# FISCAL INSTRUMENTS FOR LOW CARBON TRANSPORT IN CHENNAI

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# Abstract

This paper examines the feasibility of implementing a congestion tax for the city of Chennai in the State of Tamil Nadu. Based on secondary data, it calculates the time cost, fuel cost and cost of emissions due to congestion and makes recommendations regarding the effective design and application of such a tax. Chennai ranks one of the highest among all South Asian cities in terms of GHG emissions as well emissions of other criteria pollutants, especially NOx and PM10. The city also suffers from heavy volumes of traffic and congestion, particularly on the arterial roads. Several proposals have been discussed by the Chennai Corporation, in the recent past, to tackle these twin problems of congestion and pollution. Some of the options that are being considered include congestion tax, electronic road pricing, and ramp metering. This study represents an attempt to analyse one such option by quantifying the costs of congestion for the city of Chennai and making recommendations regarding levying a per trip charge in heavily congested corridors of the city.

Data for this study has been taken primarily from the Chennai comprehensive study on transport (CCTS, 2010). Our study reveals that in the Chennai Metropolitan region, congestion increases travel times by 1.5% – 161.8% depending on the direction of the travel. As a result of this congestion, fuel is wasted as the engine cannot run at optimal speed of the gear, emissions increase and also affects the welfare of the citizens. The additional time cost due to congestion is estimated at Rs 68.59 Crores per year in 2009 which would increase two fold by 2016 if no action is taken (assuming the same real cost of time). Fuel cost of congestion is estimated at Rs. 1.53 Crores per day or Rs. 558.45 Crores per year for 2009. The health cost of pollution load from vehicles in Chennai for the year 2009 has been estimated to be Rs. 78 Crores. Thus the time costs, fuel costs and emission costs together have been estimated at approximately Rs. 705.05 Crores annually. Assuming that the cost is distributed based on the kilometres travelled, this works out to be Rs. 3.06 per km per day. Based on an average trip length across different modes of transport of approximately 10 kms, the externality costs are computed as Rs. 30 per trip in a day based on 2009 data. To begin with, the study recommends levying a congestion fee of Rs. 30 per trip on the heavily congested stretch of radial roads on an experimental basis and then finding solutions to decongest the arterial roads.

# Contents

# 1 Context

Greenhouse gases (GHGs) and other pollutants are negative externalities imposing an external cost on the entire society and not just on the individuals who consume a certain product. One way to internalize such externalities is to impose a per unit tax/charge on the output of the firm generating the negative externality. A quick review of documented examples from across the world reveals that such fiscal measures, if well designed, can encourage less polluting alternatives and can raise significant revenues, which can subsequently be used to fund or subsidize green technologies.

The city of Chennai in Tamil Nadu ranks one of the highest among all South Asian cities in terms of GHG emissions as well emissions of other criteria pollutants, especially NOx and PM10. The city also suffers from heavy volumes of traffic and congestion, particularly on the arterial roads. Several proposals have been discussed by the Chennai Corporation, in the recent past, to tackle these twin problems. Some of the options that are being considered include congestion pricing, electronic road pricing, and ramp metering.

This paper examines the feasibility of implementing a congestion tax for the city of Chennai. Based on secondary data, it calculates the time cost, fuel cost and cost of emissions due to congestion and makes recommendations regarding the effective design and application of such a tax.

# 2 Background

Vehicular population in Tamil Nadu has been increasing over the years due to urbanisation, rising real per capita income and growth in personal transport. The number of motor vehicles in the state has increased approximately eight times from 19.21 Lakhs in 1993 to 170 lakhs in 2013-14, of which the non-commercial transport account for 93%. Out of these, Chennai district alone accounts for 47% of the total registered vehicles. With Tamil Nadu's vision of increasing its per capita income by 6 times by 2023 and expecting to grow at 11% per annum, one can expect that the number of vehicles would also increase manifold[1]. Vehicular emissions contribute to around 18% of carbon dioxide emissions (see Table 1). Moreover, as India has voluntarily committed to reduce the country's greenhouse gas (GHG) emissions intensity of GDP by 20-25% of 2005 levels by the year 2020, it becomes important that the economically important states like Tamil Nadu takes up this responsibility. Thus, if overall carbon emissions have to be reduced, emissions from transport would play a key role. Emissions from transport in addition to contributing to the GHG build up also impacts health and social life of the population.

The major source of pollution from vehicles is in the form of suspended particulate matter and black smoke which penetrate in the lungs and cause health problems. One can see from Table 1 and Table 2 that both NOx and PM10 are very high in Chennai, majority of which is contributed by vehicles. Transport sector in Tamil Nadu contributes to around 20 Lakh metric tonnes or around 18% of all $CO_2$ emissions in the state. Moreover, the pollution from vehicles is dispersed low causing higher damage. As the vehicular population increases, they also add to the congestion thereby increasing the amount of time of travel, the fuel costs, emissions and social costs. Furthermore, this commitment by the state to move to a low carbon economy is important if it has to realise its vision 2023.

**Table 1: EMISSION PROFILE OF TAMIL NADU, 2009-10**

| Emission | Source $CO_2$ Eq. (MT) |
|---|---|
| **Energy** | |
| Power Generation | 51,422,878 |
| Transport | 20,113,210 |
| Residential/Commercial | 5,582,110 |
| Other Energy | 6,364,407 |
| Fugitive Emissions | 1,238,477 |
| **Agriculture** | |
| Enteric Fermentation | 9,770,196 |
| Manure Management | 439,587 |
| Rice Cultivation | 3,655,652 |
| Agricultural Soils | 2,253,272 |
| Burning of crop residue | 305,758 |
| **Waste** | |
| Municipal solid waste | 1,241,741 |
| Domestic waste water | 481,405 |
| Industrial waste water | 482,177 |

1 (www.tn.gov.in)

**Table 1: EMISSION PROFILE OF TAMIL NADU, 2009-10 (CONTINUED)**

| Emission | Source $CO_2$ Eq. (MT) |
|---|---|
| **LULUCF** | |
| Forest Land | -3,474,664 |
| Crop Land | -8,816,247 |
| Settlements | NE |
| Grassland | 110,161 |
| Fuel wood usage | 2,556,667 |
| **Industrial sector** | |
| Industries | 18,125,505 |
| **Total Emissions in Baseline Year 2009-10** | **111,862,292** |

***Source:*** *CII (2014)*

**Table 2: STATE OF AMBIENT AIR QUALITY IN CHENNAI CITY FOR SELECTED LOCATIONS**

| Area | NOx 2007 (%) | Total NOx Emissions in kg/day | NOx 2012 (%) | Total NOx Emissions 2012 in kg/day | PM10 Emissions 2007 (%) | Total PM10 Emissions 2007 | PM10 Emissions 2012 (%) | Total PM10 Emissions (kg/day) |
|---|---|---|---|---|---|---|---|---|
| Saidapet | 71.9 | 216.65 | 80.3 | 309.65 | 25.27 | 117.52 | 26.14 | 181.42 |
| Adyar | 78.8 | 274.93 | 85.7 | 406.98 | 9.5 | 431.21 | 10.25 | 642.96 |
| Mylapore | 82.1 | 460.37 | 88.1 | 691.15 | 14.49 | 470.41 | 14.93 | 735.36 |
| Triplicate | 64.2 | 184.43 | 74.3 | 256.78 | 28.19 | 100.36 | 29.36 | 155.13 |
| RK Nagar | 63.9 | 203.77 | 74 | 283.29 | 4.68 | 570.55 | 4.91 | 875.2 |
| Ambattur | 13.5 | 1865.96 | 20.1 | 2019.75 | 9.1 | 509.94 | 10.59 | 706.12 |

***Source:*** *www.tn.gov.in*

# 3 Instruments for Low Emissions from Transport

What are the various policy measures that can reduce emissions from vehicles? Policy instruments can be geared towards vehicle type, fuels, emissions and behaviour of individuals. This can be achieved through 1) Encouraging Research and Development to enable a shift to new cars with better hybrid technologies which use clean fuels like electricity, hydrogen etc., 2) Having stricter emission norms through command and control regulations, 3) Encouraging behavioural changes in individuals to shift to public transport or low carbon vehicles through information measures, 4) Using existing markets to encourage the shift to lower carbon transport (taxes, charges, fees, fuel levies etc.), 5) Using tradable permits (through emissions trading permits) etc. In addition, one might have to think about pure transportation policies like limiting the traffic on certain routes, levying congestion charges to ease the traffic on the roads, levying differentiated parking fee, promoting public transportation system etc.

