Energy Resources, Economics and Environment
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Lecture 23
Energy Policy – Part 2

Let me just give you an example, we talked about one of the things that we talked of in policies is that first you should look at what are the kind of decisions which we are looking. So, if we look at the international level, there are international agreements, for instance for the Montreal Protocol, for the greenhouse gases, for compare chlorofluorocarbons, limiting chlorofluorocarbons and controlling the ozone layer and that was fairly successful.

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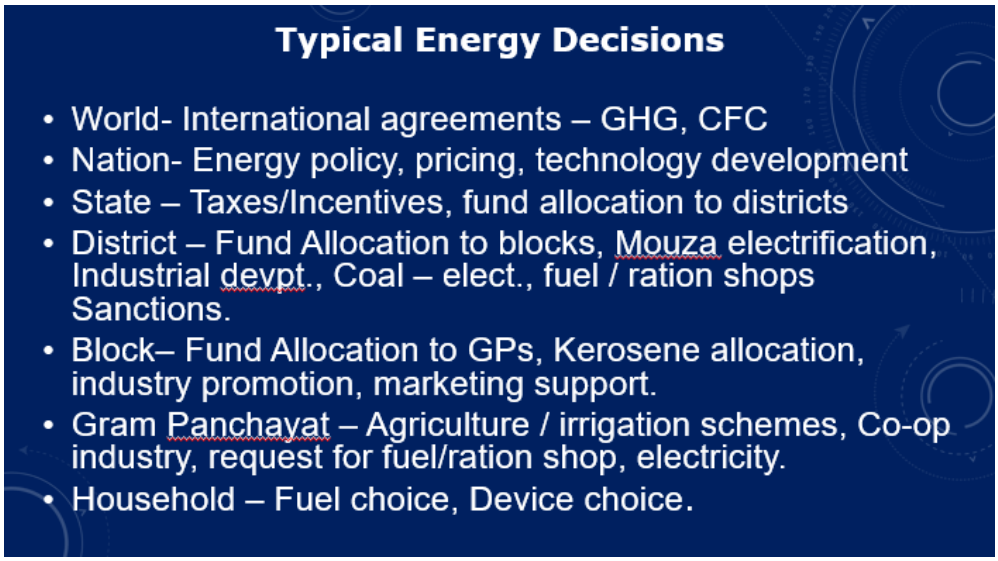

And now we have the Paris agreement for the greenhouse gases and the idea is to limit it to less than the temperature to less than 2^{o} C, and preferably even go towards 1.5. Now, there are still several issues related to how these are going to be implemented, monitored, what kind of penalties and other things, but we have moved in this way when these are voluntary agreements.

At the country level, there are several policies for instance should we be providing a kerosene subsidy, should we providing an LPG subsidy for excess, for electricity, for low income houses, should we be giving electricity at subsidize or free, for agriculture, should we be providing subsidy for agriculture, should we be providing a carbon tax.

So as of now there is cess on coal, and recently there was a government notification that there was a news item in early January saying that there would be the tax on coal is going to be taken

away. And it is not yet clear whether that is going to happen but the particular policy. The pricing, and allowing market to maintain the price or letting administering the price is another kind of policy measure.

In the Indian context, we have a significant amount of tax on petrol and diesel, which are the transport fuels. And so that is a big source of revenue for the government. Technology development, what kind of policies do we have to support and encourage technology development, at the state level again there are taxes and incentives.

Some of these now has been sort of streamlined and we have this scheme of the GST and the electricity is still outside the GST. Again, in the state the kind of fund allocation to different units and districts. In the districts they fund allocation to the blocks, the electrification of villages, some kind of industrial development, the ration shops and the sanctions of the quantities.

In the blocks the allocations to the villages, kerosene allocation, industry promotion, marketing support, gram panchayats, agriculture irrigation scheme, cooperative industry, requests for ration shops, fuel shops, electricity supply and household of course, the decisions of fuel choice and device choice. So, these gives you sort of hierarchy of the different kinds of decisions and the decision making process and one can look at how policies impact and at what aspect they impact.

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There are again some more examples of energy policies, in buildings there are these building codes. And now we have these ECBC and the TERI-GRIHA where we have codes which will

result in energy efficient buildings, we have standards and labelling and the Bureau of energy efficiency has actually now provided the star rating system by which you can see what is the performance of different refrigerators or air conditioners or fans.

