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THE TRAGEDY OF URBAN ROADS: SAVING CITIES FROM CHOKING, CALLING ON CITIZENS TO COMBAT CLIMATE CHANGE

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I. ROADS AS "COMMON GOODS": THE TRAGEDY OF URBAN ROADS

Streets and plazas are, by definition, public space. Public space is a *locus* of meeting, both physical and virtual, of individual interests that were formed within private spaces.

Streets and plazas therefore represent a "common good" exposed like any other common good to the *Tragedy of the Commons*.[1] In 1968, Garrett Hardin contended that if everybody deems unlimited her or his right to use a common good, its unrestricted demand will ultimately exhaust the finite resource through over-exploitation. Indeed, in tragedies of the commons, users over-exploit a resource and impose mutual externalities upon each other. Tragedies of the commons therefore fall within the broader class of large-group externality problems. The characteristic that differentiates tragedies of the commons from the rest of the class is that self-destructiveness is absent in other large-group externality problems. Pareto superior[2] policy moves have to be different for tragedies of the commons from those undertaken in other large-group externality problems. Governmental intervention or regulation is always needed in tragedies of the commons to save the resource users from themselves and their mutually-imposed harms.

Many citizens in western countries believe that they hold an unlimited right to invade streets with their automobiles. Automobiles have taken

1. *See* Garrett Hardin, *The Tragedy of the Commons*, 162 SCI. 1243 (1968).

2. As opposed to Pareto optimality—under which there is *no superior move* possible from the current point of distribution—a move from one distribution point to another is Pareto *superior* when at least one party is better off and no one else is worse off. For a clear definition of Pareto optimality and Pareto superior moves, see Jules Coleman, *Efficiency, Auction and Exchange*, *in* MARKETS, MORALS AND THE LAW 67, 72 (1988). Coleman states "[a]n allocation of resources is Pareto superior to an alternative allocation if and only if no person is disadvantaged by it and the lot of at least one person is improved." *Id.*; *see also* RICHARD A. POSNER, THE ECONOMIC ANALYSIS OF LAW 12 (3d ed. 1986) (defining a Pareto superior transaction as one that makes at least one person in the world better off and no one worse off).

over public spaces. In turn, these spaces are not only deteriorating from an environmental point of view, but are losing their original function of loci of life and meeting of humans (which is problematic from a social point of view). The vanishing of public spaces is leading to the vanishing of many aspects of urban life: cohabitation, encounters, and the unplanned and uninstitutionalized confrontation of diverse lifestyles, habits, cultures, and stories. These aspects of urban life have historically made cities the preferred place for cultural development and innovation.[3] Alternatively, the automobile projects the characteristics of private life by closing people in steel bodies.[4]

Traffic congestion represents the perfect showcase for the tragedy of the commons, a collective action problem in which a resource held in common—urban streets and roads—is subject to overuse and degradation.[5] All users undertake and benefit from driving their own vehicles, congesting urban streets and releasing greenhouse gases ("GHG"s), but bear little of the congestion-related and climate-related costs of their own driving. They have little or no incentive to take into account these externalities in making the decision to drive.[6] Traffic congestion illustrates why mutuality entails the persistence of an externality. All drivers face the same decision environment. Also, non-coercive solutions are not viable because of the high transaction costs. Negotiations among commuters are in fact impossible. Finally, traffic congestion illustrates the effects of over-utilization of a resource (e.g., roads) that is rivalrous in consumption. Like other tragedies of the commons, resource users inflict losses upon themselves as a group in terms of the ability to use the resource, by lengthening commute times and degrading the transportation resource. Externalities are also imposed upon non-users, the air-breathing public, in the form of pollution.

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3. *See generally* Sheila R. Foster, *The City As an Ecological Space: Social Capital and Urban Land Use*, 82 NOTRE DAME L. REV. 527 (2006).

4. *See* KENNETH T. JACKSON, CRABGRASS FRONTIER: THE SUBURBANIZATION OF THE UNITED STATES 246-71 (1985) (elucidating the harmful effects of dependency on automobiles and describing the pitfalls of "drive-in culture" in the United States).

5. Collective action problems arise where self interest leads rational individuals to behave in a manner contrary to what would be best for the group, and therefore collective action is necessary to achieve group benefits. *See* MANCUR OLSON, THE LOGIC OF COLLECTIVE ACTION: PUBLIC GOODS AND THE THEORY OF GROUPS (1971).

6. ARTHUR CECIL PIGOU, THE ECONOMICS OF WELFARE pt. II, ch. 9 (1932). A.C. Pigou developed the theory of externalities which deals with cases where some of the costs or benefits of activities spill over onto third parties. There are negative and positive externalities. When a cost is imposed on third parties, there is a negative externality. The benefit to third parties deriving from an activity in which they are not directly involved is instead called a positive externality. *Id.*

The traditional solution to traffic congestion, typically driven by frustrated drivers rather than advocates against air pollution, has been the expansion of roadway capacity.[7] This has proven to be a self-defeating strategy. The expansion of roadway capacity reduces transportation costs and generates new demands by new users. For example, new roadway capacity provides an incentive for new residential development.[8] This solution ignores the second-order effects, those which are easily seen once one appreciates the nature of the externality. For example, in the tragedy of fishing, even if it were physically possible to respond to over-fishing by stocking the fishery with more fish, this would only attract more fishermen to come in and participate in the tragedy.[9]

Garrett Hardin, in his seminal article *Tragedy of the Commons*, suggested two main solutions to commons problems: privatization and regulation.[10] Hardin categorized these as the "enclosure" of commons.[11] He noted that historically the problem has been first addressed through the use of all resources as commons (open and unregulated access to all) and then policymakers' attention has been shifted to systems in which commons are "enclosed" and subject to differing methods of regulated use (access prohibited or controlled).[12] Hardin's solutions to address the tragedy of the commons (i.e. privatization and regulation) were later updated and completed by a third solution: common ownership.[13]

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7. Robert H. Freilich & S. Mark White, *Transportation, Congestion and Growth Management: Comprehensive Approaches to Resolving America's Major Quality of Life Crisis*, 24 LOY. L.A. L. REV. 915, 926 (1991).

8. *See id.*; Lior Jacob Strahilevitz, *How Changes in Property Regimes Influence Social Norms: Commodifying California's Carpool Lanes*, 75 IND. L.J. 1231, 1247 n.76 (2000).

9. *See* Shi-Ling Hsu, *What is a Tragedy of the Commons? Overfishing and the Campaign Spending Problem*, 69 ALB. L. REV. 75, 96 (2005).

10. *See* Hardin, *supra* note 1, at 1245; *see also* Scott Gordon, *The Economic Theory of a Common Property Resource: The Fishery*, 62 J. POL. ECON. 88 (1954); Anthony Scott, *The Fishery: The Objectives of Sole Ownership*, 63 J. POL. ECON. 116 (1955). For more recent work on various strategies to regulate and govern the commons, see Carol Rose, *Rethinking Environmental Controls: Management Strategies for Common Resources*, 1991 DUKE L.J. 1, 8-11 (1991).

11. *See* Hardin, *supra* note 1, at 1248.

12. *Id.* at 1244-45.

13. ELINOR OSTROM, GOVERNING THE COMMONS: THE EVOLUTION OF INSTITUTIONS FOR COLLECTIVE ACTION 2 (1990) (demonstrating that the first to identify the tragedy of the commons was Aristotle); *see also* Susan Jane Buck Cox, *No Tragedy on the Commons*, 7 ENVTL. ETHICS 49 (1985); Robert C. Ellickson, *Property in Land*, 102 YALE L.J. 1315, 1388-91 (1993).

Public finance theory has offered a similar explanation of the urban congestion phenomenon.[14] It has argued that with congested roads

> [t]he use of the available space is distinctly rival and exclusion (the auctioning off or sale of the available space) would be efficient and should be applied. The reason is that use of crowded space would then go to those who value it most and who are willing to offer the highest price.[15]

However, this theory also contended that "such exclusion would be impossible or too costly to be administered" and therefore concluded that such "exclusion should but cannot be applied" at least "until techniques can be found to apply exclusion."[16] In our current environment, the difficulty of applying exclusions can be overcome and it is no longer possible to say that roads are an example of a public good that causes a market failure and justifies public provision. Techniques to record the passage of vehicles through intersections and permit the imposition of corresponding charges have been developed to allow exclusion from, or limit the use of, crowded urban streets.[17]

This Article argues that the best response to the tragedy of road congestion has to rely on market-based regulatory techniques and public policies aimed at controlling the demand-side of transportation congestion. Among market-based regulatory techniques, economists seem to favor price-based instruments (i.e. taxes and subsidies) over quantity-based instruments (i.e. cap-and-trade schemes). This Article will argue instead that quantity instruments, such as tradable permits of road usage and real estate development, can better internalize all the externalities that road congestion produces. This Article also advances the idea that quantity instruments are more successful tools in addressing urban congestion for four reasons: (1) they respond better to equity concerns; (2) they are therefore more politically viable; (3) they are more likely to be well designed; and (4) they are able to represent a catch-all strategy for externalities produced by congestion.

Part II of this Article illustrates the costs that congestion imposes on society or, to use the preferred language of economists, the negative externalities that road congestion produces. Part III sheds light on the underlying causes of urban congestion. Part IV enumerates regulatory tools that are available to address the negative externalities of urban congestion and

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14. *See generally* RICHARD A. MUSGRAVE & PEGGY B. MUSGRAVE, PUBLIC FINANCE IN THEORY AND PRACTICE (1989).

15. *Id.* at 43-44.

16. *Id.* at 44.

17. The development and use of such techniques was first suggested by William S. Vickrey, *Pricing in Urban and Suburban Transport*, 53 AM. ECON. REV. 452, 459 (1963).

proposes a comparative analysis of the different strategies that have been implemented to address this problem throughout the world. Part V outlines possible policy options that should complement the regulatory framework to enhance the chances of success of the chosen regulatory scheme. Finally, the last section concludes by stressing the need for further differentiation and experimentation in order to shape a new understanding in the use and management of the "commons" and advocates for a bottom-up regulatory strategy to address climate change and global warming, a strategy centered upon the regulation of individual behavior at the urban level.

II. A TRAGIC AND COSTLY RIDE

To better understand the nature of the problem we must first turn to the analysis of the factors that have contributed to the increasing importance of urban congestion. Americans and almost every developed population drive too much. This does not imply a moral judgment—it is an economic argument.[18] Dubner and Levitt exemplify the externalities produced by congestion by explaining that:

> [T]he behavior of Person A (we'll call him Arthur) damages the welfare of Person Z (Zelda), but Zelda has no control over Arthur's actions. If Arthur feels like driving an extra 50 miles today, he doesn't need to ask Zelda; he just hops in the car and goes. And because Arthur doesn't pay the true costs of his driving, he drives too much.
>
> What are the negative externalities of driving? To name just three: congestion, carbon emissions and traffic accidents. Every time Arthur gets in a car, it becomes more likely that Zelda—and millions of others—will suffer in each of those areas.[19]

Urban congestion is primarily an environmental problem. Automobiles are currently responsible for 75% of hydrocarbon emissions, 45% of nitrogen oxide emissions, and 34% of the volatile organic compound emissions in the United States.[20] In addition, automobiles contribute substantially to the amount of carbon monoxide emissions.[21] Indeed, vehicle emissions are

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18. Stephen J. Dubner & Steven D. Levitt, *Not-So-Free Ride*, N.Y. TIMES, Apr. 20, 2008 (Magazine) [hereinafter Dubner & Levitt, *Not-So-Free Ride*], *available at* http://www.nytimes.com/2008/04/20/magazine/20wwln-freakonomics-t.html.

19. *Id.*

20. Lathrop B. Nelson, *Unclogging Virginia's Roads: Aligning Computer Incentives in Northern Virginia*, 28 TRANSP. L.J. 185, 203 (2000).

21. Tirza S. Wahrman, *Breaking the Logjam: The Peak Pricing of Congested Urban Roadways Under the Clean Air Act to Improve Air Quality and Reduce Vehicle Miles Traveled*, 8 DUKE ENVTL. L. & POL'Y F. 181, 186 (1998).

250% higher under congestion conditions than under conditions of freely flowing traffic.[22]

Automobiles also damage the global climate. Motor fossil fuels are major contributors of carbon dioxide and other greenhouse gas emissions. "[C]ongestion caused an extra thirty million tons of carbon dioxide to be released into the air in the United States in a recent year."[23] Vehicle use is also responsible for a significant amount of water pollution, as pollutants originating as air emissions often find their way into surface waters. Paving land for roads and parking in urban areas (amounting to about 40% in many cities) increases the amount of impermeable surface which results in increased runoff.[24] The environmental negative externalities caused by carbon emissions have been quantified and apparently impose on society a cost of about $20 billion a year.[25]

Congestion is, however, a cross-cutting issue that has more than just environmental pitfalls. It is a phenomenon that also has energy,[26] economic,[27] safety,[28] and public health[29] implications. As to the economic loss caused by road congestion, a Texas Transportation Institute study discovered that wasted fuel and lost productivity due to congestion cost $78 bil-

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22. JONAS ELIASSON & MATTIAS LUNDBERG, TRANSEK AB, SWED. NAT'L ROAD ADMIN., ROAD PRICING IN URBAN AREAS 22 (2002), *available at* http://www.transport-pricing.net/download/swedishreport.pdf.

23. TRANSP. AIR QUALITY CTR., ENVTL. PROT. AGENCY, TRANSPORTATION CONTROL MEASURES: CONGESTION PRICING 2 (1998), *available at* http://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=00000HZN.TXT.

24. *See generally* Strahilevitz, *supra* note 8.

25. Dubner & Levitt, *Not-So-Free Ride*, *supra* note 18, at 1.

26. ROBERT J. SHAPIRO ET AL., AM. PUB. TRANSP. ASS'N, CONSERVING ENERGY AND PRESERVING THE ENVIRONMENT: THE ROLE OF PUBLIC TRANSPORTATION (2002), *available at* http://www.apta.com/research/info/online/documents/shapiro.pdf ("Any serious effort to reduce our dependence on foreign oil and make significant environmental progress must address the way Americans travel. . . . [G]reater use of public transportation offers the single most effective strategy currently available for achieving significant energy savings and environmental gains without creating new government programs or imposing new rules on the private sector."); DAVID L. GREENE, CTR. FOR TRANSP. ANALYSIS, TRANSPORTATION'S OIL DEPENDENCE AND ENERGY SECURITY IN THE 21ST CENTURY 3 (1997), *available at* http://ntl.bts.gov/lib/5000/5800/5846/oildep/pdf (stating that petroleum consumption is becomingly increasingly concentrated in the transportation sector).

27. According to the Texas Transportation Institute, a research group associated with Texas A&M University, traffic congestion represents a $7.4 billion economic loss to the New York area's economy. *See* DAVID SCHRANK & TIM LOMAX, TEX. TRANSP. INST., 2007 URBAN MOBILITY REPORT (2007), *available at* http://mobility.tamu.edu/ums/.

28. Aaron S. Edlin & Pinar Karaca Mandic, *The Accident Externality from Driving*, 114.5 J. POL. ECON. 931 (2006), *available at* http://works.bepress.com/aaron_edlin/21.

29. The increasing level of physical inactivity is a growing case for mortality. *See* U.S. DEP'T OF HEALTH AND HUMAN SERVS., PHYSICAL ACTIVITY AND HEALTH: A REPORT OF THE SURGEON GENERAL, *available at* http://www.cdc.gov/nccdphp/sgr/contents.htm.

lion a year.[30] But the "too much driving" lifestyle presents even worse figures when it comes to car accident ratios. In 2006, two economists demonstrated that accidents impose an unpaid cost of roughly $220 billion a year.[31] In sum, 200 million U.S. licensed drivers who drive three trillion miles each year produce about $300 billion in externality costs. According to Dubner and Levitt, drivers should probably bear "at least an extra ten cents per mile if we want them to pay the full societal cost of their driving."[32]

Before turning to the possible solutions to achieve the goal of internalization of road transport externalities, one should question why Americans drive too much. In the United States, this is a problem that originates in idiosyncratic cultural, land use, and political patterns.

III. THE UNDERLYING CAUSES OF ROAD CONGESTION

There are three main reasons why Americans drive too much. First, the price of gasoline in the United States is very low compared to other industrialized countries. Second, urban sprawl has shaped American land-use patterns in a way that makes it difficult to plan or infrastructure a public-transit system. Third, historically, interest groups favoring investments in road networks rather than rail networks and mass-transit systems were very successful in their lobbying activities.

A. Americans Drive Too Much Because They Do Not Pay Enough!

In most of the industrialized world, including Europe and Japan, pump prices are much higher than in the United States even though the wholesale price is roughly the same, because the United States has the lowest gasoline tax of any industrialized country: 14% at current prices.[33] Gasoline taxes have always been a politically sensitive issue. For instance, candidates for the 2008 presidential elections proposed a gas tax break for the summer

30. Schrank & Lomax, *supra* note 27, at B-19.

31. Edlin & Mandic, *supra* note 28, at 931. That is even though the accident rate has fallen significantly over the past ten years, from 2.72 accidents per million miles driven to 1.98 per million; overall miles driven, however, keep rising.

32. Dubner & Levitt, *Not-So-Free Ride*, *supra* note 18, at 1.

33. See U.S. ENERGY INFO. ADMIN., DEP'T OF ENERGY, GASOLINE AND DIESEL FUEL UPDATE, *available at* http://tonto.eia.doe.gov/oog/info/gdu/gasdiesel.asp?ref=bookshelf (last visited June 4, 2010). Currently the highest average gasoline prices in the United States are $3.049 per gallon in California. In the European Union, pump prices range roughly between $5 and $7 per gallon and tax pressure is about 60% of the final price. *See* Europe's Energy Portal: Fuel Prices, http://www.energy.eu/#prices (last visited June 4, 2010).

travel season to ease the impact of the 2008 surge in oil prices on U.S. drivers.[34]

As a matter of fact, in the summer of 2008, crude oil prices jumped for the first time above $100 a barrel.[35] At the time, research indicated that the price of oil would have gone on to touch $7 per gallon in the United States over the course of the following four years. The official estimate of crude oil was considered flawed and actually lower than the estimates. As a result of an increase in demand and a lack of adequate supply, the price of crude oil was believed to likely increase steadily over the following four years.[36]

Although some analysts maintained that the summer 2008 surge in oil markets was related to financial flows and had nothing to do with fundamental factors,[37] many economists believed that the surge of oil prices would be permanent due to the increased demand from new buyers and the inadequacy of the reserves. Due to the spreading global recession in late 2008, oil prices began to fall and the 2008 oil price surge proved to be transitory.[38] However, some commentators think that the oil price surge of summer 2008 has to be considered "a sort of dress rehearsal for the energy crisis we must still endure, at some point in the coming months or years, once the world's demand for oil has permanently outstripped the world's ability to supply it."[39]

David Goodstein has already predicted that "the world will soon start to run out of conventionally produced, cheap oil" and explains that humans have consumed about a trillion barrels (42 trillion gallons) which, according to Goodstein's estimates, is equal to about half of the earth's total reco-

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34. John M. Broder, *Democrats Divided Over Gas Tax Break*, N.Y. TIMES, Apr. 29, 2008, *available at* http://www.nytimes.com/2008/04/29/us/politics/29campaign.html.

35. The standard barrel of crude oil or other petroleum product is forty-two U.S. gallons. In 1999, the global oil price was $10. In the summer of 2004, oil reached $40 a barrel. During the first half of 2008, oil prices fluctuated for several weeks at about $150 a barrel, hitting an all-time high above $147 a barrel on July 3, 2008. Garry White, *Will Oil Prices Recover After Tanking in 2008?*, TELEGRAPH, Dec. 29, 2008, www.telegraph.co.uk/finance/financetopics/oilprices/4014817/Will-oil-prices-recover-after-tanking-in-2008.html.

36. Marty Jerome, *Gas to Hit $7 a Gallon*, WIRED, Apr. 29, 2008, http://blog.wired.com/cars/2008/04/4-a-gallon-gas.html ("Both Qatar's oil minister and the head of OPEC can see oil hitting $200 a barrel before the end of the year and one analyst says gas could reach $7 a gallon within four years.").

