, 1985. "Tetra Brik Aseptic Environmental Profile," 174 p.
- [470]. Lutz, E., ed. 1993. *Toward improved accounting for the environment*. Washington, DC: World Bank.
- [471]. M. "Automobile Prices Revisited: Extensions of the Hedonic Hypothesis" in N. Terleckyj, ed., *Household Production & Consumption*, New York: National Bureau of Economic Research, 1976
- [472]. M. ~r. T. Klaiber and K.E. Noveikal, Demands from Customer and Technical Requirements for Fuel Cell Cars. Churchill College Cambridge University, UK, May 1994
- [473]. M. A. Liepa and A. Borhan, High-temperature steam electrolysis: technical and economic evaluation of alternative process designs. *Int. J. Hydrogen Energy* 11,435-142 (1986).
- [474]. M. Edelman, "The Symbolic Uses of Politics," Univ. of Illinois Press, Urbana (1964).
- [475]. M. Fischer, Review of hydrogen production with photovoltaic electrolysis systems. *Int. J. Hydrogen Energy* 11, 495 501 (1986).
- [476]. M. J. Giamalva, S. J. Clarke and J. M. Stein, Sugarcane hybrids of biomass. *Biomass* 6, 6168 (1984).
- [477]. M. Krämer and T. Klaiber. Brennsroffzelle. der alternative Fahrzeugamrieb. Gemeinschaftsfachtagung SAE-CH/SATG. Wil, Switzerland. Apr. 1995.
- [478]. M. Kräner, Ganzheitliche Betracchtung zukünfriger Antriebe vet dem Hintergrund der Umwelt und Klimadiskussion, AVL-Tagung Motor und Umwelt "94, Graz, Austria. June 1994
- [479]. M. L. We&man, The ratchet principle and performance incentives, *Bell J. Econom.* 11, 302-308 (Spring 1980).
- [480]. Macedo I, Copersucar. On sugar cane harvesting and supply systems. 1999 [Pers. Comm.].
- [481]. MacKenzie, J J (1994) The Keys to the Car World Resources Institute, Washington, DC
- [482]. MacKenzie, J J, Dower, R C and Chen, D D T (1992) The Going Rate: What it Really Costs to Drive World Resources Institute, Washington, DC
- [483]. MacLean, H. L. A Life Cycle Model of an Automobile: A Technical Report; Green Design Initiative; Carnegie Mellon University: Pittsburgh, PA, 1997.
- [484]. MANNERING, F. AND WINSTON, C. "A Dynamic Empirical Analysis of Household Vehicle Ownership and Utilization." *Rand Journal of Economics*, Vol. 16 (Summer 1985), pp. 215-236.
- [485]. Martin, D J and Shock, R A W (1989) Energy Use and Energy Efficiency in UK Transport up to the Year 2010 Energy Efficiency Series No 10 Energy Efficiency

- Office, Department of Energy HMSO, London
- [486]. Matear R, Elliot B. Enhancement of oceanic uptake of anthropogenic CO by macro-nutrient fertilisation. In: Williams D et al., editors. Greenhouse gas control technologies. CSIRO Melbourne, ISBN 0643066721, 2001:39.
- [487]. Matthews, H. S. Ph.D. Dissertation, Carnegie Mellon University, 1999.
- [488]. Maxwell, J. B., Data Book on Hydrocarbons. Van Nostrand, New York, 1950.
- [489]. May, A D (1995) 'The design of integrated transport strategies' Transport Policy 2 (2) 97-105
- [490]. MAYHEW, D. Congress: The Electoral Connection. New Haven: Yale University Press, 1974.
- [491]. MCCALLUM, B.T. "Rational Expectations and the Natural Rate Hypothesis: Some Consistent Estimates." *Econometrica*, Vol. 44 (January 1976), pp. 43-52.
- [492]. McCubbin, D.; Delucchi, M. A. The Social Cost of the Health Effects of Motor-Vehicle Air Pollution; UCD-ITSRR-96-3 (11); Report # 11 in the Series: The Annualized Social Cost of Motor-Vehicle Use in the United States; Institute of Transportation Studies, University of California, Davis, 1996.
- [493]. McCubbin, N. *Science* 1991, 252(5011), 1361.
- [494]. McCubbins, Matthew and Terry Sullivan, "Constituency Influences on Legislative Policy Choice," *Quality and Quantity*, 1984, 18,299-319.
- [495]. McCubbins, Matthew D., Roger G. Noll, and Barry R. Weingast, "Administrative Procedures as Instruments of Political Control," *Journal of Law, Economics and Organization*, 1987, 3,243-77.
- [496]. McCubbins, Matthew D., Roger G. Noll, and Barry R. Weingast, "Structure and Process, Politics and Policy: Administrative Arrangements and the Political Control of Agencies," *Virginia Law Review*, 1989, 75, 431-82
- [497]. McKee, R. H.; Scala, R. A. *Toxic Subst.*. 1994, 13, 71-84.
- [498]. McLean, Brian J., "Lessons Learned Implementing Title IV of the Clean Air Act," 85th Annual Meeting of the Air & Waste Management Association, 95-RA120.04, San Antonio, Texas, 1995
- [499]. McMahon, P., 1999. A Quantitative and Qualitative Analysis of the Factors Contributing to Collisions Between Pedestrians and Vehicles Along Roadway Segments. Masters Project, Department of City and Regional Planning, University of North Carolina at Chapel Hill, NC
- [500]. Meadows, D. H. et al., 1972. *The Limits to Growth: a Report for the Club of Rome's Project on the Predicament of Mankind*. Universe Books, New York. 205
- [501]. Mendonca A, Dahl C. The Brazilian electrical system reform. *Energy Policy* 1999; 27:73–83.
- [502]. Michaelis, L (1996) 'Mitigation options in the transportation sector' in Watson, R T, Zinyowera, M C and Moss, R H (eds) *Climate Change 1995: Impacts, Adaptations and Mitigation of Climate Change: Scientific-Technical Analyses Contribution of Working Group II to the Second Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge and New York
- [503]. Miettinen, P. and R. Hamalainen. 1997. How to benefit from decision analysis in environmental lifecycle analysis. *European Journal of Operations Research* 102: 279–294.
- [504]. Miller, J.S., 2000. The unique analytic capabilities geographic information systems can offer the traffic safety community. In: *Proceedings of the Papers Presented at Transportation Research Board 79th Annual Meeting*.