And sometimes we have preferential tariffs and we did this for solar PV, wind, many of the renewables that means that when we look at a regulatory state which has a regulatory commission, if we are getting supply from renewables, we assure a price which is higher than the average price at which it was happening. And so, we had tariffs of 11 ₹, 12 ₹ / kWh initially for PV.

Now, of course those tariffs have come down and they are almost cost competitive, but in the initial years in order to spur and get people to adopt the technology we can have what is known as a preferential tariff, or also known as a feed in-tariff. And this gives a signal to investors and developers because then they are guaranteed that kind of tariff. The problem is of course, when these tariffs come down.

These tariffs which have been agreed for a 25 year period, subsequently, the distribution companies are not happy with paying that kind of high tariff throughout, but the idea is to provide an incentive so that the early innovators can get a benefit and then the, that the supply and the market for that actually grows. Subsidies we have already talked off, soft loans as we discussed in the financing case, often, we can provide loans which are at very low interest rates based on certain credit lines, because this is these are some of the technologies that we would like to see going into the market.

The carbon tax, just like we talked about a tax in the overall scheme, if we tax based on the amount of CO_2, and then that is incorporated as a cost, and that will result in reducing the emissions and so even in this, it is the question of whether it should be a cap and trade or a tax. In the case of cap and trade we basically say that totally, this is the amount of emissions and then we put we put a cap on the emissions from each sector.

Then we have certificates which are provided and people can either pay by the certificates or pay the penalty if they are beyond the allocated capacity We need to have of course, a mechanism by which we allocate CO_2 factors and in the case of, so we have, we can look at this as renewable energy certificates, and we talk of certified emission reduction 1 CER is 1 ton of CO_2 reduction per year.

And then we can have these certificates, we can have trading in the certificates, we can create a market. So, this this is sort of gives us an overview of some of the different kinds of mechanisms.

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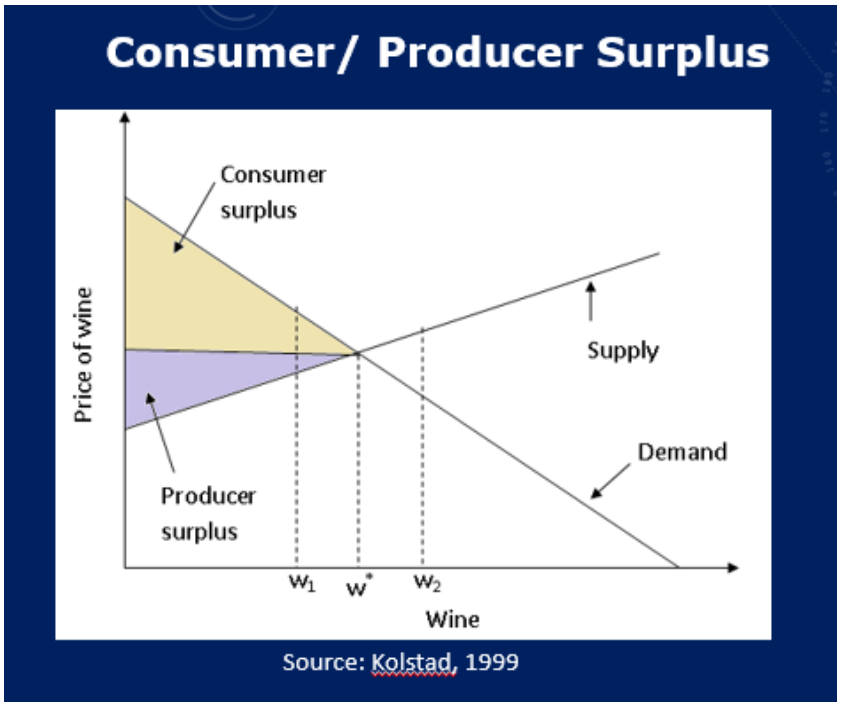

We have already discussed this earlier, this is the example from Kolstad.