Use of fiscal instruments like taxes has always been of interest to Governments since taxes are a source of revenue to meet the requirements for various infrastructural projects. A number of studies have shown that vehicle tax could significantly reduce the emissions and traffic congestion. Timilsina and Dulal (2008), reviewed different studies and found that every 1 % increase in vehicle taxes would reduce vehicle miles by 0.22% to 0.45 % and $CO_2$ emissions by 0.19 %. Different forms of vehicular taxation exists in different countries. In India, there is a one-time excise tax levied at the time of purchase of the vehicle, a special duty based on engine size, registration fee at the time of registering and a lifetime tax. Some low polluting vehicles are exempt from paying duty fee. However, this will not induce behavioural changes in the individual. It might at the most help individuals decide which vehicle to choose.

However, whether taxes can enable the shift to a low carbon economy depends on the prime purpose of the tax - is it to modify the travel behaviour, reduce carbon emissions or raise revenues? In addition to fuel taxes, a congestion tax, parking fee, user fee, auctioning of routes etc. can induce real behavioural changes on the vehicle owners. Thus, if the objective is to reduce the emissions from vehicles, the last category of pricing may be more useful. The efficacy of course depends on the nature of use of vehicles – the purpose of the trip, the nature of use, distance and time of travel etc.

In fact, an integrated approach supplementing the transport policies with the pollution control policies is required to shift to low carbon transportation. This might include 1) Mass rapid transport system; 2) Traffic management through pedestrian zones, bicycling zones); 3) Well identified parking slots other than along the roads; 4) Phasing out of highly polluting vehicles; 5) Mandatory fuel and vehicle standards etc.

## 3.1 What is done at present in Tamil Nadu?

Since emissions from two wheelers are a major source of air pollution, Tamil Nadu has passed the Motor Vehicles Act 1988 and Central Motor Vehicles Rules 1989 that prescribe certain standards for motor vehicle emissions. All vehicles which are in operation for more than a year should undergo emission tests every six months through the 248 authorized Private Emission Testing Centres throughout Tamil Nadu. The Pollution Under Control certificate is mandatory in the state.

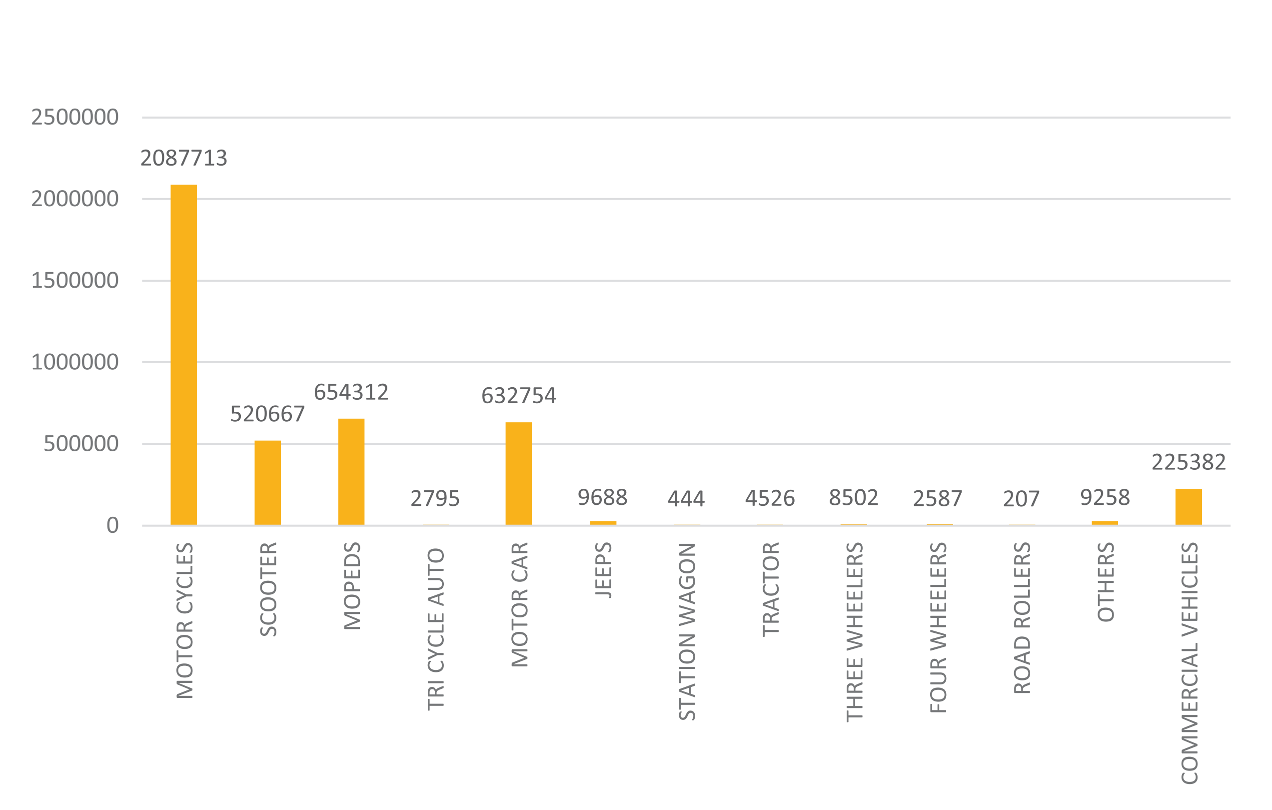
Some other measures taken include setting a time line for conversion of all the auto rickshaws run on petrol to CNG, for which the Tamil Nadu Pollution Control Board is offering a subsidy of Rs. 3000 per vehicle conversion. In Chennai city, 23 Auto LPG Dispensing Stations were set up to address the supply side. There is also a ban on new petrol and diesel auto rickshaw permits. To improve the air quality, individual motor vehicles that run on petrol are being encouraged to convert to LPG in a phased manner as per the directive of the Supreme Court of India. Lastly, the emission standards in Tamil Nadu have been tightened and Bharat Stage IV emissions norms have been introduced in Chennai. There is a complete ban on leaded fuel and there is an attempt to shift from two stroke to four stroke two-wheelers. Thus the main reliance is on command and control instruments rather than the use of fiscal instruments.

