**Air Pollution and Control**
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**Lecture 26**
**Emission Inventory: Case Study**

Hello friends. So, far we have discussed recently regarding how to develop emission inventory for different source categories like residential, commercial, for transportation sector, industrial areas, all those things. So, today we will discuss one case study, so that how to apply those theoretical relationships which are used for developing of emission inventory, how these emission inventories are constructed and what are their applications or what kind of lessons we derive from those emission inventories.

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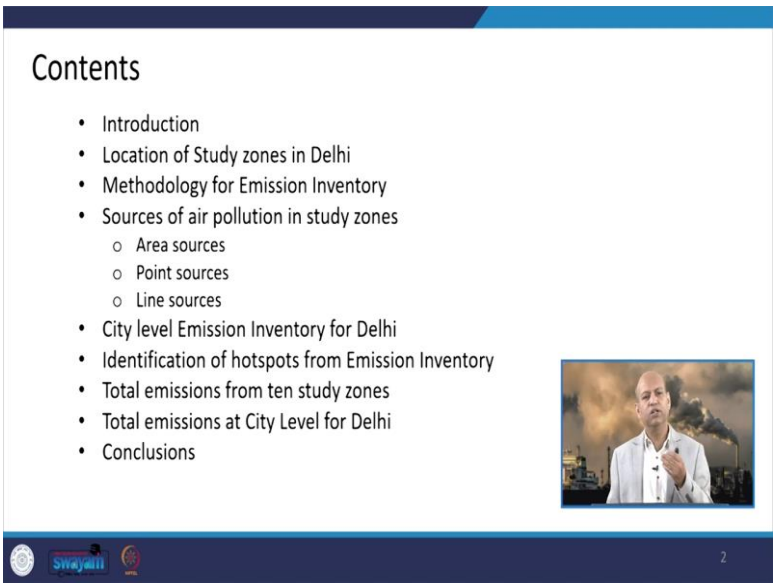


So, today's lecture will have this particular small introduction about the case study where we have taken it up. Then what is the location of the study in different zones in Delhi which is the focus area of this particular study and the methodology which has been used for development of this case study of emission inventory, then different sources which have been, incorporated in this particular study like area sources, point sources or line sources related emissions.

Then city level emission inventory for Delhi because the case studies focused on certain number of zones study zones are there 10 studies zones are there we will see, but then it has been extrapolated to estimate the emissions from the entire Delhi city. So, that methodology also we will see into. Then, we will see how the identification of hotspots have been done by this emission inventory, where lot of emissions are coming from, then the total emissions from

10 study zones as well as total emissions from the city level of the Delhi and then we will conclude.

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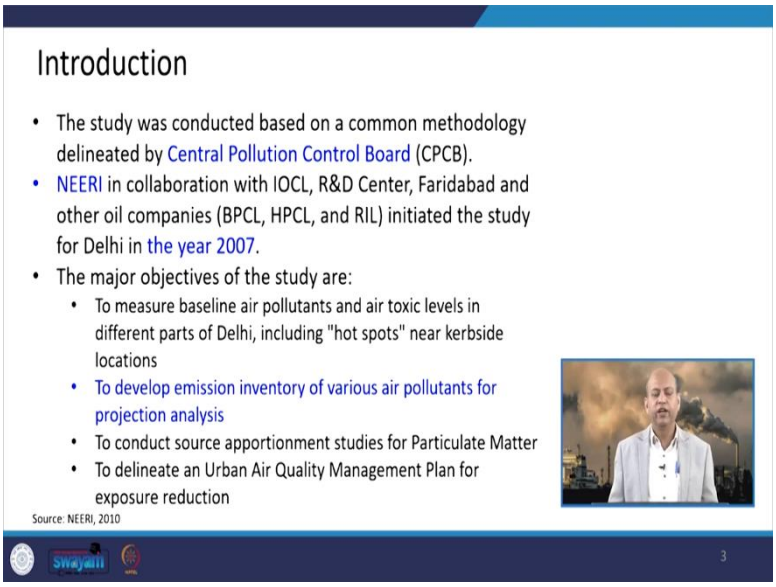


So, basically this study was conducted based on a common methodology, which was delineated by Central Pollution Control Board and NEERI in collaboration with the Indian Oil Corporation Limited and R & D Centre Faridabad of that IOCL and other oil companies like BPCL, HPCL, RIL. And they initiated this study for Delhi in the year 2007. And it was published in 2010.

Well the major objectives of this study were like to measure the baseline air pollutants and air toxic levels in different parts of Delhi city, that is mega city Delhi you can say including the hotspots, where a lot of emissions are coming from near like curb side of the roads etc, then to develop emission inventory for various air pollutants for projection analysis.

So, that we can project and analyse for the entire Delhi city and then to conduct source apportionment studies for particulate matter, which is not part of today's case study we have focused only in emission inventory development. Then to delineate an urban air quality management plan for exposure reduction, that is also not part of that, but we will touch like, what is the lessons we can learn from these results, which are of this particular emission inventory.

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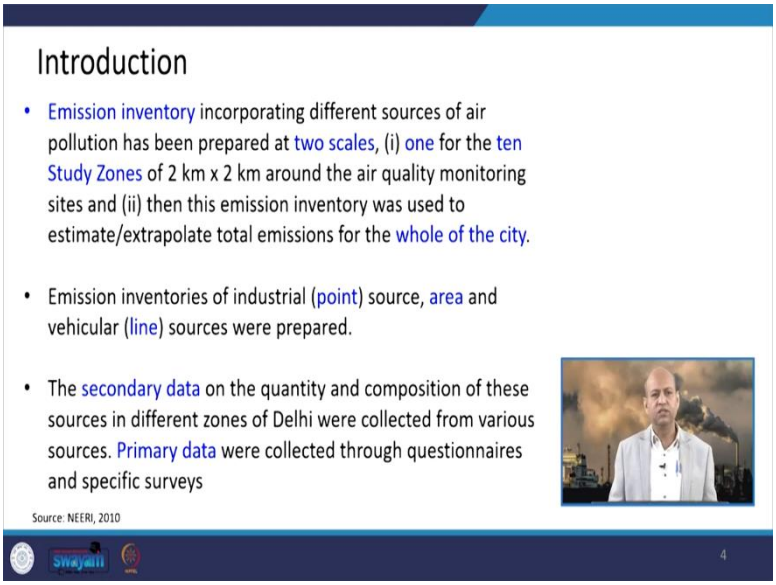


So, this particular emission inventory has 10 zones and it has got two kind of distinct scales like one for the 10 study zones of 2 x 2-kilometre, 2 kilometres x 2-kilometre around the air quality monitoring sites which are already functioning, and then the emission inventory which was developed for these time zones, which were extrapolated and total emissions for the whole city of Delhi has been estimated. So, two parts are there basically.

Then what are different sources which have been incorporated in the emission inventory or like point sources which are basically industrial sources like stack emissions, then area sources like domestic and commercial areas etc. Then vehicular sources that is line source, so all point line area source have been considered and there have been, primary data collection also based on questionnaire survey and other specific surveys plus secondary data have been taken from various kinds of published reports and other, sources of data.

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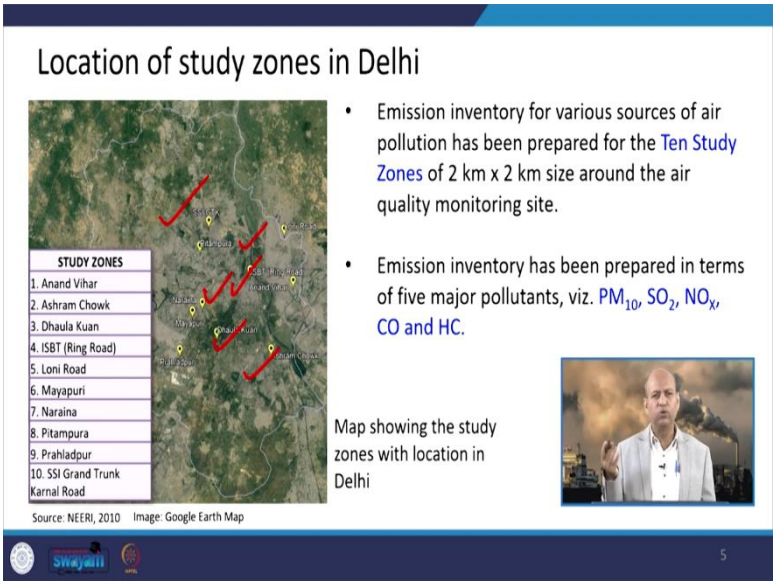


Well, so these are the locations of study zones like Anand Vihar, Ashram Chowk. So, in this particular map it is shown like a small-scale industry of Grand Trunk Karnal Road, then this is Pitampura and Naraina, then ISBT Ring Road, Ashram Chowk, Dhaula kuan. So, all these kinds of these 10 locations of the 10 study zones are depicted in this particular map which you can see and each zone has like 2 kilometre x 2 kilometre size.

So, that the detailed study can be carried out with limited resources and then we can extrapolate, because these are the kind of representative zones you can see. And it has been prepared this inventory has been prepared in terms of 5 major pollutants, which are like $PM_{10}$ that is a particulate matter of the size 10 micrometre or less and then sulphur dioxide, oxides of nitrogen $NO_2$ etc, then carbon monoxide and hydrocarbons HC.

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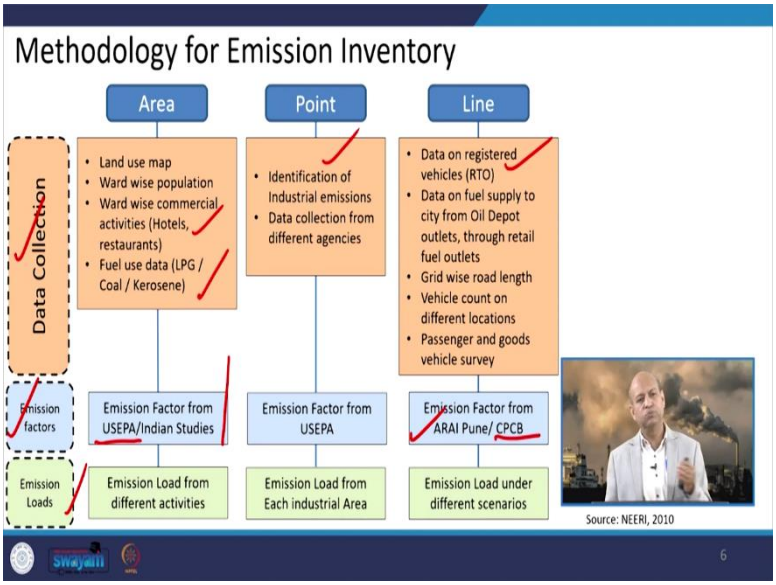


So, these are the methodologies for emission inventory for every kind of category like area source point source or line source. So, basically first of all, data collection is there for any kind of activity basically, you must remember for emission inventory development from bottom to up approach, we go first of all for data collection, we collect the data which are needed for any kind of activity which is responsible for emissions of your pollutants.

So, the activity data is important weather area source or point source or line source, activity data you have to collect and then the those total fuel burning or those kind of estimations are to be done, then emission factors are there for each kind of activity. So, those are clubbed and then total emissions are estimated that is the particular basic thing which every kind of emission inventory incorporates.

So, data collection then emission factors also, the specific emission factors means, the localised or the activity based emission factor must be there. If there are no indigenous emission factors then we have to rely upon some literature, some other like EPA or WHO reports also contained from different countries. So, whatever economies are similar to ours that we can borrow and we can use in the absence of the indigenous emission factors, then the emission loads are estimated.

So, like for example, for area source first of all we must know the land use, what kind of land use is there in that area, what are activities of domestic nature commercial nature etc. Then hotels, restaurants or fuel use data, how much LPG or coal kerosene are being burned all those things, then emission factors are to be taken from Indian studies, first of all and otherwise like

USEPA in this particular study, they have taken the emission factors from Indian studies and wherever those emission factors were not available.

So, they have, based upon USEPA United States Environmental Protection Agency's emission factors. So, that thing is common in all these for line sources like vehicular categories. So, first of all we need to collect data from like RTO office, where we can get different categories of vehicles numbers and age etc.

So, all those data then emission factors from our Pune based institute, which is automobile related institute and then CPCB related emission factors are also there, for point source, we need to identify how much industries are there or power plants are there in this study zones, which have been considered there are no power plants, but beyond that power plants are there so, they have also been incorporated.

