Centre for
Public Policy Research

Working Paper Series

Parking Space in Kochi: Issues and Solutions

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November 2010

Centre for Public Policy Research

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Abstract

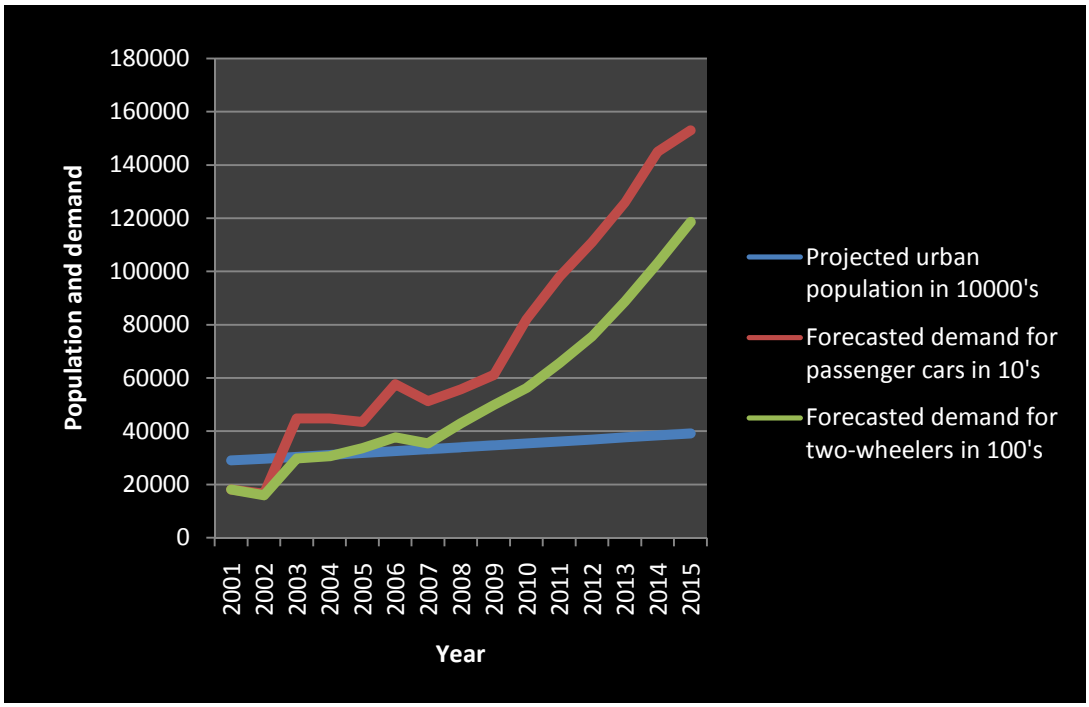
All of India's cities face an urban transport crisis. While issues such as poor connectivity, bad road quality, traffic congestion, air and noise pollution are constantly talked about, parking is seen as one having negligible effect on the quality of urban transport. The MV Asia study on parking in Mumbai shows that a car spends only 4 per cent of its life in motion and the remaining 96 per cent of the time it is parked (Mumbai Transformation Support Unit 2008). With the increasing trend in the growth of private vehicles, it is imperative that parking be seen as an important factor for making an efficient transportation system within our cities. In India, parking falls into two categories – Off-street parking and On-street parking. Off-street parking facilities have become popular and are being used by private parties such as shopping malls, theatres and office complexes that recognize parking as a variable that has considerable effect on their success as an enterprise. Customers and/or employees view parking space as a value add to the organisation's product or service, as they are ensured safe and convenient vehicle parking. The company receives competitive advantage in return. On-street parking space, on the other hand, is considered public property. Demand is clearly higher than the supply for on-street parking in the Central Business Districts of any Indian city. Such a high excess in demand has an adverse effect on the traffic system in the form of increased traffic congestion and pollution. In spite of all this, parking is considered as a marginal problem when it comes to urban transport planning and the cost of on-street parking is so low that it has no effect on its demand and fails to enter the consumption function of the average driver. This study will not look at parking just as an externality of private transport, but as an important economic variable. Rather than looking at parking as a problem that needs to be solved, it should be looked at as a tool that can be used to generate employment and income and help improve the overall quality of urban transport.

1. Background

It has been observed that for 96 per cent of its lifetime, a private automobile is immobile. In spite of this, while traffic congestion, road connectivity and road quality are considered key issues in urban transport planning, the issue of parking remains on the side-lines as an insignificant factor in urban infrastructure planning. Big cities across the world have recognised parking as an important variable and have created specific policies and plans for parking. In India, however, the problem of parking has not been given its due importance. Some might argue that parking is one of the lesser woes of urban transport, but this view has led to its exclusion from the policy framework, causing many traffic bottlenecks. This results in poor quality urban transport, misuse of land and increasing social and environmental costs.

The urban population of India has increased from 2.58 crore in 1901 to 28.53 crore in 2001(Pranati Datta, 2006).This figure is increasing steadily as more and more people flock to urban areas seeking employment and higher standards of living. With globalisation, privatisation and liberalisation, there has been an increase in employment opportunities in our cities. Subsequently, the income levels of people have risen. This rise, coupled with the decreasing cost of automobiles, has led to a huge increase in the demand for private vehicles. The graph below shows a comparison between urban population and demand for private vehicles across the country.

Figure 1: Forecasted urban population of India with forecasted demand for passenger cars and two wheelers



Source: www.indiastat.com

The graph shows that while the urban population of India grows steadily at an annual growth rate of 2.09 per cent, the demand for passenger cars and two wheelers grows at the rate of 20.94 per cent and 17.53 per cent per annum, respectively. These figures pose a major threat to the current system of urban transport, especially since the growth of road space is negligible in comparison. This calls for the development of a more holistic approach to urban planning. The growing dependency on private automobiles will only lead to further congestion on the roads. In the city of Kochi, private transport contributes to 73 per cent of all vehicular traffic, while carrying only 23 per cent of the passengers. Public transport on the other hand contributes to a mere 27 per cent of the vehicular traffic while carrying more than 77 per cent of the passenger load (RITES LTD 2001). A more organised parking structure will help bridge these gaps.

Fundamentally, parking is a problem of space. With the growing culture of automobile dependency in Indian cities, the demand for parking spaces has sky rocketed. This is especially because the infra-structural growth of our cities is unable to keep up with

the growing demand for spaces to park. The resultant scarcity of parking space has begun to spill over to other aspects of urban life in the form of congestion, fuel loss, dispersed land use and low air quality.

The parking problem can be viewed as one of supply or of parking management. The first is that of too few spaces being available for parking and the solution for this is to build more parking spaces. The second is that the available spaces are not used to their maximum capacity. The solution to the latter is parking management.

Cities across the world have been successful in using parking management as a tool to influence consumer choices and reduce travel by private vehicles. Provided that an efficient public transit system is in place, appropriate parking charges and restricting parking in various areas have led to a significant shift from private to public modes of transport.

Private transport entails both monetary or 'out-of pocket' costs and hidden social costs. The monetary costs of fuel, tolls and tax are borne directly by the user. However, the social costs are externalised and borne by the general public in the form of traffic congestion, environmental costs of air and noise pollution and reduction in pedestrian space to name a few. Since only a fraction of the population (23 per cent) uses private transport, an efficient transport policy should aim at internalising these costs as much as possible (RITES LTD 2001).

Unfortunately, the existing approach towards urban planning in India is directed towards making travel by private modes more convenient. When it comes to parking in particular, the primary focus is on providing parking to satisfy its insatiable demand stemming from uncontrolled motorisation. The defects of this approach are reflected in the current parking problem.

These defects are a result of a few assumptions.

- **Parking Space is a Public Good:**

  This assumption leads to the belief that free and unrestricted parking space is the right of every vehicle owner. Parking charges in our country are highly subsidised. This implies that the driving public enjoys cheap parking on urban commons only by externalising their costs to the other half of the population that does not require parking space. Due to this assumption, the space is subject to the tragedy of commons, which results in degradation and poor usage.