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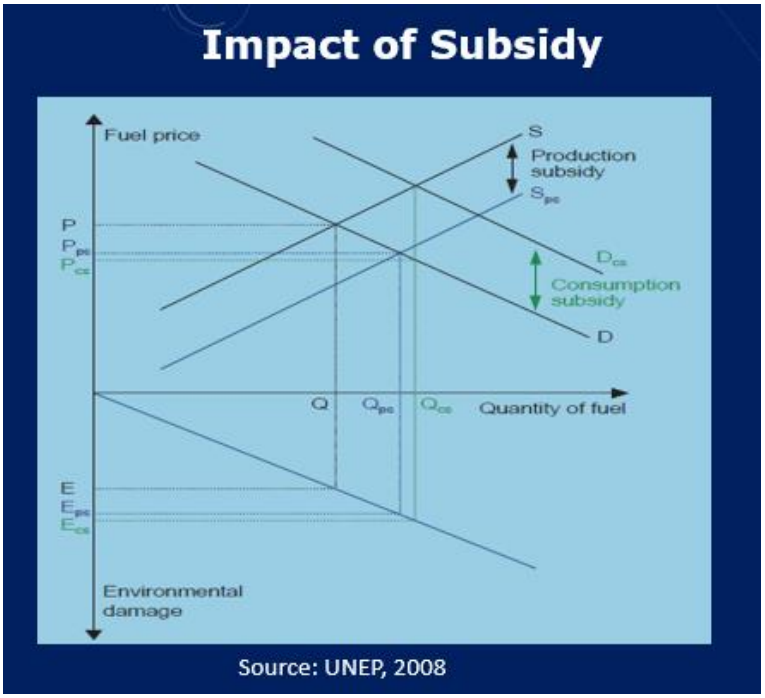

And this is from a UNEP report which shows you that the same thing which we just now saw. If we have the supply and demand intersecting, here this is the original point, if we provide a production subsidy so that the supply curve now shifts here. And then this is the QPS and the PPS and as a result of this, what will happen is in this is the environment damage increases, because the quantity of fuel, especially if it is a fuel, which is a fossil fuels, the quantity of fuel used increases.

And similarly, if we had a consumption subsidy, we move from here to this point, and even in this point, we find that the environmental damage, so we can do these kinds of analysis in terms of the impacts of subsidy. So, now let us look at a couple of examples. Let us look at one of the things that we find is that many of the cities in India are having a problem in terms of air quality.

And these increases and gets enhanced during the winter and post Diwali we have had situations where there are serious health impacts including in the capital city of Delhi, last year in 2019, we had several days where there was a health emergency declared, schools were shut, people were wearing masks and the pollution control, pollution levels were such that the upsurge in respiratory diseases.

So, let us look at one of the responses which the Delhi government has had over the years is the scheme called the odd-even scheme. So, if we want to analyse this policy, the odd-even scheme basically says that it restricts the vehicles to be operated on the road, on odd days only vehicles with an odd number plate will be allowed and in even days, the even number plate, the logic being that this will encourage carpooling, it will reduce congestion and it will reduce emissions.

So, let us look at try to analyse what is the impact of this policy. There have been a number of different studies and you can look at the details of the studies. I will just show you some of the methods of this analysis to illustrate how we can look at the policy analysis.

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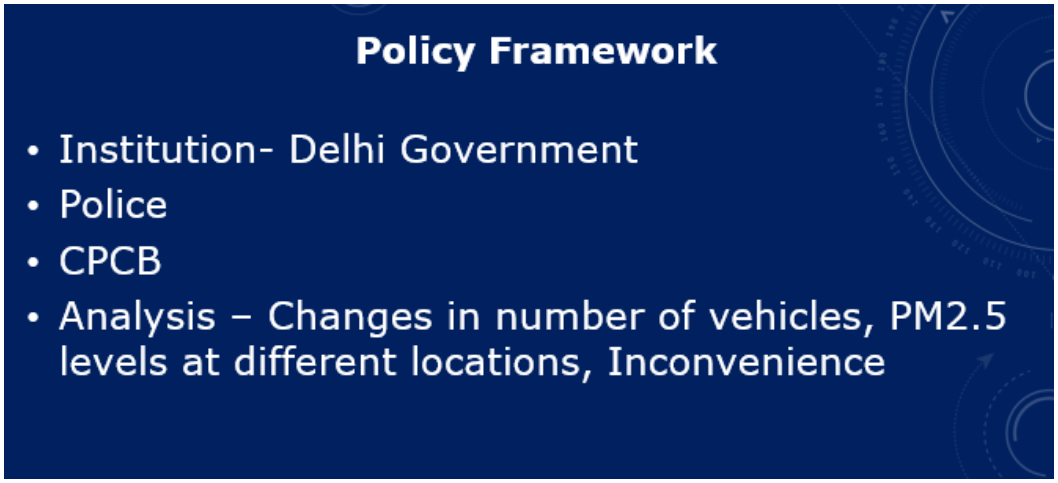

So, in terms of institutions policy framework, the institutions are the Delhi government, the police, the central pollution control board, we can analyse the changes in the number of vehicles, we can look at the particulate matter less than 2.5 micron at different locations, we can look at what happens in terms of inconvenience to people.