37. ROBERT BRYCE, GUSHER OF LIES: THE DANGEROUS DELUSIONS OF "ENERGY INDEPENDENCE" 34 (2008).

38. In 2009 oil prices, after falling by more than $100 with respect to the figures in the first half of 2008, surged again, fluctuating at about $70 a barrel. *See* http://oil-price.net/dashboard.php?lang=en (last visited Dec. 22, 2009).

39. *See* DAVID OWEN, GREEN METROPOLIS 54 (2009).

verable supply.[40] In Goodstein's view, a devastating global oil crisis will begin not when we will completely run out of oil, but when we will have reached the halfway point. This event is also known as the peak oil or the Hubbert's peak, after the geophysicist who first predicted it.[41] The Hubbert peak theory[42] contends that peak oil is the point in time at which the maximum global petroleum production rate is reached. After this point, the rate of production will enter terminal decline and the price of oil can only increase.[43] Once the peak is hit, oil will not just run out, but the supply of conventional oil will significantly drop and prices will dramatically increase.

In the past, scholars predicted that the Hubbert peak was very close, or that it had already been reached.[44] However, new oil discoveries and technological advances in the petroleum recovery process exposed flaws in such prognostics. Goodstein's worries may actually be excessive, considering that high prices incentivize drillers to look for oil in new places and new oil-extraction technologies make it possible to extract oil once inaccessible. But even if this is so, at some point oil reserves will eventually dry up. There is no doubt about the long-term trend because "oil, unlike shoes or wheat, has an end point" which may be closer than we might expect as it is related to the cost of bringing oil to the surface and making fuel out of it.[45] As a matter of fact, the world will not keep extracting oil until the very last drop of it has been pumped out of the ground; it will stop much sooner at the point when the extraction of the remaining crude oil will no longer be economically viable.[46]

Some would argue that there is always the option of the more plentiful, yet environmentally unfriendly, carbon as an energy source.[47] Or else the world could turn to "more plentiful carbon based alternatives and their derivatives."[48] In other words, it is an established conviction that there will

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40. *See* DAVID GOODSTEIN, OUT OF GAS: THE END OF THE AGE OF OIL (2004); DAVID OWEN, GREEN METROPOLIS 54 (2009).

41. M. King Hubbert, *Nuclear Energy and the Fossil Fuels*, Paper Presented Before the Spring Meeting of the Southern District, American Petroleum Institute (March 7-9, 1956), *available at* http://www.hubbertpeak.com/Hubbert/1956/1956.pdf.

42. More on peak oil can be found in KENNETH S. DEFFEYES, HUBBERT'S PEAK: THE IMPENDING WORLD OIL SHORTAGE (2001) and on websites such as www.peakoil.com and www.hubbertpeak.com.

43. According to the Hubbert model, the production rate will follow a roughly symmetrical bell-shaped curve.

44. *See* BRYCE, *supra* note 37, at 36-37.

45. *Id.* at 67.

46. *Id.* at 63.

47. *Id.* at 66.

48. *Id.* at 64. *See generally* PAUL R. EHRLICH, THE POPULATION BOMB (1968).

always be some hydrocarbon which vehicles will burn as a source of fuel.[49] It is a common belief that after oil there remains a whole series of natural resources to burn starting with natural gas, low-grade coal, and the petroleum extractable from oil sands. These too, however, are finite resources and are subject to the same peak problems; yet, not everyone believes in the disaster-tales of catastrophic energy peaks.[50]

Focus has also been aimed at alternative and renewable fuels like hydrogen-fueled cars and corn-based ethanol, but hydrogen is still not a viable solution to reduce the use of fossil fuels in vehicles. Most all of today's hydrogen is indeed produced either by using massive inputs of energy to split water molecules (and like any other energy-intensive process its by-product is a considerable amount of GHGs) or using fossil energy resources (natural gas or gasoline).[51] Also, hydrogen cars are considered one of the least efficient and most expensive ways to reduce greenhouse gases.[52] Hydrogen fuel cells are costly to produce and fragile.[53] No one knows when hydrogen cars will be broadly available—Joseph Romm, a former official at the U.S. Department of Energy, predicted, "[n]ot in our lifetime, and very possibly never."[54] Under the best estimates the mass-introduction of the plug-in hybrid electric car is still a few decades away,[55] according to a new analysis by the National Research Council.[56]

Corn-based ethanol is popularly thought of as an option, but its cost-ineffectiveness is well documented. According to Robert Hahn,

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49. Andrew P. Morriss, *Fuels and the Future of the Automobile (and Trucks Too)*, Paper Presented at the Environmental Governance Seminar at New York University School of Law (Fall 2007).

50. *See* STEVEN D. LEVITT & STEPHEN J. DUBNER, FREAKONOMICS: A ROGUE ECONOMIST EXPLORES THE HIDDEN SIDE OF EVERYTHING 268-69 (2006).

51. NAT'L ACAD. OF ENG'RS, THE HYDROGEN ECONOMY: OPPORTUNITIES, COSTS, BARRIERS, AND R&D NEEDS 91 (2004).

52. *See* Matthew L. Wald, *Questions About a Hydrogen Economy*, SCI. AM., May 2004, at 66-73.

53. JOSEPH J. ROMM, HYPE ABOUT HYDROGEN: FACT AND FICTION IN THE RACE TO SAVE THE CLIMATE (2004); JOSEPH J. ROMM, CTR. FOR ENERGY AND CLIMATE SOLUTIONS, THE CAR AND FUEL OF THE FUTURE, *reprinted in* 34 ENERGY POLICY 2609 (2006), *available at* http://www.if.uidaho.edu/~vutgikar/Fall2007/Hydrogen/FutureCar&Fuel.pdf.

54. Marty Jerome, *Is it Time to Give Up the Hydrogen Hoax?*, WIRED, Aug. 15, 2007.

55. *See* Jad Mouawad, *Report: Meaningful Numbers of Plug-In Hybrids Are Decades Away*, GREEN: A BLOG ABOUT ENERGY AND THE ENVIRONMENT, Dec. 14, 2009, http://greeninc.blogs.nytimes.com/2009/12/14/report-meaningful-numbers-of-plug-in-hybrids-still-decades-away/ (last visited Dec. 20, 2009).

56. NAT'L RESEARCH COUNCIL, TRANSITIONS TO ALTERNATIVE TRANSPORTATION TECHNOLOGIES—PLUG-IN HYBRID ELECTRIC VEHICLES, *available at* http://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=12826.

> [i]f annual production increases by three billion gallons in 2012—a plausibly modest number when the EPA made its own calculations—we estimate that the costs will exceed the benefits by about $1 billion a year. If domestic production reaches the more optimistic Energy Department projection for that year, net economic costs would likely top $2 billion annually."[57]

In addition, efforts to produce ethanol have been detrimental in other ways. Western countries' subsidizing the production of biofuels exacerbated the world food crisis in 2008.[58] The International Monetary Fund estimated that corn-based ethanol production in the United States was the main cause of the rise in world corn demand over the past five years.[59]

Thus, it is time to start thinking of possible alternatives to individual mobility as it exists today. The bulk of alternative policies should be based on fostering collective mobility and, therefore, public transportation. In many parts of the United States, however, it does not appear that commuters are ready or willing to give up their automobiles or trucks for public transit.[60] The reason adduced is that, in most parts of the country, urban areas are not dense enough in order for public transit to exist or work properly.[61] The fact is that it is not only extremely inexpensive to drive in America, but Americans love their cars. Automobiles play a central role in the American economy as the primary source of transportation. Cars, trucks, and sport utility vehicles ("SUV"s) are an important part of the American conception of mobility and personal autonomy. Driving has even become a solitary experience because many middle-class families own more than one car. The average American car commuting to or from work has only 1.09 occupants.[62] Driving and commuting are not perceived as a moment of aggregation and an opportunity to interact with family

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57. Robert Hahn, *Ethanol's Bottom Line*, WALL ST. J., Nov. 24, 2007, at A10.

58. Aditya Chakrabortty, *Secret Report: Biofuel Caused Food Crisis*, GUARDIAN, July 3, 2008, *available at* http://www.guardian.co.uk/environment/2008/jul/03/biofuels.renewableenergy.

59. Valerie Mercer-Blackman, Hossein Samiei & Kevin Cheng, *Biofuel Demand Pushes Up Food Prices*, IMF SURV. MAG., Oct. 17, 2007, http://www.imf.org/external/pubs/ft/survey/so/2007/RES1017A.htm.

60. The most recent statistics available show that the average American household consists of 2.58 people, of whom 1.77 are licensed drivers, and owns 1.89 cars travelling 21,187 miles per year. The average American instead travels 35,244 miles by car per year. *See* FED. HIGHWAY ADMIN., 2001 NATIONAL HOUSEHOLD TRAVEL SURVEY (2004), *available at* http://nhts.ornl.gov/2001/pub/STT.pdf.

61. Paul Krugman, Op-Ed., *Stranded in Suburbia*, N.Y. TIMES, May 19, 2008, *available at* http://www.nytimes.com/2008/05/19/opinion/19krugman.html.

62. Lior Jacob Strahilevitz, *How Changes in Property Regimes Influence Social Norms: Commodifying California's Carpool Lanes*, 75 IND. L. J. 1231, 1236 (2000).

members, colleagues, and friends; rather, the car is viewed as a private space where one can isolate one's self from others and the pressures of everyday life.[63]

B. I Love My Backyard. Let's Sprawl.

The ideals represented by automobile use and ownership explain the popularity of suburban living. Land use policies and real estate development patterns have and continue to favor the use of private automobiles as the primary means of transportation.[64]

Most Americans are locked into their driving habits and can do little to alter their fuel-buying patterns when prices rise.[65] For example, from 1990 to 2000, the number of workers with commutes lasting longer than sixty minutes increased by almost 50%, according to Census Department.[66] In a survey by the American Automobiles Association and the American Public Transportation Association, only 26% of respondents used public transportation at least once during the year, whereas 91% of respondents admitted they prefer to use their cars for their daily travel needs.[67] Americans generally prefer to live in less densely populated suburbs and "prefe[r] detached dwellings over row houses, rural to city life, and home ownership to renting."[68]

American ideals of individualism and freedom lie underneath the passion for open spaces—suburban living and automobile use make this love a reality. These ideals substantiate the cultural substratus of urban sprawl. Sprawl is development that (1) extends far from traditional urban centers, or (2) regardless of its location, is built in a way that requires residents and visitors to be highly dependent on automobiles.[69] Sprawl endangers the stability of older neighborhoods, increases auto-induced air pollution and

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63. *Id.*

64. PETER NEWMAN & JEFFREY KENWORTHY, SUSTAINABILITY AND CITIES: OVERCOMING AUTOMOBILE DEPENDENCE 31 (1999).

65. OWEN, *supra* note 39, at 117.

66. *See* ALAN E. PISARSKI, TRANSP. RESEARCH BD., COMMUTING IN AMERICA III: THE THIRD NATIONAL REPORT ON COMMUTING PATTERNS AND TRENDS (2006).

67. *See* Press Release, Am. Transp. Ass'n, 9 out of 10 Say Congestion has not Improved or Gotten Worse, According to a Poll by AAA and the American Public Transportation Association (Apr. 2, 2003), *available at* http://www.publictransportation.org/resources/releases/030402.asp.

68. Lathrop B. Nelson, *Unclogging Virginia's Roads: Aligning Computer Incentives in Northern Virginia*, 28 TRANSP. L.J. 185, 205 (2000).

69. *See* OLIVER GILLHAM, THE LIMITLESS CITY 4 (2002) (recalling various definitions of such phenomena, many of which involve these two factors); *see also* Timothy J. Dowling, *Reflections on Urban Sprawl, Smart Growth, and the Fifth Amendment*, 148 U. PA. L. REV. 873, 874 (2000) (defining sprawl as "automobile-dependent" development).

traffic congestion, causes drivers to become obese through lack of exercise, and confines those unable to drive, such as the poor or disabled.[70] On the other hand, defenders of the status quo assert that sprawl is "the way the majority of Americans eagerly choose to live."[71] Even so, there are plenty of arguments to put a leash on further sprawling of cities and metropolitan areas. The reality is that since 1960, in many areas, acreage has been increasing faster than populations.[72]

According to U.S. Department of Agriculture's National Resources Inventory ("NRI"), urban and built-up areas increased from 51.9 million acres in 1982 to 76.5 million acres in 1997, equaling an area approximately the size of Ohio.[73] From a natural resource standpoint, this conversion of farm and forestland produces fragmentation in wildlife habitat, increases air pollution due to more automobile travel, creates groundwater contamination and shortages, and increases stormwater runoff from impervious surfaces.[74]

In short, these land-use patterns indicate that soon there will not be any more land that can be developed or land to dedicate to sustainable-living uses, like agriculture.

C. The Financing Structure of U.S. Transportation Policies and Funding: A Public Choice Tale

Finally, the pressure of what can be called the "road industry"—car makers, real estate developers, public works contractors, unions, and oil companies—has shaped federal spending in the transportation sector. Historically, the major part of such financing has been channeled toward increasing the capacity of roadway and highway networks rather than favoring the modernization and improvement of urban and regional public transit systems.[75] Policymakers have the protagonist role in the tragedy of urban congestion. Under the pressure of the highway industry they have

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70. GILLHAM, *supra* note 69, at 74 (citing environmentalists, urban politicians, public transit advocates, and historic preservation advocates as leading sprawl opponents).

71. *See id.* at 69.

72. MARK A. BENEDICT & EDWARD MCMAHON, GREEN INFRASTRUCTURE: LINKING LANDSCAPES AND COMMUNITIES 6 (2006).

73. *See* RALPH E. HEIMLICH & WILLIAM D. ANDERSON, ECON. RESEARCH SERV. USDA, DEVELOPMENT AT THE URBAN FRINGE AND BEYOND: IMPACTS ON AGRICULTURE AND RURAL LAND 12 (2001).

74. *Id.* at 32, 34.

75. *See* Robert J. Dilger, *TEA-21: Transportation Policy, Pork Barrel Politics, and American Federalism*, 28 J. FEDERALISM 49, 50 (1998); Adrienne Zitka, *Road Work Ahead. Slow Down. What About Public Transit?: The Future of the Transportation Equity Act for the 21st Century*, 3 RUTGERS J.L. & URB. POL'Y 520, 521 (2006).

diverted large parts of the resources meant to improve transportation towards the construction of new roads, thereby incentivizing the use of cars. Indeed, the first comprehensive piece of legislation on U.S. transportation networks is the Federal Aid Highway Act, enacted in 1956.[76] It authorized the construction of America's interstate highway system.[77] Since the Federal Aid Highway Act, the federal government dedicated large parts of its surface transportation resources to the construction of interstate highways.[78] Consequently, the role of the national highway department officials became crucial in determining the scope and nature of the American transportation system.[79]

In 1991, a wind of change in America's highway and mass-transit policies seemed to blow towards an integrated and intermodal transportation system. The Intermodal Surface Transportation Efficiency Act ("ISTEA") was aimed at enhancing surface transportation programs and local involvement in transportation decision-making.[80] The bill was mainly intended to reduce congestion,[81] but also to recalibrate funding from highways to mass transit. In the end, however, not much funding was diverted to mass transit. Indeed, many states had already committed funds to numerous highway projects by the time ISTEA was passed.[82] ISTEA was reauthorized as TEA-21 on June 9, 1998.[83] TEA-21 was a six-year, $217 billion authorization of federal highway, bridge, and transit programs for the period of October 1, 1997 through September 30, 2003.[84] TEA-21 built on the work of ISTEA and increased highway funding to $175 billion and transit funding to $41.4 billion. Overall, only a small fraction of TEA-21 funds have been invested in public transportation.[85] Finally, after a one-

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76. Federal-Aid Highway Act of 1956, Pub. L. No. 84-627, 70 Stat. 374.

77. *Id.* pmbl.

78. ROBERT JAY DILGER, AMERICAN TRANSPORTATION POLICY 21 (2003).

79. *Id.* (explaining how local government officials and urban planners still played a role, but the overall design and location of the interstate system was decided by national and state government officials. Also noting how "national and state highway engineers imposed professional, uniform road construction and design standards throughout the nation").

80. Intermodal Surface Transportation Efficiency Act of 1991, Pub. L. No. 102-240, 105 Stat. 1914.

81. *See* SAMUEL K. SKINNER, DEP'T OF TRANSP., INTERMODAL SURFACE TRANSPORTATION EFFICIENCY ACT OF 1991—SUMMARY (1991), *available at* http://ntl.bts.gov/DOCS/ste.html.

82. *See* DILGER, *supra* note 78, at 59.

83. *See* Cynthia J. McNabb, *Viability of a Sustainable and Feasible National Transportation System*, 26 TRANSP. L.J. 133, 138-39 (1998).

84. Transportation Equity Act for the 21st Century (TEA-21), Pub. L. No. 105-178, 112 Stat. 107 (1998).

85. Zitka, *supra* note 75.

year extension of the TEA-21, the Safe, Accountable, Flexible, Efficient Transportation Equity Act—A Legacy for Users (SAFETEA-LU) authorized funding of federal transit and highway programs through 2009.[86] SAFETEA-LU is considered to be a significant victory for public transit advocates. It provided a record level of federal transit investment—$52.6 billion over 6 years—an increase of 46% over the amount guaranteed in TEA-21. SAFETEA-LU also increased annual guaranteed transit funding from a level of $7.2 billion in 2003 (the last year of TEA-21) to $10.3 billion in 2009.

Not only does SAFETEA-LU represent a change of pace in the transportation funding structure, but it is also a very important milestone in the modernization of U.S. transportation policy for its commitment to fight the gridlock of U.S. transportation networks. In particular, since the enactment of the ISTEA, the U.S. Department of Transportation has been administering the Intelligent Transportation Systems ("ITS") Program. Now, in reauthorizing the ITS Program, section 5306 of the SAFETEA-LU requires the U.S. Department of Transportation to continue to invest in technologies and systems that can aid in reducing congestion by 5% by 2010.[87] Such projects can include any innovative and aggressive technology-based congestion mitigation strategies.

In May 2006, the U.S. Department of Transportation announced its *National Strategy to Reduce Congestion on America's Transportation Network* (the "Congestion Initiative") and one of the major components of the Congestion Initiative is the Urban Partnership Agreement ("UPA").[88] The U.S. Department of Transportation has decided to provide Urban Partners up to $100 million of ITS research and development funds over three years through the Intelligent Transportation System Operational Testing to Mitigate Congestion Program ("ITS-OTMC Program"), to be established by the Department as part of the ITS Program.[89] In addition to providing funding

86. The bill was signed into law by President Bush on August 10, 2005 as Pub. L. No. 109-59.

87. *See* Fed. Highway Admin., U.S. Dep't of Transp., Intelligent Transportation Systems (ITS) Research (2005), http://ops.fhwa.dot.gov/safetea/itsresearchfactsheet.htm (last visited May 13, 2010).

88. The congestion initiative is a comprehensive federal program to reduce congestion on U.S. transportation networks (roads, rails, runways, and waterways). The purpose of UPAs is to acquire proposals by metropolitan areas in order to favor the implementation of strategies aimed at reducing traffic congestion. For more on the Urban Partnership Agreement, see Fed. Highway Admin., U.S. Dep't of Transp., Urban Partnership Agreement and Congestion Reduction Demonstration Programs, http://www.upa.dot.gov/ (last visited Dec. 26, 2009).

89. To support congestion-reducing strategies, the Department of Transportation will mainly utilize discretionary funding available under the Department's ITS-OTMC Program.

for Urban Partnerships, SAFETEA-LU gives states more flexibility to use road-pricing strategies as a congestion management and transportation finance tool.[90] UPA and other SAFETEA-LU funds are boosting the creativity of local governments leading to the implementation of new anti-congestion policies, some of which will be discussed in Part IV.B, dedicated to the case studies analysis.

IV. THE REGULATORY TOOLBOX

A law and economics approach to solving road congestion problems would suggest solutions oriented toward internalizing congestion externalities by modifying incentives and thereby changing individual behavior. Leaving aside common ownership, which becomes a viable solution only under very specific circumstances,[91] we remain stuck with the choice between privatization and regulation. Privatization, however, is really just another form of regulation.[92] Most of the time, what is perceived to be a privatized solution is instead a form of regulation entailing some kinds of artificially created propriety-like interests.[93] Thus, it is only a question of choosing the most appropriate regulatory tool. But how do we choose and what are the options?