- **Pure Demand Centric Planning:**

  Parking is constantly spoken about as a 'problem' that is to be dealt with by providing a set solution. The misbelief that private transport is the most preferred mode of transport has led to plans being made solely on the basis of the forecasted demand for parking space. Such an approach does not take into consideration that parking imposes both direct and indirect costs on urban transport. Considering that vehicular population is increasing at a much higher level than road- space, this will only worsen the situation.

- **Using Short Term Solutions to Solve Long-Term Problems:**

  Plans made on the basis of the above mentioned assumptions only cater to very short-term demand for parking. Such plans not only fail to provide for the increasing demand, but also encourage it. For example, how often does parking space or parking rates influence a person's choice of transportation?

So long as there is visible, inexpensive provision for parking, there will be an increase in the usage of private vehicles, further abetting the problem. Therefore, it is imperative to arrive at a solution that on one hand provides space for parking while simultaneously managing demand for parking on the other.

A successful parking policy calls for the reversal of these beliefs. As long as parking is bundled with private transport, the effect of parking as a tool for traffic demand management will be negligible. Parking should be seen not just as a problem but also as an economic activity subject to rational economic behaviour with the capacity to generate income and employment.

Such a change in perspective implies that 'parking' can even influence consumer choices in favour of public transportation. Thus, the income generated from organised parking must be channelled into improving the public transit system to further facilitate this shift.

However, bringing about a paradigm shift in the urban planning process is not an easy task. First, Indian cities are faced with a backlog when it comes to planning and infrastructure. This is most visible in the transport sector. In most cities, except for Delhi, Mumbai and Kolkata, the public transport system is restricted to buses and auto-rickshaws. Unless a well-connected system of mass public transit is in place, the usage of private modes on a daily basis will continue to increase. Second, there is the issue

of the social status attached to owning and using private transport. This will be one of the strongest barriers in reducing private vehicles on Indian roads. Public transport, on the other hand, is often stigmatised by the upper and middle classes. One can argue that the choice of private transport over public transport is well justified by the poor service and connectivity offered by the latter in comparison to the conveniences offered by the former. Private transport, in comparison, does offer many luxuries. However, as mentioned earlier it also has several hidden costs. These costs invariably affect the non-users causing disequilibrium in the market. The extent to which these costs are internalised to the user can be used to judge the equity of the transport policy.

This paper seeks to study parking from this renewed perspective. Parking will be studied as a variable that creates costs and also as a tool for traffic demand management. It will be looked at in relation to land use, traffic congestion, environment and total quality of urban life. Parking shortage within the central business areas of the city will be viewed as a case in point to the promotion of public transit. The current parking practices in Kochi will be studied in order to identify the existing flaws and opportunities for improvement. The report will include a proposal for a parking plan on MG Road, Kochi. It will also include recommendations made to stress the importance of this approach to parking when new plans and policies are made.

2. Place of Parking in the System of Urban Transport

> 'Picture a pasture, open to all. It is to be expected that each herdsman will try to keep as many cattle as possible on the commons…As a rational being; each herdsman seeks to maximize his gain. Explicitly or implicitly, more or less consciously, he asks, "What is the utility *to me* of adding one more animal to my herd?"… The positive component is a function of the increment of one animal…The negative component is a function of the additional overgrazing created by one more animal…the rational herdsman concludes that the only sensible course for him to pursue is to add another animal to his herd. And another; and another. But this is the conclusion reached by each and every rational herdsman sharing a commons. Therein is the tragedy. Each man is locked into a system that compels him to increase his herd without limit--in a world that is limited.'
>
> *Garrett Hardin, 'The Tragedy of the Commons', 1968.*

Such a tragedy can be witnessed on our streets with regard to parking spaces. Due to the lack of earmarking and regulation of parking spaces in the city, car owners are free

to park at any location, at any angle, for any amount of time they choose. The Corporation of Kochi has provided organised parking spaces at a few locations (e.g. Park Avenue Road, Jayalakshmi Silks). However, it has not been implemented on the basis of any economic or scientific method. Parking spaces are seen as public spaces that can be used by anybody for their benefit. Mismanagement of parking spaces results in various parties exploiting the space for their own purposes ultimately rendering the space inefficient. This can be avoided by marking out parking lots and charging for their usage. However, this loss is small in comparison to the total efficiency loss faced by the city from not having organised parking.

2.1 Direct and Indirect Costs of Urban Transport

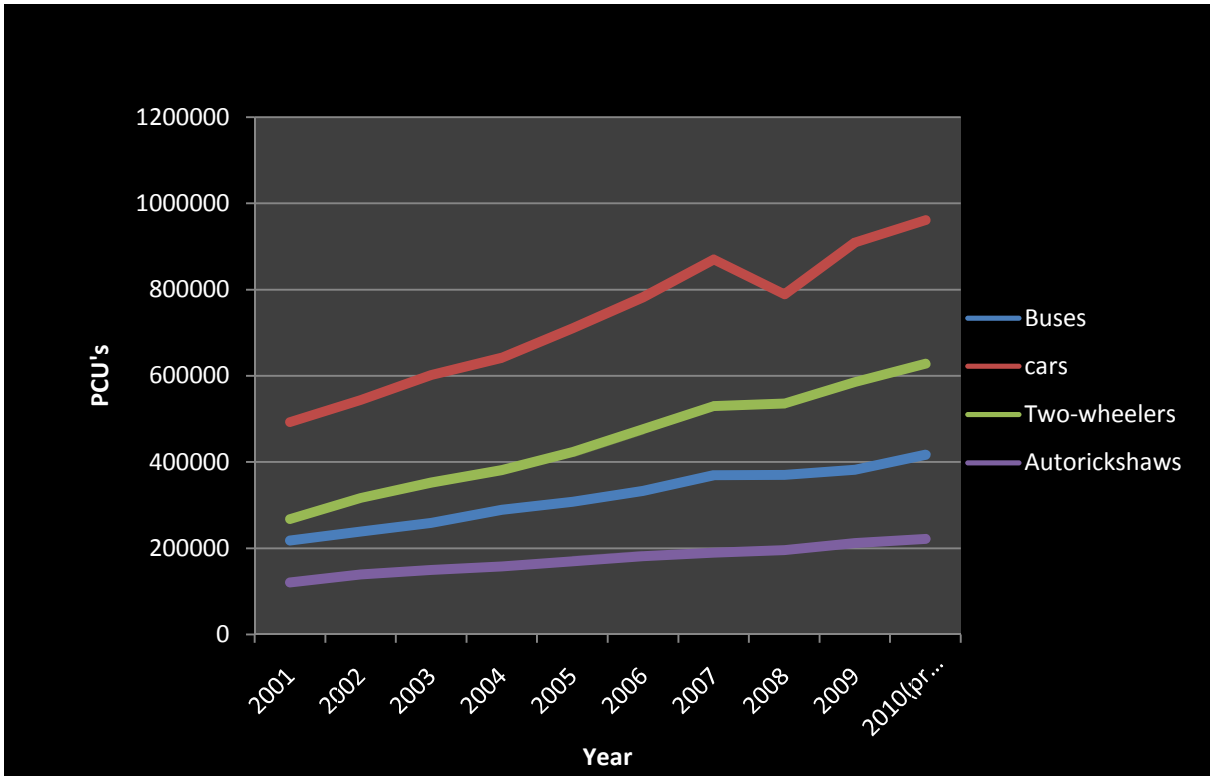
Parking, if not properly managed, has numerous negative effects. One can argue that until recently, parking has posed an insignificant problem, that too only to the driver. However, as car ownership in India increases it is sure to cause major bottlenecks in the transport system. The exclusion of parking from the planning process will only further fuel demand for already scarce parking space.