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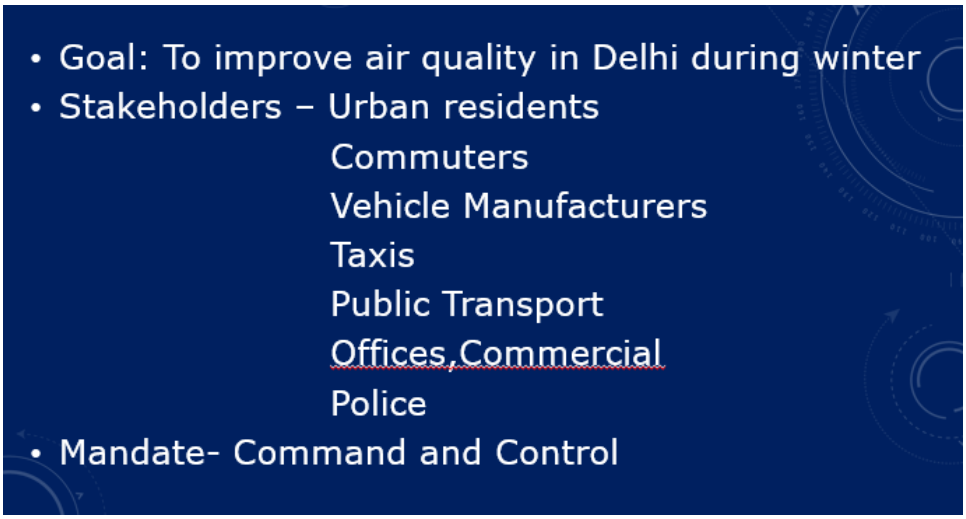

The goal is to improve air quality in Delhi during the winter. Multiple stakeholders, the first stakeholder are the urban residents, and especially those who are living near the roads, the commuters because we are also seeing whether or not if we, if the commute becomes more troublesome, vehicle manufacturers if we specify different kinds of emission norms.

Taxis and public transport, public transport can have a spurt in the public transport. There can be an impact on offices and commercial and schools, police, the method which was odd and even method is a command and control kind of it is a mandate, which is based on legislation

by the government and so the implementation of this would be done by the police and then we can see the impact in terms of the pollution control board. This is what we talked about.

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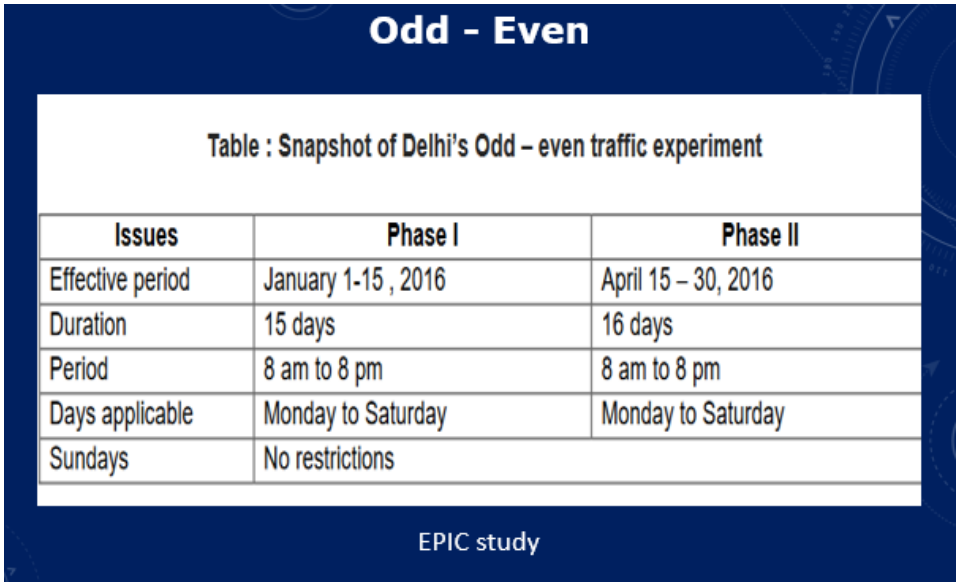

And so, the snapshot, there are different kinds of studies which have been done. One of the studies done by the set of researchers in epic is to look at the 2 phases, phase 1 was from January 1 to 15 2016 and April 15 to 30. And this is 15 days, 16 days and the days which were applicable Monday to Saturday, we can look at these were the days when it was there.