In general, the choice of regulatory tools requires a threefold analysis. The first level of analysis implies the choice between traditional command-

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For more about the ITC Congestion Initiative, see ITS Congestion Initiative Notice, 71 Fed. Reg. 242 (Dec. 18, 2006), *available at* http://www.its.dot.gov/press/pdf/itscongestion.pdf.

90. For example,

> States are given latitude in the operation of High Occupancy Toll (HOT) lanes, allowing priority consideration for use of toll revenues for alternatives (such as transit) to single occupant vehicles. In addition, the Federal Highway Administration's Value Pricing Pilot Program is continued and enhanced along with several other pilot and demonstration programs to encourage congestion strategies aimed at air quality, energy conservation and efficiency. New provisions allow state/local governments expanded use of "toll credits" for local match for federal highway and transit projects—revenues from toll facilities may be counted as local matching funds regardless of whether or not federal funds were or are used for the toll facility.

AM. PUB. TRANSP. ASS'N, SAFE, ACCOUNTABLE, FLEXIBLE, EFFICIENT TRANSPORTATION EQUITY ACT—A LEGACY FOR USERS: A GUIDE TO TRANSIT-RELATED PROVISIONS (2005), *available at* http://www.publictransportation.org/reports/asp/safetea_lu_brochure.asp.

91. *See* OSTROM, *supra* note 13, at 211 (arguing that the keys of success to such regimes seem to be small size, stable membership, and a homogenous culture where norms of reciprocity and trust predominate).

92. *See generally* Amy Sinden, *The Tragedy of the Commons and the Myth of a Private Property Solution*, 78 U. COLO. L. REV. 552 (2007).

93. *Id.* at 566-77.

and-control techniques[94] and market-based instruments.[95] It is established, however, that conduct rules and fixed performance standards (traditional command-and-control techniques) are more costly than incentive-based taxes and tradable allowances (market-based instruments).[96] Within economic incentive schemes, the regulator has to choose between price instruments and quantity instruments. Fees or taxes are price instruments. Cap-and-trade schemes (e.g., marketable permits or credits) are quantity instruments. Finally, within the camp of quantity instruments, the theory distinguishes between tradable quota systems, tradable credit systems, and transferable development rights.[97]

A. Price Versus Quantities as Applied to Road Congestion

How should a regulator decide between quantity and price instruments if she intends to fight road congestion? The contest of instrument choice is far from settled. Fans of price-based tools (liability rules and taxes)[98] and advocates of Coase quantity-based schemes (property rules and tradable allowances) vie with each other.[99] There is an unsettled debate on the rela-

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94. *See, e.g.*, Howard Latin, *Ideal Versus Real Regulatory Efficiency: Implementation of Uniform Standards and 'Fine-Tuning' Regulatory Reform*, 37 STAN. L. REV. 1267 (1985); Thomas O. McGarity, *Radical Technology-Forcing in Environmental Regulation*, 27 LOY. L.A. L. REV. 943 (1994); Sidney A. Shapiro & Thomas O. McGarity, *Not So Paradoxical: The Rationale for Technology-Based Regulation*, 1991 DUKE L.J. 729 (1991).

95. *See* STEPHEN BREYER, REGULATION AND ITS REFORM 271-84 (1982); ALLEN V. KNEESE & CHARLES L. SCHULTZE, POLLUTION, PRICES, AND PUBLIC POLICY 69-84 (1975); Bruce A. Ackerman & Richard B. Stewart, *Reforming Environmental Law*, 37 STAN. L. REV. 1333, 1348 (1985); Richard B. Stewart, *Controlling Environmental Risks Through Economic Incentives*, 13 COLUM. J. ENVTL. L. 153 (1988); T.H. Tietenberg, *Economic Instruments for Environmental Regulation*, 6 OXFORD REV. ECON. POL'Y 17 (1990). *See generally* FREDERICK R. ANDERSON ET AL., ENVIRONMENTAL IMPROVEMENT THROUGH ECONOMIC INCENTIVES (1977).

96. Maureen L. Cropper & Wallace E. Oates, *Environmental Economics: A Survey*, 30 J. ECON. LITERATURE 675, 686 (1992).

97. *See* Richard B. Stewart, *A New Generation of Environmental Regulation?*, 29 CAP. U. L. REV. 21, 28-30 (2001).

98. *See* WILLIAM J. BAUMOL & WALLACE E. OATES, THE THEORY OF ENVIRONMENTAL POLICY 21-22, 29 (1988); LOUIS KAPLOW & STEVEN SHAVELL, NAT'L BUREAU OF ECON. RESEARCH, ON THE SUPERIORITY OF CORRECTIVE TAXES TO QUANTITY REGULATION (1997); PIGOU, *supra* note 6.

99. *See* Ronald H. Coase, *The Problem of Social Cost*, 3 J.L. & ECON. 1 (1960) (advocating a property-based approach to pollution control). Others have developed the idea further. *See, e.g.*, JOHN H. DALES, POLLUTION, PROPERTY & PRICES (1968) (elaborating on the tradable allowances approach); T.H. TIETENBERG, EMISSIONS TRADING: AN EXERCISE IN REFORMING POLLUTION POLICY (1985) (evaluating an emissions trading program); W. David Montgomery, *Markets in Licenses and Efficient Pollution Control Programs*, 5 J. ECON. THEORY 395 (1972) (providing a theoretical foundation for a proposal to establish a market in pollution licenses). *See generally* Thomas H. Tietenberg, *Transferable Discharge Permits*

tive virtues of price[100] vs. quantity[101] instruments to achieve optimal results.[102] The main difference is that a quantity instrument fixes the overall quantity (e.g., level of congestion) and allows the compliance costs to vary. In contrast, with pricing formulas, the price (i.e. the congestion fee) is fixed and therefore the cost is certain while the congestion level is allowed to vary according to the demand. Quantity instruments like cap-and-trade systems determine uncertainty in the cost of compliance. The price of a permit is indeed not known in advance. On the other hand, the main disadvantage of taxes is that the outcome (i.e. the amount of traffic) is not guaranteed.

The environmental economics literature is struggling to identify criteria in order to help legislators and regulators choose the right regulatory tool.[103] In sum, uncertainty over costs of compliance with a quantity-based regulation, revenue-raising possibilities of pricing instruments, possible creation of market power as a consequence of quantity restrictions, and higher transaction costs associated with a quantity-based regulatory scheme seem to favor the adoption of pricing tools. Fairness instead seems to be the more compelling factor in favor of quantity instruments.[104] This Article argues that the two main factors (efficiency under uncertainty and fairness) converge in sponsoring a quantity-based approach to road congestion.

1. Efficiency

The so-called Weitzman rule as applied to the road congestion tragedy leads to the conclusion that, in a world of uncertainty about costs of congestion reduction, quantity-based instruments would be preferred to prices

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and the Control of Stationary Source Air Pollution: Reply, 56 LAND ECON. 391 (1980) (discussing the implementation of transferable discharge permits for air pollution).

100. *See, e.g.*, Guido Calabresi & A. Douglas Melamed, *Property Rules, Liability Rules, and Inalienability: One View of the Cathedral*, 85 HARV. L. REV. 1089 (1972); Louis Kaplow & Steven Shavell, *Property Rules Versus Liability Rules: An Economic Analysis*, 109 HARV. L. REV. 713 (1996); A. Mitchell Polinsky, *Controlling Externalities and Protecting Entitlements: Property Right, Liability Rule, and Tax-Subsidy Approaches*, 8 J. LEGAL STUD. 1 (1979); Carol M. Rose, *Rethinking Environmental Controls: Management Strategies for Common Resources*, 1991 DUKE L.J. 1.

101. *See generally* Martin L. Weitzman, *Prices vs. Quantities*, 41 REV. ECON. STUD. 477 (1974).

102. *See* Peter Bohm & Clifford S. Russell, *Comparative Analysis of Alternative Policy Instruments*, *in* 1 HANDBOOK OF NATURAL RESOURCE AND ENERGY ECONOMICS 395 (Allen V. Kneese & James L. Sweeney eds., 1985).

103. For a concise introduction to the economic theory of envrionmental economics and policy instrument choice, see KEOHANE & SHEILA M. OLMSTEAD, MARKETS AND THE ENVIRONMENT, 125 (2007).

104. *See* Jonathan B. Wiener, *Global Environmental Regulation: Instrument Choice in Legal Context*, 108 YALE L.J. 677, 729.

only if congestion escalation is way more worrisome than abatement-costs escalation.[105]

First, some economists have argued that uncertainty in road congestion exists. As a matter of fact, even if speed-flow relationships are able to be determined with precision for the road in question, uncertainties would arise because the marginal value of time is uncertain (and would also probably vary at different times of the day).[106] Hence, for a given road at a given time, any additional vehicle should be weighed against the inconvenience of using an alternative means of transport, shifting the time of travel, or forgoing the trip altogether. The marginal congestion cost of an additional vehicle is initially low. Additional vehicles have negligible congestion effects. The cost escalation becomes very worrisome as the road approaches full capacity.[107] Thus,

> for busy roads during peak hours, the marginal cost curve may be substantially more steeply sloped than the marginal benefits curve at the optimum vehicle density. If uncertainty is important, this suggests policy should employ a scheme of tradable licenses to cap road use at the point before congestion becomes a major cost.[108]

2. Equity and Political Economy

Fairness seems to be a further compelling argument in favor of quantity-based instruments. Economists and mayors seem to favor congestion pricing, most likely because its revenue-raising nature makes it appealing to any policymaker. For example, the Bloomberg Administration congestion

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105. *See generally* Martin Weitzman, *Prices vs. Quantities*, 41 REV. ECON. STUD. 477 (1974). *See* HENRY D. JACOBY & A. DENNY ELLERMAN, MIT JOINT PROGRAM ON THE SCIENCE AND POLICY OF CLIMATE CHANGE, THE SAFETY VALVE AND CLIMATE POLICY (2002); Warwick J. McKibbin & Peter J. Wilcoxen, *The Role of Economics in Climate Change Policy*, 16 J. ECON. PERSPECTIVES 107-29 (2002); William A. Pizer, *Combining Price and Quantity Controls to Mitigate Global Climate Change*, 85 J. PUB. ECON. 409, 410 (2002); Marc J. Roberts & Michael Spence, *Effluent Charges and Licenses Under Uncertainty*, 5 J. PUB. ECON. 193, 193 (1976); *see also* William D. Nordhaus, *To Tax or Not to Tax: Alternative Approaches to Slowing Global Warming*, 1 REV. ENVTL. ECON. & POL. 1, 26-44 (2007); Ian W.H. Parry & Wallace E. Oates, *Policy Analysis in the Presence of Distorting Taxes*, 19 J. POL'Y ANALYSIS & MGMT. 603-13 (2000); Wiener, *supra* note 104, at 729.

106. *See generally* Cameron Hepburn, *Regulation by Prices, Quantities, or Both: A Review of Instrument Choice*, 22 OXFORD REV. ECON. POL'Y 226 (2006).

107. Steven A. Morrison, *A Survey of Road Pricing*, 20 TRANSP. RES. PART A: POL'Y & PRAC. 87 (1986); David M. Newbery, *Pricing and Congestion: Economic Principles Relevant to Pricing Roads,* OXFORD REV. ECON. POL'Y 6, 22-39 (1990).

108. Hepburn, *supra* note 106, at 241.

initiative for New York City did not address this issue at all.[109] There seemed to be a suspicious blind trust in the power of "prices" since the start of the initiative.[110] Not even the formation of a panel that studied the proposal further led to a different conclusion.[111]

Market failure exists—and government intervention in the form of some regulation aimed at reducing congestion is needed. Also, the illustration of the underlying causes helps define policy and regulatory objectives. The main target for a regulation of road congestion should be the reduction of road demand. This goal can be achieved by setting forth a regulation and a related funding scheme that creates incentives to reduce road usage by drivers and reduce the impact on road usage by real estate developments.

This Article advances the proposition that, in addressing road congestion, the "how much" question (i.e. the optimal degree of road demand reduction) may not be answered solely "on the basis of economic efficiency calculations that seek to maximize net benefits by setting marginal benefit equal to marginal cost, but rather on the basis of some nonefficiency considerations of importance to political decisionmakers."[112] There are two main reasons for not applying efficiency considerations to the choice of regulatory instruments. First, leaving aside the GHG emissions negative externality, there is hardly any uncertainty over the benefits and costs of road congestion. Economists argue that, as traffic flow approaches full capacity of the network, costs approach infinity.[113] Roads are a network. They are the river in which the traffic stream flows. The environmental characteristics of the road network affect its capacity and therefore its efficiency level—in particular the agility with which the traffic is able to flow through its arteries.[114] But overall, like any other network, roads have a limited capacity, and congestion signals that roads are almost at full capaci-

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109. CITY OF NEW YORK, PLANYC, A GREENER, GREATER NEW YORK 135 (2007) [hereinafter PLANYC], *available at* http://www.nyc.gov/html/planyc2030/downloads/pdf/full_report.pdf.

110. OWEN, *supra* note 39, at 145.

111. William Neuman, *Panel Passes Congestion Pricing Plan*, N.Y. TIMES CITY ROOM BLOG, http://cityroom.blogs.nytimes.com/2008/01/31/panel-passes-congestion-pricing-plan/ (Jan. 31, 2008, 17:00 EST).

112. Wiener, *supra* note 104, at 729 (internal citations omitted) (arguing that incentive-based regulatory instruments "can minimize the cost of achieving a level of pollution control determined by nonmarket means [and could] be preferred by those who do not share the view that all social allocations should be guided solely by considerations of economic efficiency.").

113. *See generally* Morrison, *supra* note 107.

114. *See generally* GIOVANNI FRAQUELLI ET AL., REGULATING PUBLIC TRANSIT NETWORKS: HOW DO URBAN-INTERCITY DIVERSIFICATION AND SPEED-UP MEASURES AFFECT FIRMS' COST PERFORMANCE? (2002).

ty. The cap may not be left to the market to be determined. To put it in different terms, there is no uncertainty over marginal benefits ($300 billion in externality costs savings.)[115] This is a very compelling argument to start thinking about a political proposal that designs the future society in a more sustainable way. This shows that only the "how to" question should be answered on the basis of efficiency considerations. Indeed "how to" regulate can be distinguished from "how much" to regulate.[116] Even if the target level of environmental protection is not determined on an economic efficiency basis (e.g., political compromise), the regulator must still figure out how to achieve that level by choosing the most cost-effective regulatory instrument (i.e. taxes or tradable allowances).[117]

From this point of view, quantity instruments seem to be the most cost-effective tools. If the socially acceptable "how much" has been selected by the government on non-efficiency grounds, the regulator can only try to achieve that level of congestion as cost-effectively as possible ("how to"). Now, tradable quantity allowances, more than taxes, guarantee the selected level, while the actual level of pollution/congestion could still deviate from the selected one if the real cost is not certain.

There is a second and more compelling reason why efficiency should not play a role in the choice of the regulatory tools to be applied to road congestion. Economic theoretical prescriptions are rarely met in practice because governments cannot design instruments without accounting for political realities.[118] Politicians have to safeguard the support of their constituencies and lobby groups to secure reelection. Instrument selection is better explained by political economy and the income effect than by considerations of economic efficiency.[119]

Indeed, the introduction of congestion pricing increases the welfare of community as a whole, but it also implies wealth redistribution effects.[120]

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115. Dubner & Levitt, *supra* note 18.

116. *See* Bohm & Russell, *supra* note 102, at 397 ("[C]hoice of policy goal and choice of instrument or implementation system are essentially separable problems.").

117. *See* Howard K. Gruenspecht & Lester B. Lave, *The Economics of Health, Safety, and Environmental Regulation*, *in* 2 HANDBOOK OF INDUSTRIAL ORGANIZATION 1507, 1520-21 (Richard Schmalensee & Robert D. Willig eds., 1989) ("[R]egulatory targets are usually set through the political process, not through the use of some grand optimization calculus. [Economists can help] by taking the politically set objectives as given and devising a cost-minimizing approach to reaching them, thereby pursuing the goal of cost effectiveness rather than optimality.").

118. *See generally* DAVID PEARCE ET AL., COST BENEFIT ANALYSIS AND THE ENVIRONMENT: RECENT DEVELOPMENTS (2006).

119. Dieter Helm, *Economic Instruments and Environmental Policy*, 36 ECON. & SOC. REV. 3, 205–28 (2005).

120. *See* W. BAUMOL & W. OATES, THE THEORY OF ENVIRONMENTAL POLICY 76 (1988).

In general, the situation of most of the motorists who have to switch to other means of transportation deteriorates, whereas it improves for a minority with high values-of-time. Governments instead collect toll revenues and become wealthier. Thus, there is generally little chance of a congestion charge being accepted unless motorists are convinced that the government will distribute the resources collected efficiently and equitably.[121] Also, cap-and-trade is the best approach in terms of environmental effectiveness, cost effectiveness, and distributional equity.[122]

As to environmental effectiveness, taxes present a fundamental tradeoff between certainty regarding costs, which they can guarantee, and certainty about the level of emissions, which they cannot guarantee. Second, taxes provide "automatic temporal flexibility" while a cap-and-trade system doesn't unless specific provisions for banking, borrowing, and cost-containment mechanisms are implemented.[123] Finally, if a carbon tax (rather than a cap-and-trade) regime is implemented, political economy arguments would force to aim at less severe targets.

Taxes and cap-and-trade can both be cost-effective tools.[124] As to the distributional consequences of the two approaches, the key difference between a tax and a cap-and-trade instrument is the consequence that political pressures may produce. If exerted on a cap-and-trade system, political pressures may lead to different allocations of allowances, which may have a distributional impact but would not affect environmental effectiveness and cost-effectiveness.[125] To the contrary, political pressures exerted on a carbon tax system will end up in sectors and firms negotiating exemptions with the regulator, which would reduce environmental effectiveness and increase costs.[126]

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121. CHARLES RAUX, ORG. FOR ECON. CO-OPERATION & DEV., HOW SHOULD TRANSPORT EMISSIONS BE REDUCED? POTENTIAL FOR EMISSION TRADING SYSTEMS 34 (2008).

122. Robert N. Stavins, *Cap-and-Trade or a Carbon Tax?*, 25 ENVTL. F. 1, 16 (2008).

123. *Id.* at 31.

124. *Id.* at 51.

125. *Id.* at 24.

126. In a paper presented within the framework of The Hamilton Project, launched by The Brookings Institution (www.hamiltonproject.org), Stavins sketches the key features of a cap-and-trade system for GHG emissions and argues that

> [a] cap-and-trade system is the best approach in the short to medium term. Besides providing certainty about emissions levels, cap-and-trade offers an easy means of compensating for the inevitably unequal burdens imposed by climate policy; it is straightforward to harmonize with other countries' climate policies; it avoids the current political aversion in the United States to taxes; and it has a history of successful adoption in this country. The paper proposes a specific cap-and-trade system with several key features including: an upstream cap on CO_2 emissions with gradual inclusion of other greenhouse gases; a gradual downward

B. A Case-Study Analysis

Under the assumption that road-demand reduction has to be defined as the objective of a new regulation of urban mobility, and that the limited capacity of road networks should be allocated in a way that prevents congestion, the next part of this Article focuses on the different choices of policy and regulatory instruments available or already implemented to achieve the targets discussed above.[127] This section briefly examines the characteristics of price instruments and quantity instruments implemented or proposed to address congestion. The case study analysis will confirm, and actually strengthen, the theoretical primacy of quantity-based instruments over price-based by showing that the former bear an advantage over the latter in terms of environmental effectiveness and cost-effectiveness on the one hand, and in terms of fairness and equity concerns—and therefore public acceptability—on the other.