The Indian transport scenario is undergoing a major change. The India State of the Environment Report, 2001, brings the following figures to our attention:

> 'Road-based passenger transport has recorded very high growth in recent years especially since 1980-81. It is estimated that the roads accounted for 44.8 billion passenger kilometres in 1951 which has since grown to 2,515 billion passenger kilometres in 1996. The freight traffic handled by road in 1996 was about 720 billion tonne kilometre which has increased from 12.1 tonne kilometre in 1951 (MoST 1996). In contrast, the total road network has increased only 8 times from 0.4 million kilometres in 1950-51 to 3.3 million kilometres in 1995-96. The slow growth of road infrastructure and high growth of transport performance and number of vehicles all imply that Indian roads are reaching a saturation point in utilising the existing capacities'.

Even more consequential is the increasing dependence on private modes of transport. We can see an increasing trend in motor-bike and car ownership around the country. The following diagram shows trends in vehicle ownership in Kerala. The growth in the number of cars and motorbikes reflects the increasing demand for private vehicle ownership in the state.

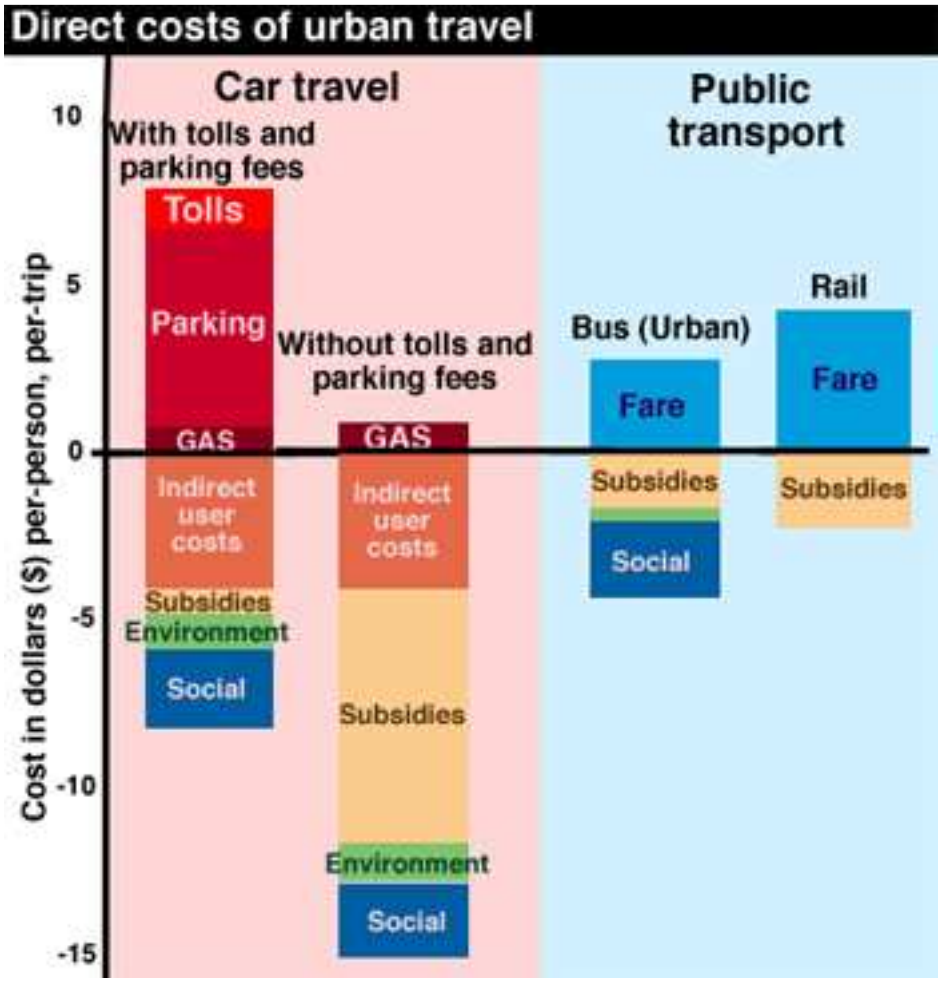
Figure 2: Growth of urban vehicles in Kerala from 2001-10



Source: Kerala State Planning Board

Private modes of transport offer a host of advantages but it also comes with its costs. While costs of the vehicle and fuel are borne by the car owner, the social and environmental costs are passed on to the non-driving public in the form of externalities. This creates a situation of market failure. An equitable system of public transport should aim at internalising these costs as much as possible. The current system in place in India is highly biased towards the private automobile owner. Even though visible efforts are being made to improve public transit facilities, the unintended focus remains on making private travel more attractive. The highly subsidised parking facility all over the city stands testimony to this fact. Given below is a diagram that depicts the costs of urban travel. Evidently, not charging for parking decreases the operating costs of private transport to such a large extent that people find it more convenient to drive to work every day despite the high tax levied on fuel.

Figure 3: Direct costs of urban travel



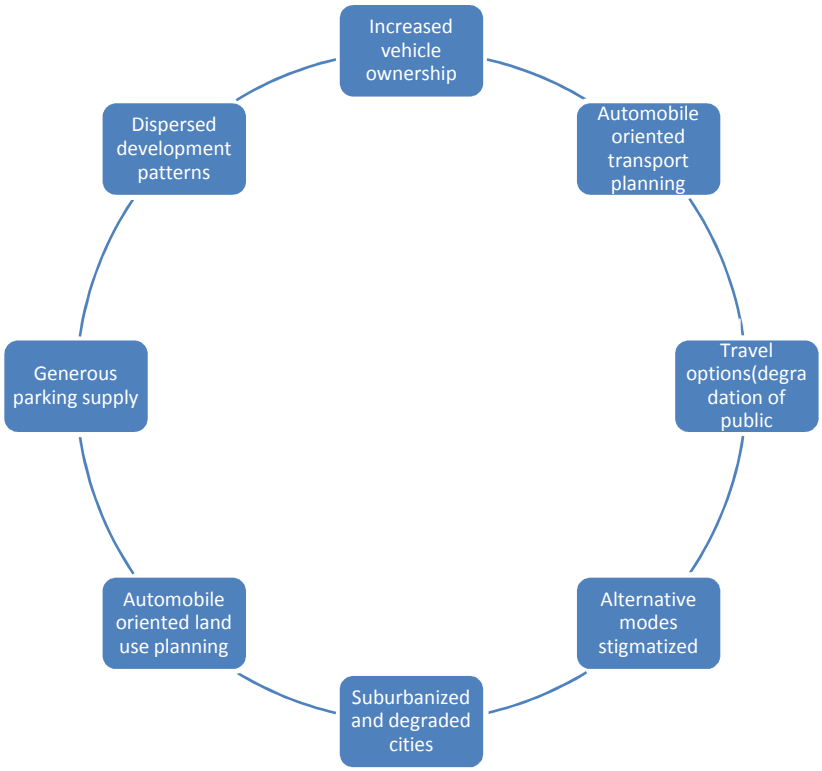
Source: Graph based on the data from '*Transportation for Liveable Cities*'[1]

2.2. Land Use and the Cycle of Automobile Dependency

The entry of private automobiles into the urban transport scenario as the preferred means of travel led to a significant change in land-use patterns. The increased convenience offered by private transportation resulted in people choosing lower rent over proximity to the workplace (land value in the suburbs were relatively lower than those in the central business districts). Planning processes are carried out with the convenience of these motorists in mind with little regard for the consequences. This generates a cycle of automobile dependency.

[1] Graph based on date from Vukan R. Vuchic, *Transportation for Livable Cities.* Available at http://en.wikipedia.org/wiki/Parking.

Figure 4: The cycle of automobile dependency



2.3. Indian Transport Scenario

Kochi, in the past decade, has grown out into its suburbs such as Kakkanad and Edapally. While one can argue that urban fringe development is beneficial in that as density decreases, land value falls, thereby reducing the cost of housing. Unfortunately other economic, social and environmental costs are largely hidden and therefore fail to feature in the planning process.