## 3.2 Nature of Vehicular Demand in Chennai

This section focuses only on Chennai, as vehicular population in Chennai is nearly 50% of the total number of vehicles in Tamil Nadu. The city of Chennai is a very important economic base for Tamil Nadu as well as India with a mix of small scale, industrial and commercial activities. The economic activities are mainly concentrated in the Central Business District. Chennai has circular and radial roads. Due to export processing zones, industrial estates, special economic zones, bio-technology parks, information technology parks in Chennai, the population and the vehicles in the city have increased considerably leading to increase in pollution as well as congestion. The summary of daily traffic volume at different mid blocks in Chennai for 2002 is presented in Annexure I:

Chennai has a very good public transportation network with buses, trains and mass rapid transport system. However, the buses are overcrowded during peak hours. Recently, new premium service has also been introduced to encourage the shift from private to public transport. The total length of road network in Chennai is around 2780 kms and it has radial and ring pattern of network. The vehicular population in Chennai is growing at around 9.7% per annum. The composition of the vehicular growth shows that the number of buses have remained more or less stagnant while two-wheelers have increased by 24 times since 1984. Motor Cycles in Chennai constituted 50% of registered vehicles in 2014 (as seen in Figure 1), much higher than the remaining metro cities in India.

**Figure 1: COMPOSITION OF VEHICLES IN CHENNAI (AS OF 2014)**




***Source:*** *http://www.tn.gov.in/sta/stat1.html*

Given the nature of demand, pollution and road congestion, the following section discusses the advantages and disadvantages of different applicable fiscal instruments to enable the shift to a low carbon economy in Tamil Nadu with special reference to the city of Chennai.

# 4 Applicable Fiscal Instruments for Low Carbon Transportation in Chennai

Fiscal instruments to reduce the carbon emissions from fuel use can be 1) Fuel taxes (excise tax), direct emission taxes (carbon tax, sulphur tax), emission charges or fees; 2) Vehicle taxes (vehicle registration fees, ownership tax or license fees) and subsidies (for clean vehicles etc); 3) Targeting behaviour (auctioning of routes, congestion tax, parking fees, restricted parking or no parking zones etc). All these instruments work through making the user pay for the carbon emissions due to vehicle use. The key idea of these instruments is to target the demand for fuel, vehicles and behaviour by vesting the decision making ability to use the vehicle or alternate modes with the vehicle owners. Which policy instrument to use depends on the nature of the problem – is the problem arising because of use of low quality fuel, congested roads, or because of heavy dependence on personal transport? For this we need to understand the nature of demand and infrastructure facilitating the use. The following section gives some examples of fiscal policies implemented by different countries across the world.

## 4.1 Congestion Charges or Road Pricing

In cities like Chennai where the vehicle carrying capacity is low, each addition of vehicle beyond the carrying capacity imposes additional marginal costs on other vehicles in the form of time costs, fuel costs, social costs and health costs. Congestion charges are levied so as to reduce the marginal social costs by making the users pay for the congestion that they are causing. The congestion charges levied would be the difference between the social marginal costs and the private costs. Congestion taxes and charges can take many forms:

**4.1.1 Area Licensing Scheme** – Singapore introduced for the first time area licensing scheme in 1975. This required drivers to purchase a special permit to drive the car in some restricted zones during the peak hours. The prime objective of this scheme was to regulate the traffic and the government had set a target that the volume of traffic be reduced by 25% to 30%. The scheme has been quite successful as well as profitable due to long campaigning efforts by the government as well as complementary efforts made by the government to create more parking spaces outside the restricted zone, improve the public transport within the zone, facilities like park and ride and increase the parking rates within the restricted zone. The permit fee ranged between $1.50 to $2.50 per day. The scheme, which successfully operated for 23 years till 1998, brought behavioural changes in the commuters by avoiding routes of the restricted zone, changing the timings of commuting and using public transport. (World Bank, 1978). However, there were some problems arising out of this scheme like increase in traffic outside the restricted zones, unexpected rush in evening peaks etc.

In India, there was some discussion on implementing congestion tax on motorists in the city of Delhi. It was proposed to levy a fee of INR 150 on cars (CII, 2014), motorbikes entering central areas during the day.

### 4.1.2 Electronic Road Pricing System

Electronic Road Pricing system is similar to area licensing scheme but based on a pay-as-you-use principle. Motorists are charged only when the roads are used during peak hours and the charges vary for different roads and time periods. Moreover, this does not require buying monthly or daily license. The number plate is automatically read and the bill is sent home at the end of the month. Singapore replaced its area licensing scheme with the electronic road pricing system in 1998. A key feature of this scheme is that it is revised every third month and the pricing is linked with the desired vehicle speed. If the speed falls, the charge goes up and is displayed on the bill board. Further, the pricing has also some environmental features. Hybrid and electric vehicles pay a lower fee. The charges vary for different vehicles and time of the day. The revenue goes to the national account.

This system is in place in London as well, which was introduced in 2003. In London, a vehicle entering a core 22 km zone is required to pay a charge of £5 between 7 AM and 18.30 PM on weekdays. The charge has been increased to £8 since July of 2005 (Schmöcker et. al., 2005). A key feature is that the fee is levied per day irrespective of the distance travelled and discounted weekly passes are also available. There are no toll booths but vehicles are charged based on the cameras located at boundary and at different points within the zone. The primary purpose of the scheme in London is to reduce congestion as well as raise revenues.

Norway had introduced an electronically operated cordon pricing scheme in 1991 in the cities of Bergen, Oslo and Trondheim. The toll ring had 11 toll stations surrounding the city centre and vehicles coming inside the city were charged through an electronic tag. The pricing was differentiated based on the time and day and the type of the vehicle. There is free passage after 5 PM and during the weekends and there are no monthly passes. The traffic has reduced by 10% after the introduction of this scheme. The revenues earned were earmarked for infrastructure investment.  This was taken over by a second generation scheme called zonal charging system which became operational from 1998. The city is now divided into 6 zones and the pricing is based on the number of zones crossed. There are no charges after 6 pm during the week days and during weekends.

The state of California in the U.S.A has adopted a different pricing referred to as value pricing. The commuters pay a charge for driving in express ways with less traffic. The tolls are automatically obtained by a transponder on the windshield. The basic objective of this scheme is to ensure that the speed of the vehicles is maintained at 65 mph. The revenue goes towards financing road infrastructure. The other more popular scheme in California is the HOT (High Occupancy Toll) lanes. These are parallel to existing roads but used only by high occupancy vehicles like buses, cars with more than 3 passengers and those paying additional fees. The level is set so that the speed does not drop below 65 mph. Such HOT lanes are in operation in Toronto as well as Melbourne. In Melbourne the fee is for the use of roads that connect the radial motorways with the city centre. They also use transponders and cameras to charge the vehicles.

In some countries, the introduction of congestion pricing was smooth but in others like Netherlands, Sweden, Hongkong there was lot of opposition to the move and hence the idea was shelved.

## 4.2 Emission Taxes

An emission tax is levied on fuels in proportion to the emissions (e.g carbon, nitrogen oxide, sulphur, VOCs etc.). A carbon tax is levied based on the carbon content of the fuels, a nitrogen tax on the NOx emissions from fuel and sulphur tax based on the sulphur content of the fuel. The carbon tax is the most popular one in different countries in a bid to mitigate climate change. Taxes on other emissions are not that popular. Given the pollution situation in Chennai and the fact that the total suspended particulate matter is very high, a tax can be levied on SPM. However, this is not very popular. Therefore, initially the target can be carbon, sulphur or nitrogen taxes as it leads to improvement in the quality of fuels and also enables the shift to low carbon transport. For the situation in Chennai, this is better than fuel taxes, which can have regressive impacts.

## 4.3 Subsidies

This is the most popular fiscal instrument for transport sector. This can be used in combination with congestion pricing and emission taxes so as to induce change in behaviour. By punishing emissions and rewarding emission cuts, the shift to low carbon transport would be faster. Subsidies can be provided to public transportation and vehicles which run on clean fuels, as well as firms investing in R&D. However, subsidies alone may not be effective in reducing the congestion and number of vehicles. The total carbon emissions may still increase in the long run.

