The Law, Economics, and Policy of Urban Congestion

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ABSTRACT

This paper 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. In particular, among these market-based regulatory techniques, economists seem to favor price-based instruments (e.g. taxes and subsidies) over quantity-based instruments (i.e. cap-and-trade schemes). The main argument of this paper is instead that quantity instruments, such as tradable permits of road usage and/or of real estate development, can better internalize all the externalities that road congestion is capable of producing. This paper advances also the idea that quantity instruments are more successful tools in addressing urban congestion for two reasons: a) they are more politically viable; and b) they respond better to equity concerns.

1. ROADS AS "COMMON GOODS". THE TRAGEDY OF ROAD CONGESTION

Streets and plazas are, by definition, public space. Public space is *locus* of meeting (*i.e.* exchange, confrontation, mediation, cooperation and even conflict or face-offs), both physical and virtual, of individual interests which were formed within private spaces.

Streets and plazas represent therefore a "common good" exposed like any other common good to the *Tragedy of the Commons*. In 1968 Garrett Hardin contended that if everybody deems unlimited her/his right to use a common good, its unrestricted demand will ultimately exhaust the finite resource through over-exploitation[1]. Indeed, in tragedies of the commons users over-exploit a resource and impose mutual externalities upon each other.

Tragedies of the commons fall therefore within the broader class of large-group externality problems. But the characteristic that differentiate them from the rest of the class is that self-destructiveness is absent in other large-group externality problems. Thus Pareto Superior[2] policy moves have to be different from those undertaken in other large-group externality problems. In other terms governmental intervention/regulation is always needed to save the resource users from themselves and their mutually-imposed harms.

The major part of citizens in western countries has been led to believe that they hold an unlimited right to invade streets with their automobiles. It is enough to buy a car – fortunately for car drivers not everybody can afford one - and this right cannot be taken away by anyone. In this way public spaces have been handed to automobiles and are not only deteriorating (which is important from an environmental point of view) but also subtracted from 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 determining the vanishing of urban life: the cohabitation, the encounter and the unplanned and not institutionalized confrontation of diverse lifestyles, habits, cultures and stories. This is what has made cities in history the preferred place for cultural development and innovation. The automobile instead projects on the streets the characteristics of «private» life by closing ourselves in their steel bodies.

[1] Garrett Hardin, *The Tragedy of the Commons*, 162 Science 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.

Traffic congestion represents therefore the perfect showcase for the tragedy of the commons. Traffic congestion illustrates why mutuality entails the persistence of an externality. All drivers face indeed 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 (*i.e.* 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. But we know that externalities are also imposed upon non-users, the air-breathing public, in the form of pollution.

However, traditionally, the political justification for intervention has been to save drivers and protect their commuting. The clamor for solving traffic problems has come more typically from frustrated drivers than from advocates against the imposition of air pollution externality upon the general public.

This might explain why, the traditional solution to traffic congestion has been the expansion of roadway capacity[3]. However, this has proved to be a self-defeating strategy. The expansion of roadway capacity reduces transportation costs and this generates new demands by new users – such as new residential development - that are incentivized by the new roadway capacity[4].

This solution ignores the second-order effects, effects that are easily seen once one appreciates the nature of the externality. Let's take the example of 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[5].

Hardin suggested potential solutions to commons problems including: privatization; polluter pays; regulation. Hardin categorized these as the "enclosure" of commons. He noted that historically the problem has been first addressed through the use of all resources as commons (unregulated access to all) and then policymakers' attention has been shifted to systems in

[3] 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).
[4] 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).
[5]See Shi-Ling Hsu, *What Is a Tragedy of the Commons? Overfishing and the Campaign Spending Problem*, 69 Alb. L. Rev. 75, 96 (2005).

which commons are "enclosed" and subject to differing methods of regulated use (access prohibited or controlled).

Public finance theory has offered a similar explanation of the urban congestion phenomenon. It has argued that with urban 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 the use of crowded space would then go to those who value it the most and who are willing to offer the highest price"[6]. However, Musgrave contended that "such exclusion would be impossible or too costly to be administered" and therefore concluded that such "exclusion should but cannot be applied".

We know now that the difficulty of applying exclusion can be overcome and therefore it is no longer possible to say that roads are an example of public good which causes a market failure and therefore justifies public provision.

This paper 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. In particular, among these market-based regulatory techniques, economists seem to favor price-based instruments (e.g. taxes and subsidies) over quantity-based instruments (i.e. cap-and-trade schemes). The main argument of this paper is instead that quantity instruments, such as tradable permits of road usage and/or of real estate development, can better internalize all the externalities that road congestion is capable of producing. This paper advances also the idea that quantity instruments are more successful tools in addressing urban congestion for two reasons: a) they respond better to equity concerns; and therefore b) they are more politically viable; c) they are more likely to be well designed; and d) they are able to represent a one catch-all strategy for externalities produced by congestion.

Section II of the paper illustrates the costs that congestion imposes on society or, to use a language that economists like better, the negative externalities that road congestion produces. Section III sheds light on the underlying causes of urban congestion. Section IV enumerates regulatory tools that are available to address the negative externalities of urban congestion, while section V outlines possible policy options that should complement the regulatory framework to enhance the chances of success of the chosen regulatory scheme. Section VI proposes a comparative analysis of the different strategies that in different parts of the world

[6] R. Musgrave & P. Musgrave, Public Finance in Theory and Practice 43-44 (1989).

have been implemented to address this problem. Finally, section V concludes by stressing the need for further differentiation and experimentation in order to shape a new understanding in the use and management of "common living resources".

2. A TRAGIC AND COSTLY RIDE

To better understand the nature of the problem we have to first turn to the analysis of the factors that have contributed to the increasing importance of urban congestion.

Americans and almost any developed population drive too much.

This does not imply a moral judgment. It is a an economic argument[7].

Dubner and Levitt exemplifies the externalities produced by congestion in the following way

> "the 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".

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.[8] Also, automobiles contribute substantially to the amount of carbon monoxide emissions.[9] Indeed vehicle emissions are 250 percent higher under congestion conditions than under conditions of freely flowing traffic.[10]

Automobiles damage also the global climate. Motor fossil fuels are major contributors of carbon dioxide and emissions of other greenhouse gases. And "congestion causes an extra

[7] Stephen J. Dubner & Steven D. Levitt, Not-So-Free Ride, April 20, 2008 available at http://www.nytimes.com/2008/04/20/magazine/20wwln-freakonomics-t.html

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

[9] 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. 186 (1998).

[10] Transek AB, Swedish National Road Administration (Vägverket), *Road Pricing in Urban Areas 22 (The Federation of European Transport and Environment and the Swedish National Road Administration* (Vägverket) 2002), available at http://www.transport-pricing.net/download/swedishreport.pdf.

thirty million tons of carbon dioxide to be released into the air" each year in the United States.[11]

But automobiles do not have damaging effects only in terms of air pollution. 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. Atmospheric deposition and urban runoff contribute to such pollution. Paving land for roads and parking in urban areas (amounting to about forty percent in many cities) increases the amount of impermeable surface which results in increased runoff. [12]

Now, the environmental negative externalities caused by carbon emissions have been quantified and they apparently impose on society a cost of about $20 billion a year[13].

However congestion is a cross-cutting issue that has not just environmental pitfalls. It is a phenomenon that has also energy[14], economic[15], safety[16] and public health[17] 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 billion a year[18].

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[11] Office of Mobile Sources, EPA, *Transportation Control Measures: Congestion Pricing* 2 (1998).

[12] Strahilevitz, supra note 4, at 6.

[13] Stephen J. Dubner & Steven D. Levitt, supra note 7, at 1.

[14] Robert J. Shapiro et al., *Conserving Energy and Preserving the Environment: The Role of Public Transportation* (July, 2002) ("Any serious effort to reduce our dependence on foreign oil and make significant environmental progress must address the way Americans travel.") and ("... greater 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."), available at http://www.apta.com/research/info/online/documents/shapiro.pdf.

David L. Greene, *Transportation's Oil Dependence and Energy Security in the 21st Century*, Oak Ridge National Laboratory Center for Transportation Analysis, at 3 (October 1997) (stating that petroleum consumption is becomingly increasingly concentrated in the transportation sector), available at http://ntl.bts.gov/lib/5000/5800/5846/oildep/pdf.

Natural Resources Defense Council, *Keeping the "E" in ISTEA; Transportation Energy and the Federal Role in Conservation* (explaining that when Americans travel, they are forced to drive and that Americans take some 86 percent of their trips by car, as compared to eight percent by walking, three percent by bicycle, and about three percent by public transit), available at http://www.nrdc.org/air/transportation/istea/chapI.asp.

See also American Public Transportation Association, American Public Transportation Association, The Benefits of Public Transportation: An Overview (Sept. 2002), available at http://www.apta.com/research/info/online/documents/ben_overview.pdf ("Public transportation helps lead the nation towards its goals and policies of protecting the environment, conserving energy, and providing for the health, safety, and security of its citizens.").

[15] 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 and Tim Lomax. Texas Transportation Institute, 2007 Urban Mobility Report, available at http://mobility.tamu.edu/ums/, September 2007.

[16] Aaron S. Edlin and Pinar Karaca Mandic, *The Accident Externality from Driving*, Journal of Political Economy 114.5 (2006) at 931-955, also available at: http://works.bepress.com/aaron_edlin/21.