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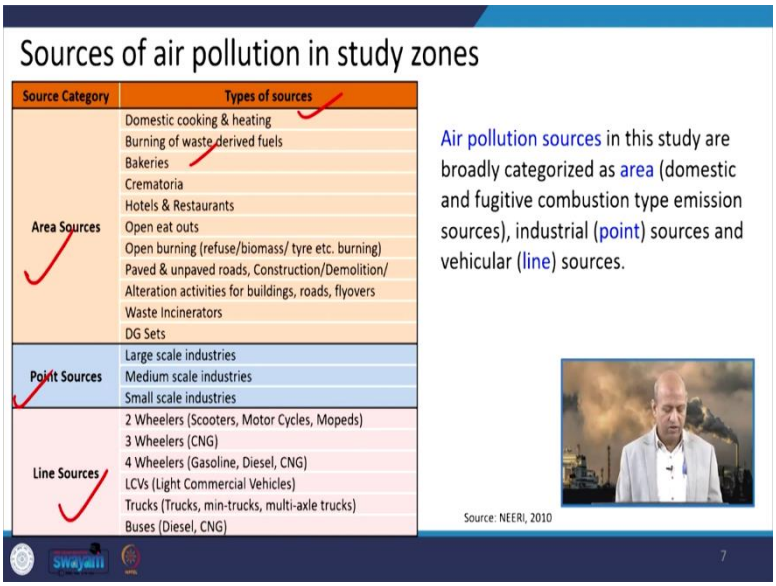


So, if we go by sources like different sources like area sources, so these like domestic cooking or heating then burning of the waste, derived, waste derived fuels like those residue etc, then bakeries or hotels, restaurants etc have been incorporated in point source, large scale industries, medium scale industries or smaller scale industries. Those related information we have missed in this study has been taken. Then in line source like 2 wheeler, 4 wheeler, 3 wheeler and then with fuel they are being run by like CNG or these gasoline that is petrol or diesel, all those kind of related different categories have been taken up.

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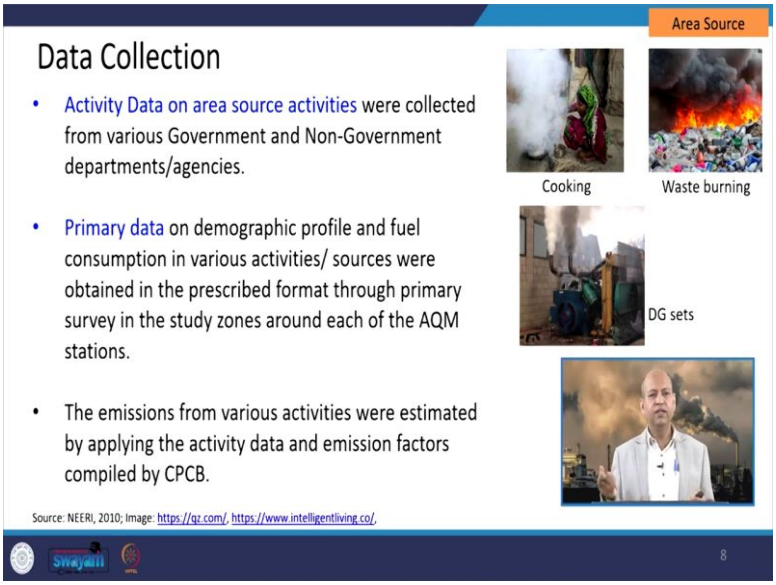


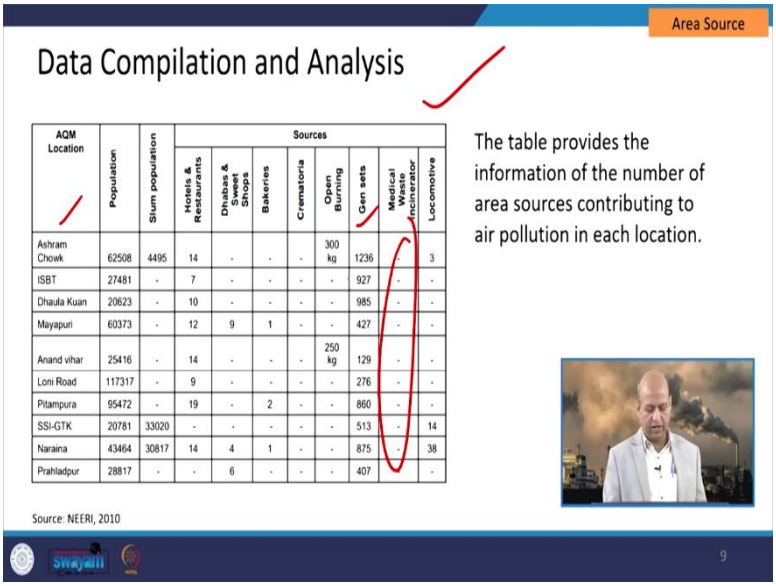


| AQM Location | Population | Slum population | Sources | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Hotels & Restaurants | Dhabas & Sweet Shops | Bakeries | Crematoria | Open Burning | Gen sets | Medical Waste Incinerator | Locomotive |
| Ashram Chowk | 62508 | 4495 | 14 | - | - | - | 300 kg | 1236 | - | 3 |
| ISBT | 27481 | - | 7 | - | - | - | - | 927 | - | - |
| Dhaula Kuan | 20623 | - | 10 | - | - | - | - | 985 | - | - |
| Mayapuri | 60373 | - | 12 | 9 | 1 | - | - | 427 | - | - |
| Anand vihar | 25416 | - | 14 | - | - | - | 250 kg | 129 | - | - |
| Loni Road | 117317 | - | 9 | - | - | - | - | 276 | - | - |
| Pitampura | 95472 | - | 19 | - | 2 | - | - | 860 | - | - |
| SSI-GTK | 20781 | 33020 | - | - | - | - | - | 513 | - | 14 |
| Naraina | 43464 | 30817 | 14 | 4 | 1 | - | - | 875 | - | 38 |
| Prahladpur | 28817 | - | - | 6 | - | - | - | 407 | - | - |

Then so, data collection as I said that activity data have been collected with primary sources like survey based and then the secondary sources from different kinds of reports or publications from government as well as non-government organisations. So, this kind of data compilation and analysis was established like metrics has been there, like air quality monitoring locations for Ashram Chowk, ISBT, Dhaula Kuan etc.

Then how much population is there in that particular zone, how much slum population is there because their burning of fuel is distinct than the other population. So, that has been segregated hotels, restaurants then these dhabas or, the sweet shops, bakeries, they also emit lot of emissions because of fuel burning in their activities. Open burning then Gensets because

whenever electricity is not there then generators run. So, diesel is used and lot of emissions are there medical waste incinerators, wherever.

So, in these particular zones there were not neither medical waste in incinerators or neither there were any crematoria's. So, those kinds of emissions were not there, then locomotives were there, a few locations like Ashram Chowk and the Naraina etc. So, those have been also considered.

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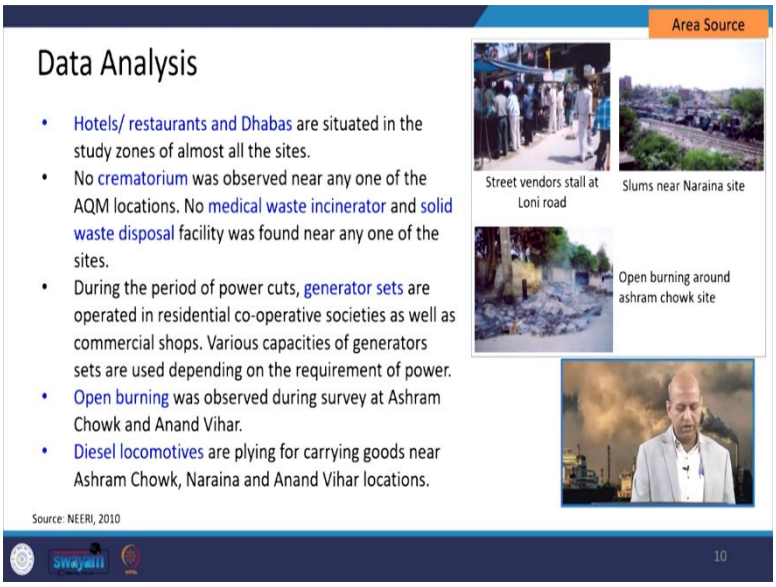


Well, so as I said, like hotels or open burning diesel locomotives, which were plying to carry goods in between Ashram Chowk, Naraina, Anand Vihar locations they have been also considered.

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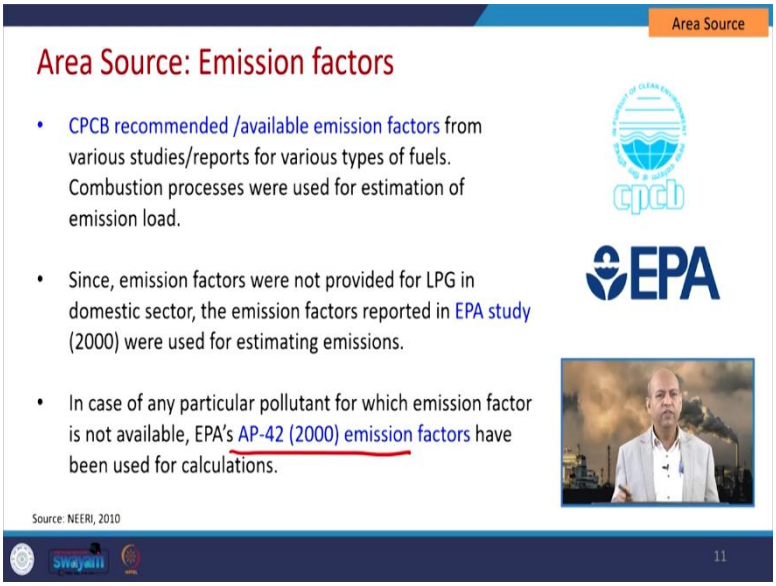

Well, so emission factors as I said that CPCB Central Pollution Control Board has recommended the emission factors for various activities. So, whatever emission factors were available for from CPCB, then they those have been taken. Otherwise, this EPA's AP-42 2000 emission factors compilation is there for different sources and activity, those have been taken wherever, indigenous data are not available for emission factors.

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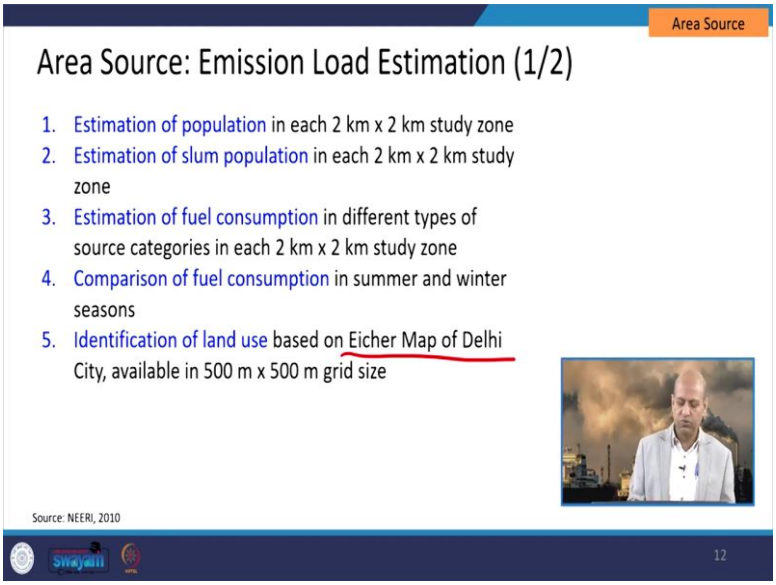


Well, so area sources if we consider first of all, then the estimation of population in each 2 kilometre x 2 kilometre study area was carried out then the slum population and estimation of fuel consumption or comparison of the fuel consumption in summer, so season seasonal variation or winter seasons that has been also taken up. Identification of the land use pattern so, that it can give different information like Eicher map was used in nowadays, sophisticated maps are there, but in 2007 they used the Eicher map of the Delhi city for the land use patterns.