Pricing formulas are almost uniformly translated into a time-of-day-sensitive congestion tax or fee and by subsidizing alternative transportation modes such as transit and bicycling. Singapore Electronic Road Pricing[128] and London Congestion Charge[129] are the most prominent examples of this solution. Milan has recently adopted a similar scheme.[130] This was also

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> trajectory of emissions ceilings over time to minimize disruption and allow firms and households time to adapt; and mechanisms to reduce cost uncertainty. Initially, half of the program's allowances would be allocated through auctioning and half through free distribution, primarily to those entities most burdened by the policy. This should help limit potential inequities while bolstering political support. The share distributed for free would phase out over twenty-five years. The auctioned allowances would generate revenue that could be used for a variety of worthwhile public purposes. The system would provide for linkage with international emissions reduction credit arrangements, harmonization over time with effective cap-and-trade systems in other countries, and appropriate linkage with other actions taken abroad that maintains a level playing field between imports and import-competing domestic products.

ROBERT N. STAVINS, THE BROOKINGS INST., A U.S. CAP-AND-TRADE SYSTEM TO ADDRESS GLOBAL CLIMATE CHANGE (2007), *available at* http://www.brookings.edu/~/media/Files/rc/papers/2007/10climate_stavins/10_climate_stavins.pdf.

127. *See generally* Erik Verhoef et al., *The Economics of Regulatory Parking Policies: The (Im)Possibilities of Parking Policies in Traffic Regulation*, 29 TRANSP. RES. PART A: POL'Y & PRAC. 141 (1995).

128. *See generally* A.P. Gopinath Menon & Chin Kian-Keong, *ERP in Singapore—What's Been Learnt from Five Years of Operation?*, 45-2 TRAFFIC ENGINEERING AND CONTROL 62 (2004).

129. TRANSPORT FOR LONDON, CENTRAL LONDON: CONGESTION CHARGING IMPACTS MONITORING: SIXTH ANNUAL REPORT, JULY 2008 (2008), *available at* http://www.tfl.gov.uk/assets/downloads/sixth-annual-impacts-monitoring-report-2008-07.pdf.

130. Ken Belson, *Toll Discounts for Going Green*, N.Y. TIMES, Jan. 27, 2008, *available at* http://www.nytimes.com/2008/01/27/automobiles/27GREEN.html; *see also* Richard

the "road" chosen by the Bloomberg Administration in New York City for its anti-congestion initiative,[131] although it faced strong political opposition.[132]

Conversely, the alternative market-oriented, quantity-based schemes receive multiform implementation. Theoretically, the model should be based on a cap-and-trade approach, whereby an aggregate cap on all sources of congestion is established and these sources are then allowed to trade back against a mobility credit or a mobility permit (to own or to drive a car). The credit trading scheme could be instituted between individual drivers and even between real estate developers and suburbs:[133] the city of Seattle is one of the few U.S. cities to launch a car cash-out program, dubbed Commuter Cash, which denotes some features of the credit trading approach but is comparable to the credit-trading schemes enforced in other sectors.[134]

The second quantity measure could be the institution of a capped driving rights licensing system similar to the taxi medallions scheme.[135] This is a solution that relies on the highly debated virtues of property rights schemes (e.g., internalization of externalities; reduced enforcement costs; higher safety standards).[136] Cities such as Singapore and Rome have implemented capped car-ownership/driving-rights schemes,[137] although Rome in particular cannot be properly considered a cap-and-trade system, as trade is limited or prohibited.[138]

Owen, *Congestion Fee Leaves Milan in a Jam*, N.Y. TIMES, Jan. 3, 2008, *available at* http://www.timesonline.co.uk/tol/news/world/europe/article3123679.ece.

131. Neuman, *supra* note 111. The congestion pricing plan would have charged passenger cars $8 to cross into the charging zone in Manhattan from 60th Street and southward between the hours of 6 a.m. and 6 p.m.

132. *See generally* Nicholas Confessore, *$8 Traffic Fee for Manhattan Gets Nowhere*, N.Y. TIMES, Apr. 8, 2008, *available at* http://www.nytimes.com/2008/04/08/nyregion/08congest.html.

133. The macroeconomic scale of the problem could suggest the implementation of credit trading schemes similar to those implemented under the Clean Water Act. *See* Lynda Hall & Eric Raffini, *Water Quality Trading: Where Do We Go From Here?*, 20 NAT. RESOURCES & ENV'T 38 (Summer 2005). *See generally* James S. Shortle & Richard D. Horan, *Water Quality Trading*, 14 PENN ST. ENVTL. L. REV. 231 (2006).

134. For details, see http://www.seattle.gov/waytogo/commutercash.htm.

135. Most U.S. cities have a taxicab licensing scheme which restricts the number of cabs allowed onto the streets. The licenses are sometimes called medallions.

136. Sinden, *supra* note 92, at 539. *See generally* Katrina M. Wyman, *From Privilege to Property: The Case of Taxi Medallions* (2007) (on file with Fordham Urban Law Journal).

137. Yii Der Lew & Wai Yan Leong, *Managing Congestion in Singapore—A Behavioural Economics Perspective*, JOURNEYS, May 2009, at 15.

138. *See* JOINT OECD/ECMT TRANSP. RESEARCH CTR., MANAGING URBAN TRAFFIC CONGESTION 225 (2007), http://www.internationaltransportforum.org/Pub/pdf/07Congestion.pdf. For information on Rome's congestion scheme, visit http://www.civitas-

1. Price Instruments: Congestion Pricing Schemes

In 1963, William S. Vickrey argued that "in no other major area are pricing practices so irrational, so out of date, and so conducive to waste as in urban transportation."[139] He did not mean that pricing instruments were not a viable means to address congestion. On the contrary, he advocated congestion charges and tried to implement a road pricing plan in Washington.[140]

Since Vickrey made his assertion, theory and practice of transport economics has actually focused almost exclusively on the use of price instruments. The London Congestion Charge is the most prominent example.[141] Singapore has adopted a congestion pricing scheme complemented by a vehicle ownership quota scheme.[142] More recently, two global cities, New York and Milan, have turned to congestion pricing. There was an attempt in New York to implement a congestion pricing scheme, but the proposal was turned down because of political opposition.[143] Milan was more successful, and the congestion pricing scheme is effective as of January 2, 2008.[144]

a. London

In 2003, London adopted a cordon-style congestion pricing scheme as a way to reduce traffic levels in the city.[145] The congestion zone is enclosed

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initiative.org/measure_sheet.phtml?lan=en&id=38, and see WAYNE BERMAN ET AL., MANAGING TRAVEL DEMAND: APPLYING EUROPEAN PERSPECTIVES TO U.S. PRACTICE 9 (2006), *available at* http://international.fhwa.dot.gov/traveldemand/p106015.pdf.

139. William S. Vickrey, *Pricing and Resource Allocation in Transportation and Public Utilities: Pricing in Urban and Suburban Transport*, 53 AM. ECON. REV. 452, 452 (1963) [hereinafter Vickrey, *Urban and Suburban Transport*].

140. William S. Vickrey, *Statement on the Pricing of Urban Street Use*, 36 J. URB. ECON. 42, 48-56 (1994) [hereinafter Vickrey, *Urban Street Use*].

141. Jonathan Leape, *The London Congestion Charge*, 20 J. ECON. PERSP. 157, 158-59 (2006); Georgina Santos & Gordon Fraser, *Road Pricing: Lessons from London*, 21 ECON. POL'Y 263, 264-310 (2006).

142. *See* Lew & Leong, *supra* note 137, at 17. *See generally* Georgina Santos, *Urban Congestion Charging: A Comparison between London and Singapore*, 25 TRANSPORT REV. 511, 516-21 (2005) [hereinafter Santos, *Urban Congestion Charging*].

143. Sam Schwartz et al., *A Comprehensive Transportation Policy for the 21st Century: A Case Study of Congestion Pricing in New York City*, 17 N.Y.U. ENVTL. L.J. 580, 594-95 (2008).

144. Marco Bertacche, *Milan Introduces Congestion Charge to Cut Pollution*, N.Y. SUN, Jan. 3, 2008; BBC News, *Milan Introduces Traffic Charge*, Jan. 2, 2008, http://news.bbc.co.uk/2/hi/europe/7167992.stm.

145. Santos, *Urban Congestion Charging*, *supra* note 142, at 511, 523. In 2005, London Congestion Charge levied £5 per day for all vehicles and charging times from 7:00 a.m. to

within a boundary formed by the Inner Ring Road, which is not subject to the congestion charge.[146] The charging system is enforced through a network of cameras situated at entry and exit points to the congestion zone.[147] This video circuit "records images of traffic and sends them to a central processor where the license plate numbers are [automatically monitored to verify their presence within] the list of vehicles that have been paid for."[148] Registered owners of unauthorized automobiles—those who have not paid in advance or do not pay before midnight on the day of travel—will be fined.[149] Licensed taxis, public service vehicles, motorcycles, mopeds, emergency vehicles, disabled drivers, and alternative fuel vehicles are exempted from the congestion charges, whereas residents within the congestion charging zone pay only 10% of the charge.[150]

The exemption and the incentive for the use of alternative fuel vehicles such as hybrids is important from an environmental perspective, since they not only use less gasoline but also emit 90% fewer smog-forming pollutants, as well as half of the carbon dioxide that a conventional automobile does. In addition, the exemption for alternative-fuel vehicles is boosting sales of hybrid vehicles. In fact, sales of hybrid vehicles during the first quarter of 2005 doubled the sales in the first quarter of 2004.[151]

The results of London's pricing scheme were initially impressive. Air pollution decreased with a 12% decline in particulate matter and nitrogen oxides emissions and a 20% decline in carbon dioxide levels.[152] Traffic

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6:30 p.m., which can be paid in advance or on that day until 10:00 p.m. Late payment rises to a £10 fine if paid between 10:00 p.m. and midnight.

146. TODD LITMAN, VICTORIA TRANSP. POLICY INST., LONDON CONGESTION PRICING: IMPLICATIONS FOR OTHER CITIES 2 (2006); *see also* TRANSPORT FOR LONDON, WHAT DO I NEED TO KNOW ABOUT THE CENTRAL LONDON CONGESTION CHARGING ZONE? 2 (2007), *available at* http://www.tfl.gov.uk/assets/downloads/English-Congestion-charging.pdf; Michael H. Schuitema, *Road Pricing As a Solution to the Harms of Traffic Congestion*, 34 TRANSP. L.J. 81,101 (2007).

147. LITMAN, *supra* note 146, at 3.

148. Schuitema, *supra* note 146.

149. *Id.*

150. *Id.* See categories of exempted vehicles and discounts at http://www.tfl.gov.uk/roadusers/congestioncharging/6713.aspx.

151. Schuitema, *supra* note 146, at 102; Carpages.co.uk, *Toyota Prius Sales Surge in 2005*, July 7, 2005, http://www.carpages.co.uk/toyota/toyota-prius-07-04-05.asp?switched=on&echo=981703353. *See also* Christine Buckley, *Prince Joins Famous List of Converts to Greener Toyota*, TIMES, July 7, 2005. A similar result occurred in Virginia where the access to highways' dedicated lanes incentive was very effective in encouraging the use of new hybrids. Editorial, *The Hybrid's Free Ride*, WASH. POST, Jan. 16, 2005, at B06.

152. ENVTL. DEF., ALL CHOKED UP: HEAVY TRAFFIC, DIRTY AIR AND THE RISK TO NEW YORKERS 7-9 (2007), *available at* http://www.edf.org/documents/6117_AllChokedUp_NYCTrafficandHealthReport.pdf.

patterns improved with a 30% decrease in traffic congestion and a 37% traffic speed increase. Public transportation benefited too from a 20% to 40% reduction in taxi travel costs and a 20% increase in bus ridership during the morning commute.[153]

Initial reports of improvement, however, were soon called into question,[154] and the latest reports actually show no sign of improvement against pre-charging conditions in 2002.[155] Also, some commentators doubt that the implementation of the congestion charge scheme was the sole factor responsible for the beneficial changes registered after its implementation.[156]

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153. *Id.* at 8; Sean D. Beevers & David C. Carslaw, *The Impact of Congestion Charging on Vehicle Emissions in London*, 39 ATMOSPHERIC ENV'T 1, 1-2 (2005).

154. TRANSPORT FOR LONDON, CENTRAL LONDON: CONGESTION CHARGING IMPACTS MONITORING: THIRD ANNUAL REPORT APRIL 2005 2-6 (2005), *available at* www.tfl.gov.uk/assets/downloads/thirdannualreportfinal.pdf (stating that, as to congestion in the central zone "[m]ore recent surveys have shown evidence of more variable conditions compared to those in 2003, and may suggest some increase in congestion," while there have been "reductions in congestion on both the Inner Ring Road (the non-charged route around the boundary of the charging zone) and the main radial routes approaching the charging zone, but these are now smaller than those seen in 2003 immediately following the introduction of the scheme" and "[t]raffic on the Inner Ring Road fell very slightly during 2004, though this still represents a small net increase on pre-charging conditions in 2002 overall." As to the environmental impact of the charging scheme, the 2005 report already recognized that "[t]he picture for NO_2 is mixed, with evidence at several sites across London (both outside and within the charging zone) of unexpected recent increases that do not seem to be related to traffic volumes. PM_{10} concentrations (and episodes) have reduced to levels prevailing before charging. It is not possible to detect a 'congestion charging effect' in measured air quality data").

155. *See* TRANSPORT FOR LONDON, *supra* note 129, at 3-6 ("Reporting in TfL's *Third Annual Impacts Monitoring Report* on conditions following two years of operation of the original central London scheme, TfL observed consistent reductions to congestion of around 30 percent, against pre charging conditions in 2002—towards the top end of TfL's range of expectation. By 2005 this percentage reduction had fallen to 21 percent. In 2006, following a significant deterioration in network performance over that year, TfL reported in its *Fifth Annual Impacts Monitoring Report* that congestion in the original central London zone during 2006 was only 8 percent below conditions in 2002 before the introduction of the scheme" and "In the original central London charging zone, congestion has further intensified in 2007. The average measurement of congestion in the original central zone during charging hours in 2007 was identical to the representative value for 2002 used by TfL to reflect pre charging conditions. The early months of 2008 have seen no further material change." As to the environmental impact "[t]here have been modest beneficial impacts to emissions of key road traffic pollutants, with estimated scheme-attributable reductions inside the western extension zone of 2.5% to oxides of nitrogen (NO_X), 4.2% to fine particles (PM_{10}), and 6.5% for carbon dioxide (CO_2). As noted in previous annual impacts monitoring reports, trends in measured ambient outdoor air quality across central and inner London continue to primarily reflect factors external to the scheme, such as the weather and vehicle technology changes, not all of which have been beneficial. No clear scheme impacts from either the original central or western extension zones can therefore be discerned.").

156. *See* R.W. Atkinson et al., *The Impact of the Congestion Charging Scheme on Ambient Air Pollution Concentrations in London*, 43 ATMOSPHERIC ENV'T 5499, 5500 (2009).

Although the pricing mechanism has never been in danger of being revoked, during the 2008 mayoral campaign, then-candidate Boris Johnson promised to shrink the congestion zone back to its initial, pre-2005 area, removing the western expansion and shutting off Mayor Ken Livingstone's plan to increase the charge for the most polluting vehicles.[157] In October 2009, Mayor Boris Johnson announced his new plan to change London's congestion scheme foreseeing the removal of the western extension and the introduction of an automated payment account system, provisionally entitled CC Auto Pay.[158] In addition, however, Johnson's plan provides for an increase of the daily charge to £9 for CC Auto Pay customers and an increase of the daily charge to £10 for customers who do not take up CC Auto Pay and continue to pay through existing payment systems.[159]

This demonstrates that in order to keep the congestion scheme working, it needs constant increases in the congestion charge. By constantly raising the charge, the regulator can only hope to maintain a certain fixed, rigid reduction in congestion (30% in the case of the London congestion scheme). London shows that further improvements in congestion mitigation or any environmental positive effects are not achievable solely through a pricing scheme.

b. Singapore

Singapore's congestion pricing practices are complemented by a vehicle ownership quota scheme discussed in Part IV.B.2.[160] In 1975, Singapore introduced a $3 daily pass or $60 monthly pass for private vehicles entering the central business district ("CBD").[161] The cordon-style charging scheme (the so-called Area Licensing Scheme) initially applied to automobiles entering the CBD during the morning peak hours (7:30-9:30).[162] Only vehicles displaying a paper license were allowed to enter the zone. Carpoo-

157. The zone was expanded westward in 2005. Sam Wilson, *Congestion Charge Hike for Gas-Guzzling Cars*, TELEGRAPH, Feb. 12, 2008, *available at* http://www.telegraph.co.uk/earth/earthnews/3324965/Congestion-charge-hike-for-gas-guzzling-cars.html; *see also* BBC News, *Mayor Quashes £25 C-charge Hike*, July 8, 2008, *available at* http://news.bbc.co.uk/2/hi/uk_news/england/london/7494495.stm.

158. *See* Press Release, Greater London Authority, Mayor Outlines Congestion Charge Overhaul (Oct. 15, 2009), *available at* http://www.tfl.gov.uk/corporate/media/newscentre/archive/13289.aspx.

159. *Id.*

160. Lew & Leong, *supra* note 137; Menon & Kian-Keong, *supra* note 128.

161. Lew & Leong, *supra* note 137, at 15-16.

162. Peter L. Watson & Edward P. Holland, *Relieving Traffic Congestion: The Singapore Area License Scheme* 24 (Urb. Projects Dep't, The World Bank, Staff Working Paper No. 281, 1978), *available at* http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2003/01/23/000178830_98101903400431/Rendered/PDF/multi0page.pdf.

lers, buses, motorcycles, and freight vehicles were exempt from the requirement.[163] The result was an immediate 76% reduction in the use of private cars within the CBD, a 30% increase in carpooling, and a doubling of bus usage.[164] It was also found that many people shifted their travel times within the CBD to just before and after the restricted hours. One negative impact of the congestion pricing scheme was a slight traffic increase on roadways around the CBD, as commuters sought to avoid the restricted area and find alternate routes.

In 1989, in an effort to strengthen the results of the CBD's congestion pricing scheme, the charging hours were extended to the afternoon peak hours and the exemptions were eliminated for all vehicles except public transit.[165] Five years later in 1994, the charging hours were once again extended, but this time lower fees were added to cover the hours between the morning peak and afternoon peak hours (10:15-4:30).[166]

In 1998, the paper license system was replaced by an electronic cash card system: the Electronic Road Pricing ("ERP").[167] The cash cards operate much like telephone cards and may be purchased or recharged at retail outlets, banks, gas stations, and automatic machines. The cards are then affixed to the vehicle's windshield and different charges for different roads at different times are automatically deducted from the card as the vehicle passes under gantries.

The lasting effects of Singapore's congestion pricing system have been encouraging. Although the morning peak-hour traffic has slowly increased since 1975, congestion is still 31% lower than before the charges were introduced. These results have held despite a 33% increase in employment and a 77% increase in the number of cars. In addition, the reliability of the cash card debiting system has been studied and estimated at 99.99% accuracy.[168] The annual revenue from the congestion pricing system equals about €40-50 million, while the costs for operation and maintenance are only about €8 million.[169]

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163. Lew & Leong, *supra* note 137, at 16.

164. *Id.*

165. J.Y.K. Luk, *Electronic Road Pricing in Singapore*, ROAD & TRANSPORT RES., Dec. 1999, *available at* http://findarticles.com/p/articles/mi_qa3927/is_199912/ai_n8875414/?tag=content;col1.