- [505]. Miller, R. E.; Blair, R D. *Input-Output Analysis: Foundations and Extensions*; Prentice-Hall: Englewood Cliffs, NJ, 1985.
- [506]. Milliman, Scott R., and Raymond Prince, "Firm Incentives to Promote Technological Change in Pollution Control," *Journal of Environmental Economics and Management*, 1989, 17, 247- 65.
- [507]. Mitchell, Robert, and Richard Carson, *Using Surveys to Value Public Goods: The Contingent Valuation Method*. Washington, D.C.: Resources for the Future, 1989

- [508]. Mogridge, M J M (1983) *The Car Market Psion*, London
- [509]. Montero, Juan Pablo, "Optimal Design of a Phase-in Emissions Trading Program with Voluntary Compliance Options," Working Paper 97-003, MIT Center for Energy and Environmental Policy Research, July 1997b.
- [510]. Montero, Juan Pablo, "Volunteering for Market-Based Environmental Regulation: The Substitution Provision of the SO₂ Emissions Trading Program," Working Paper 97-001, MIT Center for Energy and Environmental Policy Research, January 1997
- [511]. Montgomery, W. D., "Markets in Licenses and Efficient Pollution Control Programs," *Journal of Economic Theory*, 1972, 5, 395-418.
- [512]. Morisugi, H (1995) *Japanese Transport Case Study on the Social Costs of Automobiles* Consultants' report for the OECD project on Environmental Implications of Energy and Transport Subsidies, OECD, Paris (forthcoming)
- [513]. *Motor Vehicle-Related Air Toxics Study*, EPA 420-R-93- 005; Office of Mobile Sources, U.S. Environmental Protection Agency, U.S. Government Printing Office: Washington, DC, April 1993.
- [514]. Mowery DL, Graboski MS, Ohno TR, McCormick RL. *Appl Catal B* 1999; 21:157.
- [515]. MVEG (1992) *Policy Options for the Control of Car CO₂ Emissions* Report of the MVEG Ad-Hoc Group Commission of the European Communities, Directorate General for Internal Market and Industrial Affairs Reference III/VE/SEC/70 Brussels
- [516]. N. J. Maskalick, *Hydrogen generation by high-temperature water vapor electrolysis using solid-oxide electrolyte cells*. Technical Progress Report of Brookhaven National Laboratory, BNL-34840, 1-28 (1984).
- [517]. Näätänen, R., Summala, H., 1976. *Road User Behavior and Traffic Accidents*. North-Holland, Amsterdam.
- [518]. NATIONAL ACADEMY OF SCIENCES AND NATIONAL ACADEMY OF ENGINEERING. *The Costs and Benefits of Automobile Emissions Control*. Washington, D.C.: 1974.
- [519]. *National Biennial RCRA Hazardous Waste Report (Based on 1989 Data)*; EPA-530/R-92/027; U.S. Environmental Protection Agency, U.S. Government Printing Office: Washington, DC, Feb. 1993.
- [520]. *National Economic Research Associates, Key Issues in the Design of NO_x Emission Trading Programs to Reduce Ground-Level Ozone*, Palo Alto: Electric Power Research Institute, EPRI TR-104245, July 1994.
- [521]. NATIONAL MARKET REPORTS, INC. *Red Book: Official Used Car Valuations*. Chicago: National Market Reports, 1968-1984.
- [522]. *National Research Council, Rethinking the Ozone Problem in Urban and Regional Air Pollution*, National Academy Press, Washington, D.C. (1991).
- [523]. Neilson CE. *LM2500 gas turbine modifications for biomass fuel operation*. *Biomass Bioenergy* 1998;15(3):269–73.
- [524]. Newell Richard G., Adam B. Jaffe, and Robert N. Stavins, "Environmental Policy and Technological Change: The Effects of Economic Incentives and Direct Regulation on Energy-Saving Innovation," paper presented at the 1997 Allied Social Science Association meeting, New Orleans, January 1997.
- [525]. Newell, Richard G., and Robert N. Stavins, "Abatement Cost Heterogeneity and Potential Gains from Market-Based Instruments." Working paper, John F. Kennedy School of Government, Harvard University, June 1997
- [526]. Newman, P and Kenworthy, M (1990) *Cities and Automobile Dependence* Gower, London
- [527]. NHTSA, 2000. *Traffic Safety Facts 1999*, DOT HS 809-093, U.S. Department of Transportation, National Highway Traffic Safety Administration (NHTSA), National Center for Statistics and Analysis. Online available from 17 November 2000
- [528]. Nicholon, A., *Le Véhicule Électrique. Mythe ou Réalité?* éditions de la Maison des Sciences de rHomme, Paris, 1984.
- [529]. Nichols, Albert L., John G. Farr, and Gordon Hester, "Trading and the Timing of Emissions: Evidence from the Ozone Transport Region," *National Economic Research Associates, Cambridge, Massachusetts*, Draft of September 9, 1996

- [530]. Noll, R., "The Political Foundations of Regulatory Policy," *Zeitschrift fur die gesamte Staatswissenschaft*, 1983, 139, 377-404.
- [531]. Nordhaus, W. D.; Kokkelenberg, E. C. *Nature's Numbers: Expanding the National Economic Accounts to Include the Environment*; Panel on Integrated Environmental and Economic Accounting, Committee on National Statistics, Commission on Behavioral and Social Sciences and Education, National Research Council: Washington, DC, 1999.
- [532]. Nordhaus, W.; Tobin, J. In *Economic Growth*; National Bureau of Economic Research General Series 96E; Columbia University Press: New York, 1972.
- [533]. North Carolina Center for Geographic Information and Analysis (NCCGIA), 2000. *Pedestrian and Bicycle Safety Analysis Tools*.
- [534]. North Carolina Center for Geographic Information and Analysis (NCCGIA), 2000. *Pedestrian and Bicycle Safety Analysis Tools*.
- [535]. NOVEM (1992) *Transport Policy, Traffic Management, Energy and Environment Consultants Report to the IEA*, Paris, Netherlands Agency for Energy and the Environment, Utrecht
- [536]. Novotny, G., "Transferable Discharge Permits for Water Pollution Control in Wisconsin," Department of Natural Resources, Madison, Wisconsin, mimeo, December 1, 1986.