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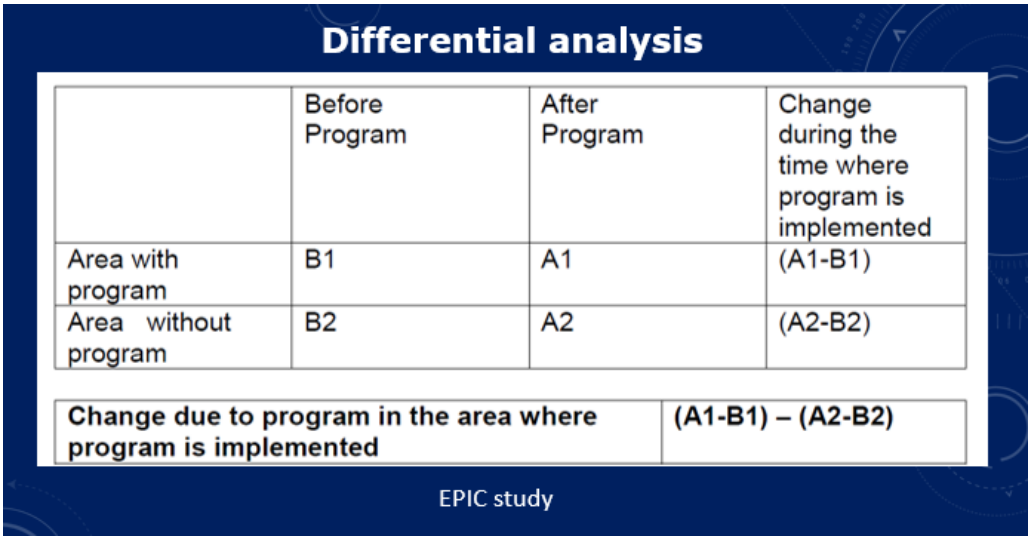

The way it has been done is there are two kinds of comparative analysis. One is that we look at an area like Delhi, where the program is implemented. And we look at a neighbouring area where the program has not been implemented. And we look at in those time periods before and

after the program that means a period when the program was not implemented, and period after the program was implemented.

So, we get A1 minus B1 is change during the time where the program is implemented. And as a baseline, we compare that to the area where the program has not been implemented, and A2 minus B2, and we see whether or not and this we are talking in terms of an emission factor PM 2.5 and see whether or not this difference is more than the difference in the other regions, so it is a fairly simple logical framework.

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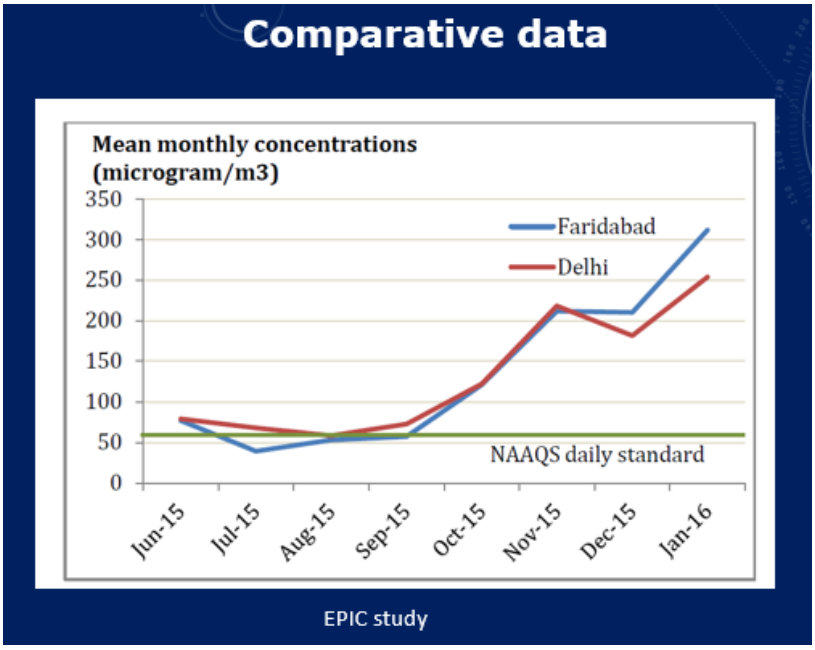