## 4.4 Parking Charges

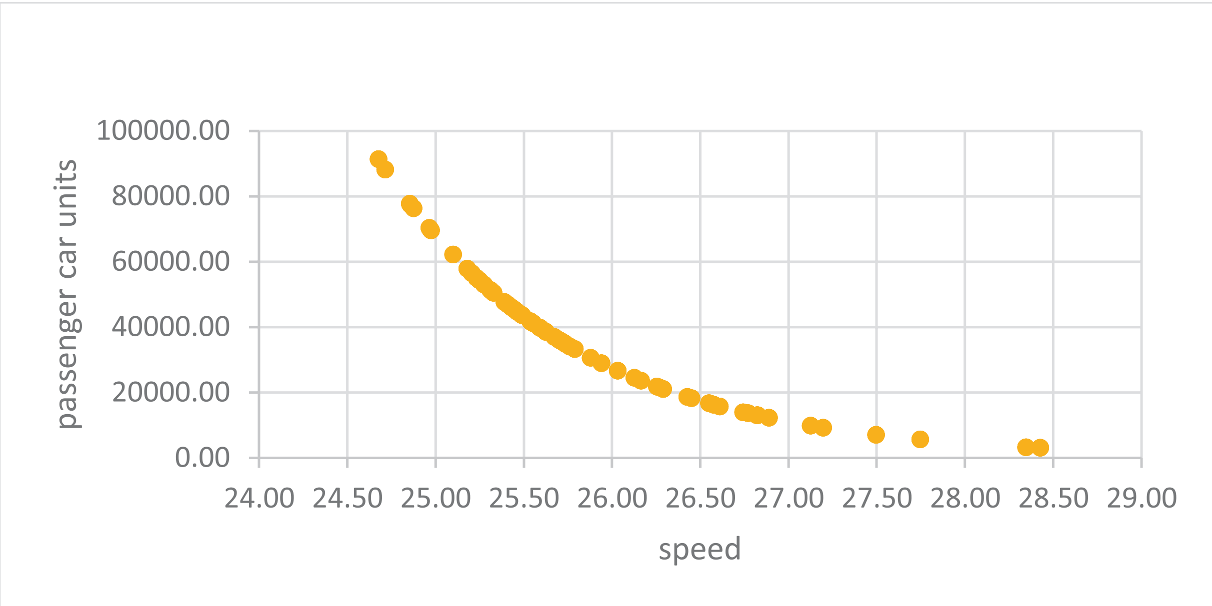
In conjunction with other instruments suggested above, parking charges and designated no-parking zones along with strict enforcement have the potential to reduce vehicular carbon emissions drastically. This works through increasing the cost of usage of cars. As a result of higher parking charges and strict parking restrictions, the consumers might change the time of their travel, change the mode of transportation or reduce the number of visits. However, it may also be possible that it increases the use of auto-rickshaws and taxies and may not result in reduced carbon emissions.

# 5 Application and Recommendations for a Congestion Tax in Chennai

Chennai experiences very heavy congestion and also has a chaotic transport system. The Chennai comprehensive study on transport (CCTS, 2010) showed that around 55,000 taxis, 18,000 buses and 1 million private cars ply on the city streets. Chennai has very good elevated mass rapid transportation system, several areas have been designated as one-way and the heavy vehicles are restricted during the peak time. The Madras Transport Corporation has a fleet size of 3,095 buses operating on 585 routes and the overcrowding is around 150% of the maximum fleet capacity on these routes[2]. Around 78,155 goods vehicles cross the city limits every day (CCTS, 2010). The Chennai Metropolitan area is served by around 2,780 kms of road network. There are four major radial roads (i) Anna salai (NH45); ii) Periyar EVR salai (NH4); (iii) Chennai-Kolkotta salai (NH5); and (iv) Chennai - Thiruvallur Salai (NH205). Other radial roads include Kamarajar salai, East Coast Road, Rajiv Gandhisalai (OMR), NSK salai (Arcot Road) and Thiruvottiyur High Road. In addition, there are two orbital roads - Chennai by-pass Road and Jawaharlal Nehru Road which have reduced the congestion on Anna Salai.

The roads have a limited capacity but new vehicles are added to the road every day. The average volume carried by Anna Salai, for example during 2006 was about 1.58 lakh passenger car units (PCU) as against its capacity of 60,000 PCU per day (Expert Committee on Road Transport Network, 2008). It is clear from Figure 2 that as the volume of passenger car units decreases, the speed increases. This means that each vehicle beyond the carrying capacity of the road would add more cost on other users.

**Figure 2: RELATION BETWEEN SPEED AND PASSENGER CAR UNITS IN CHENNAI**




***Source:** Authors regression analysis based on CCTS (2010) for the selected intersections*

2 Expert Committee Report on Road Transport Network (2008)

The volume to capacity ratio in some places is more than 8 (see Table 3).

**Table 3: CARRYING CAPACITY OF SOME BUSY ROADS IN CHENNAI (2008)**

| | Carrying Capacity | Volume to Capacity Ratio in 2008 |
|---|---|---|
| Anna Salai (@Saidapet) | 2700 | 5.08 |
| Periyar EVR Salai (@Amjikarai) | 1800 | 3.14 |
| Jawaharlal Nehru Salai (@Ekkathungal) | 2700 | 2.75 |
| Erukanchery High Road (@Vyasarpadi) | 1500 | 2.66 |
| Mount-Poonamale Road (@ MIOT Hospital) | 1800 | 3.14 |
| Thiruvottiyur High Road (@Washermanpet Railway Station) | 800 | 8.33 |
| Durgabhai Deshmukh Road (@Thiru Vi Ka bridge) | 1450 | 7.41 |
| Rajaji Salai (@Beach Station Road) | 1140 | 1.66 |
| Perambur High Road (@Perambur Railway Station) | 600 | 9.52 |