Commenting on the increased demand for private transport in our urban centres, Urban Development Minister S Jaipal Reddy said:

> Upwardly mobile classes are crazy about cars. A car is a status symbol in the country and this state of car mania can be done away with only in a subliminal way and not by the government…restrictions cannot be imposed. Policies can be designed to discourage buying of cars and using public transport instead.

> Parking policy is one such subliminal method. By controlling the usage of parking spaces by regulation and pricing, we can have a direct influence on the cost of car travel, thereby influencing demand for it on a daily basis. It is important to observe that the policy is not against usage of private transport, but for the maintenance of a sustainable level of usage and the mitigation of the externalities caused by it.

3. Parking Management

On May 13, 1935, Carl C. Magee of Oklahoma City, Oklahoma filed a patent for the first 'coin controlled parking meter' (http://www.ionet.net/~luttrell/index2.html 2010).In 2004, in Bengaluru, we saw India's first automated parking facility in use. This lag is not surprising as motorisation hit India much later than it did the developing nations and until recently our cities have not fared too badly as a result of inadequate parking, or so it seems. So far our transportation problems have been dealt with as distinct problems with technical solutions, isolated from one another. For instance, flyovers are seen as a way to reduce crowding on roads with little focus on the reasons for the unprecedented increase in traffic. Unfortunately, such a strategy only results in worsening the problem. While parking can easily be mistaken as an inconsequential variable in urban transport, the crowding of our cities, increasing trend of using private vehicles on a daily basis and the disorganisation of urban transport tells us that this is an error that can cost us dearly in terms of efficiency and cost.

Another better way is to look at transportation problems as ones caused by mismanagement and misallocation of resources and costs. Such problems can be dealt with by using market-based solutions such as Parking Management.

Parking is divided into two major categories: On-street parking and Off-street parking. In Kochi, people prefer to park on streets adjoining their destination. This space is usually free, save for a few locations where the corporation has issued tenders to private parties for their maintenance. In these spaces the parking fare is ₹10/hour.

Off-street parking is less popular as it is only available in limited areas and usually away from the commercial hubs. In Kochi, there are a few plots that have been converted to off-street parking space by the private party that owns them. A licence is

to be acquired for this. Fortunately, not too much land surface has been converted into off-street parking lots as in other cities across the globe.

3.1. Transportation Demand Management and Parking Policy

According to the Victoria Transport Policy Institute, "Transportation Demand Management is a general term for strategies that result in more efficient use of transportation resources." Parking has often been referred to as a tool for travel demand management. However, for parking to be successful as a tool we require a more advanced and organised system of public transport and better pedestrian facilities. The mass transit in Kochi consists mainly of buses operated by the public sector and private parties. Private buses seem to have a monopoly here but with the introduction of new low-floor buses under JNNURM and their popularity with the commuting population, we can expect to see a change in this.

Currently, the parking system in Kochi operates free of heavy regulation. Exceptions to this case arise when establishments earmark space, which is then restricted to their customers and employees. While this may solve their problem and reduce spill-over it results in the spaces being vacant when not in use by the respective parties. This under-utilisation can be avoided by the introduction of shared parking practices.

However, before we begin to use parking as a tool for achieving wider transportation goals we must have an efficient parking infrastructure that can live up to its role in the system. This should be a combination of facilities, schemes and practises. The main goals and strategies of the parking plan should be as follows:

Figure 5: Goals and strategies of the parking plan

Primary Objectives	Strategy
To utilise available space to its maximum capacity	• Clear earmarking of spaces • Priority based pricing • Use of parking meters • Setting maximum limits for time share parking
To make parking convenient for drivers	• Use of signage to direct drivers and show parking status • Leasing out of spaces for regular users • Issuing of smart cards to use for parking

To reduce negative externalities that arise from parking	• Setting of a price which is neither negligible nor unaffordable to control the demand • Ban parking on certain roads • Imposing effective fines on rule breakers

In order to achieve the above mentioned objectives, supplementary plans must be made. These plans are made with the intention of helping people adjust to the change in policy. Participation of the public will greatly increase the feasibility of the project.

- Much of the apprehension to the change in policy will be as a result of being ignorant of the process and the benefits that can be derived from it. Publishing a city travel guide will help remove this apprehension and create awareness on the new parking facilities and their benefits. This will create an atmosphere that is conducive to the implementation of the new plans. The manual should also contain 'Smart-transit' plans that help in using the city's public transit services.
- Improving accessibility and pedestrian paths around parking spaces to make it more convenient to walk from the parking space to the destination. This reduces the inconvenience of parking in a space that may not be very close to the desired location.
- Although carpooling is common in some cities, it is quite rare in Kochi. It can be observed that most cars in the city have only one or two people travelling in them while an average car can carry up to five people comfortably. Car-pooling can reduce the vehicular traffic on the streets leading to less crowded streets. Car pools can be organised in residential complexes and housing colonies for people commuting to or via the same destinations.
- During holiday seasons such as Onam or Christmas there is increased traffic on the streets. Special plans must be made on these occasions to combat the excess demand for parking. Price variations should be used to manage this demand.
- Providing parking facilities at important bus stations and transit stops in fringe areas. This will encourage use of public transit in the city. If off-street parking facilities are made near metro rail stations, urban fringe commuters can park

there and use the trains to travel around the city. This will help reduce traffic in the central business districts and reduce cost of travel.

- The latest substitute to owning a car is sharing a car. Car sharing is a unique rental system for cars that allows all the privileges one enjoys while having a car. This will help to reduce vehicular traffic and parking demand to a great extent.

As mentioned earlier, parking planning is virtually non-existent in our urban centres. Starting from the basics offers us the opportunity of learning from the mistakes of others. Studies have been conducted in this field, new approaches to the problem have been evolved and parking technology has been improved. We must use this opportunity to our advantage while planning for parking and urban transport as a whole.

3.2. Defining and Estimating Demand for Parking Space

"Parking demand refers to the amount of parking that is estimated to be used at a particular time, place, and price" (Victoria Transport Policy Institute 2010). A vehicle needs a total of three parking spaces-- one at the owner's residence, one at his /her workplace and the last at any location where the vehicle owner goes. At any given point in time, a vehicle is either on the move or parked at one of these locations.

Parking on the streets is directly controlled by the market forces, with individuals parking where it is most convenient for them. Hence, the excess demand for space in one location spills over to the surrounding areas causing a domino effect.

This also means that a driver has to spend time looking for a space to park. This process has both time and fuel costs and adds to the congestion on streets. These costs can be minimised by providing adequate parking at every location. By using an appropriate pricing strategy we can also control the over-all demand for parking in the area. When asked to pay directly for parking spaces on a daily basis, motorists may consider using alternative modes of transportation.

3.2.1. Estimation of Demand

The correct estimation of parking demand is imperative to evaluate parking problems and solutions. The determinants of parking demand are vehicle ownership, modal split,

time (when drivers park), duration (how long drivers park for), geographic location (suburb or CBD) and quality of alternative modes of transport. While estimating the demand for parking; factors such as travel demand management, land use development regulations, economic development regulations and environmental goals must be taken into account. According to the Victoria Transport Policy Institute, estimating demand for parking is more a value judgement than a technical exercise.

Demand for parking in urban centres is of a cyclical nature – daily, weekly and annual cycles. For instance, in Kochi, MG Road has high parking demand from 9 am to 6 pm (office working hours), while others areas such as Oberon Mall, for example, will face higher demands in the non-working hours. Similarly, the demand for parking increases during festivals and holidays. Demand can also vary with the type of establishment. One is likely to park longer at a theatre than a convenience store. Another factor is the type of trip. A person who commutes every day to work will park his car in one location for long hours on five days in a week for at least seven months in a year. The demand of a shopper on the other hand is more random in nature. Another important observation we can make here is that when it comes to pricing, a person who is required to park for long hours consistently, is more price sensitive as a larger sum of their income is devoted to paying for parking.