- [537]. NRC (National Research Council) (1992) *Automotive Fuel Economy: How Far Should We Go?* National Academy Press, Washington, DC
- [538]. O. E. Williamson, "Markets and Hierarchies: Analysis and Antitrust Implications," Free Press, New York (1975).
- [539]. O. Kamada, *Theoretical concentration and attainable temperature in solar furnaces. Solar Energy* 9, 39~17 (1965).
- [540]. Oates, Wallace E., Paul R. Portney, and Albert M. McGartland, "The Net Benefits of Incentive Based Regulation: A Case Study of Environmental Standard Setting," *American Economic Review*, December 1989, 79, 1233-42.
- [541]. O'Bryan, T. R.; Ross, R. HJ. *Toxicol. Environ. Health* 1988, 1, 119-34.
- [542]. Ogden, J., 1999. *Hydrogen energy systems studies. Proceedings of the 1999 US DOE Hydrogen Program Review*. Denver, CO
- [543]. O'Neil, W., "The Regulation of Water Pollution Permit Trading under Conditions of Varying Streamflow and Temperature." In Joeres, E. and M. David, eds., *Buying a Better Environment: Cost Effective Regulation Through Permit Trading*. Madison, Wisconsin: University of Wisconsin Press, 1983, 219-231.
- [544]. Opschoor, J., "Economic Instruments for Environmental Protection in the Netherlands," ENV/ECO/86.15, Organization for Economic Cooperation and Development, August 1, 1986.
- [545]. Orfeuil, J-P (1993) *EIOMents pour une prospective transport, bnergie, environnement Institut National de Recherche sur les Transports et leur Scurittr, Arceuil*
- [546]. Orfeuil, J-P (1995) *Essai d'Evaluation des Couts Externes des Transports Routiers et des Conskquences de leur Internalisation Consultants' report for the OECD project on Environmental Implications of Energy and Transport Subsidies Forthcoming 1996, OECD, Paris*
- [547]. Ormerod B, Angel M. *Ocean fertilisation as a CO sequestration option. Cheltenham: IEA Greenhouse Gas R&D Programme, 1998.*
- [548]. Orr JC, Sarmiento JL. *Potential of marine macroalgae as a sink for CO₂: constraints from a 3-D general circulation 2 model of the global ocean. Water Air Soil Pollut* 1992; 64:405-421.
- [549]. OSAT (Office for the Study of Automotive Transportation). 1996. *Delphi VIII: Forecast and analysis of the North American automotive industry: vol. 3, materials*. Ann Arbor, MI: Office for the Study of Automotive Transportation, University of Michigan Transportation Research Institute
- [550]. östlund, S., *The Limits and Possibilities in Designing the Environmentally Sustainable Firm, Business Strategy and the Environment Vol. 3, Part 2, 1994.*
- [551]. OTA (US Congress, Office of Technology Assessment) (1991) *Improving New Car Fuel Economy: New Standards, New Approaches* OTA-E-504 OTA, Washington, DC

- [552]. OTA (US Congress, Office of Technology Assessment) (1994) Saving Energy in US Transportation OTA-ETI-589 OTA, Washington, DC
- [553]. OTA (US Congress, Office of Technology Assessment) (1995) Advanced Automotive Technology OTA-80 OTA, Washington, DC
- [554]. Ott, R (1993) 'Traffic in Zurich' in International Conference on Travel in the City: Making it Sustainable OECD/ECMT, Paris
- [555]. Ottinger, R. L. In Social Costs of Energy, Proceedings of an International Conference held at Racine, WI, Sept. 8-11; Hohmeyer, O., Ottinger, R. L., Eds.; Springer-Verlag: Berlin, 1992.
- [556]. Oum, T H, Waters, W G II and Yong, J S (1990) A Survey of Recent Estimates of Price Elasticities of Demand. for Transport Policy, Planning and Research Working Paper WPS 359 World Bank, Washington, DC
- [557]. P. Howard. Ballard PEM-FC Powered Bus Project. Fuel Cells for Transportation, TopTec. SAE. Diamond Bar. USA, Mar. 1993.
- [558]. P. Mislevy, J. P. Gilreath, G. M. Prine and L. S. Dunavin, Alternative production systems: nonconventional herbaceous species. In Methane from Biomass: A systems Approach. W. H. Smith and J. R. Frank. Eds). pp. 261-276. Elsevier Applied Science, New York (1987).
- [559]. Packer, E Runzheimer International, Rochester, WI. Personal communication, September 1996.
- [560]. Palmer CA, Erbes MR, Pechtl PA. Gate cycle performance analysis of the LM2500 gas turbine utilising low heating values in IGTI. vol. 8, ASME COGEN-TURBO ASME, p. 69-76.
- [561]. Panella, G., "Economic Instruments for Environmental Protection in Italy," ENV/ECO/ 86.11, Organization for Economic Cooperation and Development, September 2, 1986
- [562]. Papanek, V., Design for the Real World, Human Ecology, and Social Change, Thames and Hudson, London, 1984.
- [563]. Parry, Ian, Robertson Williams, and Lawrence Goulder, "When Can Carbon Abatement Policies Increase Welfare? The Fundamental Role of Distorted Factor Markets," Working paper, Resources for the Future and Stanford University, September 1997.
- [564]. Patel JG, Horvath AI. Biomass co-firing in gas turbines. In: The First World Conference and Exhibition on Biomass for energy and industry, Sevilla, Spain, 2000, Proceeding, vol. 1. London: James & James; 2000. p. 937-40.
- [565]. Patterson, D., Bureau of Water Resources Management, Wisconsin Department of Natural Resources, Madison, Wisconsin, telephone interview, April 2, 1987.
- [566]. Paulson, S. E. and Seinfeld, J. H., J. Geophys. Res 97, 20703 (1992).
- [567]. Pechan, E.H., The Acid Rain Data Base Version 1 (ARDBV1), E.H. Pechan Associates Inc., Contract no. 68-D3-0005, prepared for the US Environmental Protection Agency's Office of Atmospheric Programs, Acid Rain Division: Washington, DC, 1995
- [568]. Peled, A., Haj-Yehia, B., Hakkert, A.S., 1996. ArcInfo-Based Geographical Information System for Road Safety Analysis and Improvement
- [569]. Pento, T. 1997. Dynamic life-cycle inventory modeling with input-output tables and joined time projections. Seventh Annual Meeting of Society of Environmental Toxicology and Chemistry—Europe, 6-10 April. Amsterdam: SETAC
- [570]. Peterson's, 2000. Peterson's Thomson Learning. Peterson's 4 Years Colleges, Lawrenceville, NJ
- [571]. Petroleum Industry Environmental Performance, Third Annual Report; American Petroleum Institute: Washington, DC, May 1995.