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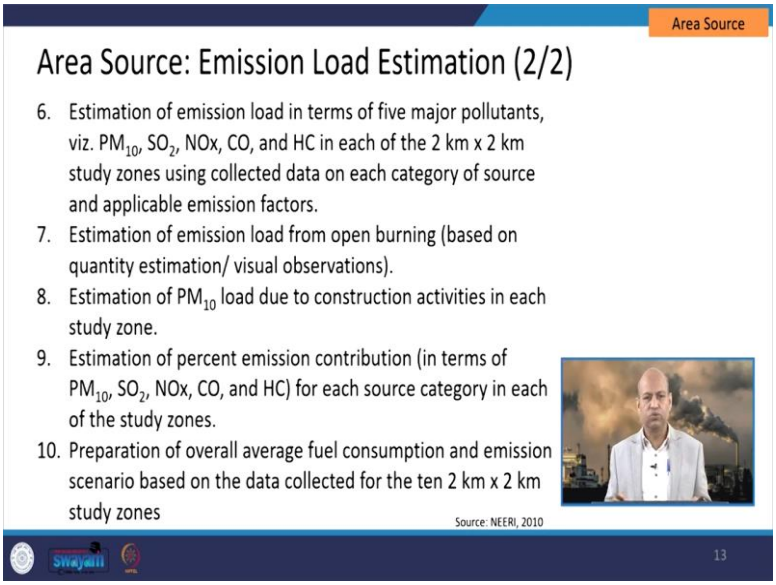


Well, then estimation of emission load in terms of 5 major pollutants like $PM_{10}$ as I said earlier or $SO_2$, $NO_x$, CO and HC. So, in within that 2 kilometre by 2 kilometre estimations have been made, and this percent emission contribution for each source category has also been estimated when you have the total and from different sources. So, you can easily calculate how much percentage coming from different sources or how much percentage of a particular pollutant is coming from a particular source. So, those kinds of things we can easily play. So, that has been given in this particular report.

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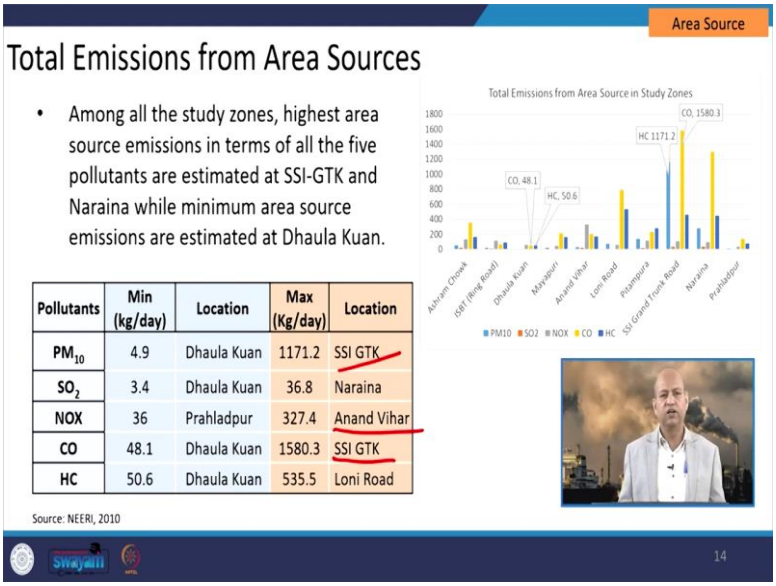


Well, so if we talk about the total emissions from area sources in those particular zones, so you can see like there are these emissions of CO carbon monoxide. So, from this small-scale

industrial area of Grand Trunk Road and the Naraina they have been much more responsible for emissions of CO, carbon monoxide and these hydrocarbons are also there.

So, if we see the location wise like $PM_{10}$, the minimum emissions are from Dhaula Kuan basically Dhaula Kuan and Prahladpur are responsible for minimum emissions of different pollutants and pollutant wise like $PM_{10}$ maximum emission was from the smallest scale industries in Grand Trunk Karnal Road and the $NO_x$ emissions were more in, Anand Vihar and the CO emissions were again from the small-scale industries Grand Trunk Road. So, that way different, locations have been identified where maximum emissions are there, and where minimum emissions are there.

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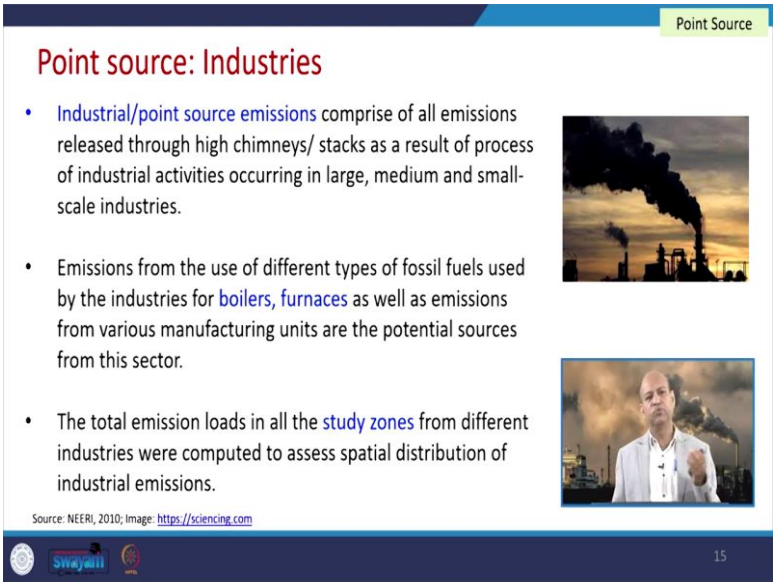


Well for point sources like industries, so the industrial point sources for that particular, survey was conducted and stacks were counted how many chimneys are the stacks are there which are emitting those air pollutants, well boilers, furnaces related, data were collected, and then total emission loads were estimated by those using those formula which are used for stack emissions.

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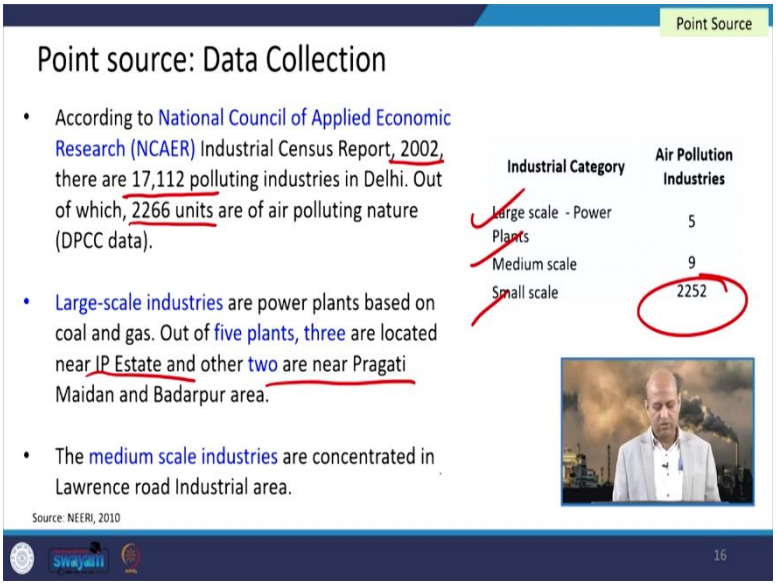


Well then in the data collection has been done from National Council of Applied Economic Research related reports 2002 There are like, in 2002, this was 17,112 polluting industries. So, that way those data have been there, and these 2,266 units are polluting in nature from DPCC data that was taken out of which, so segregation has been there, large scale, medium scale small scale, small scale are like 2252 industries are there.

And then, in large scale industries power plants were considered basically there are like 5 plants, but there they were not in those study zones. And these three are located in IP estate and then the two are near Pragati Maidan and Badarpur area areas. So, those have also been considered, then medium scale industries, concentrated on Lawrence road industry areas, so those who have been also considered in this study.

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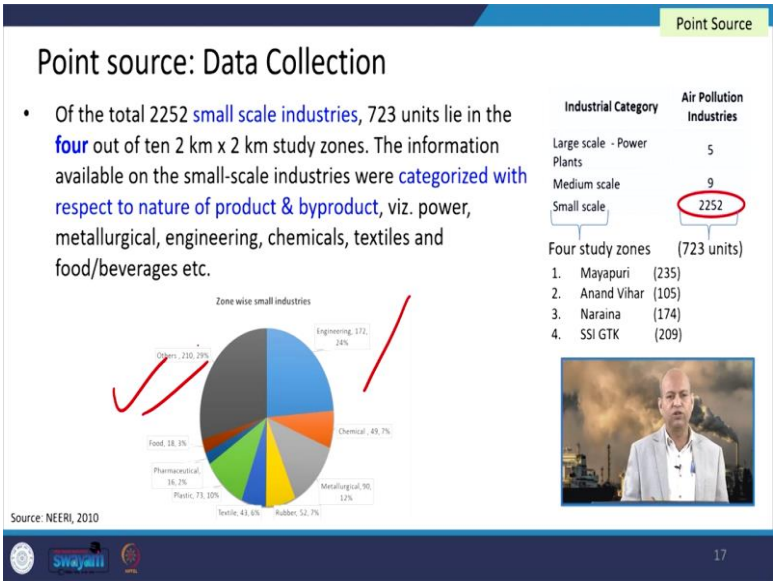


Well, when we talk about these small scale industries and if we see where they are located, so Mayapuri, Anand Vihar, Naraina and these small scale industries Grand Trunk Karnal Road is there. So, engineering studies like if we zone wise if we see which kind of industries are there which are responsible for various kind of emissions. So, the engineering chemical metallurgical pharmaceutical, so those kind of industries are there and then other industries other kind of which are not in this particular category.

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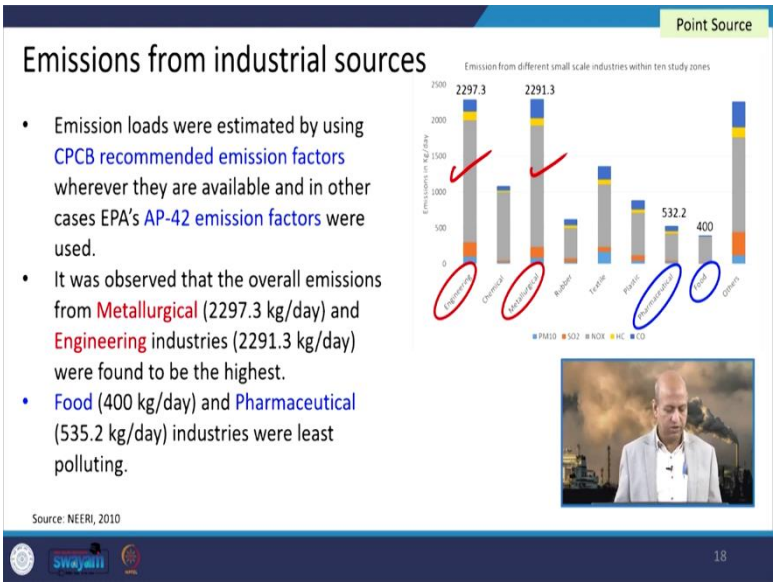


Well, when we talk about like engineering industries are there emissions from different small-scale industries. So, the engineering industries metallurgical industries are responsible for maximum emissions you can see and NOx emissions are coming lot of from all these kinds of

industries. So, you can see the dominating emissions are NOx from these particular industries in a very large quantity.

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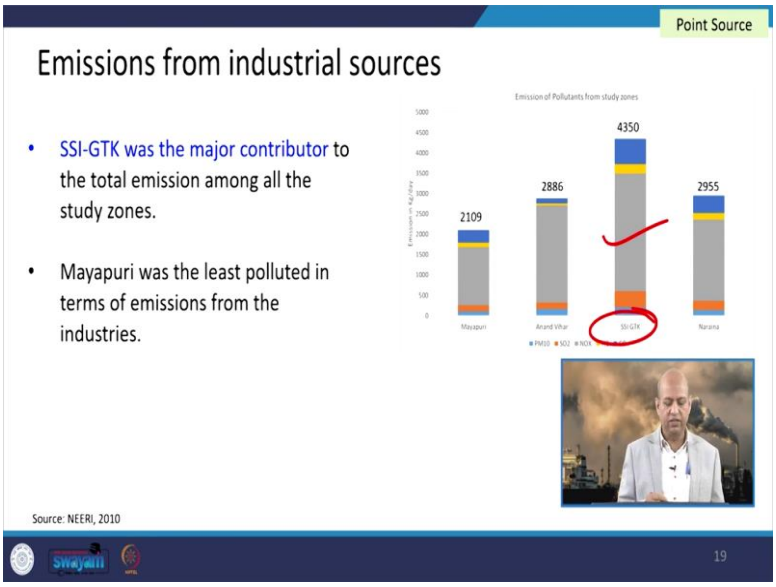


Well, if you see these from industrial sources again pollutants like $PM_{10}$ or sulphur dioxide, $NO_x$ etc. So, again $NO_x$ is dominating and then CO is also there. So, you can see the difference between different kind of areas like this small-scale industrial area of Grand Trunk Karnal Road is the major contributor, if we compare with other industrial areas. Mayapuri is the least polluting area in that sense.