[17] The Surgeon General's 1996 report, *Physical Activity and Health*, considered the increasing level of physical inactivity as a growing case for mortality.

[18] Schrank, David and Tim Lomax, *supra* note 14 at B-19.

But the "too much driving" lifestyle presents even worst figures when it comes to car accidents ratios. In 2006 two economists demonstrated that accidents impose an unpaid cost of roughly $220 billion a year[19].

In sum, 200 million U.S. licensed drivers who drives 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 10 cents per mile if we want them to pay the full societal cost of their driving"[20].

Before we turn onto the possible solutions to achieve the goal of internalization of road transport externalities, we should probably ask ourselves why Americans drive too much. In the US this is a problem that originates in idiosyncratic cultural, land use and political patterns.

3. THE UNDERLYING CAUSES OF ROAD CONGESTION

The reasons for why Americans drive too much can be traced back to three main factors. First, the price of gasoline in the U.S. is lower than in any other industrialized country. Secondly, urban sprawl has shaped American land use pattern in a way that makes it difficult to plan or infrastructure a public transit system. Thirdly, historically interest groups favoring investments in road networks rather than rail networks and mass transit systems were very successful in their lobbying activities.

3 (A) Americans drive too much because they don't pay enough!

In most of the industrialized world, including Europe and Japan, pump prices are much higher than in the U.S. even though the wholesale price is roughly the same. The difference lies in the heavy tax load those countries impose to discourage consumption. Conversely, the U.S. has the lowest gasoline tax of any industrialized country: 18.4 percent at current prices[21] and

[19] Aaron S. Edlin and Pinar Karaca Mandic, *supra* note 15. And that's even though the accident rate has fallen significantly over the past 10 years, from 2.72 accidents per million miles driven to 1.98 per million; overall miles driven, however, keep rising.)

[20] Stephen J. Dubner & Steven D. Levitt, supra note 7, at 1.

[21] Pump prices worldwide are available at http://uk.reuters.com/article/oilRpt/idUKL1881342520080118. See also Andy Eckardt, *$8 for a gallon of gas?! in Germany, yes*, available at http://worldblog.msnbc.msn.com/archive/2008/03/18/781155.aspx. In Europe pump prices range between $7 and $10 per gallon, whereas in Japan gasoline prices are $5.41 per gallon. Currently US drivers are paying $3.65 per gallon while Saudi Arabia and Iranian drivers pay about 0.50 cents per gallon.

presidential candidates have even proposed the very quick fix of a gas tax break for the summer travel season[22].

In the last few months crude oil prices jumped for the first time above $100 a barrel[23]. Recent research indicated that the price of oil would go on to touch $7 per gallon in United States in the next four years. The official estimate of crude oil is considered to be flawed and actually lower than the current official estimates. As result of this increase in the demand and lack of adequate supply, the price of crude oil will most likely increase steadily over the next four years[24].

Although some analysts still maintain that the recent surge in oil markets is underpinned by issues related to financial flows and that it has nothing to do with fundamental factors, many economists believe that the new surge of oil prices is due to the surge of the demand by new buyers and the inadequacy of the reserves.

Almost all the economists admit that the Hubbert peak – beyond which oil price can only increase – is very close or it has already been reached. The Hubbert peak theory[25] 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[26]. 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.

It is a pretty established conviction that there will always be some hydrocarbon which vehicles will be burning a as a source of their fuel.[27] It is common belief that after oil there is

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[22] John M. Broder, *Democrats Divided Over Gas Tax Break*, April 29, 2008 available at http://www.nytimes.com/

[23] …

[24] Marty Jerome, *Gas to Hit $7 a Gallon*, April 29, 2008 available at 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"). According to a CIBC World Markets report "Increasingly tight oil supplies will continue to push the price of oil higher with the cost of crude hitting US$150 a barrel by 2010 and soaring to US$225 a barrel by 2012, forecasts a new energy report from CIBC World Markets. This will result in skyrocketing consumer gas prices in Canada with the national average price topping $1.40 this summer, $1.80 in the summer of 2010 and $2.25 by 2012. The report finds that current oil production estimates produced by the International Energy Agency (IEA) overstate supply by about nine per cent since it counts natural gas liquids in its numbers. The report notes that natural gas liquids, while valuable hydrocarbons, are not a viable substitute for oil and cannot be economically used as a feedstock for gasoline, diesel or jet fuel.". The report is available at http://research.cibcwm.com/economic_public/download/sapr08.pdf.

[25] Marion K. Hubbert, *Nuclear Energy and the Fossil Fuels*, paper presented before the spring meeting of the Southern District, American Petroleum Institute, Plaza Hotel, San Antonio, Texas, March 7-8-9, 1956. M.K. Hubbert, *Nuclear Energy and the Fossil Fuels*, in *American Petroleum Institute Drilling and Production Practice*, 1956, 23, 7–25.

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

[27] Andrew P. Morriss, *Fuels and the Future of the Automobile (and Trucks Too)*, paper presented in the Environmental Governance Seminar held at New York University School of Law (Fall 2007).

still the whole series of natural resources starting with gas. However similar arguments apply. They are finite resources.

Focus has also been put on alternative and renewable fuels like the use of hydrogen-fueled cars. But this is not a solution to reduce the use of fossil fuels in vehicles. Most all of today's hydrogen is indeed produced using fossil energy resources. Also a hydrogen car is considered to be one of the least efficient and most expensive ways to reduce greenhouse gases. Hydrogen fuel cells are costly to produce and fragile. Very expensive studies are being conducted to produce inexpensive fuel cells that are robust enough to survive vibrations all cars experience. Nobody knows when hydrogen cars will be broadly available. Joseph Romm, a former official at the U.S. Department of Energy asked with the question replied: "Not in our lifetime, and very possibly never".[28]

Of course we could always turn to the more environmentally unfriendly carbon. We are plenty of it but it is much more polluting.

Thus it may be about time to start thinking to possible alternatives to individual mobility at least as it is conceived today. It goes without saying that the bulky part of alternative policies should be based on fostering as much as possible collective mobility and therefore public transportation.

However, in most part of the US commuters are not ready or willing to give up their (sometime gigantic) automobiles or trucks for public transit. The reason adduced is that in most part of the country urban areas are not so dense and that public transit does not exist or work properly.

Fact is that it is not just really cheap to drive in America. Truth is that Americans love their cars. Automobiles play a central role in the American economy as the primary source of transportation. Also cars, trucks and SUVs are an important part of the American conception of mobility and personal autonomy. Now driving has even become a solitary experience because many middle-class families own more than one car. In 1990, the average American car commuting to or from work contained only 1.09 occupants. Driving alone is seen as a symbol of American individualism and represents the ideals of freedom and liberation. Driving and commuting are not perceived as a moment of aggregation and an opportunity to

[28] Marty Jerome, *Is It Time to Give Up the Hydrogen Hoax?*, Wired (August 15, 2007).

interact with family members, colleagues, and friends. Conversely, the car is viewed as a private space where one can isolate oneself from others and the pressures of everyday life.[29]

3.(B) I love my backyard. Let's sprawl

The ideals represented by automobile use and ownership explain the popularity of suburban living. The question then turns on the land use aspects of the problem. Real estate development patterns have favored and continue to favor the use of private cars as main means of transportation.

Most Americans are locked into their driving habits, and can do little to alter their fuel-buying patterns when prices rise, experts say. For example, the number of workers with commutes lasting longer than 60 minutes grew by almost 50 percent from 1990 to 2000, according to Census Department data.

According to an AAA poll, only 29 percent of Washington metropolitan area residents prefer city living with public transportation whereas 65 percent of residents prefer to use their cars to get to work, school and shopping. Americans generally love to live in a less densely populated suburb and "prefer detached homes over row houses, rural living over city life, and home ownership over renting."[30]

American ideals of individualism and freedom lie underneath the passion for open spaces and suburban living and automobile use is what makes this love possible.

These ideals substantiate the cultural substratus of urban sprawl. Sprawl is development that (1) extends far from traditional urban centers and/or (2) regardless of its location, is built in a way that requires residents and visitors to be highly dependent on automobiles.[31] Sprawl endangers the stability of older neighborhoods, increases auto-induced air pollution and traffic congestion, causes drivers to become obese through lack of exercise, and freezes people too

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

[30] Lathrop B. Nelson, *Unclogging Virginia's Roads: Aligning Computer Incentives in Northern Virginia*, 28 Transp. L.J. 185, 204 (2000).

[31] See Oliver Gillham, The Limitless City 4 (2002) who recalls various definitions of such phenomenon many of which involving these two factors; Timothy J. Dowling, *Reflections on Urban Sprawl, Smart Growth and the Fifth Amendment*, 148 U. Pa. L. Rev. 873, 874 (2000) who defines sprawl as "automobile-dependent" development.

poor or disabled to drive out of civic life.[32] On the other hand, defenders of the status quo assert that sprawl is "the way the majority of Americans eagerly choose to live."[33]

Either way, there is plenty of arguments to put a leash on further sprawling of cities and metropolitan areas. The reality is that

> Between 1960 and 1990 metropolitan-area population grew by 50% while the acreage of developed land increased 100 percent. About 45% of new construction in 1994 - 1997 occurred in rural areas, with nearly 80% being land bordering urban areas. Overall this translates to over 2.8 million acres being converted per year, with 2 million devoted to housing
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> According to USDA's National Resources Inventory (NRI), urban and built-up areas increased from 65.3 million acres in 1992 to 79 million acres in 1997, equaling an area approximately the size of Ohio. In most states, prime farmland is being converted at two to four times the rate of other, less productive agricultural land. From a natural resource standpoint, this conversion of farm and forest land 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. [34].