166. *Id.*

167. Lew & Leong, *supra* note 137, at 19.

168. Menon & Kian-Keong, *supra* note 128, at 63.

169. *Id.*

c. New York

New York's commitment to regulate traffic with pricing instruments goes back some time. Tolling is a longstanding regulatory tool in the New York traffic congestion policy.[170] Mayor Ed Koch proposed the first comprehensive congestion scheme applying to all single-occupant vehicles ("SOV"s) entering Manhattan in 1980. The parking garage industry and the Automobile Club of New York fiercely opposed Koch's plan, bringing a lawsuit, *Automobile Club of New York, Inc. v. Koch*.[171] The City of New York lost the suit on grounds that the State had not granted the City the powers necessary to implement Koch's plan. Koch's administration tried once again to pass a congestion pricing scheme through Commissioner Ross Sandler's plan establishing a $10 charge to enter Manhattan below 59th Street.[172] Sandler's plan had no better luck. The coalition of interests opposing it was stronger than ever, compelling the Koch Administration to give up a pricing policy tackling the City's congestion problems.[173]

In 2000, a facility-based congestion pricing scheme was introduced on several New York City bridges and tunnels.[174] Unfortunately, this pricing scheme has had a minimal impact on traffic congestion. One year after its enforcement, the scheme registered a 7% decrease in the number of commuters and trucks traveling during the morning peak period and a 4% decrease in the number of vehicles using the facilities during the afternoon peak period. The scheme caused, however, a 7% increase in travel after the

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170. Since its opening in 1883, drivers of horse carriages were charged a penny to cross the Brooklyn Bridge. *See* Schwartz et al., *supra* note 143, at 590. Upon opening the Holland Tunnel in 1927 and the Lincoln Tunnel in 1937, drivers were charged a toll to cross the Hudson River. *Id.*

171. 1981 N.Y. Misc. LEXIS 3518 (N.Y. Sup. Ct. May 4, 1981). Koch's traffic regulation foresaw a ban for SOVs entering the four East River bridges during rush hour on weekday mornings. *Id.* at 3. The ban's purpose was to improve environmental conditions in Midtown Manhattan by forcing SOVs to use the East River toll tunnels. The court held that the City had no authority to impose the ban under either N.Y. Vehicle and Traffic Law § 1640 or § 1642 because: (1) there was no express grant of authority from the State to impose the proposed traffic regulation; (2) the regulation could not be authorized under the omnibus provision of § 1640 as it was not sufficiently similar to any of the express provisions set forth therein; and (3) there were no reasonable alternate routes available for SOVs during rush hour. *Id.* at 7-9.

172. David Dunlap, *Koch Backs $10-a-Day Fees on Vehicles to Reduce Pollution*, N.Y. TIMES, Aug. 4, 1987, at B1.

173. *See* Aaron Naparstek, *Congestion Charging in New York City: The Political Bloodbath*, Dec. 4, 2006, *available at* http://www.streetsblog.org/2006/12/04/congestion-charging-in-new-york-city-the-political-bloodbath/.

174. Namely, the George Washington Bridge, Lincoln Tunnel, Holland Tunnel, Goethals Bridge, and Outerbridge Crossing. *See* Michael H. Schuitema, *Road Pricing As a Solution to the Harms of Traffic Congestion*, 34 TRANSP. L.J. 81, 102-03 (2007).

afternoon peak period.[175] The slight results in congestion reduction are probably due to the marginal increase in charges during peak periods. Some argue, however, that the real reason is the lack of alternatives to using the facilities during these hours.[176]

The introduction of a congestion pricing scheme has been one of the main political landmarks of the Bloomberg Administration in its second term. The first attempt was carried out in 2005 with a proposal to charge all vehicles entering Manhattan.[177] This bold proposal was soon dismissed to avoid political backlash.[178]

On May 16, 2006, the U.S. Department of Transportation ("USDOT") announced its new *National Strategy to Reduce Congestion on America's Transportation Network*—a bold and comprehensive initiative to reduce congestion on the nation's roads, rails, runways, and waterways.[179] One major component of the National Strategy is the Urban Partnership Agreement ("UPA"). Under the UPA, USDOT's partner cities would commit to the implementation of "aggressive strategies under the umbrella of the 'Four Ts'—tolling, transit, telecommuting and technology—a combined approach to reducing traffic congestion. The goal is to demonstrate success of this approach in reducing congestion in the short term."[180]

New York City applied to be part of the UPA and was initially shortlisted among the nine cities applying for funding.[181] New York was eligible to receive up to $354 million in federal funding for transit and transportation system improvements[182] to finance the implementation of its congestion pricing scheme set forth in the PlaNYC 2030, Mayor Bloomberg's blueprint for making New York City green.[183]

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175. Press Release, The Port Auth. of N.Y. & N.J., The Early Returns: Port Authority Releases Preliminary Congestion Pricing Data for Bridges, Tunnels and Path, Press Release No. 92-2001 (June 26, 2001), *available at* http://www.panynj.gov/press-room/press-item.cfm?headline_id=74.

176. Schuitema, *supra* note 174, at 103.

177. *See* Sewell Chan, *Driving around Manhattan, You Pay, Under One Traffic Idea*, N.Y. TIMES, Nov. 11, 2005, at B1.

178. Sam Schwartz et al., *supra* note 143, at 591.

179. The plan is available at http://isddc.dot.gov/OLPFiles/OST/012988.pdf.

180. A primer on this strategy is available at http://www.fightgridlocknow.gov/upas.htm.

181. Danny Hakim & Ray Rivera, *City Traffic Pricing Wins U.S. and Spitzer's Favor*, N.Y. TIMES, June 8, 2007, *available at* http://www.nytimes.com/2007/06/08/nyregion/08congestion.html.

182. Mary Peters, U.S. Sec'y of Transp., Remarks on Partnership for New York City, Jan. 14, 2008, *available at* http://www.dot.gov/affairs/peters011408.htm.

183. Editorial, *The Mayor's Ode to Earth Day*, N.Y. TIMES, Apr. 23, 2007, at A18; *see* PLANYC, *supra* note 109.

This time Mayor Michael Bloomberg's proposal put forward a milder congestion pricing scheme to address traffic problems in Manhattan, envisaging to charge $8 for cars and $24 for commercial trucks entering or leaving Manhattan south of 86th Street between 6:00 a.m. and 6:00 p.m. on weekdays.[184] The proposal faced strong political opposition of some state lawmakers and federal funding was conditional upon winning state approval.[185] It was, therefore, decided to subject Bloomberg's congestion pricing scheme to an extensive review carried out by a City-State jointly appointed panel of experts, the New York City Traffic Congestion Mitigation Commission ("Traffic Commission").[186] The Traffic Commission came up with a plan slightly different from the original one.[187] Under the Commission's plan, cars would be charged an $8 fee to drive into the areas of Manhattan south of 60th Street on weekdays between 6:00 a.m. and 6:00 p.m. Trucks would pay $21, except for low-emission trucks, which would pay $7.[188] The City Council approved the new version of the congestion pricing bill proposed by the Commission. However, the plan was defeated by a non-vote of the New York State Assembly, whose approval was necessary to pass the congestion pricing scheme.[189] This also caused the loss of federal funding awarded to the City of New York through the Urban Partnership initiative which was redirected towards the less ambitious plans of Chicago and Los Angeles.[190]

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184. PLANYC, *supra* note 109, at 89; Thomas J. Lueck, *Bloomberg Draws a 25-Year Blueprint for a Greener City*, N.Y. TIMES, April 23, 2007, at B1.

185. *See generally* Nicholas Confessore, *Congestion Pricing Plan Dies in Albany*, N.Y. TIMES CITY ROOM BLOG, (Apr. 7, 2008, 15:01 EST), http://cityroom.blogs.nytimes.com/2008/04/07/congestion-pricing-plan-is-dead-assembly-speaker-says/?hp.

186. *See* https://www.nysdot.gov/programs/congestion_mitigation_commission.

187. *See* Nicholas Confessore, *Spitzer Signs Bill to Put Congestion Pricing Plan on Track*, N.Y. TIMES, July 27, 2007, at B5 (describing a state bill that "create[s] a 17-member commission to consider different plans for reducing traffic congestion in New York, including the pricing scheme favored by Mr. Bloomberg"); William Neuman, *Members Named for Panel Studying Traffic-Cutting Pricing Plan*, N.Y. TIMES, Aug. 22, 2007, at B2; *see also* William Neuman, *New York to Get U.S. Traffic Aid, but with Catch*, N.Y. TIMES, Aug. 15, 2007, at B1.

188. TRAFFIC CONGESTION MITIGATION COMM'N, REPORT TO THE TRAFFIC CONGESTION MITIGATION COMMISSION & RECOMMENDED IMPLEMENTATION PLAN 64 (Jan. 31, 2008), *available at* https://www.nysdot.gov/programs/repository/TCMC-Final-Report.pdf [hereinafter FINAL REPORT].

189. *See generally* Confessore, *supra* note 185.

190. *See* Nicholas Confessore, *$8 Traffic Fee for Manhattan Gets Nowhere*, N.Y. TIMES, Apr. 8, 2008, at A1, *available at* http://www.nytimes.com/2008/04/08/nyregion/08congest.html; Jennifer 8. Lee, *Chicago Gets New York's Congestion Money*, N.Y. TIMES CITY ROOM BLOG, (Apr. 29, 2008, 15:29 EST), http://cityroom.blogs.nytimes.com/2008/04/29/chicago-gets-new-yorks-congestion-money/.

d. Milan

Milan has recently adopted a cordon-style congestion pricing scheme, effective as of January 2, 2008.[191] Milan's council passed a pollution/congestion traffic regulation, called "Ecopass," aimed mainly at tackling Milan's serious air quality issues, rather than its congestion problems.[192] Under the Milan Ecopass Scheme ("MES"), any vehicle entering the MES Limited Traffic Zone ("LTZ"), Milan's central business district, between 7:30 a.m. and 7:30 p.m. from Monday to Friday, must pay for and display an Ecopass ticket.[193] The MES charges levy from €2-10, on a sliding scale of engine types. The most polluting vehicles, as determined by the GHG emission standards of the vehicle, the fuel type, and the presence of filters, are charged the most.[194] The nature of transport (personal or commercial) is also a factor in determining the fee. In other words, the "least polluting" vehicles will pay €2 a day, while the most polluting vehicles pay €10 to enter the LTZ. Low-emissions (Euro 4-5 diesel cars and Euro 3-4-5 gasoline cars) and electric, hybrid, LPG, or methane vehicles are exempt from paying a fee, whereas older vehicles (gasoline or diesel pre-Euro emissions standards) do not have access to the LTZ at all.[195] Additionally, Milan's congestion pricing scheme contemplates a multiple-entry pass (fifty days of access, not consecutive, at a reduced price), as well as a fixed annual fee of up to €250 for residents of the LTZ.[196] As for technology and the enforcement strategy, access to the LTZ is monitored at forty-three gates, equipped with electronic cameras reading vehicles plates, that debit the card holder's account or issue fines of €70 to offenders.[197]

Milan's mayor, Letizia Moratti, targeted a 30% cut in pollution levels and a 10% reduction in traffic.[198] Accordingly, MES was primarily intro-

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191. Ken Belson, *Toll Discounts for Going Green*, N.Y. TIMES, Jan. 27, 2008, at AU, *available at* http://www.nytimes.com/2008/01/27/automobiles/27GREEN.html.

192. Richard Owen, *Congestion Fee Leaves Milan in a Jam*, TIMES ONLINE, Jan. 3, 2008, http://www.timesonline.co.uk/tol/news/world/europe/article3123679.ece.

193. BBCNews.com, Milan Introduces Traffic Charge, Jan. 2, 2008, http://news.bbc.co.uk/2/hi/europe/7167992.stm.

194. Lucia Rotaris et al., *The Urban Road Pricing Scheme to Curb Pollution in Milan, Italy: Description, Impacts and Preliminary Cost–Benefit Analysis Assessment*, 44 TRANSP. RES. PART A: POL'Y & PRAC. 359, 360-62 (2010); Marco Bertacche, *Milan Introduces Congestion Charge to Cut Pollution*, N.Y. SUN, Jan. 3, 2008, *available at* http://www.nysun.com/foreign/milan-introduces-congestion-charge-to-cut/68854/.

195. *See* Ecopass Factsheet at 6, *available at* www.milieuzones.nl/documents/ecopass brochureinglese.pdf.

196. Owen, *supra* note 192.

197. *See* Ecopass Factsheet, *supra* note 195, at 3.

198. BBCNews.com, *supra* note 193.

duced to address air pollution, rather than congestion.[199] As described above, under the MES, cars are charged according to the vehicle GHG emission standard, with little or no differentiation based on congestion levels.[200] In the first nine months after the introduction of the MES, PM_{10} values were abated by 19%, NO_x by 14%, and CO_2 by 15%, while congestion dropped only 3.6% within the MES area, and 12.3% outside the MES area, with a 14.2% reduction in the number of vehicles entering the LTZ.[201] From an environmental standpoint, MES air emissions improvements are similar to those obtained in London (-16%, -13.4% and -16%, respectively), whose congestion charge scheme is aimed at tackling congestion rather than environmental externalities.[202] As in the London case, no further improvements have been registered so far.[203] Traffic levels are slowly returning to the pre-Ecopass levels.[204] This is partly attributable to the fact that the the number of exempted vehicles entering the LTZ has grown exponentially (18.8%) due to the MES exemptions incentive to vehicular rejuvenation.[205] Even initial environmental benefits seem to show some setback.[206] The recent decision to extend the MES as it is, with the exemption for Euro 4 diesel and other non zero-emission vehicles until December 2010, might contribute to further decline of the initial environmental benefits.[207]

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199. Michael Day, *Milan 'is Pollution Capital of Europe'*, DAILY TELEGRAPH, Mar. 7, 2008, *available at* http://www.telegraph.co.uk/earth/earthnews/3335208/Milan-%27is-pollution-capital-of-Europe%27.html.

200. Lucia Rotaris et al., *The Urban Road Pricing Scheme to Curb Pollution in Milan, Italy: Description, Impacts and Preliminary Cost–Benefit Analysis Assessment*, 44 TRANSP. RES. PART A: POL'Y & PRAC. 359, 360-62 (2010).

201. Lucia Rotaris et al., *The Urban Road Pricing Scheme to Curb Pollution in Milan: A Preliminary Assessment* 8 (Univ. of Trieste, Dep't of Econ. & Statistics, Working Paper No. 122, 2009), *available at* http://www2.units.it/nirdses/sito_inglese/working%20papers/files%20for%20wp/wp122.pdf; *see also* AGENZIA MOBILITÀ AMBIENTE E TERRITORIO, MONITORAGGIO ECOPASS: PRIMO SEMESTRE 2009 INDICATORI SINTETICI 4, 13-38 (2009), *available at* http://www.comune.milano.it/dseserver/ecopass/report.html (follow "Ecopass - I resultati del primo semestre 2009" hyperlink).

202. Rotaris et al., *supra* note 201, at 8.

203. AGENZIA MOBILITÀ AMBIENTE E TERRITORIO, *supra* note 201, at 5.

204. Alex Roe, *Milan's Ecopass Concerns*, BLOG FROM ITALY: LIFE IN THE LIVING MUSEUM, Jan. 22, 2009, http://www.blogfromitaly.com/milans-ecopass-concerns/.

205. AGENZIA MOBILITÀ AMBIENTE E TERRITORIO, *supra* note 201, at 10.

206. Alex Roe, *Milan's Ecopass Saga Continues*, BLOG FROM ITALY: LIFE IN THE LIVING MUSEUM, Mar. 23, 2009, http://www.blogfromitaly.com/milans-ecopass-saga-continues/.

207. Gianni Santucci, *Cede L'effetto-Diga, 7 Mila Auto in Più*, CORRIERE DELLA SERRA, Jan. 12, 2009, *available at* http://milano.corriere.it/milano/notizie/cronaca/09_gennaio_12/ecopass_auto_aumentano-150890417368.shtml.

2. Quantity Instruments

a. Tradable Permits

Tradable permits have already been implemented to address several environmental issues all around the world.[208] Studies on their potential use in the transport sector, however, have begun only recently. Haynes C. Goddard, among the first scholars to support the use of tradable vehicle use permits to control mobile emissions from road usage, advanced the adoption of permits as an instrument to guarantee a predetermined air quality goal through a cost-effective and politically palatable instrument.[209] He suggested that the introduction of a pre-fixed, total number of "tradable vehicle use permits" would allow the regulator to achieve the pursued air quality standard.[210] The number of permits would be determined as a function of prefixed pollutants' concentrations levels, and such permits would be allocated to the existing vehicle population for free (grandfathering), in a one-off distribution round.[211] Goddard's proposal contemplates different types of perpetually valid permits: "base permits" would allow vehicle use on designated days under any air quality conditions; "interruptible permits" could allow the regulator to suspend a permit-holder's right to use her vehicle under particularly poor air quality conditions; and "temporary permits," sold at a fixed price, would allow unanticipated vehicle use and travel to and from areas outside the city.[212]

Erik Verhoef, Peter Nijkamp, and Piet Rietveld explored more extensively the possible implementation of tradable permits to regulate road transport externalities and suggested both supply-side (automobile and fuel industry) and demand-side (user-oriented) strategies to tackle environmental or congestion externalities.[213] Besides the user-oriented schemes tackling vehicle ownership, they considered four innovative schemes to tackle

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208. THOMAS TIETENBERG, EMISSIONS TRADING: AN EXERCISE IN REFORMING POLLUTION POLICY (1985); *see also* ORG. FOR ECON. CO-OPERATION & DEV., TRADEABLE PERMITS: POLICY EVALUATION, DESIGN AND REFORM (2004).

209. *See generally* Haynes C. Goddard, *Promoting Urban Sustainability: The Case for a Tradable Supplementary Licence System for Vehicle Use*, 36 URB. STUD. 2317 (1999) [hereinafter Goddard, *Promoting Urban Sustainability*]; Haynes C. Goddard, *Using Tradeable Permits to Achieve Sustainability in the World's Large Cities*, 10 ENVTL. & RESOURCE ECON. 63 (1997) [hereinafter Goddard, *Tradeable Permits*].

210. *See* Goddard, *Tradeable Permits*, *supra* note 209, at 81-82.

211. *Id.*

212. *Id.* at 82.

213. *See generally* Erik Verhoef et al., *Tradable Permits: Their Potential in the Regulation of Road Transport Externalities*, 24 ENV'T & PLAN. B: PLAN. & DESIGN 527 (1997).

road-usage externalities (hereinafter "Verhoef schemes"):[214] (1) tradeable permits driving day rights ("TDDR");[215] (2) restricting the number of miles cars are allowed to drive through a tradable vehicle-miles scheme ("TVM");[216] (3) a system of tradable fuel permits ("TFP") as a "regulation of non-localized and time-independent externalities"—strongly suggested to address environmental externalities;[217] and (4) tradable road-pricing smart cards ("TRPS") to address congestion externalities.[218] Under the TRPS scheme, a road user would be assigned a certain number of smart card units and her car would be equipped with a meter ticking off a certain quantity of units per mile driven on the basis of the time and the area of driving.[219]

As in Goddard's proposal, Verhoef schemes would provide an initial grandfathering of the existing vehicle population to avoid political backlash and the possibility for non-holders of tradeable road-usage permits to get temporary driving rights at a prefixed price.[220] However, unlike Goddard's scheme, which contemplated "perpetual" permits, Verhoef schemes envisage an annual validity for permits and therefore yearly rounds of permit reallocation.[221] Furthermore, to enhance the fairness and equity of such schemes, Verhoef subdivides permits into different categories, providing vulnerable groups of road users such as elderly, low-income, and disabled motorists with reserved permit quotas.[222] Both Goddard and Verhoef schemes can therefore be considered hybrid schemes because they provide for some quantitative flexibility through the temporary, fee-based road usage.

Along the same lines, Charles Raux carried out an extensive review of several tradable-permit schemes aimed at addressing mainly road usage environmental externalities. He differentiated such schemes on the basis of the potential targets of tradable permits.[223] As a matter of fact, a marketa-

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214. *Id.* at 534.
215. *Id.* at 537.
216. *Id.*
217. *Id.* at 538.
218. *Id.* at 538-39.
219. *Id.*
220. *Id.*
221. *Id.*
222. *Id.*
223. RAUX, *supra* note 121. Raux's previous work in this area is also instructive. *See* Charles Raux, *The Use of Transferable Permits in the Transport Sector*, *in* IMPLEMENTING DOMESTIC TRADABLE PERMITS: RECENT DEVELOPMENTS AND FUTURE CHALLENGES (OECD ed., 2002); Charles Raux, *The Use of Transferable Permits in Transportation Policy*, 9 TRANSP. RES. PART D: POL'Y & PRAC. 185 (2004) [hereinafter *Transferable Permits*]; Charles Raux, *Tradable Driving Rights in Urban Areas: Their Potential for Tackling Con-*

ble traffic or congestion-allowance scheme may be designed to target different factors contributing to the tragedy of urban roads.[224] First, the scheme could target the technical characteristics of vehicles (e.g., energy source, vehicle unit consumption, and pollutant emissions).[225] In Europe, vehicle unit emissions are categorized into the so-called Euro standards.[226] Such standards could represent the basis for establishing regulation that addresses the intensity of vehicle use based on the relevant pollutants emissions class. Under such a scheme, the number of rights required to use a vehicle would be allocated according to the vehicle's emissions category.