3.2.2. Determinants of Demand

- **Vehicle Ownership:**

  The increase in the ownership of private vehicles has been a major factor in raising the demand for parking. In 2009, 1,38,107 private cars and 5,11,857 motorbikes were registered in Kochi alone (Kerala State Planning Board 2009). Provided that this figure continues to grow, which it most certainly will, scarcity of parking space is sure to become a major concern in the future.

- **Time:**

  Time is a major factor in determining demand for parking in specific areas. In the Central Business District, the highest demand for parking is during the day from 9 am to 5 pm as many commuters drive to work.

- **Nature of Trip:**

  The purpose for which a trip is made is directly related to the duration of parking, which can influence parking demand. Commuters who drive to work

every day are observed to park for the longest time. Customers or shoppers on the other hand park for shorter durations. By observing which area attracts what kind of passenger trips we can identify the demand pattern for the area.

- **Location:**

  Parking demand is generally higher in Central Business Districts rather than in the suburbs. This is mainly a result of people flocking to the city centre for their jobs. Moreover, most commercial establishments such as retail stores, theatres and banks are located in the Central Business Districts.

- **Modal Split:**

  The modal split will tell us exactly how much of the passenger load is travelling by private vehicles. If the modal split towards a particular area is in favour of public transit, that area will have relatively less demand for parking. In the city of Kochi, private modes contribute to 73 per cent of vehicular traffic while carrying only 23 per cent of the passengers. Public transport on the other hand contributes to a mere 27 per cent of the vehicular traffic while carrying more than 77 per cent of the passenger load.

- **Quality of Public Transport:**

  The quality of public transport exercises a major influence on the modal split which in turn affects demand. The better the public transport facility, the fewer people resort to driving on a daily basis. This reduces the demand for parking. A good system of public transit is also essential for the success of parking policies.

3.3. Supply of Parking Spaces

Determining parking supply is the second stage of planning for parking. It is crucial that adequate parking supply be provided, particularly in sensitive areas, as both over supply and under supply of parking result in severe traffic bottlenecks. The supply of parking depends directly on the space available in the considered area. Parking can be optimised such that it maximises the usage of the space while ensuring that the space remains accessible.

3.3.1. Different Modes of Parking

There are three modes of parking based on the positioning of the vehicle in the space – Parallel Parking, Perpendicular Parking and Angular Parking.

- **Parallel Parking**

  Vehicles are arranged in a line with the front of one vehicle facing the rear of the one ahead. This is the most common form of parking on MG Road. Parallel parking spaces are considered very difficult to access.

Figure 6: Parallel Parking

- **Perpendicular Parking**

  Vehicles are parked alongside each other, perpendicular to the curb or a wall. This kind of parking can be seen in front of some shops and buildings that provide enough space for it.

Figure 7: Perpendicular Parking

- **Angular Parking**

  Cars are parked alongside as in perpendicular parking but at an angle – normally of 60 degrees to the curb. Angular parking is most common in a parking lot because it takes up total space and is easier to access. It can also be used on streets where space is adequate.

Figure 8: Angular Parking

Figure 9: DIMENSIONS OF A PARKING SPACE

Type of space	Standard Dimensions	Total Area in square meters
Parallel parking	2.4 x 6.1	14.64
Perpendicular parking	5.5 x 2.75	15.125
Angular parking	4.9 x 2.4	11.76

These plots do not by themselves constitute the parking space. Provision should be made for accessibility, pedestrian space and aisle space. Although angular parking takes up the least space, parallel parking is most suitable for curb side parking on MG road due to the lack of availability of space.

3.3.2. Problem of Over and Under Supply of Parking

The problems resulting from under-supply of parking are common knowledge. The lack of parking space is a definite burden on the driver. Hence, the lack of parking supply in a place will render the area less economically competent and unattractive to businessmen, residents and customers. Limited parking space in an area will also increase the time spent in looking for a parking space, thus increasing time and fuel costs and adding to traffic congestion. It also leads to spill over of parking on to smaller roads and residential areas.

Over-supplying parking results in the very same problems increasing supply of parking was meant to solve. First, plentiful parking supply that exceeds demand will only lower the price of parking. This acts as a subsidy to private transport, resulting in an increased number of cars on the streets furthering traffic congestion and pollution. The rate at which vehicular ownership is increasing suggests that the problem will not be of too little space but too many cars.

Second, in the case of surface parking, when needless parking supply is provided it decreases the land available for more useful purposes. This hinders in-fill development and results in dispersed land use and poor quality cities.

The problem of under supplied parking is however given more priority than of over-supply. The main reason for this is psychological. We can very quickly associate not finding parking space to the problem of under-supply whereas we hardly associate traffic congestion and air pollution with an oversupply of parking. One can argue that Indian cities have not evolved to the extent to which we need to set maximum requirements, but with the number of commuters choosing to drive to work increasing every day, it is high time this aspect be taken into consideration.

A balanced supply of parking is essential. This balance is struck when there is enough number of parking spaces to accommodate recurrent peak demand but not so much as to encourage more drivers and cause negative spill-over. The resulting cut in parking supply must be compensated with alternate modes of travel.

3.4. Price of Parking

Parking is an externality of private transport. The large share contributed by private transport to vehicular traffic (73 per cent) coupled with their low passenger density (23 per cent) represents the extent of disproportion in the transport system of Kochi. With the hidden subsidies offered to car users in terms of free or cheap parking, these

costs are not recovered through appropriate pricing and taxation. This implies that the hidden costs generated by 23 per cent of the population spills over to the remaining 73 per cent.

In simple terms the price of a good is the sum of money or its equivalent for which it is bought or sold. In classical economics, price is wholly dependent on demand and supply. Although this view may not hold true now, the price of a good still plays an important role in the functioning of the market. Pricing is considered an efficient measure of demand control. Furthermore, pricing mechanisms can be used to prevent inflation or deflation in the economy.

The price of a good is said to reflect its value in the market. Once we establish parking spaces as a 'good' it is only natural that a price should be set for its use. This price should be in accordance with the economic value of the space. Nevertheless it is necessary to define the specific reasons for which parking spaces should be priced.

Why do parking spaces need to be priced?

- To cover costs of land – opportunity cost
- To control demand
- To prevent the market from being distorted
- To generate revenue for maintenance

The cost of provisioning a good in the market is often used as a reference point while setting its price. Cost based pricing involves adding a fixed sum or percentage of the cost of production to the total cost to come up with the price. But what is the cost of a parking space? The costs that are incurred during provisioning space for parking are costs of land, cost of the facility – whether it is building an off street parking complex or installing parking meters on the streets, maintenance costs and other social and environmental costs.

Land use patterns have diverse economic, environmental and social impacts. For instance some land use patterns may be more favourable to people with cars and others maybe more convenient to those using public transit. Transportation and land use are closely connected. The first obvious connection is that land is used for transportation and any land use plan will involve demarcating land for transportation purposes –roads, railways, parking lots. The second, indirect connection, lies in the

effect of the composition of transport on land use. The increase in private modes will lead to a spread out or dispersed land use pattern while the increase in usage of public transport will lead to a more compact, infill development. In order to justify using land for parking as opposed to using it for housing or development, the price must be set to reflect the opportunity costs of the land in question.

Pricing is often used as a tool to offset excess demand. With regard to parking too, pricing can be used to control the demand for parking spaces. This is a method of transportation demand management. Different prices can be set according to the availability and convenience of the space. These prices will serve as a financial disincentive for parking and discourage long term parking in prime locations. This will be discussed in detail later in this section.

The failure to charge a price for parking results in the misallocation of costs which leads to the distortion of the market. In other words, free parking results in market failure. The reason for this is that 'free' parking is in fact quite costly. Parking imposes various costs on the entire transport system as it takes up space and adds to traffic congestion. Hence, providing free or cheap parking represents a case of market distortion where the one who creates the cost is not held directly accountable. Pricing the user directly for using parking helps to avoid these distortions and also to mitigate the costs.