And you can see now the main monthly concentrations and then the neighbouring area is Faridabad. And we can see very clearly that these sort of go together, and here it looks like there is a decrease as compared to Faridabad.

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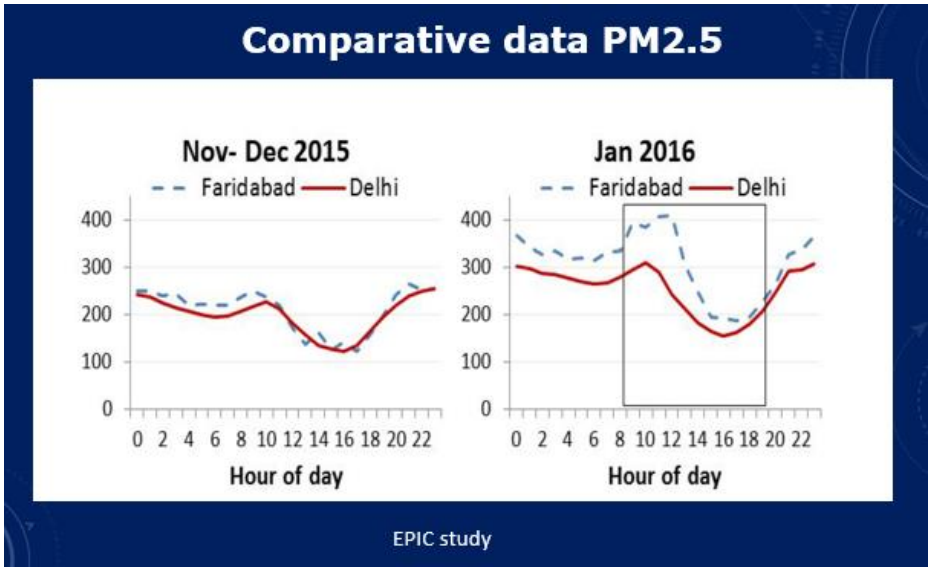

Similarly, if you look at the hour of day for November to December 2015, these two are together, Delhi and Faridabad in 2015, here there was no odd-even scheme. In the case of January 2016, these were the days where there is, this is the hours and you can see that there is a dip as compared to the Faridabad. So, there seems to be some evidence that there is an impact in terms of this.

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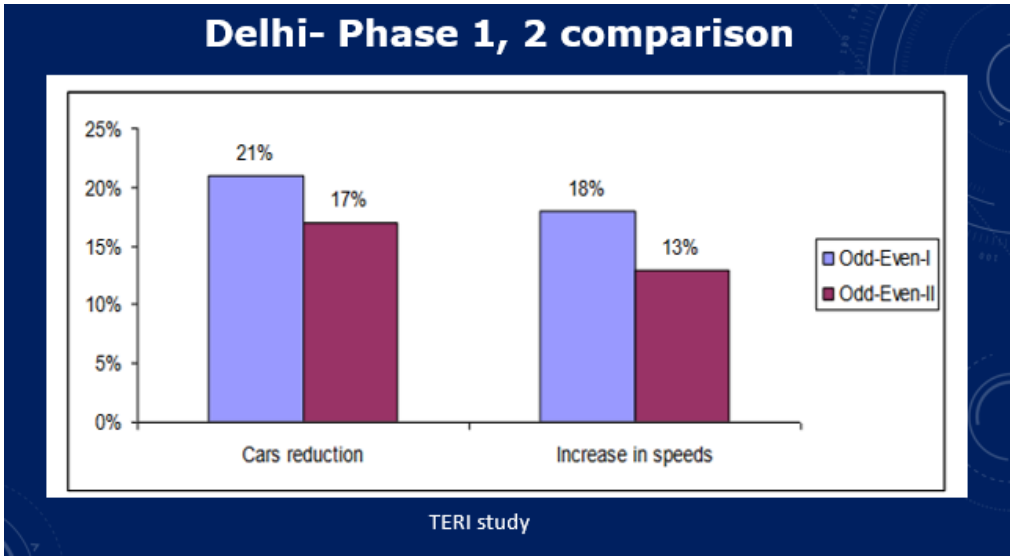

There is a, in both these phases, the reduction in cars, is about 21 % and 17 % in the other case, and this has resulted also in an increase in speeds.