And they forgot the congestion externality caused by the "more automobile travel". In other terms, in few decades America is going to eat itself!

This is true from two standpoints. First, there is not going to be any more developable land. Second, there will be no land to dedicate to sustainable-living uses like agriculture.

3(C). The financing structure of US transportation policies and funding. A public choice tale

Finally, the pressure of what can be called the "highway industry" - which include car makers, real estate developers, public works contractors, unions and oil companies - has shaped federal spending in the financing of the transportation sector.

In the past the major part of such financing has been channeled towards increasing the capacity of roadway and highway networks rather than favoring the modernization and

[32] Gillham, supra note 31, at 74 citing environmentalists, urban politicians, public transit advocates, and historic preservation advocates as leading sprawl opponents.
[33] See Gillham, supra note 31, at 69.
[34] See USDA, Maintaining Farm and Forestland In Rapidly Growing Areas, 2000

improvement of urban and regional public transit systems[35]. Environmental groups have played a minimal role in this game but could play a major one in the years to come in particular if the issue is going to be faced at the local level.[36]

The policymakers have obviously the protagonist role in the tragedy of urban congestion. Under the pressure of the highway industry they have diverted large part of the resources destined to the transportation sector towards the construction of new roads thereby incentivizing the use of cars.

Indeed, the first comprehensive piece of legislation on US transportation networks is the Federal Aid Highway Act which was enacted in 1956. It authorized the construction of America's interstate highway system.[37] Since the Federal Aid Highway Act, the federal government dedicated large part of its surface transportation resources to the construction of interstate highways. [38] Consequently the role of national highway department officials became crucial in determining the scope and nature of the American transportation system. [39]

Only 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 decisionmaking.[40] The bill was mainly intended to reduce congestion, [41] but also to recalibrate funding from highways to mass transit. However not much funding was eventually diverted to mass transit. Indeed many states had already committed funds to numerous highway projects when ISTEA was passed. [42]

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[35] Robert Jay Dilger, *TEA-21: Transportation Policy, Pork Barrel Politics, and American Federalism,* The Journal of Federalism 1998 28(1):49-69; 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 (2006).

[36] David Schoenbrod, Saving Our Environment from Washington 42-45 and 113-114 (2005).

[37] Federal-Aid Highway Act of 1956, Pub. L. No. 108-356, 70 Stat. 374 (codified as amended in scattered sections of 23 U.S.C.A.)

[38] Robert J. Dilger, *American Transportation Policy* 5 (Praeger Publishers 2003) available at http:// www.polsci.wvu.edu/ipa/PS493/AmericanTransportationPolicy.htm.

[39] 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.")

[40] Intermodal Surface Transportation Efficiency Act of 1991, Pub. L. No. 102-240, 105 Stat. 1914 (codified as amended in scattered sections of 23 U.S.C.A.).

[41] *See* Message by Samuel K. Skinner, Secretary of Transportation, *Summary of the Intermodal Surface Transportation Efficiency Act of 1991*, National Transportation Library (1991), *available at* http:// ntl.bts.gov/DOCS/ste.html.

[42] *See* Dilger, *supra note* ____

ISTEA was reauthorized as TEA-21 on June 9, 1998. [43] 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.[44] TEA-21 builds on the work of ISTEA and increased highway funding to $175 billion and transit funding to $41.4 billion. On the whole, only a small fraction of TEA-21 funds have been invested in public transportation. [45]

Finally, after a 1-year extension of the TEA-21, the Safe, Accountable, Flexible, Efficient Transportation Equity Act - A Legacy for Users (SAFETEALU) authorized funding of federal transit and highway programs through 2009[46].

SAFETEA-LU is considered to be a big victory of the public transit advocates. It provides a record level of federal transit investment, $52.6 billion over 6 years, an increase of 46 percent over the amount guaranteed in TEA 21. SAFETEALU 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 US transportation policy for its commitment to fight the gridlock of US transportation networks.

In particular, since enactment of the ISTEA, the US 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 US Department of Transportation to continue to invest in technologies and systems that can aid in reducing congestion by five percent by 2010. Such projects can include: any innovative and aggressive technology-based congestion mitigation strategies.

And in May 2006 the U.S. Department of Transportation (the "Department") announced its *National Strategy to Reduce Congestion on America's Transportation Network* (the "Congestion Initiative"). [47] The Congestion Initiative is a comprehensive federal program to

[43] *See* American Public Transportation Association, *Facts About Reauthorization of TEA 21, at* http://www.apta.com/transitaction/facts.asp (last visited Apr. 3, 2008).

[44] Transportation Equity Act for the 21st Century (TEA-21), Pub. L. No. 105-178, 112 Stat. 107 (1998) (codified as amended in scattered sections of 23 U.S.C.A.)

[45] William W. Millar, *TEA-21 Funding will Benefit all Americans*, American Public Transportation Association (Feb. 11, 2004), at http:// www.apta.com/transitaction/capitol.asp; see also The Sierra Club, *Missing the Train: How the Bush Administration's Transportation Proposal Threatens Jobs, Commutes, and Public Transit Ridership*, 2004 Report on Sprawl (July 2004)

[46] The bill was signed into law by President Bush on August 10, 2005 (Public Law109-59)

[47] A detailed description of this project is available at http://www.fightgridlocknow.gov/.

reduce congestion on the US transportation networks (i.e. roads, rails, runways, and waterways).

One of the major components of the Congestion Initiative is the Urban Partnership Agreement ("UPA"). The purpose of UPAs is to acquire proposals by metropolitan areas in order to favor the implementation of strategies aimed at reducing traffic congestion. To support congestion-reducing strategies the Department of Transportation will mainly utilize discretionary funding available under the Department's Intelligent Transportation System Operational Testing to Mitigate Congestion Program (the "ITS-OTMC Program").

The US Department of Transportation has decided to provide Urban Partners up to $100 million of ITS research and development funds over three years through the ITS-OTMC Program to be established by the Department as part of the ITS Program.

In addition to provide funding for Urban Partnerships, SAFETEA-LU gives states more flexibility to use road pricing strategies as a congestion management and transportation finance tool[48].

4. THE REGULATORY TOOLBOX

A law and economics approach to solve road congestion problems would suggest solutions oriented towards internalizing congestion externalities by modifying the incentives to participate in the tragedy. Hardin suggested potential solutions to commons' problems including: privatization; polluter pays; regulation. Hardin categorized these as the "enclosure" of commons. He noted that historically the problem has been first addressed through the use of all resources as commons (unregulated access to all) and then policymakers' attention has shifted to systems in which commons are "enclosed" and subject to different methods of regulated use (access prohibited or controlled). The ultimate purpose of "enclosure" solutions is to reduce the pool of resource users.

[48] See section 1604 of the SAFETEA-LU under which "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".

In general the choice of regulatory tools is a threefold analysis. The first level of analysis implies the choice between traditional command-and-control techniques[49] and economic instruments[50]. However it is pretty established that conduct rules and fixed performance standards are more costly than incentive-based taxes and tradable allowances. [51]

Among economic incentive schemes the regulator has then 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[52].

4(A). Price vs. quantities as applied to road congestion

How should then a regulator (i.e. cities or region-wide transport authorities) decide between quantity and price instruments if she intends to fight road congestion?

The contest of instrument choice is far from settled. Fans of Pigouvian-like price-based tools (liability rules and taxes) [53] and advocates of à la Coase quantity-based schemes (property rules and tradeable allowances) vie with each other. [54]

[49] 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.

[50] See Bruce A. Ackerman et al., The Uncertain Search for Environmental Quality (1974); Frederick R. Anderson et al., Environmental Improvement Through Economic Incentives (1977); Stephen Breyer, Regulation and Its Reform 271-84 (1982); Allen V. Kneese & Charles L. Schultze, Pollution, Prices, and Public Policy 69-84 (1975); Charles l. Schultze, The Public Use of Private Interest 54 (1977); Bruce A. Ackerman & Richard B. Stewart, Reforming Environmental Law, 37 Stan. L. Rev. 1333 (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)

[51] Maureen L. Cropper & Wallace E. Oates, Environmental Economics: A Survey, 30 J. Econ. Literature 675, 686 (1992).

[52] See Richard B. Stewart, *A new generation of environmental regulation?*, 29 Cap. U. L. Rev. 21 (2001), and in particular at 300.

[53] See A.C. Pigou, The Economics of Welfare 172-203 (4th ed. 1932); William J. Baumol & Wallace E. Oates, *The Theory of Environmental Policy*, (1988) at 21-22, 29 and Louis Kaplow & Steven Shavell, *On the Superiority of Corrective Taxes to Quantity Regulation* (National Bureau of Econ. Research Working Paper No. 6251, 1997).

[54] see Ronald H. Coase, *The Problem of Social Cost*, 3 J.L. & Econ. 1 (1960), which advocates 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 tradeable 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); Thomas H. Tietenberg, *Transferable Discharge Permits and the Control of Stationary Source Air Pollution*, 56 Land Econ. 391 (1980) (discussing the implementation of transferable discharge permits for air pollution).