Second, the scheme could target ownership of vehicle use—a scheme of car-ownership rationing would subject purchase of a new car to auctions of a limited number of Certificates of Entitlement ("COE"s).[227] The number of COEs would be fixed each year on the basis of traffic conditions and road capacity, and COEs would be issued each month. Quantity and control of ownership is considered "a useful instrument since automobile demand is inelastic and the social cost function is steep."[228]

Third, the scheme could target the intensity of vehicle use by aiming a tradable-permits scheme toward car usage. This type of scheme may foresee the allocation of tradable quotas by trips or by vehicle-kilometers to motorists within a given urban area.[229] Allocation of the allowances would be made in favor of the "inhabitants of the urban zone" and would be "distributed free of charge equally between all the inhabitants."[230] The regulating entity would sell unallocated tradable driving rights ("TDR"s) to motorists who live outside the urban zone, to business users (e.g., freight, tradesmen, doctors, etc.), and to those TDR holders who have consumed their TDR allotment. As to trading, "rights which are not allocated free of

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gestion and Traffic Related Pollution, *available at* http://halshs.archives-ouvertes.fr/halshs-00185012/fr/; Charles Raux & Grégoire Marlot, *A System of Tradable CO_2 Permits Applied to Fuel Consumption by Motorists*, 12 TRANSPORT POL'Y 255 (2005).

224. *See* RAUX, *supra* note 121, at 10-17.

225. *Id.* at 11.

226. *See* Raux, *Transferable Permits*, *supra* note 223, at 10 ("Between the Euro IV standard and Euro I standard the permitted levels for HCs and NOx, vary in a ratio of one to ten for petrol vehicles and one to three for diesel vehicles. Particulate emissions standards have so far only been imposed on diesel vehicles (a ratio of one to six between Euro IV and Euro I) but the Euro V standard, which was under discussion at the end of 2007, will introduce limits for petrol vehicles too.").

227. *Id.* at 11.

228. *See* RAUX, *supra* note 121, at 11; Anthony Chin & Peter Smith, *Automobile Ownership and Government Policy: The Economics of Singapore's Vehicle Quota Scheme*, 31 TRANSP. RES. PART A: POL'Y & PRAC. 129 (1997).

229. RAUX *supra* note 121, at 11-12; Verhoef et al., *supra* note 213, at 535-40.

230. RAUX, *supra* note 121, at 31.

charge would be sold at a price fixed by the agency, the same price at which the agency would buy back unused rights."[231]

Fourth, the scheme could target land use through location of activities and their impact on distances traveled. To keep a leash on urban sprawl, some proposals apply tradable permits to real estate developers based on travel volumes that development projects will generate, or "performance zoning."[232] In order to do this, it would be necessary to identify traffic sources such as shopping centers, industrial, or small business zones. This scheme poses several market design problems, particularly with regard to minimizing transaction costs and making trading possible, not only within a suburb or real estate development, but also between different suburban areas and other real estate developments.

Finally, the last scheme would target end-user fuel consumption.[233] Under such a scheme, each user would be awarded a tradable quota of CO_2 which would be calculated based on the carbon contained in the fuel consumed by the end user (e.g., 900 litres per car per year). For any given quantity of fuel the road user would like to buy, he would be obliged to hand over to the regulating entity the corresponding amount of fuel consumption rights quotas.[234] Fuel rights would be allocated for free at the commencement of the scheme to every car owner or every citizen. Trading would be left to the "full market" where "those rights which are not allocated freely being auctioned" or "rights would be sold at a price fixed by the authority and at which the authority would buy back unused rights."[235] The allocation of allowances would be valid for one year. Each subsequent year, the CO_2 equivalent value of quotas held by each TDR holder would be reduced by the rate of CO_2 reduction established by the regulating authority. At the start of the scheme, each permit holder would obtain "a free allocation amounting to several weeks of rights."[236] Subsequently, the permit holder would receive rights for a period of seven days at the start of each week.[237]

Among all of these different schemes, Raux put more stress on the tradable fuel consumption rights ("TFR"s) and on the TDRs. He seems to be

231. *Id.*

232. John R. Ottensmann, *Market-Based Exchanges of Rights Within a System of Performance Zoning*, PLAN. & MARKETS (1998).

233. RAUX, *supra* note 121, at 18, 23.

234. *Id.* at 12.

235. *Id.* at 20.

236. *Id.* at 32.

237. *Id.* at 32.

strongly in favor of the former at the national level.[238] Nevertheless, in urban areas Raux considers essential the implementation of a TDR scheme. He considers TDRs crucial to targeting congestion and atmospheric pollution without incurring all the fairness concerns raised by pure pricing schemes, especially where the initial allocation allowance is made through grandfathering.[239]

Once the target is fixed, the design of a tradable-driving-permits scheme entails implementation of a large array of other features. First, the kind of technology applied in the design of the scheme is very important. The most mature technology is roadside electronic toll collection, which is based on an on-board electronic tag which uses dedicated short range communications to interface with roadside readers.[240] A second type of toll collection technology, based on a vehicle positioning system which uses satellites, is also becoming a viable solution.[241]

In order to design these specifications, further issues must be addressed. First, the unit to be traded must be determined. This might consist of driving rights or car ownership rights. It should be possible to distinguish these driving rights on the basis of space and time (congestion) and according to emissions levels (pollution). It must also be decided which regulated entities will hold and trade such rights and be obligated to return them on the basis of their car emissions or usage. This can consist of motorists or inhabitants. If the allocation of rights is free, inhabitants would receive compensation for the consequences of congestion and pollution. This would include those who drive a little or not at all, pedestrians, and public transport users. Expanding those included to people other than motorists would improve the political viability of the scheme.

The allocation criteria must also be addressed. Should these rights be allocated free of charge, or should they be allocated through an auction? The latter is a more efficient solution because it reveals the preferences of road users allocating the right upon those who value their use the most. It also creates revenue flow. As for congestion pricing, however, it also increases the financial burden on the regulated entities. This would minimize the political viability advantage that driving/ownership rights could have over congestion pricing. The median voter solution would be to allocate some

238. *Id.* at 12.

239. *Id.* at 34.

240. PRADEEP K. GULIPALLI ET AL., CREDIT-BASED CONGESTION PRICING: EXPERT EXPECTATIONS AND GUIDELINES FOR APPLICATION 7 (2008).

241. Lu Saijieet al., *Design of Electronic Toll Collection System Based on Global Positioning System Technique*, *in* COMPUTING, COMMUNICATION, CONTROL, AND MANAGEMENT 350 (2009).

of the quotas free of charge as a visible and immediate compensation in order to smooth political opposition.

The period of validity of the quotas and the quota payment obligations must also be addressed. These parameters must be fixed in a way that maintains incentives to reduce consumption of driving rights, particularly during congested periods, and to reduce pollutant emissions.

The last issue that must be addressed is how to deal with "border effects," particularly the access of occasional users and the anticipation of unforeseen behaviors which might undermine the effectiveness of the program (e.g., market power).

The next section addresses single experiences that might have some of the features of a proper tradable driving or ownership-allowances scheme.

i. Singapore Vehicle Ownership Quota Scheme

Singapore designed a Vehicle Quota System ("VQS") to control and limit the growth of its automobile population. VQS was introduced in May 1990 and requires any person interested in owning a vehicle (except for buses and emergency vehicles) to obtain a certificate of entitlement ("COE").[242] The system is managed by the Land Transport Authority ("LTA"). Pre-existing vehicles were grandfathered in and automatically received a COE.[243] For new cars, the LTA annually fixes the number of vehicles allowed for registration and revises that figure based on the number of de-registered cars and traffic conditions.[244] The allowable annual growth rate was fixed at 3% in 1990 and reduced to 1.5% in 2009.[245] The quota may be set by vehicle category and allocated to each vehicle category in proportion to that category's share of the total vehicle population.[246]

The market determines the price of owning a vehicle.[247] Indeed, buyers of new vehicles must place a bid for a COE in the competitive monthly tender auctions.[248] Each bid shall contain an economic offer for the right to

242. Lew & Leong, *supra* note 137, at 17.

243. Anthony Chin & Peter Smith, *Automobile Ownership and Government Policy: The Economics of Singapore's Vehicle Quota Scheme*, 31 TRANSP. RES. PART A: POL'Y & PRAC. 129, 135 (1997).

244. STEPHEN PERKINS, CHARGING FOR THE USE OF ROADS: POLICIES AND RECENT INITIATIVES 12 (2004).

245. Lew & Leong, *supra* note 137, at 17.

246. Sing-Fat Chu et al., *Expectations Formation and Forecasting of Vehicle Demand: An Empirical Study of the Vehicle Quota Auctions in Singapore*, 38 TRANSP. RES. PART A: POL'Y & PRAC. 367, 369-71 (2004).

247. *See id.*

248. *See id.*

own a vehicle in a particular category.[249] Under the previous sealed-bid auction system, bids were ranked from the highest to the lowest, and the COE price paid by each successful bidder was equal to the lowest successful bid price.[250] Following government reform of the VQS in May 2002, the auction system switched to an ascending online open-bid format in several phases. Auctions are at the beginning and middle of each month.[251] The COE is valid for ten years as of the date that the vehicle is registered.[252] At the end of this period, the COE holder may either de-register the vehicle or renew the license for an additional five-year or ten-year period by paying a "prevailing quota license premium."[253] For early de-registration, the COE holder is entitled to a rebate, which is calculated according to the COE premium that the owner paid and prorated by the number of months remaining on the ten-year registration.[254] Under the previous regulation, car owners could only use the rebates to offset a new car purchase, but as of September 2008, car owners are allowed to cash in the rebates. This change is intended to encourage car owners to switch to public transport.[255]

Values of COEs exceed the cost of new cars by several times.[256] Adding the price of a COE to other elements—such as import duty, registration fees, and annual road tax based on engine capacity—the total cost of car ownership in Singapore amounts to four-and-a-half to five times the actual cost of the vehicle.[257] The price of driving in Singapore is made even steeper by the real dynamics of VQS. In theory, each car buyer is first supposed to bid for a VQS license, and then place an order after the license is obtained. In practice, car dealerships often bid for VQS licenses on behalf of car buyers and then sell the car in a "bundled package" that includes a "subsidized" quota license.[258] Dealerships are also allowed to raise car prices where substantial fluctuations in the license premiums occur.

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249. *See id.*

250. *See id.*

251. *See id.*

252. *See* David O'Connor, *Applying Economic Instruments in Developing Countries: From Theory to Implementation*, 1 ENV'T & DEV. ECON. 91 (1999).

253. Chu et al., *supra* note 246, at 369-71.

254. Sun S. Han, *Managing Motorization in Sustainable Transport Planning: The Singapore Experience*, 18 J. TRANSP. GEOGRAPHY 2 (2010).

255. *Id.*

256. PERKINS, *supra* note 244, at 12.

257. O'Connor, *supra* note 252, at 14.

258. *Id*.

Under the initial 1990 VQS configuration, COEs used to be transferable before being used to purchase a vehicle.[259] The secondary market for COEs served as a device to regulate demand. Indeed, transferability is important from the social welfare perspective as it makes the allocation of COEs more flexible.[260] With licence transferability, unsuccessful bidders in strong need of a COE could purchase a COE from a successful bidder willing to sell. For example, unsuccessful bidding car dealers who had already signed sales contracts could purchase COEs from the secondary market. At the same time, transferability gave private car owners the choice of using the COE to buy a car or of selling it and switching to other transportation modes.[261] However, quota premiums rose rapidly on the secondary COE market because of speculation. The public blamed the government, which eventually responded[262] by imposing a non-transferability rule in October 1991.[263] Regardless, car dealers and traders are still able to continue trading COEs through the so-called "double transfer."[264] Car dealers continue to submit bids by proxy and register cars under their employees' names when they manage to obtain the COEs. These cars are then sold as second-hand cars, but a letter from the dealer accompanying the sale deed certifies that the second owner is actually the first real owner of the car.[265]

The success of the VQS lies in its ability to control the growth rate of the motor vehicle population.[266] The VQS reached the goal of achieving near-absolute certainty in the maximum number of cars driving on Singapore roads. Unlike strategies of control through taxes and charges, the VQS removes the element of uncertainty associated with vehicle population growth. Between 1975 and 1989, the average annual vehicle population growth rate was 4.4%. Between 1990 and 2002, after the implementation

259. Winston T.H. Koh, *Control of Vehicle Ownership and Market Competition: Theory and Singapore's Experience with the Vehicle Quota System*, 37 TRANSP. RES. PART A: POL'Y & PRAC. 749, 750 (2003).

260. *Id.*

261. *See id.*

262. Sock-Yong Phang et al. *Singapore's Experience with Car Quotas: Issues and Policy Processes*, 3 TRANSPORT POL'Y 145, 148-49 (1996).

263. *Id.*

264. Anthony T.H. Chin, *Containing Air Pollution and Traffic Congestion: Transport Policy and the Environment in Singapore*, 30 ATMOSPHERIC ENV'T 787, 801 (1996).

265. *Id.*

266. Paul A. Barter, *A Vehicle Quota Integrated with Road Usage Pricing: A Mechanism to Complete the Phase-out of High Fixed Vehicle Taxes in Singapore*, 12 TRANSPORT POL'Y 525 (2005).

of the VQS, the vehicle population growth rate plunged to 2.83%.[267] In 2009, it was fixed at 1.5%.[268]

ii. Rome Driving Permits Scheme

Rome urban mobility policy is centered upon a mix of demand management and public transport policies aimed at discouraging car usage. Traffic restrictions in Rome are tailored to the concentric nature of Rome's urban shape and become increasingly stringent toward the historic centre where the alternatives to car use are more accessible.

For more than twenty years, the core strategy in Rome's urban mobility policy has been the introduction of a Limited Traffic Zone (the "LTZ"). The principle governing Rome's LTZ scheme is that not everybody is entitled to access the LTZ. Car access to the LTZ is regulated through a fairly peculiar driving permit scheme. Such permits can be released only to residents, public services, disabled people, freight, and other private users falling within one of the few privileged categories (embassies, international organizations, the Vatican, unions, professional and business associations, political parties, banks and insurance companies, media and newspapers, hotels, craftsmen, and other users individually selected by the Mayor's cabinet) that are allowed to apply for an LTZ permit.[269] Such motorists can be considered as VIP motorists, having the exclusive right to buy or get free access into the LTZ, and they are perceived as such by the other, normal, NIP (as in Not Important Person) motorists.

Today, LTZ permits are subject to the payment of an annual fee. Residents, doctors, craftsmen (i.e. those individuals having a laboratory within the LTZ), and the Vatican pay only €55 for the permit, while all the other privileged users pay an annual fee of €550.[270] Disabled persons are entitled to a free LTZ permit.[271] Such a scheme allows the City of Rome to indirectly control the total vehicle population within the LTZ, although in a

267. Georgina Santos et al., *Transportation Policies in Singapore*, *in* ROAD PRICING: THEORY AND EVIDENCE 209-35 (Georgina Santos, 2004).

268. Lew & Leong, *supra* note 137, at 17.

269. *See* COMUNE DI ROMA, ESTRATTO DAL VERBALE DELLE DELIBERAZIONI DELLA GIUNTA COMUNALE 4 (July 29, 2006) (Deliberation of the Board of City Commissioners), *available at* http://www.comune.roma.it/servizi/sigep/findDelibereGiunta.jsp. After a formal complaint, the Vatican was able to obtain a discount on the permit fee which was lowered from €550 to €55 with the subsequent deliberation. No. 650 dated November 30, 2006, both *available at* www.comune.roma.it.

270. *Id.*

271. *Id.*

very discretional and discriminatory manner: in 2005, the total amount of LTZ permits issued was roughly 150,000.[272]

The original version of the LTZ scheme was launched in 1989 by implementing an access control system that relied on free paper permits and police enforcement employing barricades.[273] The original LTZ applied to an area of 4.6 square kilometers containing 42,000 residents, 12 Ministries and 10% of Rome's business activities, as well as the city's most important archaeological sites.[274] It was effective between 6:30 a.m. and 6:00 p.m. on weekdays and between 2:00 p.m. and 6:00 p.m. on Saturdays. The scheme limited traffic within the LTZ to 8.5% of the existing vehicle population in the city.[275]

In 1996, the City of Rome launched a more comprehensive strategy to integrate the LTZ scheme with other demand management policies, such as parking policies, charges for LTZ access permits, strict monitoring and enforcement of LTZ gates through Intelligent Transport Systems, and restrictions on the most polluting vehicles.[276]

In 2001, the City of Rome unveiled its full-scale electronic access control and flat-fee driving permit scheme ("IRIDE").[277] The scheme covers twenty-three gates and uses a combination of transponders that communicate with smartcards in on-board units and cameras using automated number plate-recognition software.[278]

In Rome, there are around two million cars registered and more than 500,000 motorcycles and scooters.[279] IRIDE restricts LTZ access to 30,000 residents, 30,000 public service motorists, 50,000 disabled drivers, 29,000 other individuals, and 8,000 freight operators.[280] IRIDE achieved a

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272. BERMAN ET AL., *supra* note 138, at 10.

273. *Id.*

274. *Id.*

275. *See* Petros Ieromonachou, Stephen Potter & James Warren, Comparisons of Different Implementation Procedures of Road Pricing Schemes in Two European Countries, Paper Presented at VIII Nectar Conference (June 2-4, 2005), *available at* http://design.open.ac.uk/potter/documents/NECTAR_Ieromonachou.pdf, at 7 ("The total number of plates permitted to access the LTZ represents about 8.5% of the total vehicles in the city."). *See also* Mario Gualdi & Carlo Sessa, *Impacts of Institutional Change on Urban Transport Policy in Rome: An Update*, GERMAN POL'Y STUD. (2002).

276. JOINT OECD/ECMT TRANSP. RESEARCH CTR., *supra* note 138.

277. STEPHEN BENNETT ET AL., COMM'N FOR INTEGRATED TRANSP., WORLD CITIES RESEARCH: REPORT ON COMPARABLE MEDIUM SIZED CITIES 52 (2005), *available at* http://cfit.independent.gov.uk/pubs/2005/worldcities/worldcities/pdf/comparablemediumcitiesfinalreport.pdf.

278. BERMAN ET AL., *supra* note 138, at 10.

279. *Id.*

280. BENNETT ET AL., *supra* note 277, at 50.

decrease of 18,000 vehicles (20%) in Rome's historic center.[281] Traffic delays have fallen by 10% without increasing traffic in non-LTZ areas.[282] The LTZ has also shown marked environmental improvements, with a reported 40% decline in benzene levels and a meaningful reduction in particulates (PM_{10}).[283]

Despite all the improvements, public transport does not represent an attractive alternative to the private car for many commuters and residents. Many riders, rather than using public transport, still prefer to use motorcycles and scooters.[284] Indeed, while only 29.1% of working commuters in New York City use their car to commute, in Rome, 57% still drive to work.[285]

The main failure of Rome's policies is that LTZ permits have been arguably granted to a very narrow array of privileged users who fall in categories selected in a very discretional manner.[286] Public choice would offer a very clear explanation of the logic behind the selection of "VIP users" only.[287] IRIDE does grant "normal users" exceptional and temporary LTZ access rights at a cost of €20 per day, up to a maximum of twenty-eight days per year. But the abnormal number of disabled drivers' permits signals an anomaly that has already raised the eyebrows of the authorities.[288] Another indication that LTZ allocation criteria should be changed is the large number of motorcyclists and scooter riders (400,000-500,000).[289]

One option for Rome is to replace the permits and flat fees with a pure charging scheme applying to all users, on the assumption that such a

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281. Antonio Musso & Maria Vittoria Corazza, *Improving Urban Mobility Management: Case Study of Rome*, 1956 J. TRANSP. RES. BOARD 52-59 (2006).

282. *Id.*

283. Loretta Gratani, Maria Fiore Crescente & Laura Varon, *Long-Term Monitoring of Metal Pollution by Urban Trees*, 42 ATMOSPHERIC ENV'T 8273, 8275 (2008).