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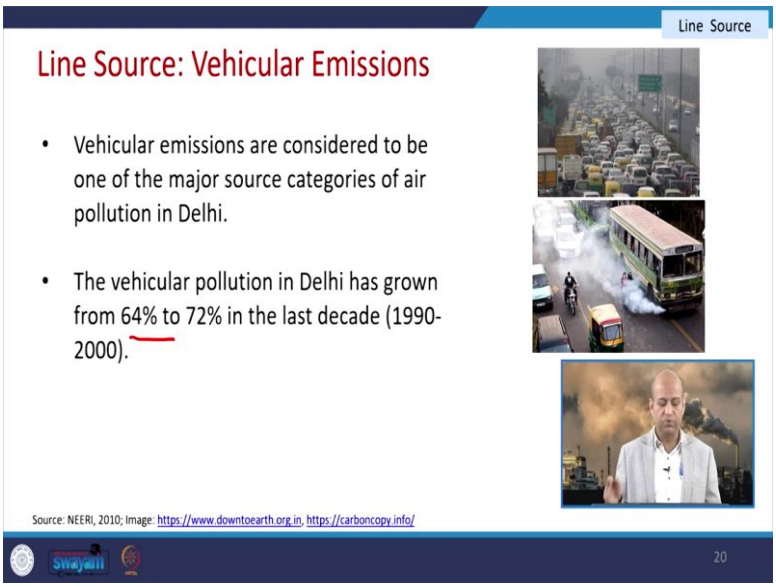


Well, now if we talk about like line source emissions, that is vehicular emissions, so, we have considered like area source point source and now, line source. So, line source basically

vehicular emissions you can think of, so these are responsible for a large amount of like CO NOx etc and they have, vehicular pollution has increased from 64 percent to 72 percent in the last decades, so lot of growth has been there.

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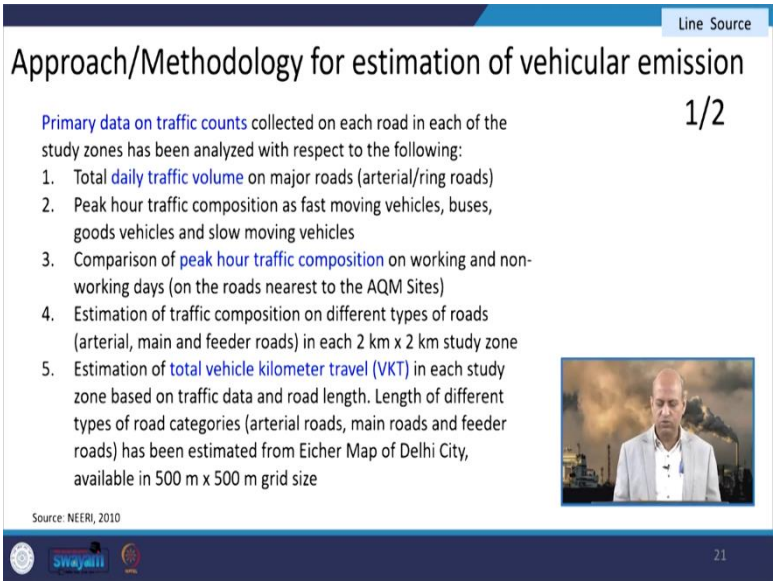


Well, so, far these calculating estimates or estimating the emissions from vehicular category. So, primary data of the traffic counts have been collected from RTO office, then different kinds of category like how much how many, vehicles are there are 4-wheeler category 2-wheeler within 2-wheeler 2 stroke engine, 4 stroke engine, so those kinds of categorization have been there and those values have been taken into.

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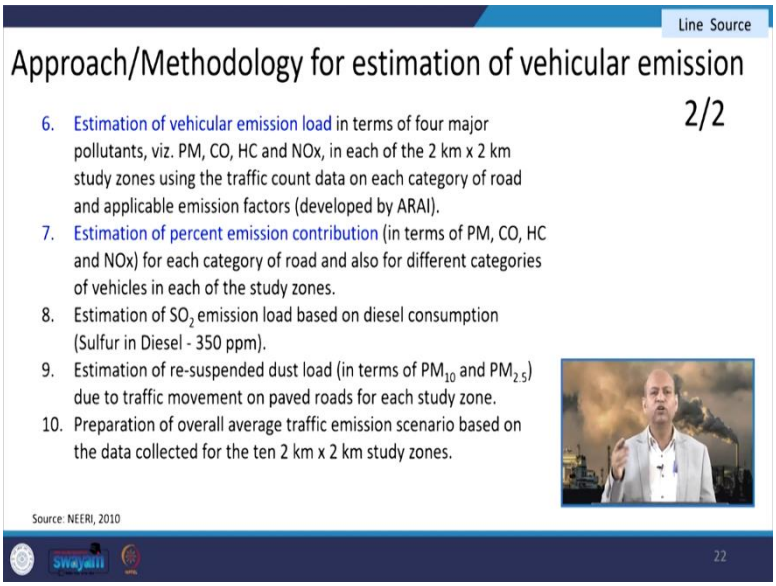

Then estimation of these pollutants like particulate matters CO, HC, $SO_2$, $NO_x$ have been there in that area. So, how many vehicles are there it is easy to take those data from this RTO office and then calculate the emissions with the help of emission factors and the total like vehicle this how many kilometres one vehicle travel so, that average value can be taken and multiplication can be done very easily.

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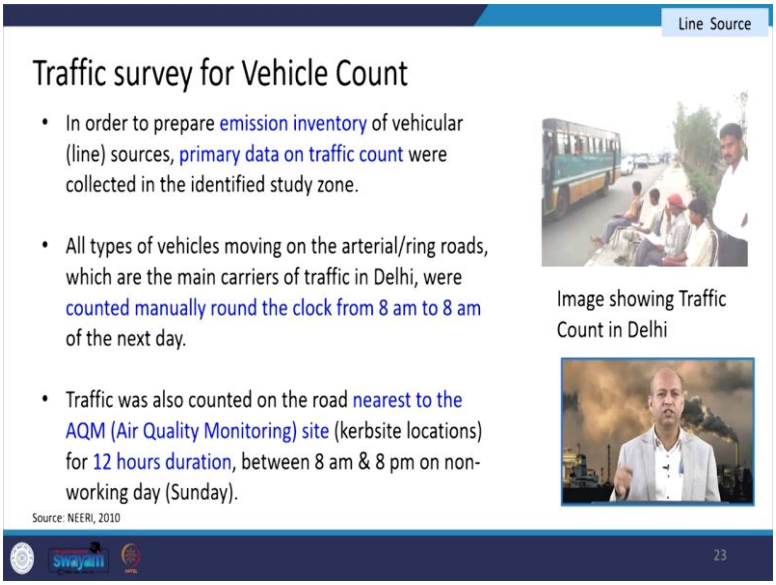


So, the survey was conducted to have the primary data on different locations. So, that way some people, those who can do a good survey were hired and they counted vehicles at particular locations of different categories of the vehicles.

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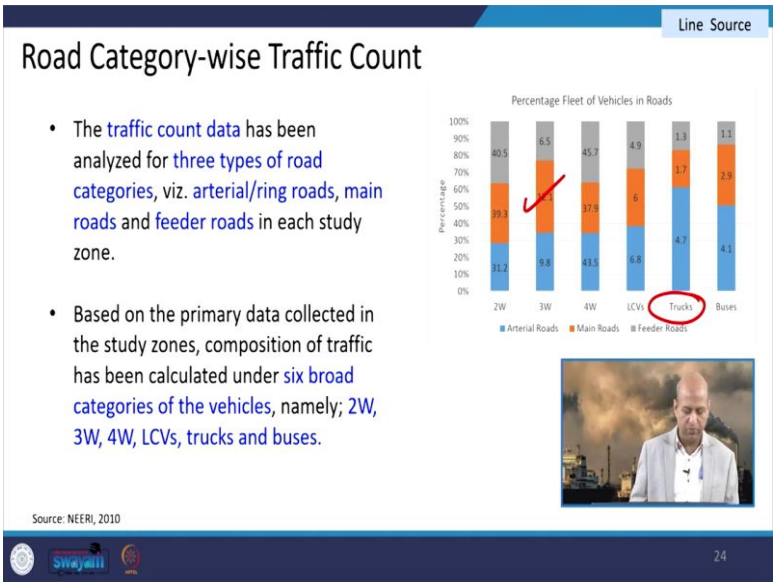

Then the road category wise do traffic count you can see here like the at the arterial roads, you can see most of the trucks are, plying on the arterial or the roads and the main roads are responsible for like 4 wheelers and these light commercial vehicles also in large number and 3 wheelers basically go on the main roads mainly. Than feeder roads are there. So, they are having like 45.7 percent if we count these, 4 wheelers, then they are mostly on these feeder roads are applying. So, those kinds of categorization have been done.

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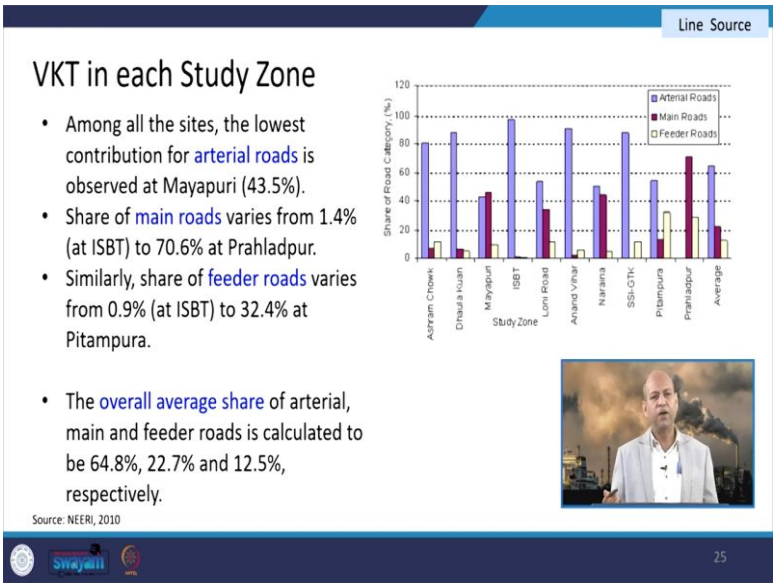


Now, if you see this Vehicle Kilometre Travelled VKT needs steady zone. So, for each category of vehicle this VKT, it has been taken into account from different reports and those counting of vehicles plus, these VKT's and then emission factors have been used for emission estimations.

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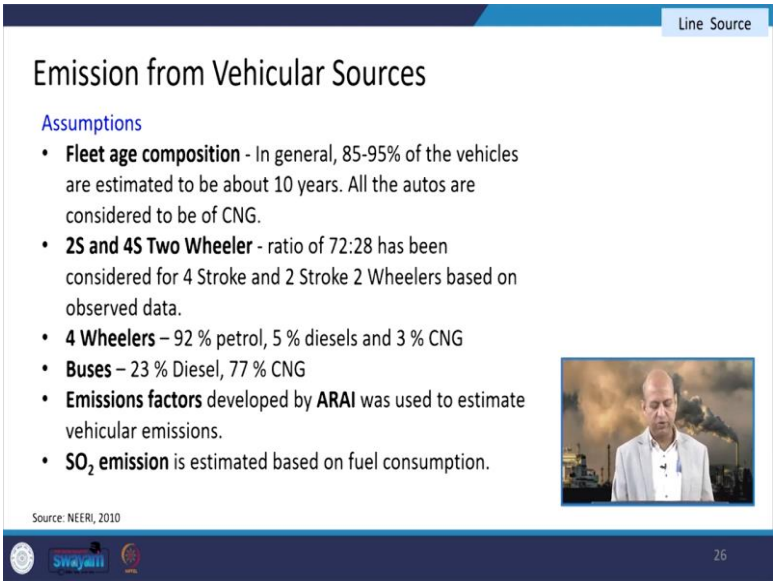


So, you can see the fleet age composition have been considered 2 stroke, 4 stroke, 2 wheeler ratio have been considered, then emission factors from ARAI has been used and the emissions have been estimated.