There is an unsettled debate on the relative virtues of price[55] vs. quantity[56] instruments to achieve optimal results. [57] 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 (e.g. the amount of traffic) is not guaranteed.

The environmental economics literature is struggling to identify criteria in order to help legislators and regulators choosing the right regulatory tool. 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[58]. I argue here that the two main factors (*i.e.* efficiency under uncertainty and fairness) both converge in sponsoring a quantity-based approach to road congestion.

4(A)(1). Efficiency

The so-called Weitzman rule 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 only if congestion escalation is way more worrisome than abatement costs escalation.[59]

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[55] 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.

[56] ; Martin L. Weitzman, *Prices vs. Quantities*, 41 Rev. Econ. Stud. 477 (1974).

[57] 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).

[58] See Jonathan B. Wiener, *Global Environmental Regulation:Instrument Choice In Legal Context*, 108 Yale L.J. 677, 729.

[59] Martin Weitzman, *Prices vs. Quantities*, 41 Rev. Econ. Stud. 477 (1974). More recently on the same issue see Marc J. Roberts and Michael Spence, *Effluent charges and licenses under uncertainty*, Journal of Public Economics 5(3): 193-208 (1976); William A. Pizer, *Combining price and quantity controls to mitigate global climate change*, Journal of Public Economics 85(3): 409-434 (2002); Warwick J. McKibbin and Peter J. Wilcoxen, *The role of economics in climate change policy*, Journal of Economic Perspectives 16(2): 107-129 (2002); Henry D. Jacoby and A. Denny Ellerman, *The safety valve and climate policy*, Energy Policy 32: 481-

First, some economists have argued that uncertainty in road congestion exists. As a matter of fact even if "speed-flow relationship 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)"[60].

Hence for a given road at a given time any additional vehicle should be weighed off 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. However the cost escalation becomes very worrisome as the road approaches full capacity. [61]

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". [62]

4(A)(2). Equity and political economy

Fairness seems to be a further compelling argument in favor of quantity-based instruments. As a matter of fact taxes may impose uncompensated costs on poorer sources[63]. But it is a very powerful argument because it brings with it an insurance from political backlash. So powerful that it is worth trying to shape a tradable allowances scheme that reduces uncertainty, raises revenues (or creates other equivalent positive economic effects), watchdogs the possible creation of market powers and minimizes transaction costs.

Economists and mayors seem to favor congestion pricing. Most likely this is due to its revenue-raising nature that makes it appetible to any policymaker. For example, the Bloomberg administration congestion initiative for New York City did not address at all this

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491 (2004); Ian W. H. Parry and Wallace E. Oates, *Policy analysis in the presence of distorting taxes*, *Journal of Policy Analysis and Management* 19(4): 603-613 (2000); Ian W.H. Parry, Roberton C. Williams III, and Lawrence H. Goulder, *When can carbon abatement policies increase welfare? The fundamental role of distorted factor markets*, Journal of Environmental Economics and Management 37(1): 52-84 (1999); Jonathan B. Wiener, *Global Environmental Regulation:Instrument Choice In Legal Context*, 108 Yale L.J. 677, 729; William D. Nordhaus, *To tax or not to tax: Alternative approaches to slowing global warming*, Review of Environmental Economics and Policy 1(1): 26-44 (2007).

[60] Cameron Hepburn, *Regulation by prices, quantities, or both: a review of instrument choice*, 22/2 (2006) 226.

[61] David M. Newbery, *Pricing and congestion: economic principles relevant to pricing roads*, Oxford Review of Economic Policy 6 (1990) 22–39; S.A. Morrison, *A survey of road pricing*, Transportation Research A 20 (1986) 87.

[62] Cameron Hepburn, supra note 52, at 241.

[63] See Jonathan B. Wiener, *Global Environmental Regulation:Instrument Choice In Legal Context*, 108 Yale L.J. 677, 729.

issue. There seemed to be a suspicious blind trust in the power of "prices" since the start of the initiative[64]. And not even the formation of a panel which studied further the proposal led to a different conclusion[65]. The quantity options was always off the table.

The previous discussion on negative externalities produced by road congestion established that a market failure exists and that government intervention in the form of some regulation aimed at reducing congestion is needed. Also the illustration of the underlying causes shall help defining 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 the impact on road usage by real estate developments.

Here I advance 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". [66]

There are two main reasons for not applying efficiency considerations to the choice of regulatory instruments.

First, even if we leave aside for a moment the GHG emissions negative externality, there is no uncertainty over the benefits and costs of road congestion. Economists argue that as traffic flow approaches full capacity of the network costs approach infinity. As a matter of fact we have to think of roads as a network. They are the bed 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[67]. But overall like any other network roads have a limited capacity. And congestion signals approach to full capacity. In other words the cap may not be left to the market to be determined. To put in different terms there is no uncertainty over marginal benefits ($300

[64] For the initial proposal see http://www.nyc.gov/html/planyc2030/html/plan/transportation.shtml.

[65] William Neuman, *Panel Passes Congestion Pricing Plan*, January 31, 2008, available at http://cityroom.blogs.nytimes.com/2008/01/31/panel-passes-congestion-pricing-plan/.

[66] See Jonathan B. Wiener, *Global Environmental Regulation:Instrument Choice In Legal Context*, 108 Yale L.J. 677, 729 citing Richard Revesz, Book Review, 11 Ecology L.Q. 451, 454 (1984) (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").

[67] Giovanni Fraquelli, Massimiliano Piacenza and Graziano Abrate, *Regulating Public Transit Networks: How Do Urban-Intercity Diversification and Speed-up Measures Affect Firms' Cost Performance?*, 75(2) Annals of Public and Cooperative Economics 193-225 (2004)

billion in externality costs savings). This seems to be a very compelling argument to start thinking about a political proposal that would design 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. [68]. Even if the target level of environmental protection is not determined on an economic efficiency basis (e.g. political compromise), the regulator has still to figure out how to achieve that level by choosing the most cost-effective regulatory instrument (i.e. taxes or tradable allowances)[69].

And 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 with the actual level of pollution/congestion could still deviate from the selected one "when true costs are uncertain".[70]

There is a further 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. [71] Politicians have to safeguard the support of their constituencies and lobby groups to secure to stay in power. Instrument selection is better explained by political economy and the income effect than by considerations of economic efficiency[72].

[68] See Peter Bohm & Clifford S. Russell, *Comparative Analysis of Alternative Policy Instruments*, in Handbook of Natural Resource and Energy Economics 395 (Allen V. Kneese & James L. Sweeney eds., 1985), at 397 ("[C]hoice of policy goal and choice of instrument or implementation system are essentially separable problems.").

[69] 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.").

[70] Richard Revesz, Book Review, 11 Ecology L.Q. 451, 454 (1983-1984).

[71] David Pearce, Giles Atkinson, Susana Mourato, Cost Benefit Analysis and The Environment: Recent Developments (2006).

[72] Dieter Helm, *Economic Instruments and Environmental Policy*, Economic and Social Review, 36(3), 205–28 (2005).

Indeed, the introduction of congestion pricing increases the welfare of community as a whole, but it implies also wealth redistribution effects[73]. 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, in general, there is little chance of a congestion charge being accepted, unless motorists are convinced that the government will distribute the resources collected efficiently and equitably[74].

Also according to Stavins cap-and-trade is the best approach also in terms of environmental effectiveness, cost effectiveness, and distributional equity[75]. First, as to environmental effectiveness,

> *a tax does not guarantee achievement of an emissions target, but it does provide greater certainty regarding costs. This is a fundamental trade off. Taxes provide automatic temporal flexibility, which needs to be built into a cap-and-trade system through provision for banking, borrowing, and possibly a cost-containment mechanism.*

Stavins stresses also the importance of political economy because

> *political economy forces strongly point to less severe targets if carbon taxes are used, rather than cap-and-trade. In principle, both taxes and cap-and-trade can achieve cost-effective reductions, and — depending upon design — the distributional consequences of the two approaches can be the same.*

Finally Stavins argues that the key difference is that

> *political pressures on a carbon tax system will most likely lead to exemptions of sectors and firms, which reduces environmental effectiveness and drives up costs — some low-cost emission reduction opportunities are left off the table. But political pressures on a cap-and-trade system lead to different allocations of allowances, which affect*

[73] W. Baumol, W. Oates, The theory of environmental policy (1988) at 76.
[74] Charles Raux, *How should transport emissions be reduced? Potential for emission trading systems*, OECD-ITF, Discussion Paper No. 2008-1, January 2008.
[75] Robert N. Stavins, *Cap-and-trade or a carbon tax?*, The Environmental Forum, 25(1): 16 (2008), available at http://ksghome.harvard.edu/~rstavins/Forum/Column_22.pdf.

distribution but not environmental effectiveness and not cost-effectiveness. [76]

4(B). A case-study analysis

Hence, 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 essay focuses upon the different choices of policy and regulatory instruments available and/or already implemented to achieve the targets that we have been illustrated in the previous pages.

This section briefly examines the characteristics of price instruments and quantity instruments implemented or proposed to address congestion.

Pricing formulas are pretty uniformly translated into a time-of-day-sensitive congestion tax or fee and by subsidizing alternative transportation modes such as transit and bicycling. London is the most prominent example of this solution. Milan has recently adopted a similar scheme. This was also the "road" chosen by the Bloomberg administration for its anti-congestion initiative[77], which however ended up facing a too strong political opposition[78].