- [572]. Pigou, A., The Economics of Welfare, fourth edition. London: Macmillan and Co., 1932
- [573]. Pigou, Arthur Cecil, The Economics of Welfare. London: Macmillan and Company, 1920.
- [574]. Pischinger, R and Hausberger, S (1993) Measures to Reduce Greenhouse Gas Emissions in the Transport Sector Institute for Internal Combustion Engines and Thermodynamics, Technical University, Graz, Austria
- [575]. Planting, M. Interindustry Economics Division, U.S. Department of Commerce,

- Washington, DC. Personal communication, September 1996.
- [576]. Plott, C., "Externalities and Corrective Policies in Experimental Markets," *Economic Journal*, 1983, 93, 106-127.
- [577]. Polak, J W and Meland, S (1994) 'An assessment of the effects of the Trondheim Toll Ring on travel behaviour and the environment' in *Proceedings, First World Congress on Applications of Transport Telematics and Intelligent Vehicle-Highway Systems Paris*
- [578]. Pollution ML. *Alternative fuels for road vehicles*. Boston, MA: Computational Mechanics Publications; 1994
- [579]. Portney, E R. *Issues Sci. Technol.* 1993-1994,10(2), 69-75.
- [580]. Portney, P. R. 1993. The price is right: Making use of life-cycle analysis. *Issues in Science and Technology X(2): 69–75*.
- [581]. Portney, Paul R., "Policy Watch: Economics and the Clean Air Act," *Journal of Economic Perspectives*, Fall 1990, 4:4, 173-81.
- [582]. Portney, Paul, *Public Policies for Environmental Protection*. Washington, D.C.: Resources for the Future, 1990.
- [583]. R. C. Fluck and C. D. Baird, *Agric. Energ. AVI Pub. Co. Inc. Westport. CT* (1980).
- [584]. R. M. Bowman, J. J. Bassam and K. F. Blurton, *Hightemperature water electrolysis for hydrogen production. Proc. 15th Intersociety Energy Conversion Engng Conf.*, pp. 1725 1730 (1980).
- [585]. R. Radner, Repeated principal-agent games with discounting, *Econometrica* 53, 1173-1198 (1985).
- [586]. Rabinovitch, J (1993) 'Urban public transport management in Curitiba, Brazil' in *Industry and Environment* 16 (1-2) *United Nations Environment Programme, Paris*
- [587]. Rabinowitz HN, Tauster SJ, Heck RM. *Appl Catal A* 2003;212:215.
- [588]. Raiffa, H., 1968. *Decision Analysis-Introductory Lectures on Choices under Uncertainty*. Addison-Wesley, Reading, MA
- [589]. Ramjerdi, F (1994) 'Some evidence on the impact of the toll ring in Oslo' in *22nd European Transport Forum, London The PTRC International Association, Hadleigh, Essex*
- [590]. Randall, Alan, Berry Ives, and Clyde Eastman, "Bidding Games for Valuation of Aesthetic Environmental Improvements," *Journal of Environmental Economics and Management*, 1974, 1, 132-49.
- [591]. Renner, H.-J., and F. Marschner, "Catalytic Reforming of Natural Gas and Other Hydrocarbons," a chapter in "Gas Production," in *Ullmann's Encyclopedia of Industrial Chemistry* (B. Elvers, S. Hawkins, M. Ravenscroft, J. F. Rousaville and G. Schulz, eds.), vol. A12, pp. 186-204. VCH Verlagsgesellschaft, Weinheim, Germany, 1989.
- [592]. Revesz, Richard L., "Federalism and Interstate Environmental Externalities," *University of Pennsylvania Law Review*, 1996, 144, 2341
- [593]. *Revue générale de Péectricité*, No. 10 (1993).
- [594]. Reynolds, W. C., "STANJAN--chemical equilibrium solver V3.89 IBM-PC," (© Stanford University 1987).
- [595]. Rice, C.A., 1998. *University of North Carolina Estimated Pedestrian Flows Map*. September 1998.
- [596]. Rice, F. *Fortune*, July 26, 1993, pp. 114-22.
- [597]. Rico, Renee, "The U.S. Allowance Trading System for Sulfur Dioxide: An Update of Market Experience," *Environmental and Resource Economics*, March 1995, 5:2, 115-29.
- [598]. Ridker, Ronald, *The Economic Cost of Air Pollution*. New York: Praeger, 1967.
- [599]. Riemer P. *Greenhouse gas mitigation technologies. Energy Convers Manage* 1996; 37:665-670.
- [600]. Roberts, P., *Veteran and Vintage Cars*, Paul Hamlyn, London, 1963.
- [601]. Rolph, E., "Government Allocation of Property Rights: Who Gets What?" *Journal of Policy Analysis and Management*, 1983, 3, 45-61.
- [602]. Rolt, L.T.C., *George and Robert Stephenson: The Railway Revolution*, Penguin Books, Harmondsworth, Middlesex, 1988.
- [603]. Rose, Kenneth, "Implementing an Emissions Trading Program in an Economically Regulated Industry: Lessons from the SO2 Trading Program." In R.

- Kosobud, and J. Ziinmermann, eds. Market Based Approaches to Environmental Policy: Regulatory Innovations to the Fore. New York: Van Nostrand Reinhold, 1997.
- [604]. Rosenberg, N., and Vincenti, W. G., The Britannia Bridge. The Generation and Diffusion of Technological Knowledge, The MIT Press, Cambridge, MA, 1978.
- [605]. Ross, M.; Goodwin, M.; Watkins, R.; Wang, M. Q.; Wenzel, T. Real-World Emissions from Model Year 1993, 2000 and 2010 Passenger Cars; American Council for Energy Efficient Economy: Washington, DC, 1995.
- [606]. Russo N, Fino D, Saracco G, Specchia V. J Catal 2005;229:459.