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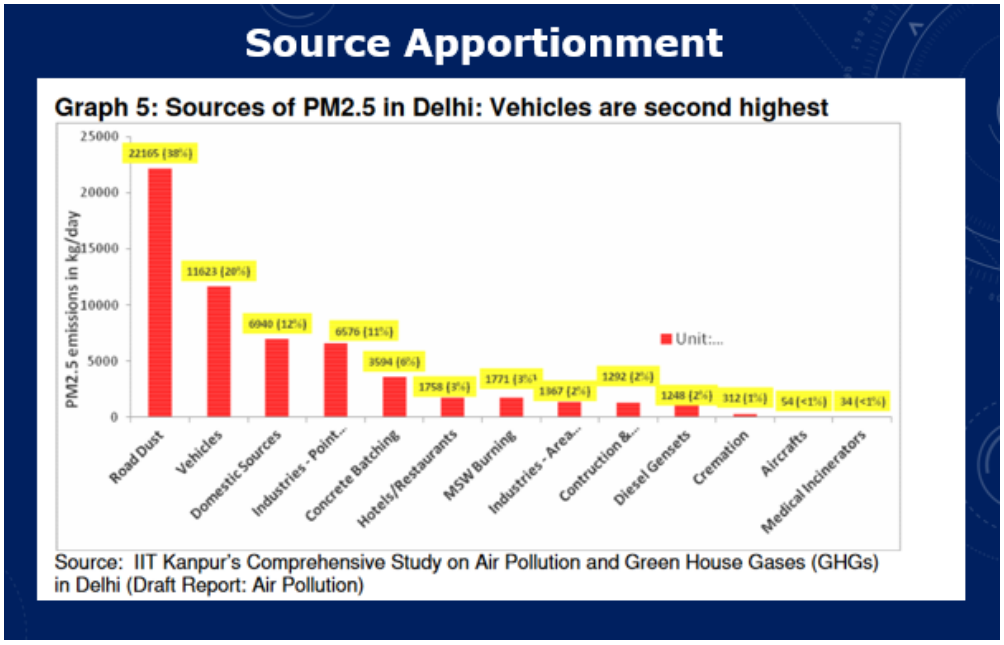

Of course, there is a different kinds of vehicles and sources vehicles account for a certain percentage of it. There is a study by IIT Kanpur and you can look at the details of this.

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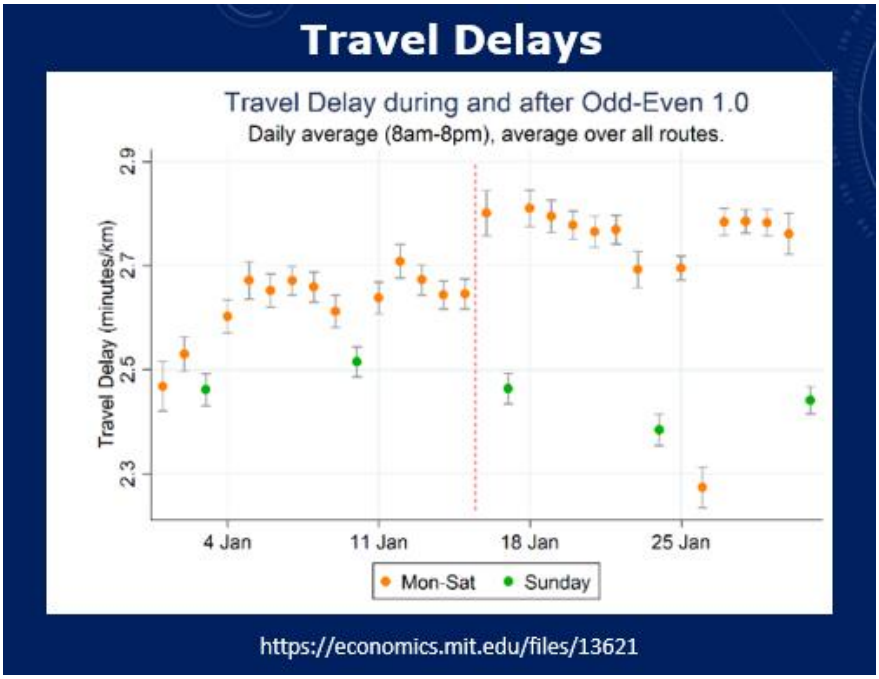