[76] Robert N. Stavins, *Cap-and-trade or a carbon tax?*, The Environmental Forum, 25(1): 16 (2008), available at http://ksghome.harvard.edu/~rstavins/Forum/Column_22.pdf. In a paper presented within the framework of The Hamilton Project launched by The Brookings Institutions (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 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". See Robert N. Stavins, *A U.S. Cap-and-Trade System to address Global Climate Change*, October 2007, available at http://www.brookings.edu/~/media/Files/rc/papers/2007/10climate_stavins/10_climate_stavins.pdf.

[77] William Neuman, *Panel Passes Congestion Pricing Plan*, January 31, 2008, available at http://cityroom.blogs.nytimes.com/2008/01/31/panel-passes-congestion-pricing-plan/. The congestion pricing plan would have charged passenger cars $8 and trucks $21 to cross into the charging zone in Manhattan from 60th Street and southward between the hours of 6 a.m. and 6 p.m.

[78] Nicholas Confessore, *$8 Traffic Fee for Manhattan Gets Nowhere*, April 8th, 2008 available at http://www.nytimes.com/2008/04/08/nyregion/08congest.html.

Conversely, the alternative market-oriented quantity-based schemes receive a 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[79]. The City of Seattle recently started a program called Commuter Cash which denotes some features of the credit trading approach but in any way it is comparable to the credit-trading schemes enforced in other sectors. [80]

The second "quantity measure" could be the institution of a capped driving rights licensing system similar to the taxi medallions scheme. This is a solution that rely on the highly debated virtues of property rights schemes (e.g. internalization of externalities; reduced enforcement costs; higher safety standards)[81]. Cities like Singapore and Rome have put in place a capped car-ownnership/driving rights scheme although Rome in particular cannot be properly considered a "cap & trade" system as trade is limited or not allowed at all.

4(B)(1). Price instruments. Congestion Pricing Schemes

In 1963 Vickrey argued that "in no other major area pricing practices are so irrational, so out of date, and so conducive to waste as in urban transportation". [82] 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[83].

Since Vickrey, theory and practice of transport economics has actually focused almost exclusively on the use of price instruments. London congestion charge is the most prominent example[84]. Singapore has adopted a congestion pricing scheme complemented by a vehicle

[79] 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-SUM Nat. Resources & Env't 38; James S. Shortle and Richard D. Horan, *Water Quality Trading*, 14 Penn St. Envtl. L. Rev. 231.

[80] For details see http://www.seattle.gov/waytogo/commutercash.htm.

[81] Amy Sinden, The Tragedy Of The Commons And The Myth Of A Private Property Solution, 78 U. Colo. L. Rev. 533; Katrina M. Wyman, From Privilege to Property: The Case of Taxi Medallions, paper presented to the Comparative Law and Economics Forum, at the Universitat Pompeu Fabra, August 20th 2007.

[82] William S. Vickrey, *Pricing in Urban and Suburban Transport*, American Economic Review, 53 (1963) 452–65.

[83] William S. Vickrey, *Statement on the pricing of urban street use*, Journal of Urban Economics 36 (1994) 42-65.

[84] G. Santos and Gordon Fraser, *Road Pricing: Lessons from London*, Economic Policy, 21(46) (2006) 264-310; Jonathan Leape, *The London Congestion Charge*, The Journal of Economic Perspectives, 20/ 4 (2006), 157-176.

ownership quota scheme[85]. More recently two global cities have turned to congestion pricing. New York has tried to implement a congestion pricing scheme but the proposal was turned down for political opposition. Milan was instead more successful and the congestion pricing scheme is effective as of January 2nd, 2008.

4(B)(1)(a). London

In 2003 London introduced a cordon-style congestion pricing scheme aimed at reducing traffic levels within the city.

The system charges £8 (if you pay by midnight on the day of travel) or £10 (if you pay by midnight the following charging day) to drive through the center of London between 7:00am and 6:30pm.

The congestion charging zone is enclosed within a boundary formed by the Inner Ring Road, which is not subject to the congestion charge. Enforcement of the charging system is left to a network of cameras situated at entry and exit points to the congestion zone. These cameras record images of traffic and sends them to a central processor where the license plate numbers are checked against the list of vehicles that have been paid for. Unless charges have been paid for in advance or are paid before midnight on the day of travel, the automobile's registered owner will be fined.

Exemptions from the congestion charges include licensed taxis, public service vehicles, motorcycles, mopeds, emergency vehicles, disabled drivers, and alternative fuel vehicles.

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 ninety percent fewer smog-forming pollutants and half of the carbon dioxide that a conventional automobile does. Furthermore, the exemption for alternative fuel vehicles is influencing sales of hybrid vehicles. Previously sales of hybrid vehicles during the first quarter of 2005, for example, were more than double the sales in the first quarter of 2004. Also, residents within the congestion charging zone pay only ten percent of the charge.

The result of London's pricing scheme is a twenty percent decrease in traffic within the city and a fourteen percent increase in bus use during the morning commute. In addition, average speeds within London are at their highest since the 1960s, travel times are more reliable, and even businesses within the zone have seen benefits.

[85] Georgina Santos, *Urban Congestion Charging: A Comparison between London and Singapore*, Transport Reviews, 25/5 (2005) 511-534

However, initial reductions of congestion after the first years of implementation have been sustained but not increased[86]. In order to further reduce congestion the Livingstone administration was planning, after an expansion of the area covered by the plan in 2005, to further extend the congestion area and to raise the fees at least for some categories of vehicles. Livingstone successfully ran for re-election in 2004, after the charge took effect. However London Mayor Ken Livingstone defeat in the recent elections against the Tory challenger Boris Johnson might partly be attributed also to Livingstone's plans to further extend the congestion pricing scheme.

Although the pricing mechanism is not in danger of being revoked, Johnson has promised to shrink the congestion zone back to its initial, pre-2005 area. The western expansion according to some transportation experts was poorly thought out. Livingstone's plan to increase the charge for the most polluting vehicles would also be off the table.

4(B)(1)(b). Singapore

Singapore is precursor in congestion pricing practices. In 1975 Singapore introduced a one dollar charge for private vehicles entering the central business district (CBD). The cordon-style charging scheme initially applied to automobiles entering the CBD during the morning peak hours (7:30 to 9:30). Only vehicles displaying a license were allowed to enter the zone. Carpoolers, buses, motorcycles, and freight vehicles were exempt from the requirement[87].

The result was an immediate seventy-three percent reduction in the use of private cars within the CBD, a thirty percent increase in carpooling, and a doubling of bus usage. 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. 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

[86] Transport for London, *Impacts Monitoring Programme*, *Annual Reports*, 2002-2006, available at www.tfl.gov,uk.

[87] J.Y.K. Luk, *Electronic road pricing in Singapore*, Road & Transport Research, Dec 1999.

morning peak and afternoon peak hours (10:15 to 4:30). Then, in 1998, the paper license system was replaced by an electronic cash card system.

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 thirty-one percent lower than before the charges were introduced.

These results have held in spite of a thirty-three percent increase in employment and a seventy-seven percent increase in the number of cars.

In addition, the reliability of the cash card debiting system has been studied and estimated at 99.99 percent accuracy. The annual revenue from the congestion pricing system equals about forty to fifty million Euros, while the costs for operation and maintenance are only about eight million Euros.

4(B)(1)(c). New York

On May 16, 2006, the U.S. Department of Transportation 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. One major component of the National Strategy is the Urban Partnership Agreement (UPA). Under a UPA, USDOT's partner metropolitan areas will commit to pursuit 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.

New York was selected and was taking part to the Urban Partnership. However its commitment to combating traffic congestion dates way back in time.

As to congestion pricing, a longstanding tool in the New York traffic congestion policy, in May 2000 the Port Authority of New York and New Jersey instituted a facility-based

congestion pricing system for the tolls on the George Washington Bridge, Lincoln Tunnel, Holland Tunnel, Goethals Bridge, and Outerbridge Crossing[88].

Unfortunately, this pricing scheme has had minimal impact on traffic congestion. One year after the scheme was implemented, four percent fewer motorists used the facilities during the afternoon peak period which corresponded to a seven percent increase in travel after the afternoon peak period. In addition, seven percent fewer commuters and trucks traveled during the morning peak period.

The slight results in congestion reduction are probably due to the marginal increase in charges during peak periods. However, some argue that the real reason is the lack of alternatives to using the facilities during these hours.

In 2007, Mayor Bloomberg has put forward a proposal for a congestion pricing scheme to address traffic problems in Manhattan. His proposal envisaged to expand the congestion pricing system up to 86th Street of Manhattan. The proposal encountered political opposition of some State lawmakers and was subject to an extensive review carried out by a City-State jointly appointed panel of experts who came up with a plan very similar to the original one. Mayor Bloomberg's plan was eventually defeated because of political opposition in the State senate. This caused also the loss of federal funding awarded to the City of New York through the Urban Partnership initiative[89].

4(B)(1)(d). Milan

Milan has recently adopted a cordon-style congestion pricing scheme effective as of January 2nd, 2008.