One of the main reasons for pricing any good or service is the generation of revenue. Similarly, parking too has the capacity to generate revenue if priced correctly. This revenue should be channelled to the maintenance of the parking systems. Currently, the revenue generated by the parking in Kochi this year as of August, 2010 is a mere ₹3, 08,930 (Corporation of Cochin 2010). This is from the five stretches of parking that the corporation has tendered out to private parties. If parking is regulated and priced as per market requirements throughout the city, we can expect to generate far greater revenue.

At present, drivers enjoy free parking everywhere in the city with the exception of the above mentioned spaces which although owned by the Corporation are managed by private parties. However, the fee set for these spaces in very low and is negligible in comparison to the other costs of driving – vehicle maintenance costs and fuel; which

plays a major role in deciding whether or not to drive. This may be the reason why parking has not entered into the average drivers consumption function as a variable.

These prices must not be viewed as an attack on the driving public but as a compensation to provide them with better parking facilities and a subsequent improvement in the transport scenario. Charging a price for a service also holds the provider more accountable, ensuring better service.

3.4.1. Key Elements for Pricing of Parking

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- Charge motorists directly for using parking space. This will facilitate immediate recovery of cost and will also act as a tool of demand management.
- The parking spaces in commercial districts should be priced higher to ensure the space for priority users – customers and clients of the particular shop/building.
- Time variable pricing must be employed to increase charges, reduce demand and manage parking during peak hours.
- Progressive prices can be charged to discourage long term parking. Long term parking must not be discounted.
- Weekly or monthly pricing should be done for long-term users, such as employees or residents. The space can be leased out, too.

  Setting the price is but only one step. Most plans and policies, especially in India, tend to fall apart in the implementation stage. To ensure the success of the pricing policy, we must make provision for its implementation as well. The process should be simple, involve minimum involvement of middlemen and leave very little room for corruption.

- Use of parking meters is necessary In order to implement the pricing strategy. It is important to provide a convenient mode of payment. With available technology, payment can be made using coins, credit cards, debit cards and smart cards. The latest technology in parking meters also enables us to maintain accurate records of the usage of the space which will help in understanding demand patterns of drivers. Such information will be very useful in improving the plan and increasing its efficiency.

- Employment of parking attendants too is crucial to the successful implementation of the system. They must be empowered to collect fines and given control of equipment needed to boot (immobilize with a clasp) or tow away vehicles whenever necessary. The attendants must also be trained in using the meters so as to aid the parkers during the introductory stages.
- Considering that parking has for so long remained free or highly subsidised, drivers may feel the parking fee to be an additional charge rather than a payment made for better services and facilities.
- Retailers and business persons often use provisioning of free parking space to gain competitive advantage. This will not be possible after the pricing is implemented.
- The equity impact of the pricing strategy will surely be questioned. Charging a driver directly for parking his car is fairer than indirect payment in the form of taxes and tolls. This ensures horizontal equity as the non-driving public is not required to subsidise the cost of parking. However, the income incidence of parking charges is higher for those coming from a lower income bracket, making it regressive in nature. We can assume that since vehicle ownership and use tend to increase with an increase in income, people from a higher income bracket are more likely to be subjected to higher parking rates.

3.5. Various Stakeholders in the Policy

Since this report discusses strategies which involve a major change in policy we need not only the support of the general public but also of various other groups looking out for their personal interests. In order for a policy to be successful, there must be an equitable distribution of the benefits and costs resulting from the policy change among the various stakeholders.

- Daily commuters and the travelling public constitute the largest group. They desire lower levels of congestion and pollution, easy accessibility and improved public transit. However, in our country, parking is usually perceived as a free good. Therefore sudden regulation and pricing may result in public disapproval. If implemented with care, this group will be the first to benefit from the policy – in terms of reduced traffic and better facilities of parking and improvements in public transit. A well designed, well placed parking facility will reduce spill-over parking to neighbourhood areas.

- Most retailers and store owners in the city face a shortage in customer volume due to a lack of parking facilities. Many of them have taken to providing parking as a service in order to attract more shoppers. A perfect example of this is the 'Smart Parking' system set up by the Brigade Shops and Establishment Association on Brigade Road, Bangalore. Since the setting up of the facility, the shops have experienced a 40 per cent hike in sales. The parking problem on MG Road being of a similar nature, such a system can be implemented here too. The same can be said of employers who have offices in the Central Business District.
- Public transit providers have a lot to gain from the parking policy, especially since they can expect a potential increase in revenue. They can also expect an increase in transit ridership and reduced congestion on the roads, which will only add to their efficiency. We must also keep in mind that to an extent the success of the policy depends on the performance of the public transit sector.
- Local officials too have much to gain and lose from the policy. On one hand the enhanced parking facility will have cumulative effects on the rest of the urban transport system improving the liveability of the locality. On the other hand they have to take into consideration the attitude of the voting public towards the change. Regulation and pricing do not elicit positive responses hence such decisions are made with much care. Ultimately the task of convincing the public of the benefits of the programme lies with the local officials hence their support is highly valued.
- Another group which has a stake in policy are the environmentalists. Their main interest lies in reducing pollution by way of CO_2 emissions by discouraging private car use and urban fringe development. Hence, such a policy that seeks to account for and mitigate environmental costs will be warmly welcomed.

4. Role of Parking in a Sustainable Urban Transport Policy

One rarely thinks of car parking in terms of environmental cost. Nevertheless, a sustainable parking system is essential to mitigate the increasing costs of motorisation. There is growing interest in sustainable development of transportation. The uncontrolled increase of private cars and motorbikes in urban India is seen as a major threat to the environmental sustainability of the present transport policy. Although it

can be argued that buses have higher emissions than cars, the passenger occupancy of a bus is 10 times higher than that of a car, lowering per passenger emission levels.

The choice and usage of parking as a policy instrument to curb pollution in cities is driven by one main objective: Reducing vehicle kilometres to be travelled. A complete model to achieve this objective will involve

- Increasing the operating costs of private transport through pricing
- Controlling travel demand by providing limited facility for parking
- Managing parking structures in a way that supplements the growth of public transport.

Big cities across the world use controlled and priced parking to discourage the use of personal vehicles on a daily basis. Therefore, while planning for parking, one must consider its environmental impacts and tap into its potential as a tool for sustainable planning.

The level of supply of parking space provided for an urban centre must reflect the need to reduce the impact of automobile usage on the environment. An over-supply of parking will reduce the price of parking thereby incentivising the use of personal modes leading to higher emission levels per passenger. When there is lavish facility for parking it only acts as a 'fertility drug' for cars (Raad 2002).As you increase parking, more cars take advantage of it. On account of this, more people drive into the city centre thereby raising pollution levels. This will also discourage people from using public transport which has been cited as a more sustainable mode of travel within the city. On the other hand, an under supply of parking will lead to bottlenecks in the system that will aggravate the problem. When there is lack of availability of parking space much time and fuel costs are incurred in searching for a space to park. This in itself will add to emission levels. Moreover, it causes traffic congestion which has a double impact on pollution as explained below.

'First the time cost of a vehicle kilometre rises rapidly with increased congestion. This is because the addition of a vehicle to an already crowded network increases travel time for many other passengers. Since the average speed has reduced to levels that are far below the optimal operating vehicles speed, this leads to increase in rate of emissions per kilometre – thus the two effects are inter-related (Johansson, 1997).'

4.1. Impervious Surface Area Reduction

Another rising concern with regard to surface parking area is the increase in impervious surface area in our urban centres. Impervious surfaces impede storm water drainage, lowering the water table and reducing existing water quality. Therefore when surface parking facilities are built, care must be taken to provide for adequate facility to help reduce run off volume and induce infiltration of rainwater into the ground. Two main strategies can be applied for this.