- [607]. Sandel, Michael J., "It's Immoral to Buy the Right to Pollute," New York Times, December 15, 1997, p. A29.
- [608]. Sauer, B.J., R.G. Hunt, and M.A. Franklin, 1990. "Background Document on Clean Products-Research and Implementation." U.S. Environmental Protection Agency, Risk Reduction Engineering Laboratory, Cincinnati, OH. EPA/600/2-90/048. 75 p
- [609]. Saunders, S. M., Baulch, D. L., Cooke, K. M., Pilling, M.J. and Smurthwaite, P. I., Int. J. Chem. Kin. 26, 113 (1994).
- [610]. Schafer, A, Schratzenholzer, L and Messner, S (1992) Inventory of Greenhouse gas Mitigation Measures: Examples from the IIASA Technology Data Bank Working Paper WP-92-85 International Institute for Applied Systems Analysis, Laxenburg
- [611]. Schipper, L, Figueroa, M J, Price, L and Epey, M (1993) 'Mind the gap: the vicious circle of measuring automobile fuel use' Energy Policy 12 1173-1190
- [612]. Schmalensee, Richard, "Greenhouse Policy Architecture and Institutions," MIT Joint Program on the Science and Policy of Global Change, Report 13, November 1996
- [613]. Schneider, R.J., Khattak, A.J., Zegeer, C.V., 2001. A proactive method of improving pedestrian safety using GIS: example from a college campus. Transportation Research Record, 1773, TRB, National Research Council, Washington, DC, pp. 97-107.
- [614]. Schumpeter, J. A., The Theory of Economic Development. Harvard University Press, Cambridge, MA, 1934.
- [615]. Schweimer, G.; Schuckert, M. Life Cycle Inventory of a Golf, Forschungsbericht Nr. K - EFVT 9604 V/5; Volkswagen Konzernforschung: Wolfsburg, Germany, 1996.
- [616]. SEADE, Data Analysis Foundation of Sao Paulo State (Fundacao Sistema de Analise de Dados, Governo do Estado de Sao Paulo, Secretaria de Estado dos Negocios de Economica e Planejamento) 2000. Available from: <http://www.seade.gov.br>.
- [617]. Segal, R (1995) 'Forecasting the market for electric vehicles in California using conjoint analysis' The Energy Journal 16 (3) 89-111
- [618]. Seinfeld, J. H., Atmospheric Chemistry and Physics of Air Pollution, Wiley, New York (1986).
- [619]. Semadeni, M., Stocker, D. W. and Kerr, J. A., I. Atmos. Chem. 16,79 (1993).
- [620]. SETAC (Society of Environmental Toxicology and Chemistry). 1993. Guidelines for life-cycle assessment: A code of practice. Workshop report. Pensacola, FL: SETAC.
- [621]. SETAC. A Technical Framework for Life-Cycle Assessment, Fava, J., Denison, R., Jones, B., Curran, M., Vigon, B., Selke, S., Barnum, J., Eds.; Society of Environmental Toxicology and Chemistry: Pensacola, FL, 1991.
- [622]. Seyama T. Catal Rev Sci Eng 1992; 34:281.
- [623]. Shaven, J. B.; Halley, J. Applying General Equilibrium; Cambridge University Press: New York, 1992.
- [624]. Shepsle, Kenneth A., and Barry R. Weingast, "Political Solutions to Market Problems," American Political Science Review, 1984, 78, 417-34.
- [625]. Shoven, J.; Whalley, J. /. Econ. Lit. 1984, 22(3), 1007-51.
- [626]. Smith, D. F., Kleindienst, T. E., Hudgens, E. E., McIver, C. D. and Bufalini, J. J., Int. J. Chem. Kin. 24, 199 (1992).
- [627]. Smith, J. M., and H. C. Van Ness, Introduction to Chemical Engineering Thermodynamics, 2nd ed., p. 422. McGraw-Hill, New York, 1959.

- [628]. Solid Waste and Emergency Response National Biennial RCRA Hazardous Waste Report (Based on 1989 Data); EPA 530-R-92-027; U.S. Environmental Protection Agency, U.S. Government Printing Office: Washington, DC, 1993.
- [629]. Speight, J. G., "Fuels, Synthetic (Gaseous)," in Kirk-Othmer Encyclopedia of Chemical Technology, 4th ed. (J. I. Kroschwitz and M. Howe-Grant, eds.), vol. 12, pp. 129-130. Wiley, New York, 1994.
- [630]. Sperling, D (1995) Future Drive." Electric Vehicles and Sustainable Transportation Island Press, Washington DC
- [631]. Sperling, D Z, Schipper, L J and DeLuchi, M A (1992) 'Is there an electric vehicle future?' The Urban Electric Vehicle OECD, Paris
- [632]. Sprenger, R., "Economic Instruments for Environmental Protection in Germany," Organization for Economic Cooperation and Development, October 7, 1986
- [633]. Stambler I. Repower steel mills with combined cycles to increase output and cut NOx. In: Gas Turbine World. Fairfield, CT: Pequot Publishing Inc; 1999. May–June.
- [634]. Stavins, Robert N., "Correlated Uncertainty and Policy Instrument Choice," Journal of Environmental Economics and Management, 1996, 30, 218-32.
- [635]. Stavins, Robert N., "Policy Instruments for Climate Change: How Can National Governments Address a Global Problem," The University of Chicago Legal Forum, forthcoming 1998
- [636]. Stavins, Robert N., "The Costs of Carbon Sequestration: A Revealed-Preference Approach." Working paper, John F. Kennedy School of Government, Harvard University, November 1997.
- [637]. Stavins, Robert N., "Transaction Costs and Tradable Permits," Journal of Environmental Economics and Management, September 1995, 29, 133-48.
- [638]. Stavins, Robert N., ed., Project 88 - Harnessing Market Forces to Protect Our Environment: Initiatives for the New President. A Public Policy Study sponsored by Senator Timothy E. Wirth, Colorado, and Senator John Heinz, Pennsylvania. Washington, D.C.: December 1988.
- [639]. Steinberg M. Fossil fuel decarbonization technology for mitigating global warming. Int J Hydrogen Energy 1999;24: 771-777.
- [640]. Stephens, R. General Motors Corporation, Detroit, MI. Personal communication, August 1996.