***Source:*** *State level committee on road connectivity (2008)*

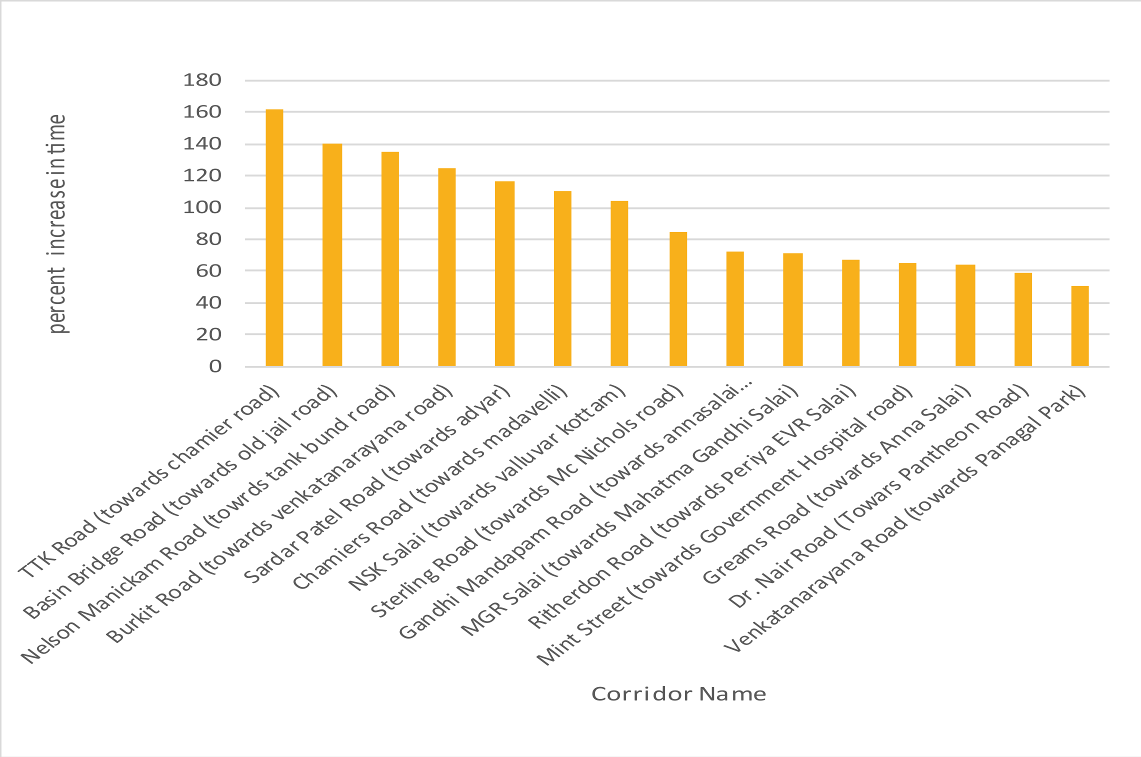
This has three impacts – the congestion increases the time taken to travel, increases fuel costs and increases the risk of accidents. According to the Chennai comprehensive transportation study (2010), 35 out of every 10,000 vehicles in Chennai turn out to be fatal and on an average 625 people die every year.

Given that the average capacity of the roads in Chennai is between 600 to 2700 vehicles at a given time, the roads are heavily congested. The average targeted speed across all modes of transport that can be reached with an average capacity reduction of 5 times (i.e 20000 passenger car units) could be around 26.5 km/hr. However, note that this is average speed across all modes.

## 5.1 Congestion Index

In the Chennai Metropolitan region, congestion increases travel times by 1.5 % – 161.8 % depending on the direction of the travel (see the Congestion Index table in Annexure II). The congestion index is computed by the authors as the ratio of difference between peak and off-peak time taken to cover the distance divided by the off-peak time taken and expressed as a percentage. The data for computing congestion index is based on the CCTS (2010) report. The congestion index indicates the extent the length of the travel is extended. Higher the percentage, higher the congestion on the road. As seen from the Figure 3, some stretches experience higher increase in travel time than others. For example, the maximum increase in travel time of 160% is recorded on TTK Road – Chamiers Road. As a result of this congestion, fuel is wasted as the engine cannot run at optimal speed of the gear, emissions increase and also affects the welfare of the citizens.

**Figure 3: PERCENT TIME INCREASE BETWEEN PEAK AND OFF-PEAK FOR SOME CORRIDORS IN CHENNAI**

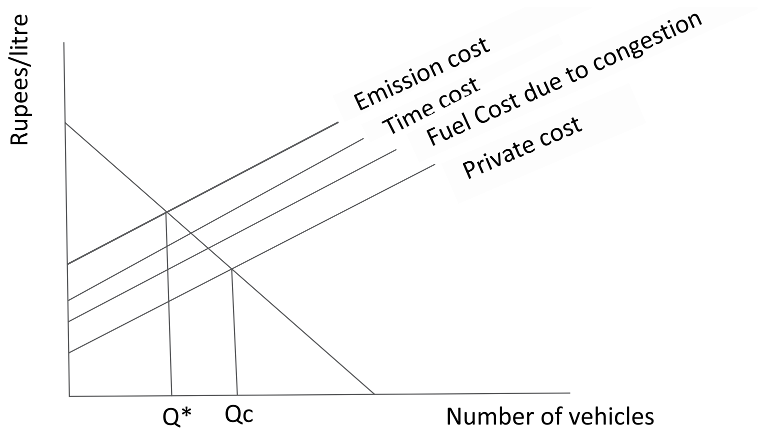



***Source:*** *Computed by the authors based on CCTS (2010) data*

## 5.2 Cost of Congestion

Individuals while deciding to use the mode of transport equates their marginal private benefits with private costs. However, when the number of vehicles exceeds the capacity of the roads, it imposes costs on the user. The costs can be in terms of the time costs, fuel costs and emission costs which need to be computed. Figure 4 below depicts how the optimal number of vehicles on the road decreases as these external costs are added to the private cost of a vehicle owner.

**Figure 4: COSTS OF CONGESTION**




### 5.2.1 Time Cost of Congestion

As per the CCTS (2010) projections, the average vehicle kilometres in 2008 were 63 lakh kilometres and the vehicle hours of travel have been estimated as 2.32 lakh hours per day in 2008. This is projected to increase to 97 lakh kilometres and

4.65 lakh hours per day by 2016 in the business as usual scenario. This means that the additional number vehicle hours of travel due to congestion as computed by authors (assuming an average increase of 25% additional time) is 0.58 lakh hours per day in 2008 and 1.16 lakh hours per day by 2016 (based on the mean congestion index developed by authors in Annexure II). This is the additional time spent as a result of congestion daily which has time costs.

CCTS (2010) estimated the time cost based on purpose and mode of transport. From this information we computed the weighted average total cost of time as Rs 0.54 per minute for the year 2009 (see Table 4).

**Table 4: COST OF TIME**

| | Work | Business | Education | Others | Modal Share |
|---|---|---|---|---|---|
| Two wheeler | 0.53 | 1.06 | 0.26 | 0.26 | 26 |
| Car | 1.08 | 2.16 | 0.54 | 0.54 | 7 |
| Auto | 0.35 | 0.7 | 0.15 | 0.11 | 6 |
| Taxi | 0.42 | 0.84 | 0.21 | 0.21 | 30 |
| Bus | 0.32 | 0.64 | 0.16 | 0.16 | 27 |
| Train/Metro | 0.5 | 0.99 | 0.25 | 0.15 | 4 |
| **Total by Purpose** | **47.99** | **19.79** | **6.33** | **67.05** | **0.54*** |

***Source:*** *Value of time by nature of work and type as per CCTS (2010) data*

** indicates the estimate computed by authors based on weighted average*

Thus the additional time cost due to congestion in 2009 is estimated as Rs 68.59 crores per year in 2009 which would increase two fold by 2016 if no action is taken (assuming the same real cost of time).

### 5.2.2 Fuel Cost of Congestion

Congestion in addition to increasing the time costs also increases the wastage of fuel. As per a policy on fuel norms, currently passenger vehicles average 16 km/litre and according to new norms the average fuel efficiency should be 18.2 km/litre by 2016-17 and 22 km/litre by 2021-22. This is however, on a road with smooth traffic and not too much of congestion. Assuming the average mileage of 16 km/litre would mean that around 3,93,750 litres of fuel is consumed every day. Given that congestion leads to reduction in mileage by almost 30% – 40%, the additional fuel consumed per day is around 2,36,250 litres per day. This is equivalent to Rs. 1.53 crores per day or Rs. 558.45 crores per year (note we have assumed average mileage to be 10 km/litre on a congested road and converted them to fuel costs assuming the average price of fuel to be Rs. 65/litre).