284. *See* Ian Fisher, *For Its Motorists, Only Parts of Rome Prove to Be Eternal*, N.Y. TIMES, Sept. 1, 2005, at A3, *available at* http://www.nytimes.com/2005/09/01/international/europe/01rome.html?_r=1&scp=5&sq=rome%20scooters&st=cse.

285. Urban Audit: City Profiles, Roma (2008), http://www.urbanaudit.org/CityProfiles.aspx (select "Italia"; then select "Roma").

286. Guido Gentile, Natale Papola & Luca Persia, *Advanced Pricing and Rationing Policies for Large Scale Multimodal Networks*, 39 TRANSP. RES. PART A: POL'Y & PRAC. 612, 631 (2005).

287. Wyman, *supra* note 136, at 48-56.

288. Marcello Viaggio, *Permessi per Disabili: Il Grimaldello per Aggirare il Pagamento Della Ztl*, IL GIORNALE, July 27, 2009, http://www.ilgiornale.it/roma/permessi_disabili_grimaldello_aggirare_pagamento_ztl/27-06-2009/articolo-id=362089-page=0-comments=1 (reporting disabled drivers permit forgeries and other LTZ rule violations related to disabled drivers' access rights).

289. BERMAN ET AL., *supra* note 138, at 10; Fisher, *supra* note 284.

scheme would be more effective at reducing traffic.[290] To the contrary, the current LTZ access permits rationing system is deemed to be capable of yielding similar welfare-increment and modal-shift effects due to the congestion pricing policy, but at much smaller implementation costs.[291]

In addition, the congestion-pricing option is less socially or politically acceptable than the LTZ scheme. The LTZ driving permit scheme encountered a great deal of public opposition, which was overcome through the persuasive advocacy of community leaders, extensive consultation, and the pressure of national and European environmental policies.[292] Now, after the initial controversy, the LTZ has gained strong support from the public. A survey showed that 75% of residents now approve of the LTZ electronic access control policy; 67.2% feel it has improved the quality of the air; and 64.7% feel that it fosters the modal shift to public transport.[293] Only shopkeepers seem less convinced of LTZ pitfalls, with approval ratios of 53%, 52.5%, and 48.5% respectively.[294] Public acceptability and support is now one of the main strengths of the LTZ permit-rationing system. This is political capital that a forward-looking administration could use to strengthen the LTZ quantity-based approach, by switching from a flat-fare system of driving permits granted in a discriminatory manner to privileged categories of users, to something closer to a cap-and-trade system of driving permits allocating permits through an auction system.

b. Tradable Mobility Credits

Another quantity-based strategy to overcome the acceptability issue and the equity concerns of congestion pricing relies upon a "mobility rights" scheme.[295] It is a hybrid system of prices and permits. Under such a scheme each local taxpayer receives a free monthly allotment of mobility rights that she can use either to drive her car in an area subject to congestion charging, or to ride public transport and alternative transport modes. Each travel mode is weighed differently based on its marginal cost. Thus, driving the car would consume the initial endowment of mobility rights faster than riding public transports, thereby providing an incentive to shift to public transport.[296] The assignment of mobility rights to individuals ra-

290. Ieromonachou, Potter & Warren, *supra* note 275, at 6-7.

291. Gentile, Papola & Persia, *supra* note 286; Musso & Corazza, *supra* note 281.

292. BENNETT ET AL., *supra* note 277, at 50.

293. *Id.* at 52-53.

294. *Id.* at 53.

295. José M. Viegas, *Making Urban Road Pricing Acceptable and Effective: Searching for Quality and Equity in Urban Mobility*, 8 TRANSPORT POL'Y 289, 292 (2001).

296. *Id.*

ther than cars would address equity and fairness concerns, as it would avoid the creation of a "market power" for those "rich enough to own more than one car."[297]

In 2005, Kara M. Kockelman and Sukamar Kalmanje proposed a scheme based on the idea of tradable emissions credits applied to road congestion, entitled "Credit-Based Congestion Pricing."[298] Such a scheme entails congestion pricing on a network of urban highways. Residents of a prescribed area are each granted a monthly endowment of travel credits, which could be used to travel on a road network or within a congestion charge area;[299] those who drive less than average can save the credit for future travel or exchange it for cash.[300] Motorists would receive a monthly allotment in the form of credits (usually monetary credits), and motorists would therefore have nothing to pay if they did not consume their monthly allowance.[301] Motorists who used more than the initial allocation would be subjected to the congestion charging regime.[302]

Credit-based congestion schemes are quantity instruments despite the apparent pricing nature. The total amount of mobility credits can indeed be fixed in advance by the regulator. It is the government that answers the "how much" question. Peter Jones imagined a system which mimics a credit-based tradable pollution permit regime:

> [C]ar owning residents living within the charged area and other selected population groups might be given a number of free Travel Units per month (either using smartcard debiting system, or through an account held by each person). Additional units could be purchased at the standard rate or at a discounted rate (though in principle there could be differences here according to category of user). By taking the idea further and making these free Travel Units available to residents (with and without a car) and

297. *Id.* at 293.

298. Kara M. Kockelman & Sukumar Kalmanje, *Credit-Based Congestion Pricing: A Policy Proposal and the Public's Response*, 39 TRANSP. RES. PART A: POL'Y & PRAC. 671-90 (2005) [hereinafter *A Policy Proposal*]; *see also* Pradeep K. Gulipalli & Kara M. Kockelman, *Credit-Based Congestion Pricing: A Dallas-Fort Worth Application*, 15 TRANSPORT POL'Y 23 (2008) [hereinafter *A Dallas-Fort Worth Application*]; Pradeep K. Gulipalli, Sukumar Kalmanje & Kara M. Kockelman, *Credit-Based Congestion Pricing: Expert Expectations and Guidelines for Application*, Paper Presented at the 84th Annual Meeting of Transportation Research Board, Washington, D.C. (Feb. 2008) [hereinafter *Expert Expectations*], *available at* www.ce.utexas.edu/prof/kockelman/public_html/TRB05CBCP.pdf.

299. *Id.*

300. *A Policy Proposal*, *supra* note 298, at 672.

301. *Id.*

302. *Id.*

> openly tradeable, then there would be a further redistribution mechanism from the rich to the poor.[303]

Some cases in the United States and around the world present several similarities with credit-based congestion pricing schemes. It is worth paying a closer attention to some of them in the following sub-sections.

i. Car Cash-Out Programs in the United States

Car cash-out programs entail paying households to stop or diminish use of cars for a certain period of time, or indefinitely. The strength of such a strategy lies within the incentive for households to change travel behaviors and push them toward alternative modes of transport, such as transit, carpool, cycling, or walking. Seattle has adopted a cash-out strategy (that closely resembles credit-based congestion schemes) relying on incentives and subsidies to give up cars and offering mobility credits to commuters.[304] There are two different programs that incentivize the modal shift from solo-car-driving to public transport or car-sharing. The first program is called One Less Car Challenge. Under this program, participants sell or donate their cars and commute by biking, busing, carpooling, car-sharing, taking taxi rides, or walking. In exchange for this modal shift, participants in the program receive $200 toward a transit pass or bike gear, a $100 discount at a local organic food store, and free memberships to bikers' associations.[305] The second incentive program, Commuter Cash, awards a credit of up to $60 in cash to commuters that reduce their drive alone by commuting at least two days per week on average for at least two months.[306] Participants also receive a $50 discount toward a Zipcar car-sharing service membership.

Atlanta has introduced the "Cash for Commuters" program within the framework of a Clean Air Campaign.[307] The program dynamics are similar to the Seattle program in that they involve a mobility credit to driver-only commuters willing to switch to another mode. Participants can earn $3 a

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303. Peter Jones, *Urban Road Pricing: Public Acceptability and Barriers to Implementation*, *in* ROAD PRICING, TRAFFIC CONGESTION AND THE ENVIRONMENT: ISSUES OF EFFICIENCY AND SOCIAL FEASIBILITY 263, 277 (Kenneth J. Button & Erik T. Verhoef eds., 1998).

304. Patrick DeCorla-Souza, *Recent U.S. Experience: Pilot Projects*, *in* 9 RESEARCH IN TRANSPORTATION ECONOMICS: ROAD PRICING: THEORY AND EVIDENCE 283, 284 (Georgina Santos ed., 2004).

305. *See* City of Seattle, Take the One Less Car Challenge!, http://www.seattle.gov/waytogo/onelesscar.htm (last visited May 26, 2010).

306. The SDOT Blog, One More Reason for One Less Car, http://sdotblog.seattle.gov/2009/11 (Nov. 23, 2009, 12:09 CST).

307. CTR. FOR TRANSP. & THE ENV'T, THE CLEAN AIR CAMPAIGN CASH FOR COMMUTERS PROGRAM: REPORT ON NOVEMBER 2004 FOLLOW-UP SURVEY 2 (2005).

day for three months—up to $100—by choosing and using an eligible alternative mode of transportation.[308] The Clean Air Campaign, which runs the program, estimated that about 29,000 commuters have participated since the program started in 2002.[309] Cash for Commuters eliminated an estimated 32.8 million vehicle miles of travel.[310] A survey by the Center for Transportation and the Environment showed that 64% of Atlanta participants still use those alternatives at least once a week, nine months to a year after the cash stops flowing.[311]

A more comprehensive car cash-out strategy has been implemented in the Washington, D.C. metropolitan area during the replacement works of the Woodrow Wilson Bridge, which spans the Potomac River between Virginia and Maryland and therefore represents a major commuter artery in the D.C. area. The program was called "Bridge Bucks" and was a one-year pilot program aimed at lessening congestion during the most crucial phase of the Wilson Bridge re-construction project (also fully replacing 12% of the Capital Beltway). Under Bridge Bucks, participants received cash for not using their cars and switching to alternative travel modes better suited to their particular lifestyle, whether train, bus, or vanpool.[312] The program was open to drivers passing through part of the project corridor in their commute to work or school.[313] But only the first 1,000 applying commuters (500 from Virginia and 500 from Maryland), could qualify for a $50 monthly credit "in the form of Metro passes or bus passes."[314] Bridge Bucks sold out in Maryland and almost hit a ceiling in Virginia.[315] Unspent money went "to vanpool operators to subsidize the riders' fares."[316]

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308. *See* The Clean Air Campaign, http://www.cleanaircampaign.org/Earn-Cash.-Win-Prizes; *see also* Cash for Commuters, http://www.commuterrewards.com/Cash-for-Commuters.

309. Emma Brown, *Cash Incentives for Carpooling to Get a Trial Run in D.C. Area*, WASH. POST, July 8, 2009, at B02, *available at* http://www.washingtonpost.com/wp-dyn/content/article/2009/07/07/AR2009070702520.html.

310. *Id.*

311. *Id.*

312. *See Ridesharing Initiative is Driven by 'Mission Possible' Outreach Campaign*, CONNECTIONS (Woodrow Wilson Bridge Project, Alexandria, V.A.), Issue 25/Spring 2004 [hereinafter CONNECTIONS], *available at* http://www.wilsonbridge.com/images/stories/pdf/newsletters/connections-04spring.pdf..

313. Steven Ginsberg, *Plan to Pay Motorists to Get Off Bridge: Wilson Officials Hope to Ease Jams*, WASH. POST, Jan. 8, 2004, at B1.

314. CONNECTIONS, *supra* note 312.

315. JOHN UNDELAND, MOVING THE NEEDLE: QUANTIFIABLE SUCCESSES IN RAISING AWARENESS AND CHANGING ATTITUDES FOR THE WOODROW WILSON BRIDGE PROJECT 13 (2005), http://www.wwblessonslearned.com/pdf/LP08B_Celebrating_Successes_Bridge_Bucks_PowerPoint.pdf.

316. Ginsberg, *supra* note 313.

The program cost $745,000.[317] Transit economics scholars seem to have built programs like Bridge Bucks on sound theoretical models.[318]

Building on Atlanta's Cash for Commuters and Bridge Bucks, the Metropolitan Washington Council of Governments has recently launched a new program called "Pool Rewards."[319] Under this program, commuters along three congested corridors are eligible to earn $2 a day for three months—up to $130—by sharing rides to work.[320]

ii. Genoa

In 2006, Genoa launched an experiment on a credit trading scheme that was still being studied as of 2008.[321] Every citizen would receive an amount of mobility credits in proportion to her own mobility needs to get access to the city center.[322] The quantity of credits may vary depending on the kind of vehicle, time, day, season, area, and level of emissions.[323] Commuters that only partially consume the awarded mobility credits may trade back the extra credits to the City in exchange for other services, such as public-transport subsidies.[324] Those who totally consume their credits may commute by public transit instead of driving or buy new credits.

The mobility credits mechanism allows citizens to pay only for their actual driving. The trial period showed a possible 15% reduction in the number of trips and 20% reduction in pollution (CO_2, CO, PM_{10}).[325]

V. LAW, ECONOMICS AND THE POLICY OF URBAN CONGESTION

This Article has focused so far on the legal and economic aspects of the tragedy of urban roads to better understand which regulatory approach—

317. *Id.*

318. Jeffrey L. Adler et al., *A Multi-Agent Approach to Cooperative Traffic Management and Route Guidance*, 39 TRANSP. RES. PART B: POL'Y & PRAC. 297, 318 (2005).

319. Lisa Rein, *Program to Offer Cash Incentives for Carpooling to Work*, WASH. POST, Oct. 26, 2009, *available at* http://www.washingtonpost.com/wp-dyn/content/article/2009/10/26/AR2009102602647.html.

320. Brown, *supra* note 309; *see also* Commuter Connections, Metro. Wash. Council of Gov'ts, 'Pool Rewards: Cash for Carpools, http://www.mwcog.org/commuter2/commuter/ridesharing/PoolRewardsProgram.html (last visited Apr. 28, 2010).

321. Davide Fiorello et al., A System Dynamics Model of Mobility Vouchers for Implementing Urban Road Pricing, Paper Presented at the 2008 REAL CORP Conference on Mobility Nodes as Innovation Hubs, at 548 (May 19-21, 2008), *available at* www.corp.at/corp_relaunch/papers_txt_suche/CORP2008_24.pdf.

322. *Id.*

323. *Id.*

324. *Id.*

325. *Id.* at 550.

price-based or quantity-based regulation—is best suited to address the externalities produced by urban congestion. However, if close attention is not paid to some pre-conditions, such as improving urban transit policies and inverting sprawling land-use patterns, even the most brilliant regulation is going to fail. Thus, an integrated approach is needed, one similar to the one the European Union is taking, that combines the urban planning, urban transit innovation, and funding policies within the urban mobility regulatory framework. In the next sections I will show what land use and urban transit policies can do to help improve the effectiveness of urban congestion regulatory schemes and how the European Union is combining these tools in an integrated urban mobility policy.

A. Land Use Tools

In designing the best regulatory framework for urban congestion, one should think of roads as a network, whose efficiency, particularly the agility with which the traffic is able to flow through its arteries, is limited by environmental characteristics and capacity.[326] Roads are the river in which the traffic stream flows. Just as is the case in polluted rivers, there are point and non-point sources of pollution. Point sources are each and every car that congests the network and any major developments (e.g., shopping outlets; amusement parks; and any other traffic attractor) that lie on, or close to, the network of roads. One could, however, look at such a phenomenon from a broader perspective and realize that municipalities or suburbs which are linked to the network are actually non-point sources. The notion of non-point sources of pollution—although not specified in the Clean Water Act ("CWA")—includes any pollution attributable to a diffuse area that cannot be traced to any discrete individual source. Drawing this parallel with water streams as described in the CWA seems to be the best way to explain the terms of the problem of urban congestion—a vast area or region-wide phenomenon which is caused not just by individuals' decision to drive their cars, but rather, and more generally, by those factors enumerated in the previous sections and in particular by the land-use patterns.

It is true, under the CWA, that policy and regulatory tools must be separated into those suited to existing sources and those suited to new sources of urban congestion. Today, new real estate development will not take into account the impact that the gentrification of a new area has on traffic and

326. Giovanni Fraquelli et al., *Regulating Public Transit Networks: How Do Urban-Intercity Diversification and Speed-up Measures Affect Firms' Cost Performance?*, 75 ANNALS PUB. & COOP. ECON. 193, 195 (2004).

roadway congestion. Land use scholars are increasingly paying attention to new techniques in order to minimize such impact.[327] The first tool in the hands of state and local governments is the transit-oriented development.[328] The second option is recourse to all the different bargaining tools (e.g., TDRs, exactions, community benefit agreements, etc.).[329]

"New Urbanism" or "Transit-Oriented Development" is emerging as a viable and attractive theory of development that is an alternative to conventional suburban development, or sprawl.[330] This theory is premised on using intelligent planning and architecture to create human scale communities instead of auto-oriented suburbia.[331] Communities designed with transit connections, mixed uses, and pedestrian-friendly standards effectively reduce auto dependency. The use of automobiles becomes less of a necessity and more of an option. Consequently, residents and employees located in more accessible, multi-modal locations tend to own fewer motor vehicles, drive less, and use alternative modes more than those in automobile-dependent locations.[332] If a community is structured in a way that enhances transit efficiency, fewer people will feel the need to drive.

Transit-oriented development contrasts sprawl and all the negative consequences of auto-centered development by giving commuters transporta-

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327. John R. Nolon, *The Land Use Stabilization Wedge Strategy: Shifting Ground to Mitigate Climate Change*, 34 WM. & MARY ENVTL. L. & POL'Y REV. 1, 26 (2009).

328. *See* Patricia E. Salkin & Amy Lavine, *Land Use Law and Active Living: Opportunities for States to Assume a Leadership Role in Promoting and Incentivizing Local Options*, 5 RUTGERS J.L. & PUB. POL'Y 317, 327 (2008).

329. *See* ROBERT C. ELLICKSON & VICKI L. BEEN, LAND USE CONTROL: CASES AND MATERIALS 165-67, 634 (2005); *see also* Steven P. Frank, *Yes in My Backyard: Developers, Government and Communities Working Together Through Development Agreements and Community Benefit Agreements*, 42 IND. L. REV. 227 (2009).

330. SCOTT LEFAVER ET AL., MINETA TRANSP. INST., CONSTRUCTION OF TRANSIT-BASED DEVELOPMENT (2001) (defining transit-oriented development as a high density, residential, or mixed-use development built within a half mile of a transportation corridor or an intensely used transportation passageway), *available at* http://transweb.sjsu.edu/MTIportal/research/publications/documents/01-05.pdf; *see* Robert Steuteville & Philip Langdon, *The New Urbanism: A Better Way to Plan and Build 21st Century Communities*, NEW URBAN NEWS, *available at* http://www.newurbannews.com/AboutNewUrbanism.html (suggesting that transportation and land-use policies be linked and the neighborhood be used as the fundamental building block of a region).

331. *See* Steuteville & Langdon, *supra* note 330; *see also* Ctr. for Transp. Excellence, Transit Benefits, http://www.cfte.org/trends/benefits.asp (last visited May 17, 2010) (explaining that public transportation fosters more livable communities by creating corridors that become natural focal points for economic and social activities and how these activities help create strong neighborhood centers that are more economically stable, safe, and productive).

332. TODD LITMAN, VICTORIA TRANSP. POLICY INST., EVALUATING PUBLIC TRANSIT BENEFITS AND COSTS: BEST PRACTICES GUIDEBOOK 27 (2010), *available at* http://www.vtpi.org/tranben.pdf.

tion choices rather than obliging them to resort to automobiles for the majority of their travel needs. Recent studies forecast significant demand increase for transit-oriented communities over the next twenty-five years and an increased demand for housing within a half-mile from transit access points, or "transit zones."[333] There is already evidence of significant increases in ridership in areas where new transit lines have been opened and transit-oriented land use development has occurred.[334] Finally, public transportation also has a positive impact on local property values because it enhances communities' livability and fosters local development.[335]

Appropriate public policies should be put in place in order to foster demand for transit-oriented development, as well as to reduce urban sprawl. First, the right infrastructure investments must be made, including continued improvements to public transportation systems.[336] Second, incentives through land use schemes should be adopted to direct private investments in the real estate market toward high density and transit-oriented areas. This may be achieved through various land use tools. The most effective tool is the recognition of a density bonus in the form of transferable development rights to those developers who are willing to defer development in one area in exchange for a density or other development bonus/credit that can be used to exceed development limits set forth in another area.