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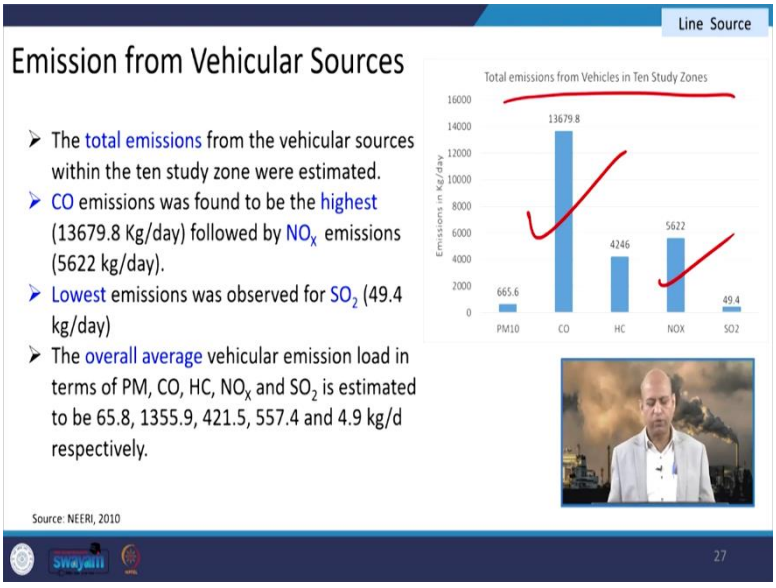


So, you can see the how many how many categories are there of the vehicles plus which pollutants like $PM_{10}$, CO, hydrocarbon, $NO_x$. So, total emissions of the vehicles in 10 is study zones if you see the maximum emissions are of the carbon monoxide (CO) and then second is the NOx and then hydrocarbons, naturally from vehicular categories, these kinds of emissions are more basically.

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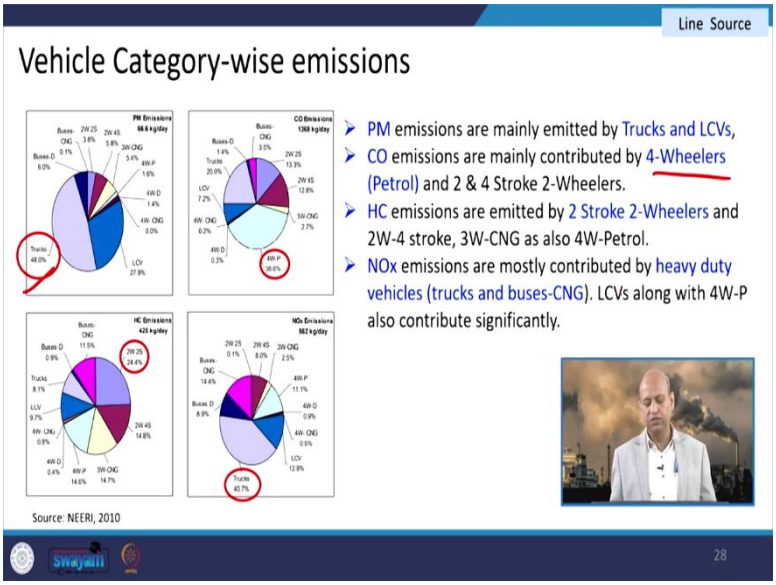


When we see vehicular category wise emissions, then like particulate matters are mainly emitted from the trucks as you can see around 48 percent. 38 percent or so the CO emissions are coming basically from 4 wheelers. So, if we want to, curb or we want to reduce the emissions of CO then we need to focus on 4 wheelers first if we talk about hydrocarbons, then they are mostly from 2 wheelers.

So, if you want to control hydrocarbons then better to control the 2 wheeler related technology, and NOx emissions are basically coming from like heavy duty vehicles, trucks etc. So, those are the major sources of different kinds of pollutants.

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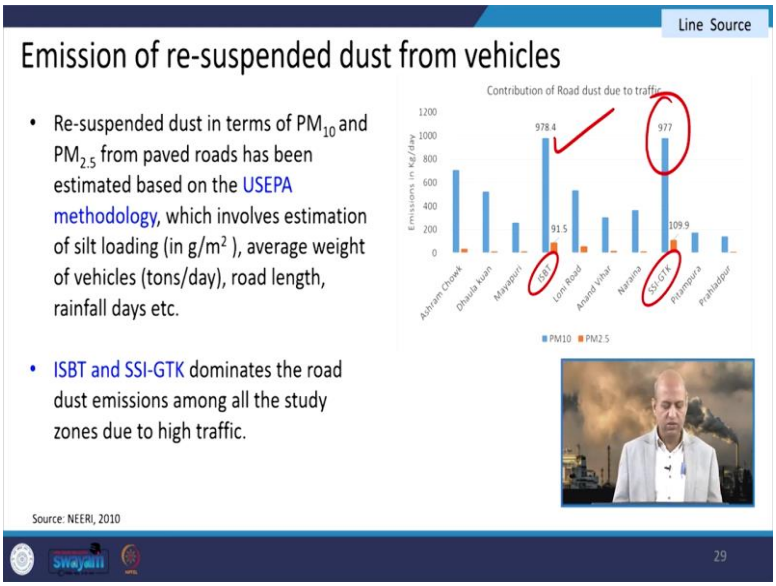

Well, then when we talk about, this re-suspended dust so, it has been estimated that near ISBT because a lot of vehicles are there on there, this bus depot, main bus depot is there and then, bus terminal and then this is small scale industry this Grand Trunk Road also has a lot of contribution of the road dust because of resuspension. So, these are basically two locations where a lot of dust suspension has been there.

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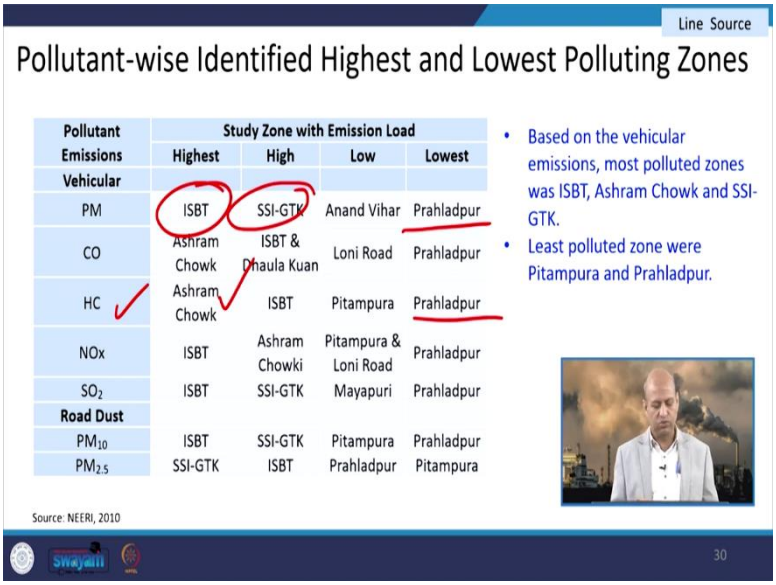


Well, the pollutant wise identified highest and lowest polluting zones if we want to consider. So, the particulate matter highest is from ISBT area. And this then high is from the small scale industry, Grand Trunk Karnal Road and lowest is in Prahladpur. Similarly, for different, like hydrocarbon, this highest in Ashram Chowk lowest in Prahladpur. So, Prahladpur you can see mostly that is the lowest emitting sector or location or the zone for different kinds of pollutants.

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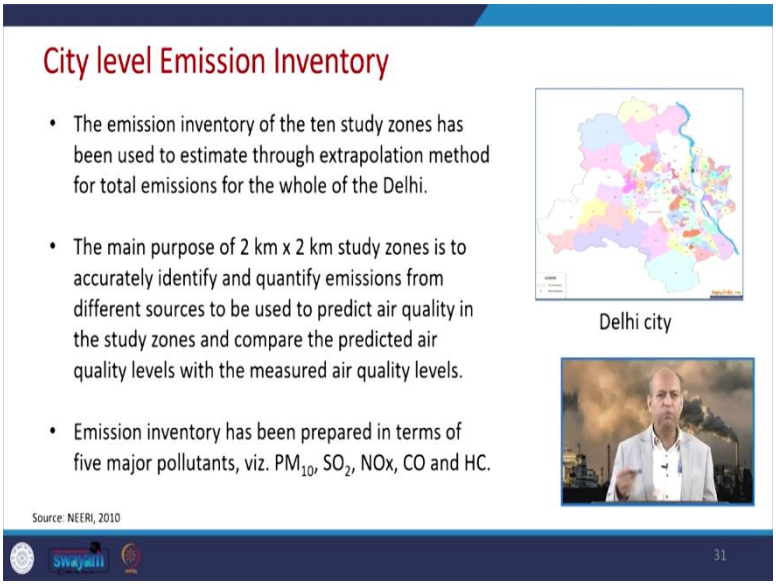


Well, when we talk about city level, because these were the zone whatever 10 zones were selected by these, researchers, those were the emission inventory developed. So, city level emission inventory was developed based on those emission inventories of 10 zones basically, so extrapolation or projection you can say have been done based on the emission estimations which have been done in those particular zones.

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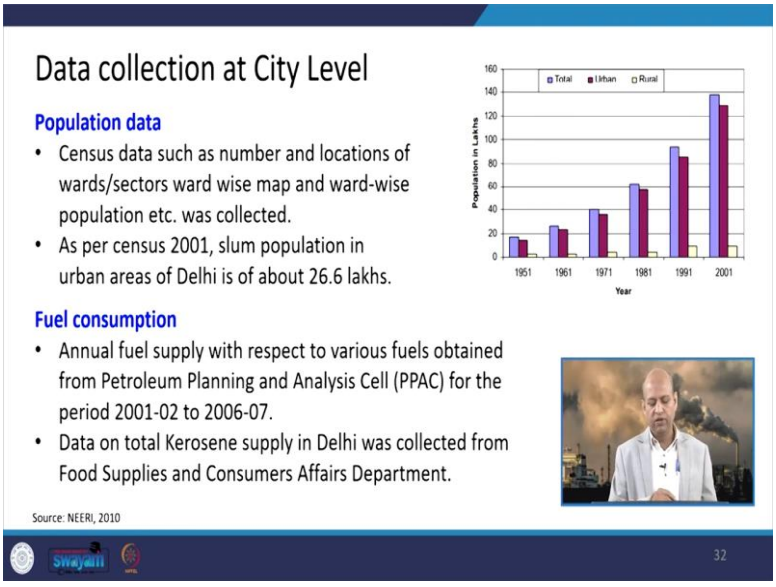


So, there have been, estimations or projections based on certain things like population data, how much fuel consumption is there. So, census data has been taken and then fuel consumption has been taken from different reports, you can see this population in lakhs and the slum

population as well as urban population ruler population, those kinds of population data have been taken.

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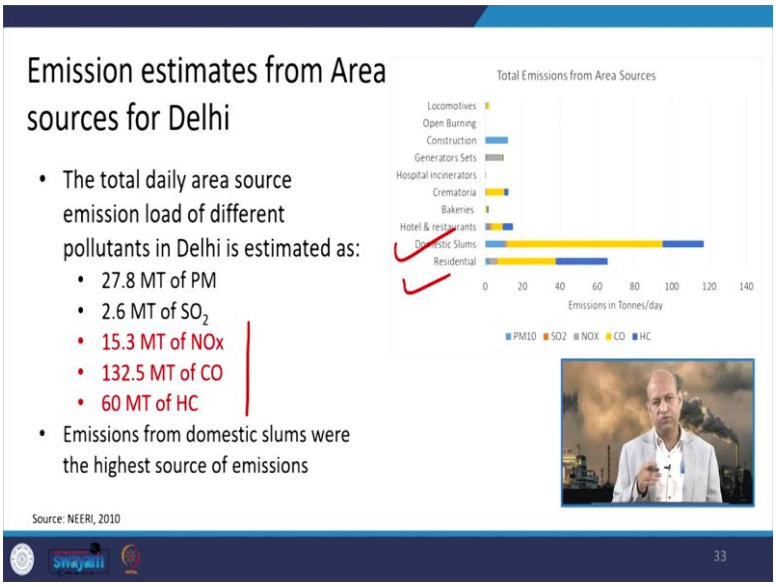


So, the emission estimates from area sources were taken from projections of those estimated values. So, it was seen that domestic slumps were responsible for the maximum emissions of carbon monoxide and hydrocarbons and residential area was also the responsible. So, these two major areas where they are for emissions, large amount of emissions, and basically if you see these NOx emissions and CO emissions and the hydrocarbon emissions, they are the dominating ones even in area sources.