- **Reducing paved area**

  This involves introducing a maximum cap on parking requirements. This can be on an area specific basis. Shared parking must be encouraged as a method to optimize available parking space – two parties requiring space at two different times can come to an agreement. For instance, a restaurant that needs space at night and on weekends can share space with a school.

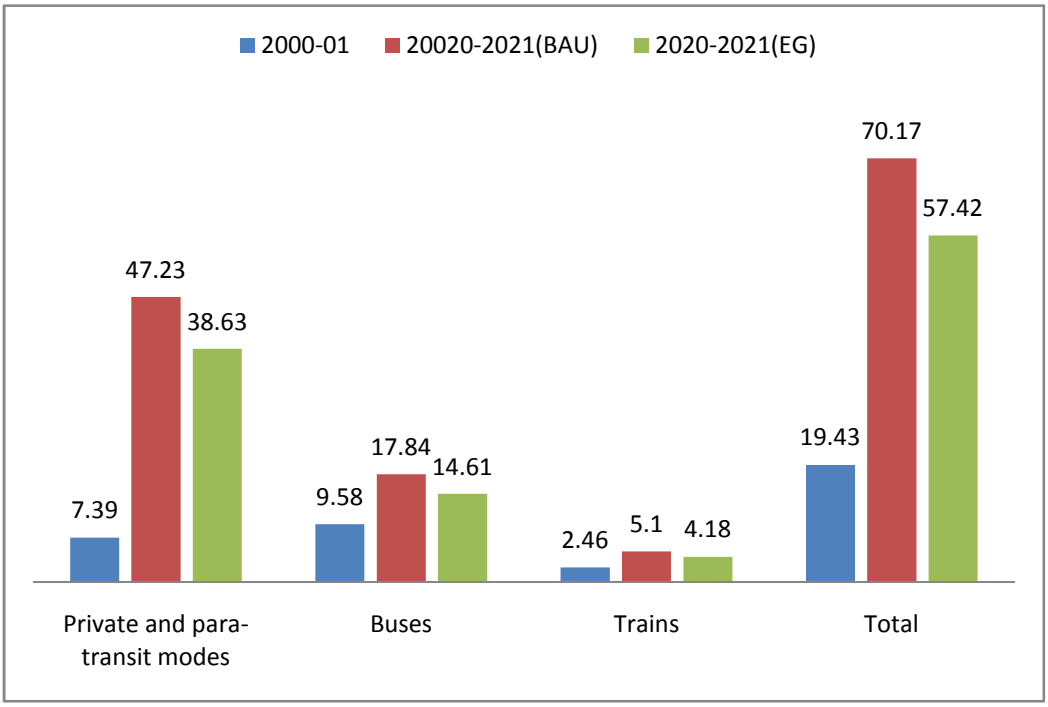
- **Incorporating plants into the parking lot design**

  Plants are an efficient way to increase infiltration of storm water. The leaves and stems of the plants intercept storm water which later evaporates into the atmosphere. They also add aesthetic appeal to the facility

4.2. Transportation and the Environment

The total estimated pollution load from the transport sector increased from 0.15 million tonnes in 1947 to 10.3 million tonnes in 1997 (India State of the Environment Report, 2001) According to a study on CO_2 emissions from passenger transport in India, in the year 2001, the per capita emission levels from private and para-transit modes stood at 7.39 while that from buses were at 9.58 (Singh 2008).The study also predicts the emission levels of 2020-21 under two circumstances. The first being the 'Business As Usual' scenario where the emission levels for ground transport modes, except rail, are assumed to remain the same as 2001 and the 'efficiency gain scenario' which assumes that the CO_2 intensities of all modes decline at the rate of 1 per cent per year. This reduction is assumed to be the result of better, fuel efficient technology and improvement in transportation system management or a combination of the two. The forecasted levels are illustrated in the figure.

Figure 10: Per capita CO_2 emission from different modes of transport (kilogrammes of carbon equivalent)



Source: CO_2 Emissions from Passenger Transport in India: 1950-51 to 2020-21

We can see that in a span of 20 years, the situation left as it is will result in an increase in air pollution with private and para-transit modes contributing to a major chunk of the emissions. Although the government has tried to mitigate these damages by using legislation, emission standards, vehicular pollution control measures and environmental audits, it has done little to help solve the problem. The Air (Prevention and Control of Pollution) Act, 1981, and the Environment (Protection) Act, 1986, are examples of this.

The table given below shows the CO_2 emission levels of various vehicles. While one can argue that buses emit much higher levels of CO_2 per vehicle-kilometre than a car, we have to take into consideration that on an average, a bus carries 10 times the passenger load of a car, thus decreasing the per passenger-kilometre emissions. Motorbikes, on the other hand, are considered the most polluting, owing to their two-stroke engines. The table below shows us the emission levels from various modes of urban transport.

Figure 12: Emissions from different types of vehicles

Type of vehicle	Average passenger per vehicle	Pollution load in gm/pass per km	Congestion effect in PCU/passenger
Two stoke two-wheeler petrol engine	2	7.13	0.375
Four stroke two-wheeler petrol engine	2	4.76	0.375
car with catalytic converter	4	0.93	0.25
Bus with diesel engine	40	1	0.075

PCU = passenger car unit

Source: CO_2 Emissions from Passenger Transport in India: 1950-51 to 2020-21[2]

5. Proposed Model for MG Road – Madhava Pharmacy to Ravipuram (Both directions)

5.1. Important Features of Scope Area

MG Road is among the most commercial roads in the city. It is a 4.4-km stretch on NH 47A, which starts at Kacheripady and ends at Thevera. The average daily traffic on MG Road is 47612 Passenger Car Unit (PCUs), near Dwaraka Hotel, and 39121 PCUs north of Rajaji Road. The following table shows the composition of vehicles, as recorded in mid-block locations. We note that two-wheelers constitute a majority of the fast-moving vehicular population (37 per cent), while cars contribute 28 per cent (RITES Ltd 2001).

[2] Note: The prototype used for cars is the least polluting, while that used for buses is most polluting.

Table 1: Composition of traffic at mid-block locations

Vehicle Type	Fast Moving Vehicles								Slow Moving Vehicles				
	Car/Jeep/Van	Two-Wheeler	Auto rickshaw	LCV/Tempo	Bus	Mini bus	Truck	Total fast moving	Cycle	Other	Total slow moving	Grand Total	Total in PCU's
Direction 1(Jos Junction to Ravipuram)	4605	6117	2961	805	1926	30	17	16460	463	1	464	16924	19419
Direction 2(Ravipuram to Jos Junction)	7020	9593	2758	1975	2960	60	1	24367	614	0	614	24981	28193
Both directions	11625	15709	5718	2780	4885	90	18	40825	1077	1	1078	41903	47612
Percentage	28	37	14	17	12	0	0	108	3	0	3	111	
Morning peak(Both directions)	1032	1669	474	229	335	1	0	3740	90	0	90	3830	3973
Percentage	27	44	12	6	9	0	0	98	2	0	2	100	

Evening peak(Both directions)	929	1173	467	282	356	2	0	3209	89	0	89	3298	3755
Percentage	28	36	14	9	11	0	0	97	3	0	3	100	

Source: Comprehensive study for transportation for Greater Cochin area, RITES LTD

The Kerala Municipal Building Rules, 1999, Chapter V, contains the minimum off-street parking requirements for developments in the State. According to the rules, "off- street parking space must not be less than 15 sq. metres for cars, three square metres for two-wheelers (except cycles) and 1.5 square metres for cycles." The requirements are given in accordance with the type of establishment and carpet area. These plans are made on the basis of an estimate of the peak demand requirement of every establishment. The standards are set with no consideration of price, cost or the cumulative effects of the whole system.

A uniform law is followed for the entire state without taking into consideration the land-use pattern. For instance, suburban fringe area requirements should be different from CBD requirements to reflect the sustainable transport management goals of the areas. Every urban centre has a unique transportation and land-use pattern, which determines the pattern of parking demand. Such a broad policy will do very little to cater to the unique parking needs of different cities. Hence, the need arises to consider parking as a variable from the early stages of town planning.