- [641]. Sterdis, A. 1997. The future of automobile materials recovery. Unpublished paper. Department of Engineering and Public Policy, Carnegie Mellon University
- [642]. Stockwell, W. R., Yang, Y. J. and Milford, J. B., A compilation of estimated uncertainty factors for rate constants in W. P. L. Carter S detailed mechanism, Prepared for Coordinating Research Council, Atlanta, GA, 13 October (1993).
- [643]. Stodolsky, E; Vyas, A.; Cuenca, R.; Gaines, L. Proceedings of the 1995 Total Life Cycle Conference; Society of Automotive Engineers, Inc.: Warrendale, PA, October 1995; p 293, pp 47-57.
- [644]. Strauss, K. H., "Aviation Turbine Fuels," in Ullmann's Encyclopedia of Industrial Chemistry, 5th ed. (W. Gerhartz, Y. S. Yamamoto, F. G. Campbell, R. Pferrerkorn, and J. F. Rounsaville, eds.), vol. A3, pp. 201-212, esp. p. 202. VCH Verlagsgesellschaft, Weinheim, Germany, 1985.
- [645]. Suchorzewski, W (1993) 'The effects of Warsaw's rising car travel' The Urban Age 2 (1)
- [646]. Sullivan, J. L.; Hu, J. Proceedings of the 1995 Total Life Cycle Conference; Society of Automotive Engineers, Inc.: Warrendale, PA, October 1995; pp 7-20.
- [647]. Summala, H., 1996. Accident risk and driver behaviour. Safety Sci. 22 (1–3), 103–117.
- [648]. Survey of Small Quantity Generators; Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, U.S. Government Printing Office: Washington, DC, 1985.
- [649]. T. Cole, Thermoelectric energy conversion with solid electrolytes. Science 221, 915 920 (1983).
- [650]. T. Masuda, K. Tanaka, A. Negishi and T. Honda, Experimental study on alkali metal thermoelectric converter. Proc. 23rd Intersociety Energy Conversion Engng Conf., pp. 347-351 (1988).

- [651]. T. Sakurai, O. Kamada, K. Shishido and K. Inagaki, Construction of a large solar furnace. *Solar Energy* 8, 117 126 (1964).
- [652]. Tanja, P T, Clerx, W C G, van Ham, J, de Ligt, T J, Mulders, A A W G, Rijkeboer, R C and van Sloten, P (1992) EC Policy Measures Aiming At Reducing CO₂ Emissions in the Transport Sector TNO Policy Research, Delft
- [653]. Taylor, P., 1977. *Quantitative Methods in Geography: An Introduction to Spatial Analysis*. Houghton Mifflin Company, Boston
- [654]. Teagan, W.P., Friedman, D.J., 1994. Fuel cells for building applications: definition of performance/cost requirements. Proceedings of the 29th Intersociety Energy Conversion Engineering Conference, Monterey, CA
- [655]. TengstrOm, E (1992) The Use of the Automobile: Its Implications for Man, Society and the Environment Swedish Transport Research Board, Stockholm
- [656]. The NiCd Electric Vehicle Information Center, Nickel-Cadmium Batteries, undated brochure, Brentwood, Essex.
- [657]. Thomas, C.E., James, B.D., Franklin, J., Lomax, D., 2000a. Analysis of residential fuel cell systems and PNGV fuel cell vehicles. Proceedings of the 2000 US DOE Hydrogen Program Review, NREL/CP-570-28890.
- [658]. Thomas, C.E., Reardon, J.F., Lomax, F.D., Pinyan, J., Kuhn, I.F., 2000b. Distributed hydrogen fueling systems analysis. Final Report for the US Department of Energy, Grant No. DE-FG01- 99EE35099, October
- [659]. Thomas, L., memorandum attached to Draft Emissions Trading Policy Statement, Environmental Protection Agency, Washington, D.C., May 19, 1986.
- [660]. Tibor, T. and I. Feldman. 1996. *ISO 14000: A guide to the new environmental management standards*. Chicago: Irwin Publishing.
- [661]. Tietenberg, T., *Emissions Trading: An Exercise in Reforming Pollution Policy*. Washington, D.C.: Resources for the Future, 1985.
- [662]. Tietenberg, Thomas H., *Emissions Trading: An Exercise in Reforming Pollution Policy*, Washington: Resources for the Future, 1985.
- [663]. Tietenberg, Thomas H., *Environmental and Natural Resource Economics*, 3rd Ed. New York: HarperCollins, 1992
- [664]. Tillmh, A.M., H. Baumann, E. Eriksson, and T. Rydberg, 1991. "Life-cycle Analyses of Selected Packaging Materials: Quantification of Environmental Loadings." Report from Chalmers Industriteknik to the Swedish Commission on Packaging, 206 p
- [665]. Tool, M. R., institutional Adjustment and instrumental Value: With Observations on "Reform" in Eastern Europe, Proceedings EAIEPE 1993 Conference, Barcelona, Spain, October 28-30, 1993.
- [666]. Town of Chapel Hill, 1999. Chapel Hill traffic and pedestrian levels. Draft of long-range plan. Transportation, Section 6. North Carolina Planning Department, NC
- [667]. Transportation Energy Data Book, 16th ed.; Davis, S., Ed.; ORNL-6898; Office of Transportation Technologies, U.S. Department of Energy, Oak Ridge National Laboratory: Oak Ridge, TN, 1996.
- [668]. Transportation Research Board. *Toward a sustainable future. Addressing the long-term effects of motor vehicle transportation on climate and ecology* [special report 251]. Washington, DC: National Academy Press; 1997.
- [669]. Transportation Statistics Annual Report 1996; Bureau of Transportation Statistics, U.S. Department of Transportation, U.S. Government Printing Office: Washington, DC, 1996.
- [670]. Tuazon, E. C., Carter, W. P. L., Aschmann, S. M. and Atkinson. R. *Int. J. Chem. Kin.* 23. 1003 (1991).
- [671]. Tully; F. P. and Droege, A. J., *Chem. Kin.* 19 251 (1987).
- [672]. U.S. Commerce (United States Department of Commerce, Inter-industry Economics Division). 1994. *Input-output accounts of the U.S. economy, 1987 benchmark* (diskettes).
- [673]. U.S. Congress, Office of Technology Assessment. *Studies of the Environmental Costs of Electricity*; U.S. Government Printing Office: Washington, DC, 1994; OTA ETI-134.