Milan's council has introduced a pollution/congestion limitation measure, know as "Ecopass". According to Milan's plan, any vehicle entering the central business district between 7:30 am and 7:30 pm from Monday to Friday, has to pay for and display an Ecopass ticket. The price of said ticket varies from 2 to 10 Euros, depending upon the "Euro" (i.e. the GHG emissions) class of the vehicle, the fuel type, the presence of approved filters, and the type of transport (personal or goods). In other terms, vehicles with super low polluting engines will pay 2 Euros a day, whereas super polluting vehicles have to pay 10 Euros to enter the center. And if

[88] The scheme increased the four dollar charge on these facilities to five dollars for the morning hours of 6:00am to 9:00am, the afternoon hours of 4:00pm to 7:00pm and weekend hours of 12:00pm to 8:00pm. The charge for trucks increase from five dollars to six dollars per axle during these same periods.

[89] Nicholas Confessore, *$8 Traffic Fee for Manhattan Gets Nowhere*, April 8th, 2008 available at http://www.nytimes.com/2008/04/08/nyregion/08congest.html.

very old vehicles (petrol or diesel pre-Euro) or a pre-Euro scooters or motorbikes, cannot buy an Ecopass at all.

In addition to the daily access EcoPass card, Milan is offering a multiple access card (50 days of access, not consecutive, with a reduced price) and an annual subscription card for residents of the ZTL. The ZTL is bounded by 43 gates equipped with electronic camera which record the passage of the vehicles, and debit the card holder's account.

4(B)(1)(e). Norway

Three Norwegian cities (Bergen, Oslo, and Trondheim) have adopted a cordon-style system of toll rings. The tolls are clearly designed to generate revenue instead of reduce traffic congestion. Congestion reduction is not an objective in Norway. The tolls are therefore relatively low and do not vary much throughout the day (the charging period is from 6:00am to 6:00pm on weekdays).

Toll locations were chosen to achieve political acceptance of the balance between the amounts paid by city and suburban residents while altering commuting behavior as little as possible.

The toll systems in Norway utilize unmanned electronic toll booths that deduct fees from dashboard-mounted transponders each time a vehicle enters the toll zone or passes a toll point.

While heavy goods vehicles pay a double toll (corresponding to the damage they cause the roadways), residents who live close to a toll station or who make frequent crossings are protected by a one-charge limit per hour. Even though congestion management was not an objective of the Norwegian toll systems, Trondheim has experienced a ten percent reduction in traffic during peak periods and an eight percent increase in traffic during off-peak periods within the charging zone.

Furthermore, as a revenue generating asset, the toll rings have exceeded expectations. The revenue in 2002 was about one billion Norwegian Krone, while the operative costs were only ten percent of that revenue. The annual maintenance costs are also minimal, amounting to about ten million Norwegian Krone. Revenues from the tolling system have been used to improve roads, build bypasses, upgrade public transit, build bicycle paths, and even to provide 200 free bicycles for use downtown.

4(B)(2) Quantity instruments

4(B)(2)(a). Tradable Permits

In general terms, a marketable traffic or congestion allowances scheme may be designed to target different things:

1. the technical characteristics of vehicles (e.g. energy source, vehicle unit consumption and pollutant emissions). In Europe, vehicle unit emissions are regulated by the Euro standards which apply to new vehicles put on the market[90]. Standards of this type can thus provide a basis for regulating the intensity of vehicle use with reference to their pollutants emissions class. In practical terms, the number of rights required to use a vehicle could, all other things being equal, be varied according to the vehicle's emissions category.
2. ownership of vehicle use; a scheme of car-ownership rationing involving auctions of a limited number of certificates of entitlement to purchase a new car. The number of certificates is determined each year on the basis of traffic conditions and road capacity and the certificates are issued each month. Quantity control of ownership are believed to be a useful instrument since automobile demand is inelastic and the social cost function is steep[91]
3. intensity of vehicle use. A tradable permits scheme aiming at car usage may foresee the allocation of quotas by trips or by vehicle-kilometres to motorists within a given urban area, with the possibility of these allowances being tradable[92]
4. land use through location of activities and its impact on distances traveled. Where urban sprawl scatters the land use pattern, proposals for applying tradable permits to real estate developers on the basis of the travel volumes that their projects will generate have been put forward[93]. In order to do this, it would be necessary to identify traffic sources (e.g. shopping centers, industrial or small business zones). It poses many market organization problems, in particular with regard to minimizing transaction costs and making trading possible, not only within a suburb or real estate development but also between different suburbia and other real estate developments.

[90] Between the Euro IV standard and Euro I standard the permitted levels for HCs and NOx, vary in a ratio of 1 to 10 for petrol vehicles and 1 to 3 for diesel vehicles. Particulate emissions standards have so far only been imposed on diesel vehicles (a ratio of 1 to 6 between Euro IV and Euro I) but the Euro V standard, which is under discussion, will introduce limits for petrol vehicles too.
[91] (Koh and Lee, 1994); Chin and Smith (1997)
[92] E. Verhoef, P. Nijkamp, and P. Rietveld, *Tradable permits: their potential in the regulation of road transport externalities*, Environment and Planning B: Planning and Design, 24 (1997) 527-548; Raux supra note ____
[93] J.R. Ottensmann, *Market-based exchanges of rights within a system of performance zoning*, Planning and Markets, (1998) 1.

Once the target is fixed. In the design of the scheme it very important the kind of technology applied. 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 dialogue with roadside readers. A second type of toll collection technology, based on a vehicle positioning system which uses satellites is also becoming a viable solution.

In order to design these specifications a series of further issues must be addressed:

1. the unit to be traded. 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);
2. the regulated entities which will hold and trade such rights and be obliged 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 a compensation for the consequences of congestion and pollution. This would involve those who drive little or not, pedestrians and public transport users and not only motorists and therefore would improve the political viability of the scheme;
3. the allocation criteria. Should these rights be allocated free of charge? Or should they be allocated through an auction. The latter is the most 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. However, as for congestion pricing, 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 of the quotas free of charge as a visible and immediate compensation in order to smooth political opposition;
4. period of validity of the quotas and the quota payment obligations. 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
5. The last issue is how to deal with “border effects”, in particular the access of occasional users and the anticipation of unforeseen behaviors which might undermine the effectiveness of the program (e.g. market power).

We now deal with single experiences which might have some of the features of a proper tradable driving or ownership allowances scheme.

4(B)(2)(a)(i). Singapore Vehicle Ownership Quota Scheme[94]

Singapore designed a Vehicle Ownership Quota System to control and limit the growth in supply of private automobiles. It was introduced in May 1990 and the system requires owners of vehicles (except for buses and emergency vehicles) to have a certificate of entitlement (COE). The system is managed by the Land Transport Authority (LTA) which determines the number of new vehicles allowed for registration while the market determines the price of owning a vehicle[95].

Registered vehicles on the roads prior to the new system were grandfathered in and automatically received a COE. Buyers of new vehicles instead are required to bid for a COE in competitive monthly tender auctions. Each bidder must indicate the amount she is willing to pay for the right to own a vehicle in a particular category. Bids are ranked from highest to lowest; each successful bidder pays a COE price equal to the lowest successful bid price. The COE is valid for 10 years from the date of registration of the vehicle[96]. The LTA determines the number of quotas and the figure is revised annually based on the number on the number of cars de-registered and traffic conditions[97].

The value of the certificates typically exceeds the cost of new car purchases several times[98]. When the price of an ownership permit is added to other price measures - an import duty, registration fee, additional registration fee, and annual road tax based on engine capacity - the final cost of car ownership in Singapore results 4.5 to 5 times the actual vehicle cost"[99]. The quota allocated to each vehicle category is in proportion to that category's share of the total

[94] Land Transport Authority (LTA), Singapore Government, *Electronic Road Pricing*, (2006) available at www.lta.gov.sg/motoring_matters/index_motoring_erp.htm; Perkins, *Charging for the Use of Roads: Policies and Recent Initiatives*, (2004) paper presented at the Fifth Annual Global Conference on Environmental Taxation Issues, Experience and Potential. Pavia, Italy, September 2004; O'Connor, D., *Applying economic Instruments in Developing Countries: from theory to implementation*, Environmental and Development Economics, 4, (1998) 91-112.

[95] Land Transport Authority (LTA), Singapore Government, *Electronic Road Pricing*, (2006) available at: www.lta.gov.sg/motoring_matters/index_motoring_erp.htm

[96] O'Connor, *Applying economic Instruments in Developing Countries: from theory to implementation"*, Environmental and Development Economics, 4 (1998) 91-112

[97] Perkins, *Charging for the Use of Roads: Policies and Recent Initiatives*, paper presented at the Fifth Annual Global Conference on Environmental Taxation Issues, Experience and Potential. Pavia, Italy, September 2004; LTA, supra note 95

[98] Perkins, supra note 97.

[99] O'Connor, suora note 96 at 103.

vehicle population[100]. Since April 2002, the Closed COE Bidding System was replaced with the COE Open Bidding System[101].