### 5.2.3 Cost of Vehicular Emissions in Chennai

There is a need for more reliable data to estimate the pollution load from vehicles. The pollution from vehicles depends on the number of vehicles on road, the type of vehicle, pattern of driving etc., which cannot be obtained from secondary sources. Nevertheless some studies computed the approximate pollution load due to vehicles in Chennai. A study by Nesamani (2009) collected primary data to estimate the pollution load due to vehicles in Chennai under different modal scenarios. They estimated emissions from motor vehicles in Chennai for the year 2005 as 431, 119, 46, 6 and 4575 tonness/day respectively for CO, VOC, NOx, PM and $CO_2$. The two and three-wheelers, according to the study by Nesamani (2009), emitted about 64 % of the total CO emissions and heavy-duty vehicles accounted for more than 60 % and 36 % of the NOx and PM emissions respectively. About 19 % of total emissions, according to the authors, were that of start emissions (emissions related to the start of a cold engine). The estimated health damage cost from automobile emissions, according to this study, was Rs. 6488.16 million for the year 2005. According to another study by Velmurugan et al (2005), for the year 2002, the estimated daily pollution loads of CO, NOx, HC and PM from vehicles from the total vehicle kilometres of 24.93 million kilometres are 177.00 t, 27.29 t, 95.64 t and 7.29 tonnes respectively. Their study used the coefficients for various categories of vehicles and by the age of the vehicle published by the Central Pollution Control Board in 2000. However, there is significant difference in the vehicle kilometres travelled between Velmurugan (2005) study and CCTS (2010) study. For the sake of consistency, we recomputed the emission load for various modes of transport based on CCTS (2010) data and computed the health cost of pollution load using the figures given by Sengupta et al (2005). As the estimates were for the year 2003, we assumed an annual inflation in health cost to be 10% and scaled the cost estimates accordingly. Under these assumptions, the health cost of pollution load from vehicles in Chennai for the year 2009 has been estimated to be Rs. 78 crores (see Table 5).

**Table 5: HEALTH COSTS OF VEHICULAR POLLUTION IN CHENNAI**

| | Estimated Emissions in Tonnes per km/day Estimated for 2008 (Based on CCTS Data) | | | | Estimated Health Damages (for 2008-2009) in Rupees Crores | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | CO | NOx | HC | PM | CO | NOx | HC | PM | Total Health Costs |
| Health Costs (Rs/kg) Based on Sengupta et al (2005) | | | | | 0.07 | 16.03 | 1.015 | 129.4 | |
| Two wheeler | 7.23 | 0.28 | 4.68 | 0.20 | 0.03 | 0.26 | 0.28 | 1.48 | 2.05 |
| Car | 2.33 | 0.60 | 0.38 | 0.09 | 0.01 | 0.56 | 0.02 | 0.69 | 1.28 |
| Auto | 6.86 | 0.04 | 4.53 | 0.15 | 0.03 | 0.04 | 0.27 | 1.17 | 1.50 |
| Taxi | 10.16 | 3.75 | 0.74 | 1.28 | 0.04 | 3.51 | 0.04 | 9.69 | 13.28 |
| Bus | 8.95 | 29.61 | 2.48 | 3.76 | 0.04 | 27.72 | 0.15 | 28.45 | 56.36 |
| Other modes | 1.91 | 1.44 | 0.23 | 0.29 | 0.01 | 1.35 | 0.01 | 2.16 | 3.53 |
| **Total by Pollutant** | **37.44** | **35.72** | **13.04** | **5.77** | **0.15** | **33.44** | **0.77** | **43.64** | **78.01** |

***Source:*** *Computed by authors based on CCTS (2010), Velmurugan (2005) and Sengupta et al. (2005)*

## 5.3 Externality Load of Vehicular Emissions in Chennai

Thus the time costs, fuel costs and emission costs together have been estimated at approximately Rs. 705.05 crores annually. Assuming that the cost is distributed based on the kilometres travelled, this works out to be Rs 3.06 per km per day. As per the CCTS (2010) the average trip length across different modes of transport is approximately 10 kms. Hence the externality costs are computed as Rs. 30 per trip in a day based on 2009 data.

## 5.4 Limitations of this Study

The estimated time costs, fuel costs and emission costs considered in the study were based on secondary sources of information. However, detailed primary survey has to be carried out to compute the exact cost of congestion at different corridors and also to understand the nature of demand. We did not have enough information on the nature of demand at different hours. Within the peak time itself, more information is required on the number of vehicles passing each way. More details are required on the nature of vehicle, vehicular load at different hours, the time costs etc, for further in-depth analysis. The estimates derived in this paper should be treated as approximate figures. We need to carry out a detailed willingness to pay study, get the specific nature of demand and the individuals travel behaviour for arriving at the exact congestion fee.

# 6 Concluding Remarks

We have looked at the congestion in different corridors in Chennai. Congestion if not addressed would impede the growth of the city. It also hurts individuals and their families as the amount of time and fuel spent due to congestion increases. Investing in creating more transport related infrastructure is not going to address the problem of congestion. It will actually put more vehicles on the road, increasing pollution and congestion. Along with other infrastructural investments, it is important to change the behaviour of the individuals. This is possible by giving more information on traffic patterns at different localities at different times of the day. This information would give an individual the choice of when to drive. As individuals are unlikely to change their behaviour on their own, some congestion pricing would motivate both people and businesses to make informed decisions. But at the same time, implementing congestion charges without improving the road infrastructure, providing alternate modes of transport can lead to more welfare losses.

If the state has to adhere to its commitment of shifting to low carbon transport, the problem of congestion has to be addressed first. This study has done a very preliminary attempt to quantify the costs of congestion for the city of Chennai and has recommended levying Rs 30 per trip on heavily congested corridors. The consumers have to be assured of a minimum speed of at least 27 km/hr while levying this charge. Otherwise, the charge would not lead to a successful outcome. In Singapore the vehicle users were assured of a minimum speed and the authorities could succeed. To begin with we suggest levying congestion fee on the heavily congested stretch of radial roads on an experimental basis and then find solution to decongest the arterial roads. The stretch can be chosen based on the vehicle carrying capacity of the road. Ideally the volume of vehicles to carrying capacity should be one. However, the losses in capacity of the road due to parking of vehicles, poor road conditions should also be rectified for the experimental stretch.

Alternatively, where the road is wide, we recommend dedicating a fixed lane for high speed driving (HSD), on a use and pay basis. HSD, by taking some vehicles off the main lane, reduces the vehicle hours on the road. But in the process it is also to be noted that the cost of providing a solution must not exceed the cost of the problem.

**In summary, the various steps to shift to low carbon transport include identifying demand side solutions like -**

1. Reduce the bottle necks in carrying capacity through dedicated parking corridors.
2. Compute the optimal carrying capacity of the roads with an objective of achieving some fixed speed limit (say 30 km/hr during peak hours).
3. Levy a congestion charge for a fixed time during the peak in slabs.
4. Where feasible, have a dedicated lane for high speed driving (for those users who are willing to pay).
5. Inform and educate people on the heavily congested and less congested localities so that individuals are able to decide the time of vehicle use.
6. Stagger the office opening times where feasible.
7. Those employees who have flexible business hours can negotiate with their employers for flexible work hours thereby decongesting the roads.
8. The solutions are feasible only through a congestion charge or fee on major arterial roads, along with a hefty parking fee.
9. More work needs to be done on exact implementation of congestion charge.