- [674]. U.S. Congressional Budget Office, *Curbing Acid Rain: Costs, Budget, and*

- Coal-Market Effects. Washington, D.C., 1986.
- [675]. U.S. Congressional Budget Office, Hazardous Waste Management: Recent Changes and Policy Alternatives, Washington, D.C.: U.S. G.P.O., May 198
- [676]. U.S. Department of Energy, Hydrogen Program Implementation Plan, FY 1994-FY 1998. Office of Energy Management. October (1993).
- [677]. U.S. Department of Energy, Hydrogen Program Plan, FY 1993-FY 1997, Office of Conservation and Renewable Energy, DOE/CH10093-147. DE92010556, June (1992).
- [678]. U.S. Energy Information Administration, "The Effects of Title IV of the Clean Air Act Amendments of 1990 on Electric Utilities: An Update," DOE/EIA-0582, March 1997, Washington, D.C.
- [679]. U.S. Environmental Protection Agency (EPA), 1995 Compliance Results: Acid Rain Program, project # EPA/430-R-96-012, Washington, DC, EPA July 1996.
- [680]. U.S. Environmental Protection Agency, "1996 Compliance Record: Acid Rain Program," EPA 430-R-97-025, June 1997, Office of Air and Radiation, Washington, D.C
- [681]. U.S. Environmental Protection Agency, "Costs and Benefits of Reducing Lead in Gasoline, Final Regulatory Impact Analysis," Office of Policy Analysis, February 1985a.
- [682]. U.S. Environmental Protection Agency, "Quarterly Reports on Lead in Gasoline," Field Operations and Support Division, Office of Air and Radiation, July 16, 1985b.
- [683]. U.S. Environmental Protection Agency, "Quarterly Reports on Lead in Gasoline," Field Operations and Support Division, Office of Air and Radiation, March 21, May 23, July 15, 1986.
- [684]. U.S. Environmental Protection Agency, Environmental Investments: The Cost of a Clean Environment. Washington, D.C.: U.S. Environmental Protection Agency, 1990
- [685]. U.S. Environmental Protection Agency. Final Report to Congress on Benefits and Costs of the Clean Air Act, 1970-1990; U.S. Government Printing Office: Washington, DC, 1997; EPA 410- R-97-002.
- [686]. U.S. Environmental Protection Agency. Final Rule, 40 CFR Part 372 (OPPTS-400082B; FRL-4922-2) RIN 2070-AC47,1994.
- [687]. U.S. ENVIRONMENTAL PROTECTION AGENCY. Test Car List. Washington, D.C.: U.S. Government Printing Office, 1980, 1981.
- [688]. U.S. EPA (United States Environmental Protection Agency). 1995a. Air Chief (CD-ROM). Washington, DC: U.S. EPA
- [689]. U.S. EPA (United States Environmental Protection Agency). 1995b. 1987–1993 toxics release inventory. (CD-ROM, EPA 749/C-95-004). Washington, DC: U.S. EPA, Office of Pollution Prevention and Toxics, June
- [690]. U.S. EPA (United States Environmental Protection Agency). 1995c. Guidance on acquisition of environmentally preferable products and services. Federal Register: 60(189): 50721–50735.
- [691]. U.S. GAO (United States General Accounting Office). 1991. Toxic chemicals—EPA's Toxic Release Inventory is useful but can be improved (GAO/ RCED-91-121). Washington, DC: U.S. GAO
- [692]. U.S. General Accounting Office, "Air Pollution: Allowance Trading Offers an Opportunity to Reduce Emissions at Less Cost," GAO/RCED- 95-30, Washington, D.C., 1995
- [693]. UN (United Nations). 1993. Integrated environmental and economic accounting. New York: United Nations Department of Economic and Social Information and Policy Analysis, Statistics Division
- [694]. UNESCAP (Government of India with the United Nations Economic and Social Commission for Asia and the Pacific and the Government of France) (1991) Sectoral Energy Demand in India RAS/86/136 United Nations Development Programme, New York
- [695]. UNESCAP (United Nations Economic and Social Commission for Asia and the Pacific) (1989-92) National Reports. for China, India, Indonesia, The Republic of Korea, Lao Republic, Malaysia, Maldives, Myanmar, Nepal, The Philippines, Sri Lanka, Thailand and Vietnam United

- Nations Development Programme, New York
- [696]. US Department of Education, 2000. Digest of Educational Statistics, 1999. NCES 2000-031 (by Thomas D. Snyder, Production Manager; Charlene M. Hoffman), National Center for Education Statistics, Washington DC
- [697]. US DOE, 2000. Fuel Cell Handbook: Fifth Edition. National Energy Technology Laboratory, Morgantown, DOE/NETL-2000/1110.
- [698]. USBM (United States Bureau of Mines). 1988. Minerals yearbook 1988.
- [699]. Users Guide to Mobile 2, U.S. Environmental Protection Agency, EPA 460/3-81-006.
- [700]. Vigon, B. W. 1997. Life-cycle inventory: Data quality issues. Proceedings of the 1997 total life-cycle conference—life-cycle management and assessment. P310 (971162): 47–54. Warrendale: Society of Automotive Engineers, Inc
- [701]. Vigon, B. W. et al. "Life-Cycle Assessment: Inventory Guidelines and Principles"; Technical Report to Risk Reduction Engineering Laboratory; U.S. Environmental Protection Agency; Washington, DC, November 1992; EPA/600/R-92/03 6.
- [702]. Vigon, B. W.; Tolle, D. A.; Cornaby, B. W.; Latham, H. C; Harrison, C. L.; Boguski, T. L.; Hunt, R. G; Sellers, J. D. Life-Cycle Assessment: Inventory Guidelines and Principles; EPA-600/R-92/245; U.S. Environmental Protection Agency, U.S. Government Printing Office: Washington, DC, Feb. 1993.
- [703]. Viscusi, W. K. Risk by Choice; Harvard University Press: Cambridge, MA, 1983.
- [704]. W. Donitz and E. Erdle, High-temperature electrolysis of water vapor-status of development and perspectives for application. Int. J. Hydrogen Energy 10, 291-295 (1985).
- [705]. W. Donitz, G. Dietrich, E. Erdle and R. Streicher, Electrochemical high temperature technology for hydrogen production or direct electricity generation. Int. J. Hydrogen Energy 13, 283 287 (1988).