4(B)(2)(a)(ii). Rome Driving Permits Scheme

In Rome the transport strategy has focused on a mix of demand management and public transport policies to reduce car use. Traffic restraint measures have been tailored to the concentric urban structure and get progressively stronger moving from the periphery to the historic centre as the choice of alternatives to the car increases

The key policy was the introduction of a restricted access zone (ZTL) limiting car access to residents, public services and certain non-residents (such as doctors). The concept met with a great deal of public opposition, which was overcome with the conviction of the political champions, extensive consultation and evidence of air quality improvements in the pilot areas. The original ZTL began in 1989 and covered an area of 4.6km^2 containing 42,000 residents, 12 Ministries and 10% of the city's jobs, as well as the most important Roman ruins. It was effective in removing 8-10% of cars during the restricted hours (0630-1800 weekdays and 1400-1800 on Saturdays), but it was poorly enforced. The Municipality then launched a more comprehensive strategy (Piano Generale del Traffico Urbano) which would build on this with policies for Demand management – parking policies to control the availability and use of on and off-street spaces, retaining the ZTL with charges for non-resident permits, stricter monitoring and enforcement of access gates using Intelligent Transport Systems and restrictions on older, polluting vehicles.

The full-scale electronic access control and flat-fee road pricing scheme (IRIDE) began in 2001. The scheme covered the 23 entrance gates and uses a combination of video cameras and microwave transponders which communicate with smartcards in on-board units. It allows access to 30,000 residents; 30,000 service vehicles; 50,000 disabled drivers who are allowed to register up to five number plates; and 29,000 authorised individuals and 8,000 freight deliveries that have paid permits.

IRIDE led to a further fall of 18,000 vehicles (20%) in the historic centre by reducing illegal use of the ZTL (Figure 3.7). The average journey time has fallen by 10% and traffic outside

[100] LTA, supra note 94.
[101] LTA, supra note 94.

the restricted area has remained largely unchanged. Air quality has improved with a 40% decline in benzene levels and a reduction in particulates (PM10s)

After the initial controversy, the ZTL has met with support from the public. A recent sample-based survey showed that 75% of residents thought that electronic access control was a good idea. 67.2% felt it would contribute to improving the quality of the air and 64.7% felt that it would contribute to increasing the use of public transport. However, shopkeepers are not so keen, with scores of 53%, 52.5% and 48.5% respectively.

Despite these improvements, the public transport networks still did not present an attractive alternative to the car for many residents and commuters. The access controls and parking policies were crucial in reducing the growth in car use, but rather than use public transport, many drivers switched to powered two-wheelers.

Modeling studies have shown that replacing the permits and flat fees with a pure charging scheme that would apply to all users would be more effective at reducing traffic. However, the Municipality considers that this would not be socially or politically acceptable

Over 70,000 permits were issued in 2001 which was considered to be too high for the number of car parking spaces available. The Municipality has been able to reduce these by 10% per year over four years, targeting non-residents whose transport needs were being increasing met by the improving public transport systems.

A survey showed that residents are largely supportive of the ZTL; 67% of the interviewees though that it would contribute to improving the air quality and 65% felt it contributed to increasing public transport use, but there is less support amongst shopkeepers

The Piano Generale del Traffico Urbano supported innovative solutions to improve the efficiency of the transport systems and Rome has become a test-bed for new applications of ITS. These has helped to tackle traffic levels and congestion (for example, through the ZTL, co-ordination of traffic signals and provision of real-time information on public transport) at very low cost because they have been delivered through public-private partnerships, often as part of EC-funded programmes

The ZTL scheme is considered to be fair as IRIDE allows almost real-time management of the list of permits and enables special access rights to be given, for example, for cultural events, weddings, emergencies (to the public hospital located inside the zone) at a cost of 15 euros.

4(B)(2)(b). Tradable mobility credits

Kockelman and Kalmanje in 2005 proposed a scheme based on the idea of tradable emissions credits applied to road congestion and they called it "Credit-Based Congestion Pricing"[102]. Such scheme entails congestion pricing on a network of urban highways. Residents of a prescribed area are each granted a monthly allowance of travel credits, and those who drive less than average can save the credit for future travel or exchange it for cash.

Motorists would receive a monthly allocation in the form of credits (in principle monetary), which could be used to travel on a road network or within a zone with congestion charging. The motorists would therefore have nothing to pay if they did not use up their allocation: beyond this allocation, they would be subjected to the congestion charging regime. Those who failed to use up their allocation completely would be able to use their credits later or exchange them for cash.

4(B)(2)(b)(i). Seattle

In Seattle the Commuter Cash incentive program awards a credit of up to $150 to commuters that stop driving alone to work.

Commuters have to stop driving alone to work 5 days per week on average for one year in order to earn the $150 credit. One may reduce 2 to 4 days of drive-alone commuting per week or reduce drive-alone commuting for less than one year to earn a pro-rated amount of $150.

As to eligibility, in the program may participate anyone who, before they heard about this program, was driving alone to work at least two days per week is eligible.

If a driver was already commuting without driving alone 4 days per week on average before hearing about the program, she is not eligible for the program.

If a driver falls into the second category, however, she is eligible for "Refer-a-Friend" incentives.

The timeline is that the one year of reduced driving must be completed by April of 2009.

It is after all a form of incentive in the form of subsidy. And supplies of incentives are limited.

4(B)(2)(b)(ii). Genova

In 2006 Genova has launched an experimentation on a credit trading scheme.

[102] K.M. Kockelman, , S. Kalmanje, *Credit-Based Congestion Pricing: A Proposed Policy and the Public's Response*, Transportation Research 39A (2005) 671-690.

Every citizen would receive an amount of mobility credits in proportion to her own mobility needs to get access to the city center. The quantity of spent credits may vary depending on the kind of vehicle, time, day, season, area and level of emissions.
The citizen that consumes only partially the so awarded mobility credits may trade back the exceeding credits with the City in exchange for other services, such as public transport subsidies. Citizens who consume their credits may give up on their vehicles and commute by public transit, or buy new credits.
The mobility credits mechanism allows citizens to pay only for their actual driving. It is a kind of Pay-As-You-Drive scheme. The scheme is built upon a serious of parameters and factors in the estimate of the number of trips by car, the application of the credit fee structure, the estimate of the various reactions of citizens and foresees a menu of possible effect on collective mobility: on public administration, families budgets and environmental impact.
A trial, carried out between May 2006 and January 2007, showed a possible 15% reduction in the number of trips and 20% reduction of pollution (CO2, CO, PM).

5. THE POLICY MENU

5(A). Land use tools

In designing the best regulatory framework for urban congestion one could think of roads as a network the environmental characteristics and capacity of which affect its efficiency level, in particular the agility with which the traffic is able to flow through its arteries[103]. They are the bed in which the traffic stream flows. Now just as with polluted rivers there are point and non point sources. One could consider point sources each and every car that congest the network or also any major development (e.g. shopping outlets; amusement parks; and any other traffic attractor) that lies on or close to the network.
However one could look at such phenomenon from a broader perspective and would realize that municipalities or suburbia which are linked to the network are to be considered as non-point sources. Proceeding in this parallel with water streams we could adopt the nomenclature of the Clean Water Act which seems to be the best suited to explain the terms of the problem and proceed along the same reasoning.

[103] Giovanni Fraquelli, Massimiliano Piacenza and Graziano Abrate, *Regulating Public Transit Networks: How Do Urban-Intercity Diversification and Speed-up Measures Affect Firms' Cost Performance?*, 75(2) Annals of Public and Cooperative Economics 193-225 (2004)

As a matter of fact the notion of non-point source of pollution – although not specified in the Clean Water Act - includes any pollution attributable to a diffuse area that cannot be traced to any discrete individual source.

The reason for adopting such approach is that through the lenses of the CWA we are able to look at urban congestion for its real nature and that is 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. To this extent just like under the Clean Water Act we also then need to distinguish policy and regulatory tools between those suited to existing sources and those suited to new sources of urban congestion.

Today new real estate development are not bound to take into account the impact that the gentrification of a new area has on traffic and roadways congestion.

Land use scholars are increasingly putting attention to new techniques in order to minimize such impact.

The first tool in the hand of State and local governments is the so called transit-oriented development

The second option that local communities have to minimize the impact of new developments is the recourse to all the different bargaining tools (e.g. TDRs, exactions, community benefit agreements, etc.).

"New Urbanism" or "Transit-oriented Development" are emerging as viable and attractive theories of development alternative to conventional suburban development, or sprawl.[104] These theories premise on intelligent planning and architecture to create human scale communities instead of auto-oriented suburbia.[105] Communities designed with transit connections, mix of uses, and pedestrian-friendly standards, reduce effectively auto dependency.

[104] Scott Lefaver et al., *Construction of Transit-Based Development*, Mineta Transportation Institute (September 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/publications/ConstructionTBD.htm (last visited March 5, 2005).

[105] See Robert Steuteville, *The New Urbanism: An alternative to modern, automobile-oriented planning and development* 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); see also Center for Transportation Excellence, *Transit Benefits* (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), available at http://www.cfte.org/trends/benefits.asp

The use of automobiles becomes less of a necessity and more of an option. Consequently, "[r]esidents and employees located in more accessible, more multi-modal locations tend to own fewer motor vehicles, drive less, and use alternative modes more than those at automobile-dependent locations."[106]

If a community is structured in a way that enhances the transit efficiency, a lower number of people will feel the need to drive.

Transit-oriented development contrasts sprawl and all the negative consequences of auto-centered development by giving commuters transportation choices rather than obliging them to resort to automobiles for the majority of travel needs.

Recent studies forecast significant demand increase for transit-oriented communities over the next twenty-five years and that many people will desire housing within a half-mile from transit access points, or "transit zones."[107] There is already evidence of significant increases in ridership in areas where new transit lines have been opened and transit-oriented land use development occurs[108].