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# Annexures

## Annexure I: SUMMARY OF DAILY TRAFFIC VOLUME AT DIFFERENT MID BLOCKS IN CHENNAI FOR 2002

| Sl. No. | Road Name | Traffic Lanes* | Proportion (In %) | | | | | | | | | Grand Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cars | Taxis | Autos | Two Wheelers | Buses | Trucks | LCVs[1] | Total FMVs[2] | SMVs | |
| 1 | L.B.Road | 2 | 13.1 | 2.4 | 10 | 47.7 | 0.9 | 1.5 | 4.1 | 79.6 | 20.4 | **30272** |
| 2 | C.I.T. Nagar | 3 | 15.5 | 1.7 | 10.9 | 52.1 | 5.9 | 1.9 | 3.5 | 91.5 | 8.5 | **53709** |
| 3 | Arcot Road | 4 | 13.8 | 2.1 | 13.7 | 51.5 | 3.1 | 1 | 1.9 | 87.3 | 12.7 | **111224** |
| 4 | Inner Ring Road | 4 | 15.3 | 3.5 | 10.1 | 47.4 | 3.2 | 4.8 | 4.5 | 88.9 | 11.1 | **58842** |
| 5 | EVR Periyar Road | 4 | 15.4 | 1.6 | 10.5 | 44.4 | 4 | 5 | 5.7 | 86.7 | 13.3 | **56245** |
| 6 | Poonamallee High Road | 4 | 16.5 | 1.3 | 14.1 | 53.4 | 2.2 | 2.6 | 2.3 | 92.4 | 7.6 | **107658** |
| 7 | M.T.H. Road | 4 | 7.1 | 0.1 | 6 | 62.9 | 2.5 | 3.2 | 3.7 | 85.5 | 14.5 | **55608** |
| 8 | Paper Mills Road | 2 | 2.9 | 1 | 8.6 | 48.5 | 1.5 | 1.5 | 1.5 | 65.6 | 34.4 | **30515** |
| 9 | Erukencheri High Road | 3 | 3.8 | 1.3 | 15.7 | 40.1 | 4 | 7.1 | 2.4 | 74.5 | 25.5 | **60851** |
| 10 | Kodambakkam High Road | 4 | 1.9 | 0.4 | 13.2 | 24.4 | 1.1 | 5.4 | 1.9 | 48.3 | 51.7 | **21081** |
| 11 | Thruvotriyur High Road | 4 | 6.3 | 0.4 | 15.2 | 39.6 | 6.1 | 5.7 | 3.8 | 77 | 23 | **56660** |
| 12 | Prakasam Salai | 2 | 2 | 0.2 | 14.7 | 36.6 | 1.4 | 1.4 | 1.8 | 58.1 | 41.9 | **43905** |
| 13 | Rajaji Salai | 4 | 11.5 | 1.6 | 17.2 | 54.5 | 3.3 | 3.3 | 2.6 | 92.5 | 7.5 | **110350** |
| 14 | Kamaraj Salai | 6 | 30.1 | 1 | 10.2 | 46.6 | 4.5 | 4.5 | 1.8 | 95 | 5 | **67049** |
| 15 | Santhome High Road | 2 | 26.5 | 1.4 | 9.7 | 44.8 | 3.5 | 3.5 | 4.6 | 93.7 | 6.3 | **54240** |
| 16 | Dr. R.K. Salai | 4 | 25.2 | 2.5 | 12 | 51.1 | 0.8 | 0.8 | 1 | 93 | 7 | **86504** |
| 17 | Kottupuram Mai Road | 2 | 22.3 | 2.5 | 11.1 | 48.9 | 1.3 | 1.3 | 1.7 | 88.9 | 11.1 | **80333** |
| 18 | Velachery Main Road | 2 | 9 | 1 | 6.6 | 62.8 | 3.3 | 3.3 | 3.1 | 89.8 | 10.2 | **39216** |
| 19 | Konnur High Road | 2 | 7.1 | 2 | 13.8 | 48.3 | 4.6 | 4.6 | 2.4 | 81.3 | 18.7 | **51218** |
| 20 | Wall Tax Road | 4 | 4.4 | 0.4 | 21.9 | 40.7 | 3.6 | 3.6 | 3.4 | 75.8 | 24.2 | **71841** |
| 21 | Anna Salai | 6 | 20.4 | 4.1 | 12.2 | 42.7 | 6.3 | 6.3 | 3.5 | 92.3 | 7.7 | **116603** |

***Note:*** **- Approximate number of Effective Traffic Lanes; 1- Light Commercial Vehicles; 2- Fast Moving Vehicles; 3-Slow Moving Vehicles*

***Source:*** *Velumurugan et al (2005)*

## Annexure II: CONGESTION INDEX (AS A PERCENTAGE) FOR DIFFERENT LOCATIONS AND CORRIDORS IN CHENNAI

| Corridor Name | Direction (towards) | Congestion Index | Corridor Name | Direction | Congestion Index |
|---|---|---|---|---|---|
| Choolaimedu High Road | Pachaiyappa College | 11.55 | MC Nichols Road | Periyar EVR Salai | 13.33 |
| Manali High Road | Manali | 8.35 | Tiruvottriyur High Road | Tiruvottriyur Road | 3.67 |
| College Road | Greams Road | 3.57 | G N Chetty Road | Anna Salai | 16.12 |
| Old Jail Road | Rajaji Salai | 21.62 | Nelson Manickam Road | Periyar EVR Salai | 30.17 |
| Periyar EVR Salai | Koyambedu | 18.76 | Chennai Byepass | Maduravoyal | 6.53 |
| Sardar Patel Road | Adyar | 116.67 | Binny Road | Pantheon Road | 10.36 |
| Durgabai Deshmukh Road | Mandaveli | 9.38 | Kathivakkam High Road | Tiruvottriyur High Road | 11.23 |
| Suryanarayana Road | Tiruvottriyur | 50.00 | Perambur Barracks Road | Vyasarpadi | 5.27 |
| Chennai Thiruvallur High Road | Avadi | 19.80 | Mint Street | Basin Bridge | 23.36 |
| Anna Salai | Guindy | 11.93 | RK Mutt Road | Greenways Road | 12.26 |
| VOC Road | Basin Bridge | 8.77 | Kilpauk Garden Road | Dr Alagappa Road | 2.86 |
| Tambaram Velachery Road | Tambaram East | 16.83 | Rajaji Salai | Old Jail Road | 13.45 |
| Thiru Vi Ka Salai | Adyar | 22.41 | Santhome High Road | Light House | 8.59 |
| Dr. Muthulakshmi Road | Lattice Bridge Road | 14.12 | Dr. Nair Road | Periyar | 18.33 |
| Eldams Road | Anna Salai | 44.94 | Luz Church Road | TTK Road | 18.03 |
| Dr. Alagappa Road | Flowers Road | 20.00 | Haddows Road | Mahathma Gandhi Salai | 1.96 |
| Mandaveli Road | Santhome High Road | 33.15 | Ritherdon Road | Pattalam | 6.61 |
| Tank Bund Road | Nelson Manickam Road | 31.74 | Rajiv Gandhi Salai | Mahabalipuram | 20.44 |
| North Usman Road | South Usman Road | 20.17 | Gandhi Mandapam Road | IIT | 9.54 |
| Thyagaraya Road | Anna Salai | 5.95 | Velachery Byepass Road | Guindy | 29.05 |
| South Usman Road | Anna Salai | 3.62 | Greams Road | Anna Salai | 64.18 |
| Greenways Road | Santhome High Road | 1.65 | Venkatanarayana Road | Anna Salai | 44.68 |
| Paper Mills Road | Red hills | 39.12 | Jawaharlal Nehru Road | Madhavaram | 23.91 |
| Mowbrays Road | Radhakrishnan Salai | 19.22 | New Avadi Road | TVS Industries | 5.07 |
| Erukkancheri High Road | Puzhal | 8.49 | St Marys Road | Mandaveli Road | 4.40 |
| Medavakkam Tank Road | Konnur High Road | 21.24 | Mahathma Gandhi Road | Sterling Road | 20.00 |
| Cathedral Road | Radhakrishnan Salai | 5.41 | NSK Salai | Vadapalani | 10.07 |
| Ennore High Road | Ennore | 16.57 | Great Northern Trunk (GNT) Road | Puzhal | 12.97 |
| East Coast Road | Mahabalipuram | 19.67 | Basin Bridge Road | Old Jail Road | 140.32 |
| Taramani Road | Taramani | 11.14 | Radhakrishnan Salai | Kamaraj Salai | 20.00 |