So, that is the situation to worry some because, these are the precursors of ozone. So, in case, ozone production starts to take place in summer or wherever solar insulation is good, then this is another big problem which, we can foresee and we have to think seriously about reducing these emissions.

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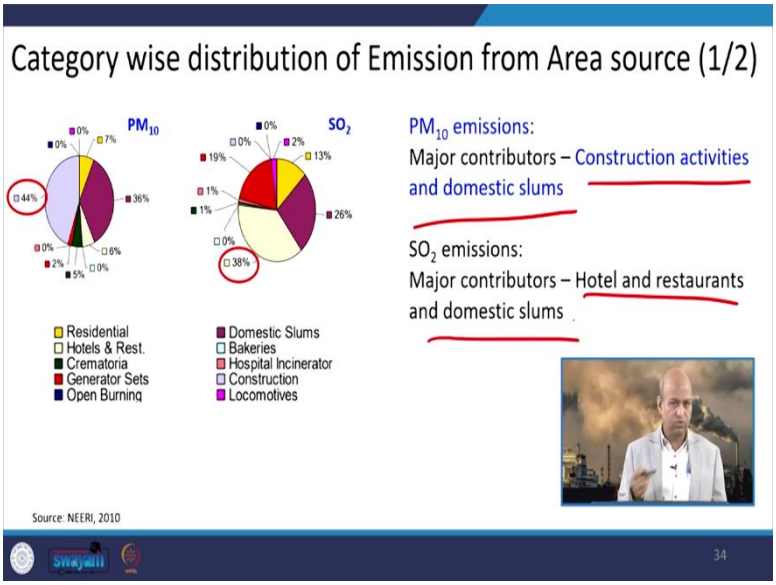


Well, when we talk about category wise distribution of emissions from area sources, so you can see like 44 percent is coming, this $PM_{10}$. So, Major 44 percent is coming from these construction activities and domestic slumps. $SO_2$ emissions in large quantities coming from hotels restaurants, because they use those kinds of fuels, coals etc. So, again, domestic slumps are also there in this particular contribution for $SO_2$.

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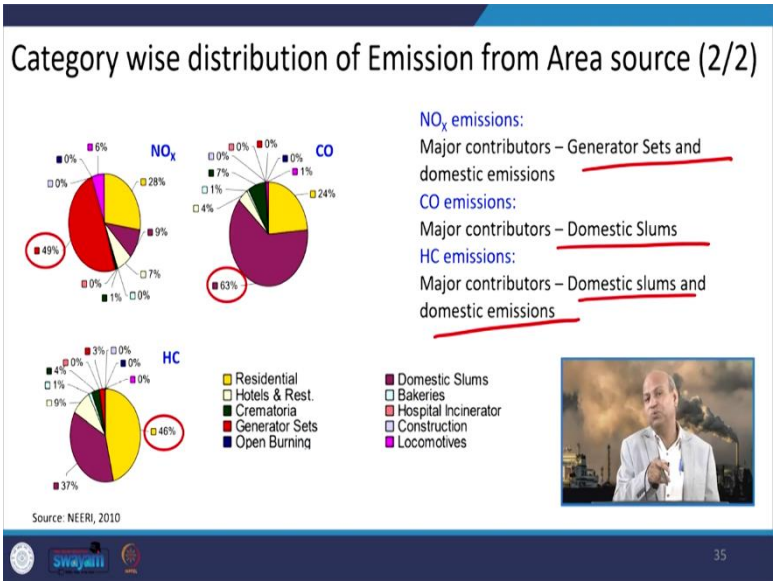


So, we hope to see, pollutant wise like NOx emissions, mostly coming from generator sets or domestic emissions CO emissions from domestic slumps, hydrocarbons, again from domestic slumps and domestic emissions. So, you can see, these areas sources are also respond because we have seen that these CO hydrocarbon etc knocks they come large in quantity in from vehicle

category which we will see again. But area sources are also giving this large quantity and that is the worrisome issue.

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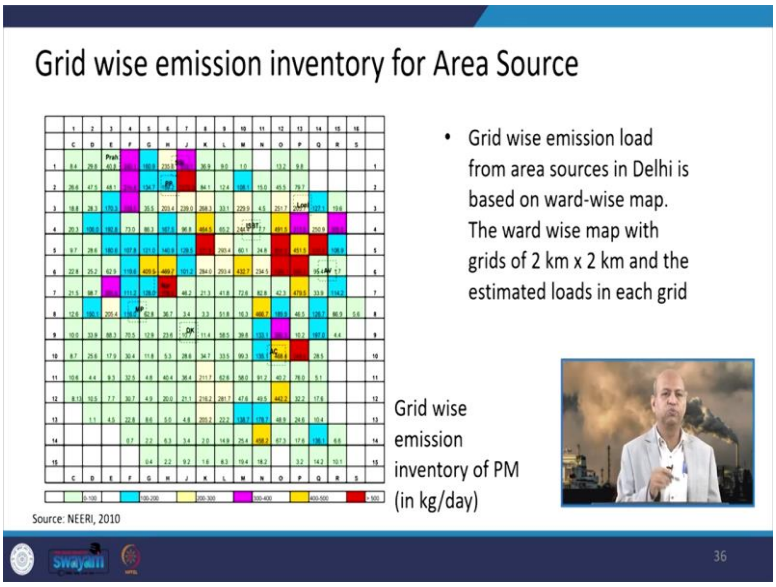


Then this grid voyage emission inventory has been developed, so that we can know which particular areas are there where lot of emissions are coming from. So, you can see this red colour area, they are the most responsible for a large amount of the emission.

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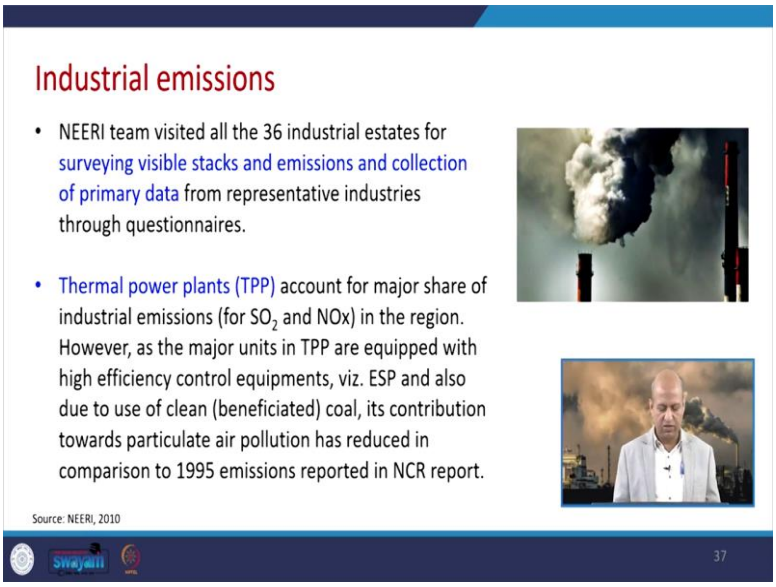


So, that we can first go and see how, what we can do to reduce in particular those kinds of hotspots, where lot of emissions are coming from. When we talk about like this industrial emission. So, as I said earlier that these NEERI team visited all, industrial areas and counted how many stacks are there for different kinds of emissions. So, they have taken also into

account like what kind of technologies they are using, like if ESPs are being used then particulate matter emissions are very low because that is effective for reducing the emissions, but then the $SO_2$, NOx emissions are also coming.

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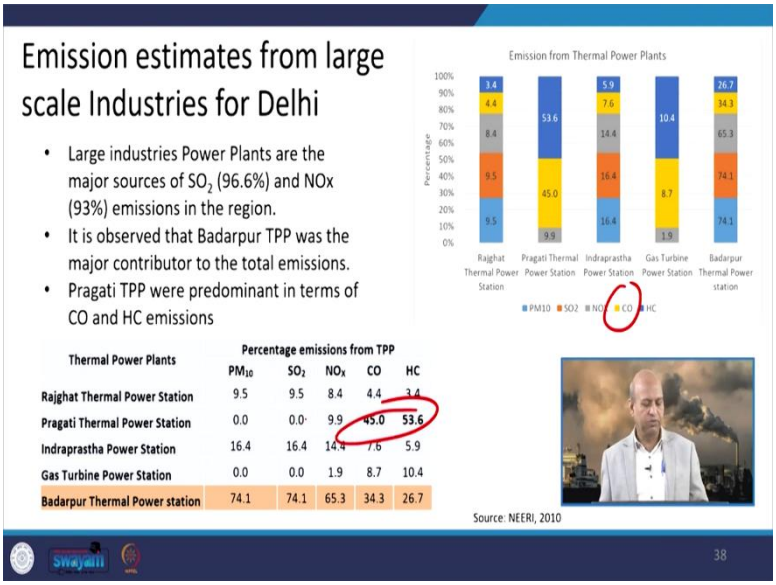


| Thermal Power Plants | Percentage emissions from TPP | | | | |
|---|---|---|---|---|---|
| | $PM_{10}$ | $SO_2$ | $NO_x$ | CO | HC |
| Rajghat Thermal Power Station | 9.5 | 9.5 | 8.4 | 4.4 | 3.4 |
| Pragati Thermal Power Station | 0.0 | 0.0 | 9.9 | 45.0 | 53.6 |
| Indraprastha Power Station | 16.4 | 16.4 | 14.4 | 7.6 | 5.9 |
| Gas Turbine Power Station | 0.0 | 0.0 | 1.9 | 8.7 | 10.4 |
| Badarpur Thermal Power station | 74.1 | 74.1 | 65.3 | 34.3 | 26.7 |

So, you can see emissions from thermal power plants and lot of emissions are there off again CO and then like from Pragati thermal, the CO emission and this hydrocarbon emissions are quite high, well when we talk about again this gas turbine power station, so same story is there, but, if you talk about NOx emissions, then this Indraprastha and Rajghat and Badarpur they are quite significant amount of NOx emissions are also there.

So, we can see percentage emissions from these thermal power plants and Badarpur thermal power plant is responsible for quite high amount of $PM_{10}$ and $SO_2$ but this Pragati thermal is responsible for highest amount of CO and hydrocarbon. So, that way we can see which power plant is emitting which kind of pollutant in a large quantity.

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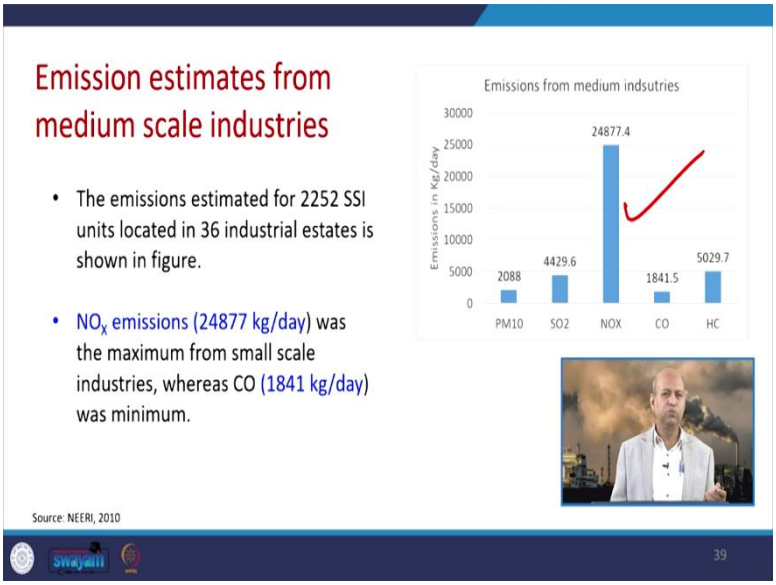


Well, when we see these emission estimates from small scale and medium scale industries, so, basically when we talk about medium scale industries, again the dominating emissions are of $NO_x$ emissions. So, as I said that, this in Delhi basically these $NO_x$, CO hydrocarbons etc, they are the things to be concentrated upon based upon this particular study. It is all the study and maybe appropriate policy measures were implemented based on this particular study.