Finally, public transportation also has a positive impact on local property values because it enhances communities' livability and fosters local development.[109]

Appropriate public policies shall be put in place if we want to foster demand for transit-oriented development as well as reduce urban sprawl.

First the right infrastructure investments must be made, including continued improvements to public transportation systems.[110]

Second, incentives through land use schemes shall be adopted that direct private investments in the real estate market towards high density and transit-oriented areas.

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[106] Todd Litman, *Evaluating Public Transit Benefits and Costs; Best Practices Guidebook*, Victoria Transport Policy Institute, at 17 (October 22, 2004).

[107] See Reconnecting America's Center for Transit-Oriented Development, *Hidden in Plain Sight: Capturing the Demand for Housing Near Transit* (September, 2004) (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).

[108] See Litman, supra note __28__ at 9 (stating that in Portland, Oregon between 1990 and 2000, major transit service improvements were implemented and the population grew by 24%, vehicle mileage by 35%, and transit ridership by 49%. In addition, most of the transit ridership consisted of discretionary riders who chose transit because it offered better service.).

[109] See Center for Transportation Excellence, *Transit Benefits* ("Studies have shown greater increases in the value of properties located near public transportation systems than in similar properties not located near public transportation.") available at http://www.cfte.org/trends/benefits.asp.

[110] See Reconnecting America's Center for Transit-Oriented Development, supra note ____; see also The Sierra Club, *Freedom to Travel, Freedom to Choose: Better Communities Start with More Transportation Choices, Challenge to Sprawl Campaign*, available at http:// www.sierraclub.org/sprawl/transportation.pdf (explaining that how 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).

This could be achieved through various land use tools.

The most effective 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.

5(B). Public transportation policies

Critics of "enclosure solutions" contend that in this way property rights are created over common resources. In the case of congestion incentives may be provided also by aggregating the mobility demand thereby inducing people to at least make utilization of the roads more efficiently. All this solutions fall under the umbrella of Demand Responsive Transport Services (DRTS) supported by ITS. This includes the use of practices like car-pooling through the creation of high-occupancy vehicle lanes. If we think of trade-offs this solution may have lesser redistributional consequences and a softer impact on civil liberties.

Incentives to change behavior may also be provided also by aggregating the mobility demand thereby inducing people to at least make a more efficient utilization of automobiles. This approach implies a turn of transportation policy towards a set of solutions relying on information technology such as Demand Responsive Transport Services (DRTS), car-pooling and car-sharing.

In particular, the latter tool is going to reshape completely the way of thinking automobiles and individual mobility. Automobile is going to become a service rather than a product. Car makers would not just produce and sell cars. They would 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 the strictly necessary 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 22 hours per day.

5(C). The EU integrated approach

Throughout Europe, increased traffic in town and city centers has resulted in chronic congestion, with the many adverse consequences that this entails in terms of delays and pollution. Every year nearly 100 billion euros, or 1% of the EU's GDP, are lost to the European economy as a result of this phenomenon. Air and noise pollution in Europe is

getting worse year by year. Urban traffic is responsible for 40% of CO2 emissions and 70% of emissions of other pollutants arising from road transport. The number of road traffic accidents in towns and cities is also growing each year: one in three fatal accidents now happen in urban areas, and it is the most vulnerable people, namely pedestrians and cyclists, who are the main victims. While it is true to say that these problems occur on a local level, their impact is felt on a continental scale: climate change/global warming, increased health problems, bottlenecks in the logistics chain, etc.

Local authorities cannot face all these issues on their own; there is a need for cooperation and coordination at European level. In Europe the issue of urban mobility is being addressed as part of a collective effort at all levels: local, regional, national and European. The European Union is playing a leading role in order to focus attention on this issue.

According to the European Commission rethinking urban mobility involves optimizing the use of all the various modes of transport and organizing "co-modality" between the different modes of collective transport (train, tram, metro, bus, taxi) and the different modes of individual transport (car, motorcycle, cycle, walking). It also involves achieving common objectives in terms of economic prosperity managing transport demand to guarantee mobility, quality of life and environmental protection. Lastly, it involves reconciling freight transport and passenger transport interests whatever the mode of transport used.

With its Green Paper on Urban Mobility[111], the Commission has launched a consultation process with a view to presenting an Action Plan which will identify a series of concrete actions and initiatives towards better and sustainable urban mobility. For each proposed action, the Action Plan will indicate a time line for implementation and the allocation of responsibilities between the various actors.

The Green Paper is premised on the idea that there is no single solution to reduce congestion. However, 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. Citizens should be able to optimize their travel through efficient links between the different modes of transport. Authorities should promote co-modality and reallocate space that becomes available after congestion mitigation measures. Intelligent and adaptive traffic management systems have also proven their efficiency in reducing congestion.

[111] *See* European Commission, *Towards a new culture for urban mobility*, COM (2007) 551 final (Sept. 25, 2007) P 17

The Green Paper suggests that less car-dependent life-styles can be promoted through new solutions like car-sharing. More sustainable use of the private car should be encouraged for example by carpooling, which will lead to roads with fewer cars each of them carrying more people. Other options may also include "virtual mobility": tele-working, tele-shopping, etc.
According to the EC Commission, attractive "park & ride" facilities can provide an incentive for combining private and collective transport. Seamless links to efficient, high quality public transport have allowed, in this way, to free inner urban areas from traffic through integrated transport systems, such as in Munich.
The Green Paper recognizes that urban charging schemes, such as in London and Stockholm, have demonstrated positive impacts on the fluidity of transport. Intelligent transport systems (ITS) allow for optimized trip planning, better traffic management and easier demand management. Flexible and multiple use of infrastructure such as in Barcelona (flexible bus-lanes, flexible loading zones/parking places), can lead to reducing pressure on road space.
The Commission believes that "mobility management" shall complement traditional infrastructure-based measures by influencing travel behavior before it starts and shifting people's attention towards more sustainable transport options. For example, developers could be encouraged to prepare a site-specific mobility plan as part of the procedure for obtaining planning permission. The idea of a "mobility impact assessment" for large scale infrastructure developments is also being taking into consideration.
We deal now with single best practices that different EU cities have adopted to address the problem of urban congestion.

6. CONCLUSION

a. Streets back to people. Streets as "*agoràs*"

We have to regain the conception of streets as social venues. In the ancient ages streets were not just a transportation network. They were also means for social networking. 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 community. 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.[112]

b. The rise and fall of "petrocracy"

It is most likely that the Hubbert peak – beyond which oil price can only increase –has already been reached. Again, Hubbert peak theory[113] 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[114]. 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. After oil there is the whole series of natural resources starting with gas. But similar arguments apply. They are all finite resources. The shortage of oil and natural resources will cause in the next year political and economic crisis[115]. Thus it may be about time to start thinking to possible alternatives to individual mobility at least as it is conceived today. It goes without saying that the bulky part of alternative policies should be based on fostering as much as possible collective mobility and therefore public transportation and Intelligent Transport Systems.

However, it would be utopistic to think that we could get rid of individual mobility overnight. Still something needs to be done in order to reduce the environmental and traffic impact of individual mobility.

c. Command-and-control vs. Economic Incentive schemes. Price vs. quantities

Economic Incentive schemes seem to be more cost-effective than command-and-control, and within the camp of EIS, in particular if we prescind from efficiency considerations, quantity instruments, such as tradable or marketable permits or credits, prove to be better tools in addressing urban congestion for four main reasons: a) they respond better to equity concerns; and therefore b) they are more politically viable; [116] c) they are more likely to be well

[112] Jane Jacobs, The Death And Life Of Great American Cities, New York 338-371 (1961).
[113] Marion K. Hubbert, *Nuclear Energy and the Fossil Fuels*, paper presented before the spring meeting of the Southern District, American Petroleum Institute, Plaza Hotel, San Antonio, Texas, March 7-8-9, 1956.
[114] According to the Hubbert model, the production rate will follow a roughly symmetrical bell-shaped curve.
[115] Tina Rosenberg, *The Perils of Petrocracy*, New York Times (November 4th 2007).
[116] Robert N. Stavins, *Cap-and-trade or a carbon tax?*, The Environmental Forum, 25(1): 16 (2008), available at http://ksghome.harvard.edu/~rstavins/Forum/Column_22.pdf.

designed[117]; and d) they are able to represent a one catch-all strategy for externalities produced by congestion.

d. The governance framework. Federalism, experimentation and differentiation

We first have to face the authority question: who has got to regulate urban congestion? Congestion is a federalism issue. The role of localities, States and federal government need to be defined very precisely to avoid responsibility-shifting policies.

In ideal terms, the urban congestion governance framework should be designed as the following:

- federal government has to be able to set a limited number of overall objectives and provide part of the funding for those objectives;
- States have to be able shape the correct regional governance and monitoring system for urban congestion by defining the optimal transportation basin and possibly establishing a regulating authority which would oversee the management of urban mobility both public and private.
- Cities have to 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 and participate to the governance of the regional public authority.

e. Complementary Policies: from the age of possession to the age of access

Carpooling, car sharing, taxis, DRTS and BRT services as the cornerstone of a new society. A society in which the individual possession of automobiles will be the exception while the rule will be the right to have access to any destination by public or collectively held means of transportation[118].

[117] Id.
[118] Jeremy Rifkin, The Age Of Access: The New Culture of Hypercapitalism, Where All of Life is a Paid-For Experience, 33-35 (2000) who preconizes the decline of physical property.