## Annexure II: CONGESTION INDEX (AS A PERCENTAGE) FOR DIFFERENT LOCATIONS AND CORRIDORS IN CHENNAI

| Corridor Name | Direction (towards) | Congestion Index | Corridor Name | Direction | Congestion Index |
|---|---|---|---|---|---|
| Konnur High Road | Brick Kiln Road | 32.91 | Poonamallee HighRoad | Poonamallee | 14.48 |
| Mount Poonamallee Road | Poonamallee | 11.48 | Burkit Road | South Usman Road | 22.13 |
| Netaji Subash Chandra Bose Road | High Court | 10.59 | Chamiers Road | Mandaveli | 110.44 |
| TTK Road | Eldams Road | 4.00 | Great Southern Trunk (GST) Road | Tambaram | 14.82 |
| Thiruvottriyur-Ponneri-Pancheti Road | Ponneri | 38.13 | Chennai Bangalore Highway (NH4) | Varadharajapuram | 17.37 |
| Avadi Poonamallee High Road | Avadi | 30.0 | Sterling Road | Mc Nichols Road | 85.11 |
| Netaji Subash Chandra (NSC) Bose Road | High Court | 10.6 | Ritherdon Road | Periyar EVR Salai | 67.03 |
| Radial Road (Pallavaram to Rajiv Gandhi Salai) | Pallavaram | 11.1 | RK Mutt Road | Thiru Vi Ka Salai | 13.25 |
| Arcot Road | Porur | 9.1 | Taramani Road | Rajiv Gandhi Salai | 35.43 |
| MGR Salai | Valluvar Kottam | 4.8 | Dr. Nair Road | Pantheon Road | 59.43 |
| Walaja Road | Anna Salai | 21.4 | Venkatanarayana Road | Panagal Park | 51.08 |
| Kamaraj Salai | Parrys | 5.5 | South Usman Road | North Usman Road | 13.15 |
| Kunrathur Main | Kunrathur | 22.3 | Tiruvottriyur High Road | George Town | 17.92 |
| Thiruvottriyur-Ponneri-Pancheti (TPP) Road | Ponneri | 38.1 | Perambur Barracks Road | Periyar EVR Salai | 21.85 |
| Red Hills Road | CTH Road | 16.8 | Arcot Road | Vadapalani | 9.22 |
| Poonamallee Byepass Road | Sriperumbudur | 10.8 | Gandhi Mandapam Road | Anna Salai | 72.51 |
| Lattice Bridge Road | Thorapakkam | 5.8 | Mowbrays Road | TTK Road | 4.88 |
| Arunachala Street | Anna Salai | 6.1 | Suryanarayana Road | Tondiarpet | 13.17 |
| Mannarsamy Koil Street | New Washermanpet | 3.0 | East Coast Road | Tiruvanmiyur | 34.73 |
| Tambaram Velachery Road | Velachery Byepass Road | 6.67 | Kathivakkam High Road | Basin Bridge | 7.64 |
| Durgabai Deshmukh Road | Adyar | 9.29 | Binny Road | Anna Salai | 27.62 |
| Nelson Manickam Road | Tank Bund Road | 135.42 | Poonamallee High Road | Koyambedu | 27.46 |
| Arunachala Street | Egmore | 25.68 | Mannarsamy Koil Street | Parrys | 24.03 |
| Burkit Road | Venkatnarayana Road | 125.34 | Greams Road | College Road | 40.32 |
| Medavakkam Tank Road | Dr Alagappa Road | 18.52 | College Road | Haddows Road | 9.68 |
| Mint Street | Government General Hospital | 64.85 | Anna Salai | Parrys | 14.23 |
| Lattice Bridge Road | Tidel Park | 9.14 | Walaja Road | Kamaraj Salai | 17.58 |

## Annexure II: CONGESTION INDEX (AS A PERCENTAGE) FOR DIFFERENT LOCATIONS AND CORRIDORS IN CHENNAI

| Corridor Name | Direction (towards) | Congestion Index | Corridor Name | Direction | Congestion Index |
|---|---|---|---|---|---|
| Dr. Muthulakshmi Road | Adyar Flyover | 1.50 | MGR Salai | Mahathma Gandhi Salai | 71.43 |
| Thiruvottriyur-Ponneri-Pancheti (TPP) Road | Thiruvottriyur | 36.15 | Tank Bund Road | Valluvar Kottam | 13.16 |
| G N Chetty Road | Thyagaraya Nagar | 37.28 | Ennore High Road | Tondiarpet | 2.87 |
| Radial Road (Pallavaram to RGS) | Rajiv Gandhi Salai | 28.88 | Basin Bridge Road | Basin Bridge Rail-way Station | 20.00 |
| Kunrathur Main | Porur | 32.81 | Konnur High Road | Villivakkam | 37.32 |
| TTK Road | Chamiers Road | 161.8 | Chennai Byepass | Irumbuliyur | 3.19 |
| Great Northern Trunk (GNT) Road (NH5) | Vyasarpadi | 42.7 | St Marys Road | Chamiers Road | 28.51 |
| Rajiv Gandhi Salai | Tidel Park | 11.9 | Paper Mills Road | Perambur | 18.28 |
| Periyar EVR Salai | Parrys | 29.75 | Sardar Patel Road | Guindy | 8.70 |
| North Usman Road | MGR Salai | 8.97 | Chamiers Road | Anna Salai | 9.97 |
| Avadi Poonamallee High Road | Poonamallee | 17.50 | MC Nichols Road | Sterling Road | 9.09 |
| Old Jail Road | Basin Bridge | 23.1 | Chennai Tiruvallur High Road | Avadi | 8.88 |
| Choolaimedu High Road | NSK Salai | 2.6 | Santhome High Road | Adyar | 3.17 |
| Red Hills Road | Puzhal | 14.5 | Poonamallee Byepass Road | Koyambedu | 11.54 |
| Thyagaraya Road | Pondy Bazaar | 4.6 | Kilpauk Garden Road | Anna Nagar | 1.14 |
| Thiru Vi Ka Salai | Anna Salai | 6.02 | New Avadi Road | Periyar EVR Salai | 18.03 |
| Netaji Subash Chandra (NSC) Bose Road | VOC Road | 13.8 | Radhakrishnan Salai | Anna Salai | 25.38 |
| Sterling Road | Loyala College | 24.00 | Chennai Thiruvallur High Road | Villivakkam | 8.88 |
| Chennai Bangalore Highway (NH4) | Porur | 13.41 | VOC Road | Chennai Central | 16.7 |
| Rajaji Salai | High Court | 10.47 | Manali High Road | Tiruvottriyur Road | 3.98 |
| Rajiv Gandhi Salai | Tidel Park | 11.88 | Jawaharlal Nehru Road | Alandur | 22.3 |
| Kamaraj Salai | Santhome | 11.6 | Mandaveli Road | St. Mary's Road | 28.0 |
| NSK Salai | Valluvar Kottam | 103.9 | Mahatma Gandhi Road | Anna Salai | 16.2 |
| Erukkancheri High Road | Basin Bridge | 16.6 | | | |

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