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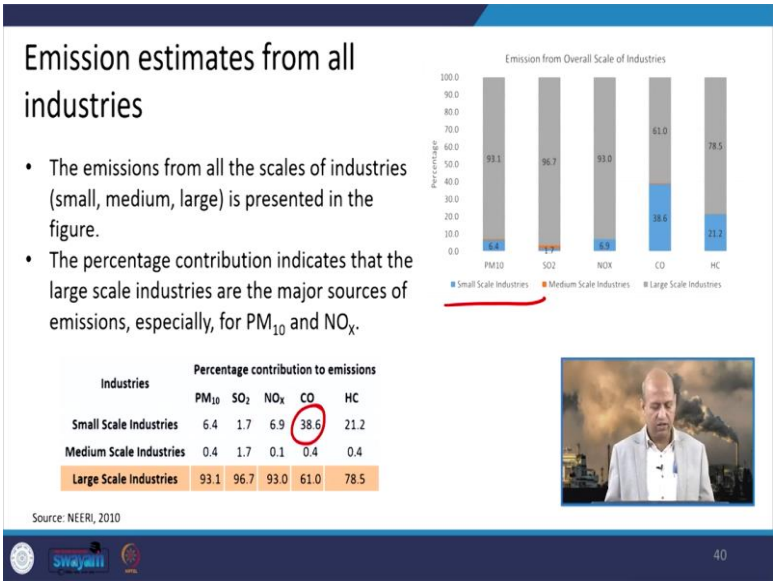


Here also, like large scale industries are responsible for like $PM_{10}$, $NO_x$ etc, and CO are from small industry, a small scale industries. So, a small scale industries are responsible for CO as well as, largest scale industry. So, fear share is there you can say, otherwise for $PM_{10}$, $SO_2$ and $NO_x$ dominating source are the large-scale industries.

So, again, you can see what is the contribution or percentage contribution of different industries for different pollutants. So, large scale industries are responsible for, very high amount of all kinds of emissions of course, but like if you talk about CO, then small scale industries are also very much responsible.

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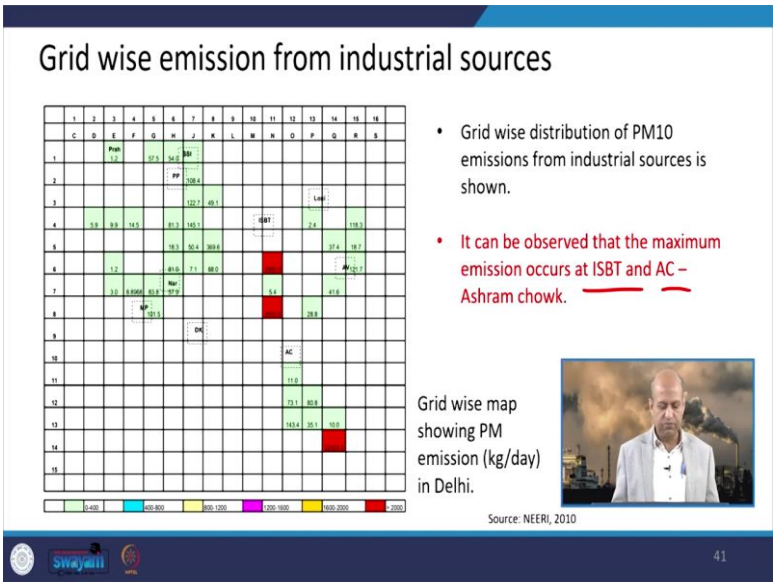


Well again, so grid wise admission inventory was development distribution of these emissions were grid wise so that we can know the hotspots. So, you can see here, this is ISBT and this Ashram Chowk have been identified as a large amount of these emissions.

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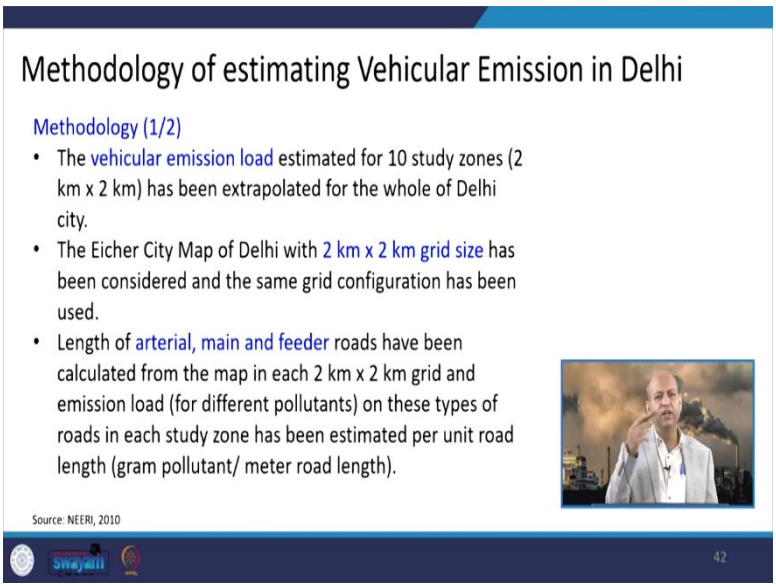


Well, so methodology for estimating vehicular emissions. Now, we come to so methodology as I said, this is based on VKT Vehicle Kilometre Travelled and the emission factors. So, in

those 2 kilometre x 2 kilometre, they were estimated and those were projected for Delhi basically.

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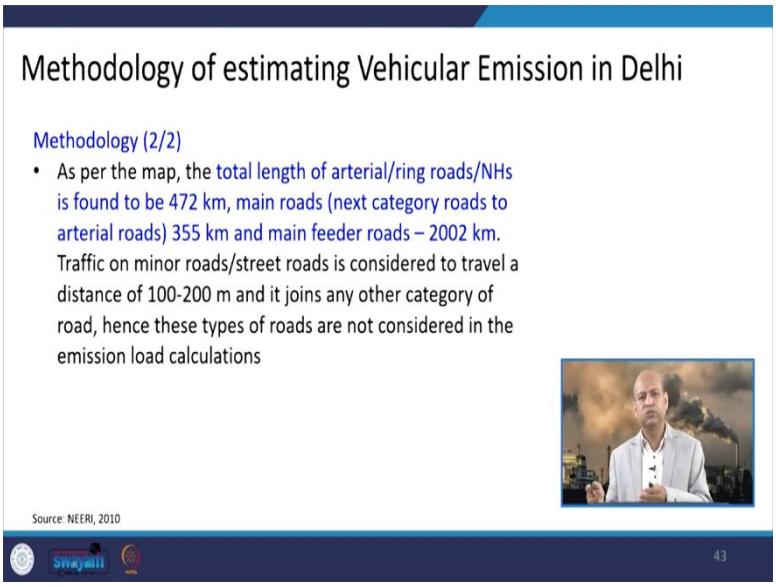


So, the total length of roads have been identified for different kinds of roads like ring roads, and then, feeder roads or those kinds of these arterial roads, all these kinds of roads. So, how many vehicles are plying on those particular roads. So, those data have been used for extrapolation of those estimations which were taken from the specific zones.

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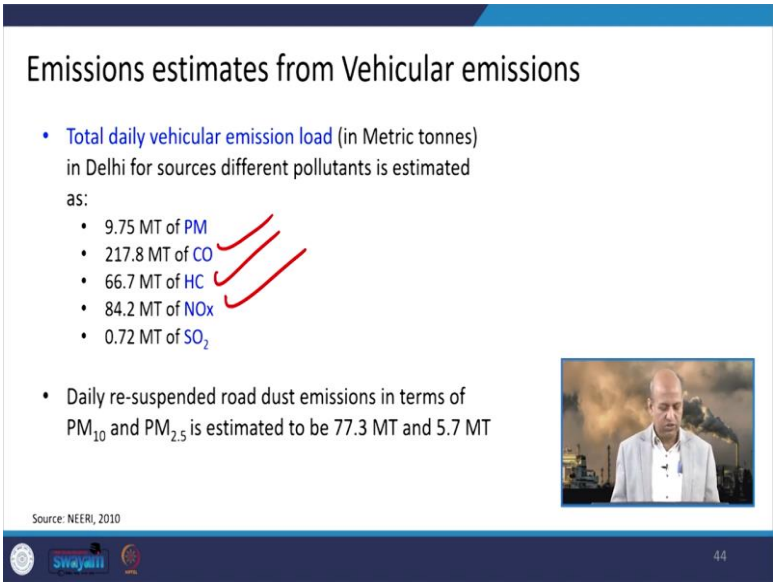


And we can see like a lot of emissions again of this $NO_x$ emission and the hydrocarbons and CO. So, they are also it is very intuitive that vehicular emissions mostly emit those kind of emission, NOx emissions and CO emissions.

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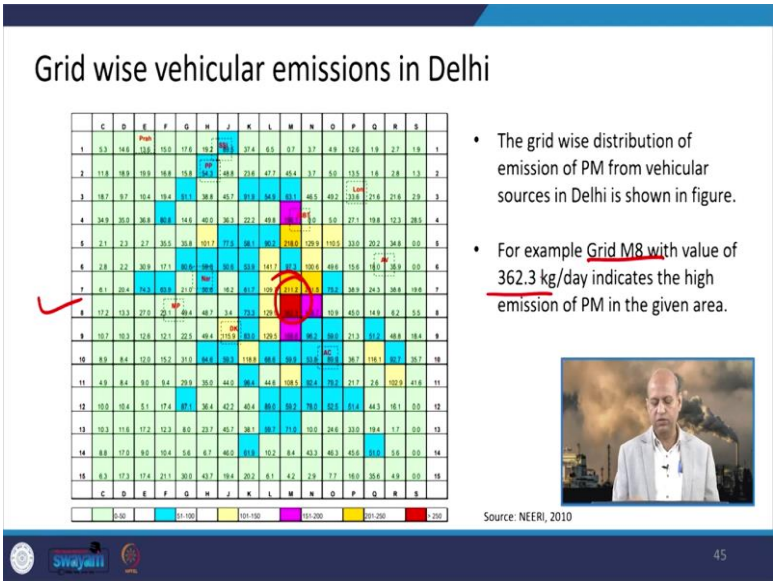


And you can see again distribution. So, to identify the hotspots, you can see like these kind of grids are there, which are responsible for like grid M8, this 8 and this M so, this M8 grid is very much responsible for high value of particulate matter, if you see around 362 kg per day.

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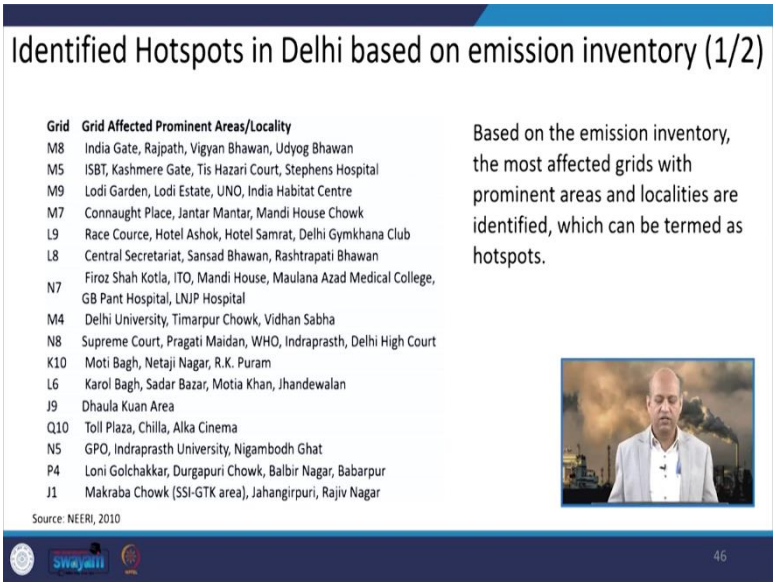


So, that particular methodology was used for identification of hotspots and those hotspots are like M8, M5, so, these are the names of the grids and these grids include those particular prominent areas like M8 India Gate, Rajpath, Vigyan Bhawan, Udyog Bhawan. So, lot of emissions from vehicle categories, maybe there. Then is ISBT, Kashmere gate and you can see all these kind of names, which are in particular grids are there.