B. Public Transportation Policies

Critics of "enclosure solutions" contend that property rights are created over common resources. In the case of congestion, incentives may also be provided by aggregating the mobility demand and thereby inducing people to at least utilize the roads more efficiently. This solution falls under the umbrella of Demand Responsive Transport Services ("DRTS") supported

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333. *See* RECONNECTING AMERICA'S CENTER FOR TRANSIT-ORIENTED DEVELOPMENT, HIDDEN IN PLAIN SIGHT: CAPTURING THE DEMAND FOR HOUSING NEAR TRANSIT 7 (2004) [hereinafter HIDDEN IN PLAIN SIGHT] (stating that their market assessment shows that at least a quarter of all new households—14.6 million households—could be looking for housing in transit zones), *available at* http://www.reconnectingamerica.org/public/display_asset/best practice176?docid=171.

334. *See* LITMAN, *supra* note 332, at 18.

335. *See* Ctr. for Transp. Excellence, *supra* note 331 ("Studies have shown greater increases in the value of properties located near public transportation systems than in similar properties not located near public transportation.").

336. *See* HIDDEN IN PLAIN SIGHT, *supra* note 333, at 8; *see also* SIERRA CLUB, FREEDOM TO TRAVEL, FREEDOM TO CHOOSE: BETTER COMMUNITIES START WITH MORE TRANSPORTATION CHOICES, *available at* http://www.sierraclub.org/sprawl/transportation.pdf (explaining that the way the government chooses to apportion transportation funding through the reauthorization of TEA-21 will be instrumental in determining whether our nation focuses on smart growth, or whether we will continue to sprawl).

by Intelligent Transport Systems ("ITS"), including practices such as car-pooling through the creation of high-occupancy vehicle lanes.[337] In terms of trade-offs, this solution may require less redistribution and also may have a softer impact on civil liberties.

Incentives to change behavior may also be provided by aggregating the mobility demand and thereby inducing people to more efficiently utilize their automobiles. This approach implies a turn of transportation policy toward a set of solutions relying on information technology such as DRTS, car-pooling, and car-sharing. In particular, the latter tool is going to completely reshape the way people think of automobiles and individual mobility. The automobile is going to become a service rather than a product. Car makers will not just produce and sell cars; they will produce and rent them out on a short-term basis to users who, in theory, would be able to pick a car at any time and in any place and use it for a specific time and purpose. In this way, we would avoid having cars parked on the side of streets for—according to recent studies—an average of twenty-two to twenty-three hours per day.[338]

C. The E.U. Integrated Approach

In European town and city centers, increased urban traffic has resulted in chronic congestion, with many adverse consequences such as delays and pollution. From an economic standpoint, it is estimated that every year the economic loss caused by urban traffic congestion is nearly €100 billion, or 1% of the European Union's GDP.[339] As to the environmental consequences of this phenomenon, air and noise pollution in Europe are increasing.[340] It has been demonstrated that urban traffic is responsible for 40% of CO_2 emissions and 70% of other pollutants' emissions arising from road transport.[341]

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337. Jenny Mageean & John D. Nelson, *The Evaluation of Demand Responsive Transport Services in Europe*, 11 J. TRANSP. GEOGRAPHY 255 (2003).

338. *See European Commission Green Paper on Urban Mobility*, *Towards a New Culture for Urban Mobility*, at 7, 10, 16-18, COM (2007) 551 final (Sept. 25, 2007) [hereinafter *Towards a New Culture for Urban Mobility*]; Willett Kempton & Jasna Tomić, *Vehicle-to-Grid Power Implementation: From Stabilizing the Grid to Supporting Large-Scale Renewable Energy*, 144 J. POWER SOURCES 280, 281 (2005). *See also* Elizabeth Boyle, *V2G Car Generates Electricity—and Cash*, UDAILY, Nov. 28, 2007, *available at* http://www.udel.edu/PR/UDaily/2008/nov/car112807.html.

339. *Towards a New Culture for Urban Mobility*, *supra* note 338, at 2.

340. *Id.*

341. *Id.*

Action on urban mobility is also considered important to accomplish the European Union's overall strategy of combating climate change, reaching the 20-20-20 objective and promoting cohesion.[342]

The number of urban traffic accidents is also constantly growing, with one in three fatal accidents now happening in urban areas, often claiming the most vulnerable people as victims, namely pedestrians and cyclists.[343]

Within the E.U. framework, urban mobility policies fall primarily within local, regional, and national competence in accordance with the principle of subsidiarity.[344] It is a phenomenon occurring on a local level, although its impact is felt on a global scale. Climate change, global warming, increased health problems, bottlenecks in the logistics chain, etc., are global problems. Local authorities should not face all these issues on their own. The European Union has recognized that there is a need for cooperation and coordination at the European level, and therefore a framework at the E.U. level to help local authorities take local actions is needed.[345]

Thus, in Europe, the issue of urban mobility is being addressed as part of a collective effort at all levels, starting locally, and working all the way up to the regional, national, and European ones. The European Union, while playing a leading role on this issue, does not intend to impose "one-size-fits-all or top-down solutions."[346] It has only committed to foster the exchange of best practices and provide funding, calling on all stakeholders to pay closer attention "to the mobility needs of vulnerable groups such as elderly, low-income groups and persons with disabilities."[347]

From a methodological point of view, the European Union has embraced a policy-integrated approach. It is perceived that such an approach can face "the complexity of urban transport systems, the governance issues and the

342. PRESIDENCY CONCLUSIONS OF THE BRUSSELS EUR. COUNCIL 12 (2007), *available at* http://register.consilium.europa.eu/pdf/en/07/st07/st07224-re01.en07.pdf. The 20-20-20 objective implies the reduction of E.U. overall emissions to at least 20% below 1990 levels by 2020.

343. *Towards a New Culture for Urban Mobility*, *supra* note 338, at 3.

344. *Action Plan on Urban Mobility*, *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions*, COM (2009) 490 final (Sept. 30, 2009) [hereinafter *Action Plan on Urban Mobility*], *available at* http://ec.europa.eu/transport/urban/urban_mobility/action_plan_en.htm.; *see also* Christian Iaione, *Local Public Entrepreneurship and Judicial Intervention in a Euro-American and Global Perspective*, 7 WASH. U. GLOBAL STUD. L. REV. 215 (2008).

345. *See* the Eur. Comm'n, *Communication on the Future of Transport*, *A Sustainable Future for Transport: Towards an Integrated, Technology-Led and User Friendly System*, COM (2009) 279 final (June 17, 2009).

346. *Action Plan on Urban Mobility*, *supra* note 344, at 3.

347. *Id.*

links between cities and their surrounding areas or regions, the interdependence between transport modes, the limitations within urban space and the role of urban systems in the wider European transport system."[348] An integrated approach is essential "for the development of transport infrastructure and services, but also for policy making to link transport with environment protection, healthy environments, land use planning, housing, social aspects of accessibility and mobility as well as industrial policy."[349] An integration of sustainable urban mobility plans and air quality plans is contemplated also by the framework of E.U. air quality legislation.[350]

According to the European Commission, the first area of intervention in rethinking urban mobility should be the optimization in the combined use of the various modes of transport through the application of the principle of "co-modality" between the different modes of collective transport (train, tram, metro, bus, taxi) and individual transport (car, motorcycle, cycle, walking).[351] It is also crucial to manage transport demand to guarantee mobility, quality of life, and environmental protection.

With its 2007 *Green Paper on Urban Mobility*, the European Commission has launched a regulatory process leading up to the 2009 Action Plan, which identifies a series of concrete actions and initiatives toward better and sustainable urban mobility.[352] The Green Paper was premised on the idea that "there is no single solution to reduce congestion" and that "alternatives to private car use, such as walking, cycling, collective transport or the use of the motorbike and scooter, should be made attractive and safe."[353] In addition, citizens should be able to optimize their travel behaviors through a more efficient coordination between the different transport modes.[354] Authorities should also promote co-modality to reallocate public space that becomes available after congestion mitigation measures are taken. For instance, "park & ride" facilities can provide an incentive for combining private and collective transport modes and to free inner urban areas from traffic through integrated transport systems.[355]

The Green Paper also suggested that less car-dependent lifestyles can be promoted through innovative transport solutions like car-sharing, and a

348. *Id.* at 4.

349. *Id.* at 4.

350. *See generally* Parliament and Council Directive 2008/50/EC, 2008 O.J. (L187) (EC).

351. *Towards a New Culture for Urban Mobility*, *supra* note 338; *see also Action Plan on Urban Mobility*, *supra* note 344.

352. *See Towards a New Culture for Urban Mobility*, *supra* note 338, at 17.

353. *Id.* at 2.

354. *Id.*

355. *Id.* at 7.

more sustainable use of private cars could be encouraged through carpooling. These policies will likely lead to fewer cars carrying more people. Along the same line, other options may also include "virtual mobility"—tele-working, tele-shopping, etc.

The Green Paper recognized that transport-demand management and, more specifically, urban roads charging schemes should represent an important part of the picture. In 2007, the European Commission briefly considered market-based schemes as regulatory tools to address the challenge of making urban traffic sustainable in environmental (CO_2, air pollution, noise) and competitiveness (congestion) terms.[356] However, in the 2009 Action Plan, market-based schemes seem to be more central as one of the main themes of green urban transport in that

> [b]y making users pay for the external costs which they cause (environmental, congestion and other costs) according to the polluter pays principle, the internalization of external costs can encourage transport users to switch over time to cleaner vehicles or transport modes, to use less congested infrastructure or to travel at different times.[357]

The E.U. Action Plan points at European Commission rules on the charging of heavy goods vehicles for the use of infrastructure[358] as a model of a regulatory scheme that allows for "the non-discriminatory application of regulatory charges in urban areas to reduce traffic congestion and environmental impacts."

The European Commission undertook to carry out a specific action to address urban aspects of the internalization of external costs:

> Once the EU framework for internalisation of external costs is established, and taking into account the conclusions of the debate launched by the Communication on a sustainable future for transport, the Commission will launch a methodological study on the urban aspects of the internalisation. The study will look at the effectiveness and efficiency of various pricing solutions, including implementation issues such as public acceptability, social consequences, cost recovery, availability of ITS (intelligent transport systems) tools and how urban pricing policies and other green zone arrangements can be effectively combined.[359]

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356. *Id.* (acknowledging that "[u]rban charging schemes, such as in London and Stockholm, have demonstrated positive impacts on the fluidity of transport").

357. *Id.*

358. *See generally Commission Proposal for the Revision of the Directive on the Charging of Heavy Goods Vehicles for the Use of Infrastructure*, COM (2008) 433 (July 20, 1999).

359. *See Action Plan on Urban Mobility*, *supra* note 344.

Intelligent and adaptive transport demand management systems have also proven their efficiency in reducing congestion. ITS help optimizing trip planning and allow better traffic management and easier demand management. Finally, mobility management shall be another important building block among the measures aimed at influencing travel behavior before it starts by shifting people's attention toward more sustainable transport options.[360] In this light, developers should be requested to prepare a site-specific mobility plan as a pre-condition to obtaining building permits. The introduction of a "mobility impact assessment" for large-scale infrastructure projects and developments shall also be taken into consideration.

CONCLUSION

Cities are choking because there are too many vehicles flooding their streets. Society must regain the conception of streets as social venues.[361] In ancient times, streets were not just a transportation network, they were also a means of social networking. Streets should be given back to the community. They are "agoràs." The social dimension of streets and plazas is still traceable in those little medieval Italian villages and cities which have banned cars from their historic centers to safeguard the character of their communities. Washington Square in New York City is also an example of how traffic can erode the city and how policies of "attrition of automobiles" have an impact on the social and development patterns of a community with minimum impact on the overall traffic conditions.[362]

Cities are increasingly running out of road capacity and running late on urban transport infrastructure. Over-exploitation of this common good is posing the question of how to better manage it. The way the use of urban roads has been addressed so far should be rethought.

The current urban mobility model is unsustainable in environmental (CO_2, air pollution, noise) and competitive (congestion and accidents) terms.[363] This car-dependent lifestyle is going to become economically bleak when what has been labeled "petrocracy," a petroleum-based lifestyle and economic system, reaches a point of rupture.[364] Driving a car would only be economically viable if vehicles were powered by drivers' self-satisfaction.

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360. *Id.*

361. Jennifer 8. Lee, *Power Flows Back to the Pedestrian*, N.Y. TIMES, June 28, 2009, at NJ13.

362. JANE JACOBS, THE DEATH AND LIFE OF GREAT AMERICAN CITIES 338-71 (1961).

363. Dubner & Levitt, *supra* note 18 (estimating that driving accounts for "more than $300 billion in externality costs").

364. Hubbert, *supra* note 41.

Land-use patterns and the "road industry" (carmakers, oil companies, developers, public works contractors, and unions) are aggravating the tragedy of urban roads by channeling resources towards policies aimed at making driving more efficient or more comfortable, thereby providing motorists with incentives to drive more, not less.[365]

Possible alternatives to individual mobility as it is conceived today should therefore be pursued.[366] The bulk of alternative policies should be based on fostering as much collective mobility as possible through public transportation and Intelligent Transport Systems. However, it would be idealistic to think that we could get rid of individual mobility overnight. Something still needs to be done in order to reduce the environmental and traffic impact of individual mobility.

The question thus becomes how to regulate individual travel behaviors. The regulatory choice is normally between command-and-control and market-based schemes. In general, market-based schemes have proved to be more cost-effective than command-and-control schemes. Within the field of market-based schemes, with specific reference to urban mobility, economists have traditionally advanced taxes to deal with the tragedy of urban congestion.[367] This Article has shown that there is an economic justification for capping the number of cars through permits, not just congestion charges which seem to be the "flavor of the month."

In stark contrast with mainstream wisdom, the case studies of urban congestion mitigation schemes have proved that pricing schemes need a constant increase in the congestion charge to keep the initial traffic level reduction effects (e.g., London and Milan) or otherwise, they are politically infeasible (e.g., New York). They work better where they are coupled with quantity instruments and political accountability is a less compelling issue (e.g., Singapore).

Thus, quantity instruments, such as tradable or marketable permits or credits seem to have a better chance of addressing urban congestion for four reasons: (1) they respond better than taxes to fairness/equity concerns, particularly if implemented upon grandfathering of preexisting vehicle population; (2) they are more politically viable because they enjoy better public acceptability than charges;[368] (3) they are more likely to be well designed;[369] and (4) they can ensure with greater certainty and stability the

365. OWEN, *supra* note 39, at 95-100, 105-16.

366. *See generally* ANTHONY DOWNS, STILL STUCK IN TRAFFIC: COPING WITH PEAK-HOUR TRAFFIC CONGESTION (2004).

367. *See generally* Vickrey, *supra* note 17, at 452-65.

368. STAVINS, *supra* note 126.

369. *Id.*

accomplishment of certain environmental and economic targets (i.e. levels of congestion and emissions) and are therefore able to represent the only catch-all strategy for all the different types of externalities produced by the tragedy of urban roads.

Of course, complementary policies are needed to facilitate this shift from an age of car possession to an age of access to cities and mobility services.[370] Carpooling, car sharing, taxis, DRTS, and Bus Rapid Transit should be another cornerstone of a new model of society. A change in these policies will result in a society where the individual possession of automobiles will be the exception, while the norm will be access to any destination by public or collectively held means of transportation.

What lessons can be learned from the tragedy of urban roads and from the proposed regulation addressing individual travel behavior? First, that regulatory efforts here are aimed at disciplining individual behavior, whereas they usually target economic operators or entities more sophisticated than the individual. Under the scheme devised for the tragedy of urban roads, the individual becomes the regulated entity.[371]

The second lesson is that climate change can also be fought at the lowest possible level: communities and end-users or citizens. Conventional wisdom about climate governance is thus overturned. It has been claimed that climate change is a global problem and that it should be regulated solely at the highest possible levels of governments.[372] In the case of urban transport, which accounts for 20% of carbon dioxide emissions,[373] the scale of

370. JEREMY RIFKIN, THE AGE OF ACCESS: THE NEW CULTURE OF HYPERCAPITALISM, WHERE ALL OF LIFE IS A PAID-FOR EXPERIENCE 33-35 (2000) (recognizing the decline of physical property).

371. Michael P. Vandenbergh, *From Smokestack to SUV: The Individual as Regulated Entity in the New Era of Environmental Law*, 57 VAND. L. REV. 515, 530 (2004).

372. For an account of this debate, see Hari M. Osofsky, *Is Climate Change "International"? Litigation's Diagonal Regulatory Rol*e, 49 VA. J. INT'L L. 585, 587 (2009).

373. *See* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC), IPCC FOURTH ASSESSMENT REPORT: CLIMATE CHANGE 2007: MITIGATION OF CLIMATE CHANGE (Bert Metz et al. eds., 2007) (claiming that transport is responsible for 23% of world energy-related greenhouse gas emissions and its rate of increase is faster than any other energy using sector); Robin Hickman, Olu Ashiru & David Banister, *Transport and Climate Change: Simulating the Options for Carbon Reduction in London*, 17 TRANSPORT POL'Y 110 (2010) (explaining that in London, "[w]ithin the transport sector, car-based CO_2 emissions dominate (at 49%) and road freight (23%)"); *see also* Kelly Sims Gallagher, Gustavo Collantes, John P. Holdren, Henry Lee & Robert Frosch, *Policy Options for Reducing Oil Consumption and Greenhouse-Gas Emissions from the U.S. Transportation Sector* (Belfer Center for Science & International Affairs, Discussion Paper, July 27, 2007), *available at* http://belfercenter.ksg.harvard.edu/files/policy_options_oil_climate_transport_final.pdf.

regulation is local and the problem can be properly addressed through a bottom-up strategy.[374]

Third, the authority question of who must regulate urban congestion must be addressed. The tragedy of urban roads is an issue of federalism. The role of localities, states, and the federal government needs to be defined very precisely to avoid responsibility-shifting policies. Ideally, the urban congestion governance framework should be designed as follows: the federal government sets a limited number of overall objectives and provides part of the funding for those objectives; states shape the correct regional governance and monitoring systems for urban congestion by defining the optimal transportation basins and possibly establishing regulating authorities which would oversee the management of urban mobility both public and private; and then cities come together and cooperatively manage the various local transportation networks in a way that allows the efficient interconnection with the main arteries of the regional network. Cities should also participate in the governance of the regional public authority.

Finally, the main responsibilities for solving the tragedy of urban roads and for fighting local and global collective action problems lies also, if not primarily, with individuals, citizens, and consumers who are facilitated by the government in taking on the challenge to pursue the general interest in their everyday lives. This is a new paradigm of society and also a new model of the relationship between governments and citizens. We are talking about the paradigm of "horizontal subsidiarity," whereby instead of trying to solve every issue themselves, governments look for allies to facilitate the initiatives of proactive citizens who, individually or in groups, are willing to take direct care of common goods.[375]

The new paradigm can represent the founding stone of a new regulatory model. Indeed, urban mobility is only a case study of a comprehensive and innovative bottom-up strategy to secure environmental protection and regulate the use of commons by putting leverage on individuals.[376] The same individual-centric approach could in fact be found in other instances, such as demand-response energy consumption reduction strategies, green build-

374. Benjamin K. Sovacool & Marilyn A. Brown, *Scaling the Policy Response to Climate Change*, 27 POL'Y & SOC'Y 317-28 (2009).

375. On this new paradigm, see Iaione, *supra* note 344; *see also* GREGORIO ARENA, CITTADINI ATTIVI (2006); Gregorio Arena, *Active Citizens*, *in* Labsus Papers, Paper n. 17 (2010) *available at* http://www.labsus.org/index.php?option=com_content&task=view&id=2121&Itemid=27.

376. *See, e.g.*, John C. Dernbach, *Harnessing Individual Behavior to Address Climate Change: Options for Congress*, 26 VA. ENVTL. L.J. 107, 160 (2008) (suggesting that individuals must be actors of climate change regulatory strategies because "[t]he problem is too daunting to focus simply on the large polluters").

ing construction regulations centered upon LEED standards, and water savings.