- [706]. W. H. Smith and J. R. Frank, Methane from Biomass: A Systems Approach. Elsevier Applied Science, New York (1987)
- [707]. W. P. Rogerson, Repeated moral hazard, Econometrica 53,69-76 (1985).
- [708]. Wallington, T. J. and Japar, S. M., Environ, Sci. Tech. 25,410 (1991).
- [709]. Wallington, T. J., Andino, J. M., Skewes, L. M., Siegl, W. O. and Japar, S. M., Int. J. Chem. Kin. 21, 993 (1989).
- [710]. Wallington, T. J., Dagaut, P., Liu, R. Z. and Kurylo M. J. Inr. J. Chem. Kin. 20. 541 (1988).
- [711]. Wallington, T. J., Potts, A. R., Andino, J. M., Siegl, W. O., Zhang, Z., Kurylo, M. J. and Huei, R. E., Int. J. Chem. Kin. 25,265 (1993).
- [712]. Walsh, M P (1993a) 'Highway vehicle activity trends and their implications for global warming: The United States in an international context' in Greene, D L and Santini, D J (eds) Transportation and Global Climate Change American Council for an Energy-Efficient Economy, Washington, DC and Berkeley, CA
- [713]. Walsh, M P (1993b) 'Global transport scenarios' in Towards a Fossil Free Energy Future: The Next Energy Transition Greenpeace International, Amsterdam
- [714]. Walter A, Llagostera J, Gallo WLR. 1998 Impact of gas turbine de-rating on the performance and economics of BIG-GT cycles. In: Advanced energy systems division, ASME International Mechanical Engineering Congress and Exposition, Anaheim, 1998. p. 67–72.
- [715]. Walter A, Rodrigues M, Overend R. Feasibility of co-firing (Biomass + Natural Gas). In: The Fourth Biomass Conference of the Americas, Oakland, California, and USA, 1998, Proceedings vol. 2. Oxford: Elsevier; 1999. p. 1321–7.
- [716]. Ward, N.J., Wilde, G.J.S., 1996. Driver approach behaviour at an unprotected railway crossing before and after enhancement of lateral sight distances: an experimental investigation of a risk perception and behavioural compensation hypothesis. Safety Sci. 22 (1–3), 63–75.
- [717]. Web site of the European Patent Agency (EPA).
- [718]. WEC (World Energy Council) (1995) Global Transport Sector Energy Demand Towards 2020 Project 3, Working Group D, World Energy Council, London

- [719]. Wei, J.; Russell, T.W.E; Swartzlander, M. W. The Structure of the Chemical Processing Industries; McGrawHill: New York, 1979.
- [720]. Weitzman, Martin L., "Prices vs. Quantities," Review of Economic Studies, 1974, 41, 477-91.
- [721]. Welch, J. L; Ross, R. H. Environ. Toxicol. Chem. 1982, 1, 95-102.
- [722]. Welch, W., "The Political Feasibility of Full Ownership Property Rights: The Cases of Pollution and Fisheries," Policy Sciences, 1983, 16, 165-180.
- [723]. Wells, H. A., Jr. Science 1991, 252(5011), 1361.
- [724]. Werner, A.F., 1991. Product Lifecycle Assessment: A Strategic Approach." Proceed ings of the Global Pollution Prevention '91 Conference, Washington D.C
- [725]. WHITE, L.J. The Regulation of Air Pollutant Emissions from Motor Vehicles. Washington, D.C.: American Enterprise Institute, 1982.
- [726]. Whitten, G. Z. and Yarwood, G., Unpublished Report, Systems Applications International, San Rafael, CA (1992).
- [727]. Wilde, G.J.S., 1994. Target Risk: Dealing with the Danger of Death, Disease, and Damage in Everyday Decisions. PDE Publications, Toronto, Ont.
- [728]. Wilde, G.J.S., Gerszke, D., Paulozza, L., 1998. Risk optimization training and transfer. Transport. Res. Part F 1, 77-93
- [729]. Williams, Jeffrey C., and Brian D. Wright, Storage and Commodity Markets. Cambridge, UK: Cambridge University Press, 1991.
- [730]. Wilson, D.C., P.J. Young, B.C. Audson, and G. Baldwin, 1982. "Leaching Cadmium from Pigmented Plastics in a Landfill Site." Environ. Sci. Tech. 16(9):560.
- [731]. Woodcock, K. E., and M. Gottlieb, "Gas, Natural," in Kirk-Othmer Encyclopedia of Chemical Technology, 4th ed. (J. I. Kroschwitz and M. Howe-Grant, eds.), vol. 12, pp. 318-340. Wiley, New York, 1994
- [732]. Wuebbles, D. J. 1995. Weighing functions for ozone depletion and greenhouse gas effects on climate. Annual Review of Energy and Environment 20: 45-70
- [733]. WYKOFF, F.C. "A User Cost Approach to New Automobile Purchases." Review of Economic Studies, Vol. 40 (July 1973), pp. 377-390.
- [734]. X. Freixas, R. Guesnerie, and F. Tirole, Planning under incomplete information and the ratchet effect, Rev. Econom. Stud. 52, 173-191 (April 1985).
- [735]. Yang. Y. Das. M. Milford. J. B. Bergin. M. S. Russell, A. G. and Stockwell, 'W. R., 'Quantification of organic compound relativities and effects of uncertainties in rate parameters, Report to the Auto/Oil Air Quality Improvement Program under Coordinating Research Council, Inc., Contract # AQIRP-19-92, August (1994).
- [736]. YAO, D.A. "Three Essays on Regulation in the Automobile Industry," Ph.D. Thesis, Stanford University, 1984
- [737]. Yohe, G., "Polluters' Profits and Political Response: Direct Control Versus Taxes: Comment," American Economic Review, 1976, 66, 981-982.
- [738]. Zegeer, C.V., Stewart, J.R., Huang, H., 2001. Safety Effects of Marked Vs. Unmarked Crosswalks at Uncontrolled Locations: Executive Summary and Recommended Guidelines, FHWA-RD-01-075. U.S. Department of Transportation, Federal Highway Administration, March 2002.
- [739]. Zuckerman, B.; Ackerman, F. The 1994 Update of the Tellus Institute Packaging Study Impact Assessment Method; SETAC Impact Assessment Working Group Conference: Washington, DC, 1995.