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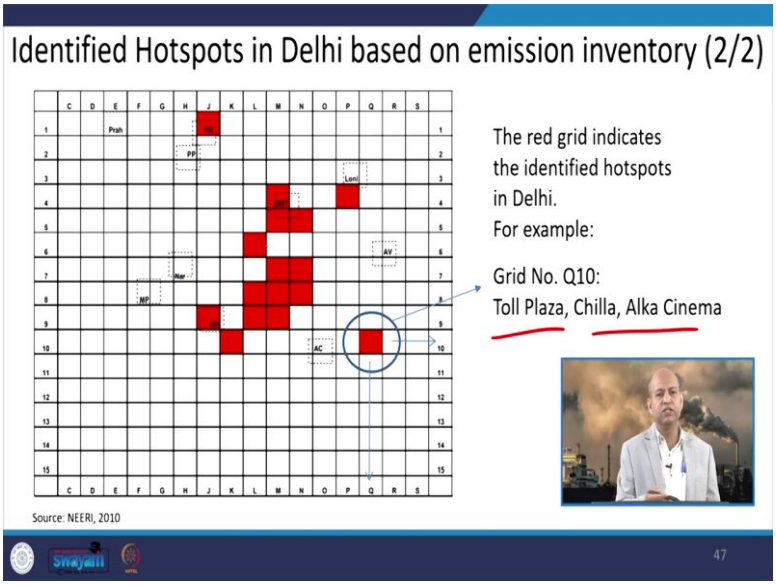


Well, so to identify the hotspots then grid number 10, Toll Plaza, Chilla these Alka Cinema, they have been identify. So, you can see the grid and you can see which places are there which need to take the attention of the policymakers.

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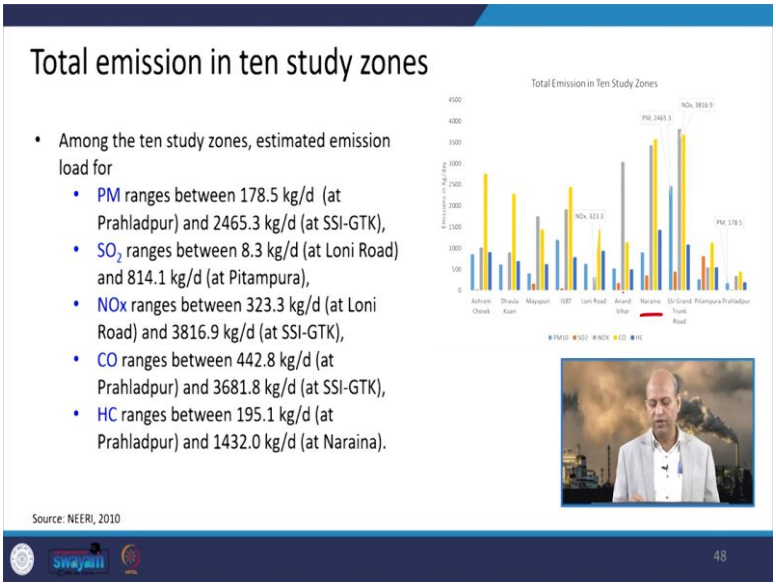


Well, when we talk about the total emissions in 10 study zones, so there are, variations are there like you can see these as I said a small scale industrial Grand Trunk Road and the Naraina and they are dominating for particulate matter and NOx emissions you can say. So, that we different kind of zones have different kinds of information.

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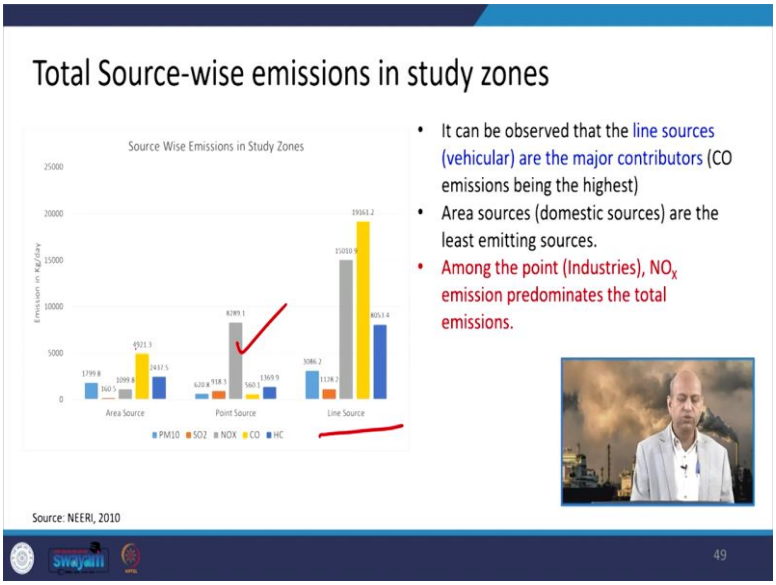


But when we talk about total source emissions, these study zones then line source emissions are dominating basically for these NOx as well as carbon monoxide that is a vehicular category basically, point source is dominating NOx for NOx in point source. And in area source, CO is more so, that way you can see which pollutant is coming more from which particular source category.

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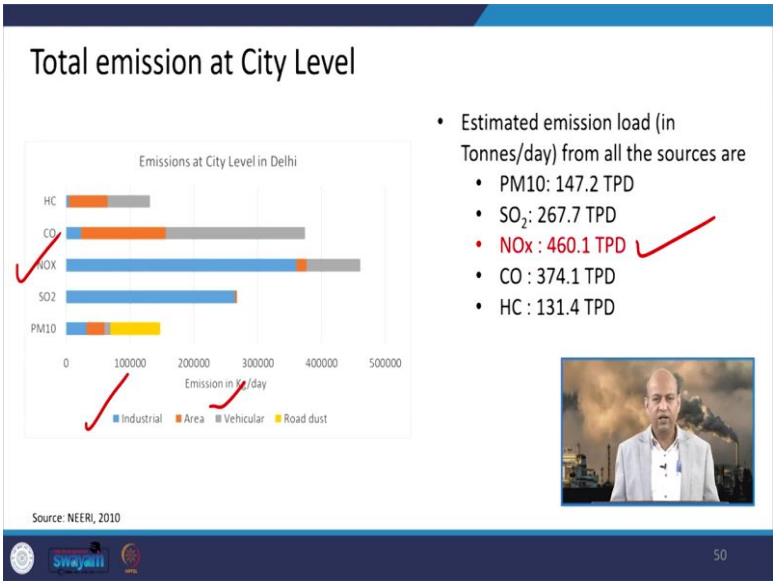


Well, when we talk about at the city level, so the NOx emissions are the highest basically and they are coming from industrial as well as vehicular emissions, this NOx. Second is CO which is coming, majorly from vehicular and then the second is from area sources. So, and $SO_2$ is

basically coming from industrial sources. So, these kind of information is there and as you can see this a lot of emissions of $NO_x$ is there.

And I always, repeated that, because of NOx and CO hydrocarbons etc peak occurs of ozone. So, we should be quite sensitive or sensitive about these kinds of pollutants, how to reduce them because they may create another problem in future if we do not give you attention.

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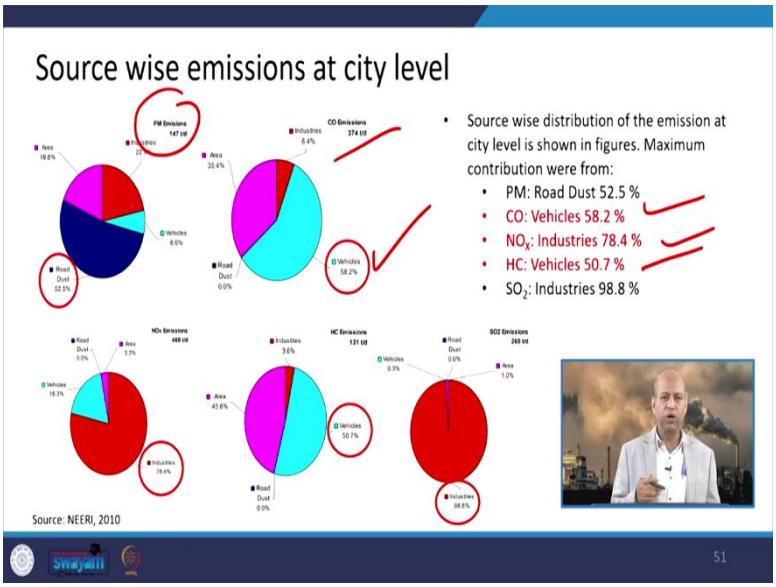


Well, source why emissions at the city level also you can see like these CO emissions NOx emissions, hydrocarbon emissions, they are dominating PM emissions like 52.5 from the road dust basically. So, that is the major source, but for CO emission the vehicle categories are the most, second is area source for these hydrocarbons again vehicle and area source are responsible and for NOx emissions again industries and vehicle categories industries are more responsible.

So, that way you can see like, $SO_2$ only industries are there to control. So, according to their amount we can look into that which kind of shows we need to first focus upon to apply certain policy interventions or technological intervention, so, that those emissions can be reduced and air quality can be improved.

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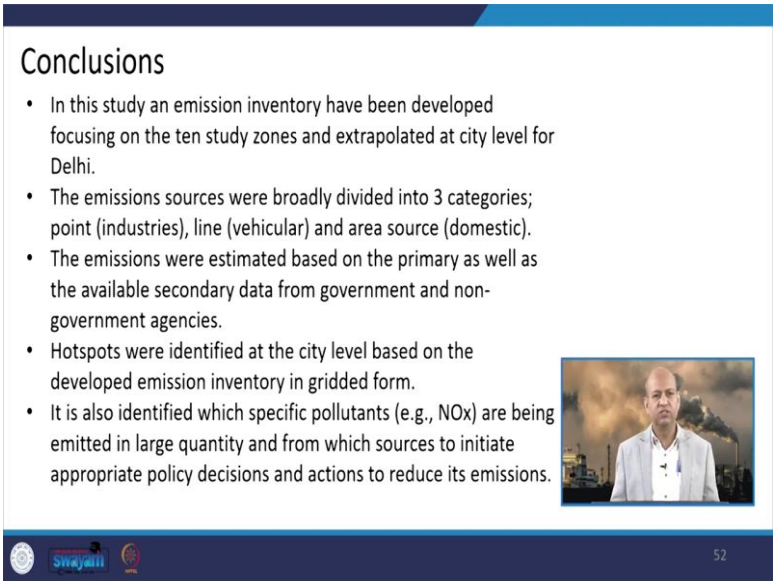


So, this is basically, case study how these emission inventories are developed and how they are, used for inferring information or insights, as we have seen which kind of pollutants are more and how to focus upon some policy decisions or technological interventions specifically for those pollutants, otherwise, they will create some other problems, whether health related or ecological related.

So, we can say that in this study, we have seen the emission inventory, which was developed focused on certain zones and then extrapolation has been done for city level and then hotspots were also identified. And it is also identified that specific pollutants like NOx are being emitted in large quantity from different sources and we can categorise or target those sources to reduce the emissions of NOx or CO and hydrocarbons.

So, that we do not fall into that kind of problem of for ozone products and because ozone is a very hazardous, pollutant in the troposphere, although it is good in the stratosphere as you know. So, those kinds of inferences or insights can be developed by these kinds of inventories. So, I hope you like this particular case study.

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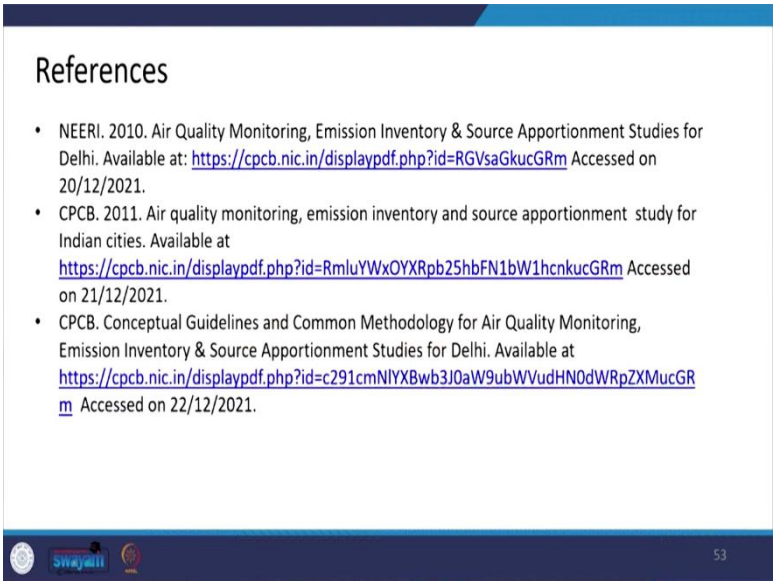


And these are the references where we have taken information for this particular case study, and you can go through this information in your free time. So, this is all for today. Thank you very much for your kind attention. See you in the next lecture. Thanks again.