Parking in Kochi is currently handled by the Corporation of Cochin. Tenders to manage parking spaces are auctioned out to private parties. A maximum fee of ₹10 per hour is charged. Minimum amount of records are maintained with regard to parking.

5.2. Model Design

The first step of evolving an efficient system of parking for the city requires an inventory to be taken of the existing and potential parking spaces. Once this is done, the availability of space should be pitted against the demand for parking. On comparing the parking requirements against the parking provision, a level of parking that is apt and keeping with the overall goals of the transport policy can be attained.

5.2.1 Earmarking of Spaces

This is the first step in creating a parking facility. An inventory must be made of the available space along the stretch of the road. We can also consider empty plots in the vicinity, which can be potentially used for off-street parking spaces. This model is, however, restricted to on-street parking.

The table below depicts the details of parking with regard to MG road.

Table 2: Parking demand on MG Road

Direction	Ravipuram to Madhava Pharmacy					Madhava Pharmacy to Ravipuram				
Vehicle Type	car	auto rickshaw	Two-wheeler	LCV	ECS	car	auto rickshaw	Two-wheeler	LCV	ECS
Parking Accumulation	156	66	142	0	258	215	71	210	0	339
Parking Demand	1698	972	1891	0	3143	2162	1038	2092	0	3723

ECS = equivalent car space

Source: Comprehensive Study for Transportation for Greater Cochin Area, RITES LTD

Parking accumulation represents the maximum number of vehicles parked at one point of time and parking demand represents the total demand of vehicles throughout the day. We can see that about 24.7 per cent of the total demand comes from autorickshaws. As a parking fee cannot be levied on autorickshaws, we must accommodate them in special stands. This is not to say that parking of autorickshaws does not create costs similar to that of parking any private vehicle. However, an autorickshaw has multiple users; a direct pricing strategy will not work. In such a situation, especially since autorickshaws are a mode of intermediate public transport, subsidizing of parking is justified.

The length of MG Road is 4.4 km. The total length available for parking on MG Road can be estimated to be 3.5 km. This can accommodate roughly 1100 PCUs in parking space. Since we are using parallel parking, this stretch can accommodate roughly 492

(3 km/6.1) PCUs in parking space. The total parking accumulation on MG road is 597 Equivalent Car Space (ECS). According to this, 83 per cent of total parking demand can be satisfied by merely organising the existing space.

Table 3: Parking space hours on MG Road

Parking space hours	Car	auto rickshaw	Two-wheeler	LCV	ECS	car	Auto rickshaw	Two-wheeler	LCV	ECS
<2	1528	962	454	0		1903	1028	481	0	
2 to 4	357	39	28	0		454	42	78	0	
4 to 6	170	0	24	0		324	0	52	0	
>6	119	0	33	0		303	0	37	0	
Total					3714					4701

Source: Comprehensive Study for Transportation for Greater Cochin Area, RITES LTD

The above table shows us the duration for which different vehicles are parked. Short-term parking for less than two hours is most common. This should be seen as a positive sign. Long-term parking must not be encouraged. Progressive pricing can be employed in order to control the duration for which vehicles are parked. Effective fines must be levied if the driver overstays his time on the meter.

5.2.2. Installation of Solar Powered Parking Meters

Once the spaces are earmarked solar powered parking meters will be installed to facilitate the collection of parking fees and regulation of duration. Latest technology is parking meters also allow us a variety of other functions. Parking management soft ware helps us to maintain records of the use of the meter which can be used for assessing the demand. The use of electronic signage to show whether the parking spaces in the block are 'full' also should be employed to guide drivers. Since we are dealing with a 4.4 km stretch with roughly 1100 spaces, 70 parking meters should be employed to serve the demand.

How does the meter work?

- The meter is powered by solar panels.
- Payment can be made using coins, Debit cards, Credit Cards, Smart cards(in the case of regular users)
- One parking meter can service four parking spaces
- Remote supervision using parking software management systems

Model of parking meter to be used

Maintenance and implementation

- Since the meters are powered by solar panels the maintenance costs are relatively lower
- Parking attendants must be hired, under the City Traffic Police. These attendants must aid users in using the machine during the initial stages and must also be empowered to charge fines and 'lock' vehicles that over stay their time or fail to pay the required fee. They must be provided with and trained to use the equipment.

Car locked using wheel clamp

5.2.3 Pricing Strategy

Pricing of the spaces must be done on the basis of location, duration and timing.

Location	**The model involves the use of already existing spaces. Therefore no land acquisition costs are incurred. However, we must take into consideration the opportunity cost of using the space for parking. Considering that MG is a commercial stretch, the land value is very high. This value is taken to be homogenous for the entire stretch.**
Duration	Being a central business district with a large population of shops and restaurants, priority is given to short term parking. Long term parking must be discouraged by using a progressive pricing strategy – charging more for longer hours
Timing	The parking demand on Mg road peaks in the evenings. Hence the parking

	charges can be slightly higher during this time in order to control the demand
Willingness to pay	In order to gain public support for the policy, prices should not be set very high. The willingness to pay more than Rs.10 for parking is not very high. Hence the fee amount should not exceed Rs.20 per hour.

Table 4: Price structure for MG Road

Time	**Parking rate**
1-2 hours	Rs.20
>2 hours	Rs.15/hour

PRICES SET FOR MG ROAD

Holiday pricing

Parking and travel demands tend to peak during Onam, Christmas, Ramadan and other festivals. A hike in prices should be resorted to in order to control this sudden increase in demand.

Willingness to Pay

The willingness to pay for parking plays a major role in determining the success and feasibility of the policy.

Table 5: Willingness to pay for parking spaces

Willingness to pay off the street (per cent)	**Car**		**two-wheelers**
Nil	3.24		0.16
1 to 5	14.56		99.08
6 to 10	79.94		0.46
10 to 15	2.27		0

On the street			
Nil	2.27		0.46
1 to 5	88.35		99.09
6 to 10	8.09		0.46
10 to 15	1.29		0

Source: Comprehensive Study for transportation for Greater Cochin area, RITES LTD

The above table shows the willingness to pay for parking facility. From the existing facilities that are offered to drivers, it is not surprising that the willingness to pay is so low. Less than 3 per cent of people are willing to pay above Rs.5 for parking spaces. However while 79.94 per cent of people are willing to pay Rs.6-10 for off the street parking space, a mere 8.09 per cent of people are willing to pay the same amount for on the street spaces. This is because of the different perceptions people have of on and off street parking spaces. Off street spaces are preferred by long term parkers as it is also considered safer. Unlike on the street spaces, off street facilities have an attendant who regulates the cars and collects a fee. Due to these reasons, off street parking spaces are recognized as a service offered in return for a fee while on the street spaces are expected to be given free of cost. If the same facility is made available on the streets we are sure to see an increase in the willingness to pay.

5.2.4. Costs and Revenues

- **Capital Costs**
  - Parking meters
  - Cost of one meter = Rs.3, 50,000/ meter
  - Total cost for entire stretch = Rs.2, 45, 00,000/-

- **Expected Revenue**
  - Price charged for two hours = ₹20
  - Time for which entire space is used= 10 hours/ day[3]

[3] Estimated time for which cars are parked on the street everyday.

- Total number of cars expected to be parked = 1100
- Total revenue collection = ₹1, 10, 000/ day

- The capital cost of the model can be recovered in 250 days of its operation.
- The maintenance costs will be minimal as meters are solar powered and energy efficient

5.2.5. Revenue Allocation

- Maintenance of the facility
- Compensation of employees – parking attendants
- Improving pedestrian accessibility
- Bus shelters, Auto stands – to encourage commuters to use public or para-transit modes of travel

5.2.6. Anticipated Impacts

- Increase in capacity of space
- Increase in sales
- Reduction in congestion
- Revenue generation
- Improvement of urban space
- Better urban transport

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