This study is from an analysis of the travel delay, and you can see that this is the 15 days when we had the odd-even scheme, you can see that the travel delays are lower than the 15 days after that and of course, this is this is whether it is, this sort of indicates that there is a reduction in the congestion in that sense.

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Table 2. Driver Survey Descriptive Statistics

	(1) Mean	(2) Observations that satisfy condition	(3) Total Observations
Panel A. Number of Respondents			
Respondents reached during phone surveys		956	
Phone surveys		4178	
Panel B. Demographics			
Age			
18-29 years old	41.5%	397	956
30-49 years old	53.6%	512	956
over 50 years old	4.9%	47	956
College degree	69.4%	663	956
Occupation			
Private employment	39.0%	373	956
Self-employed	41.8%	400	956
Government employee	6.0%	57	956
Student	8.3%	79	956
Other	3.9%	37	956
Panel C. Vehicle ownership			
Primary car has odd license plate	48.8%	467	956
Primary car age (years)	5.2	-	312
Household has another car	33.6%	321	956
Household has motorcycle	52.0%	496	953
Believes Odd-Even policy is good or very good for Delhi	69%	381	554

Table Notes. This table reports sample descriptive statistics from the baseline (recruiting) survey and the follow-up (phone) survey. More detailed information on response rates is available in Appendix Table 3.

There are some economic models which have been used and you can look at more details of this in this paper.

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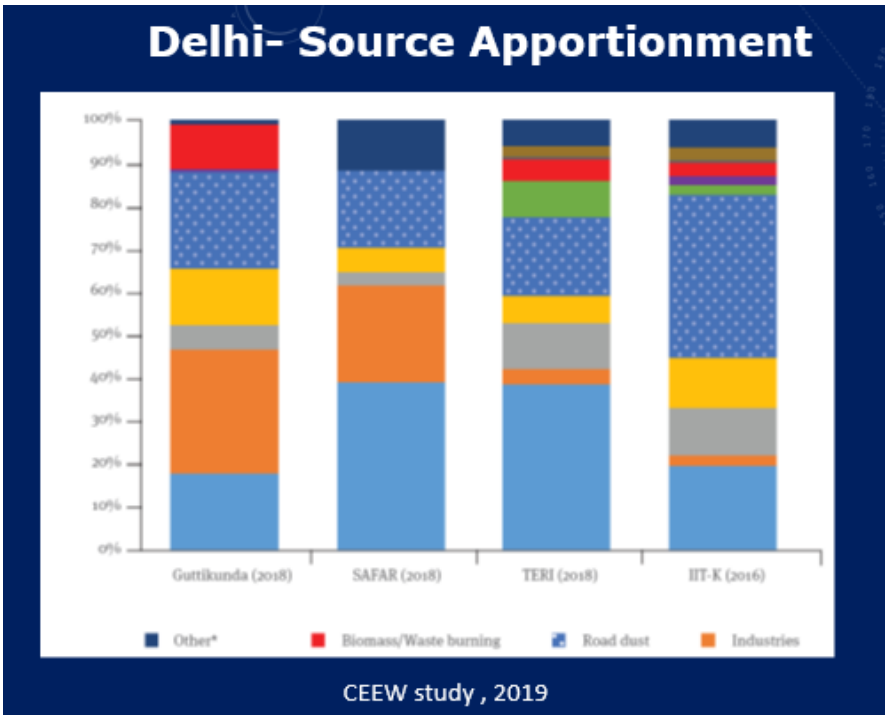

Now, there is a study by CEEW and you can look at this, this a Delhi based think tank and this reviewed the different kinds of source apportionment studies done by different studies, IIT

Kanpur, TERI, Guttikunda and SAFAR. And you can see that the share of road dust industries, there is a variation between the different studies and so there is an uncertainty in terms of source apportionment.

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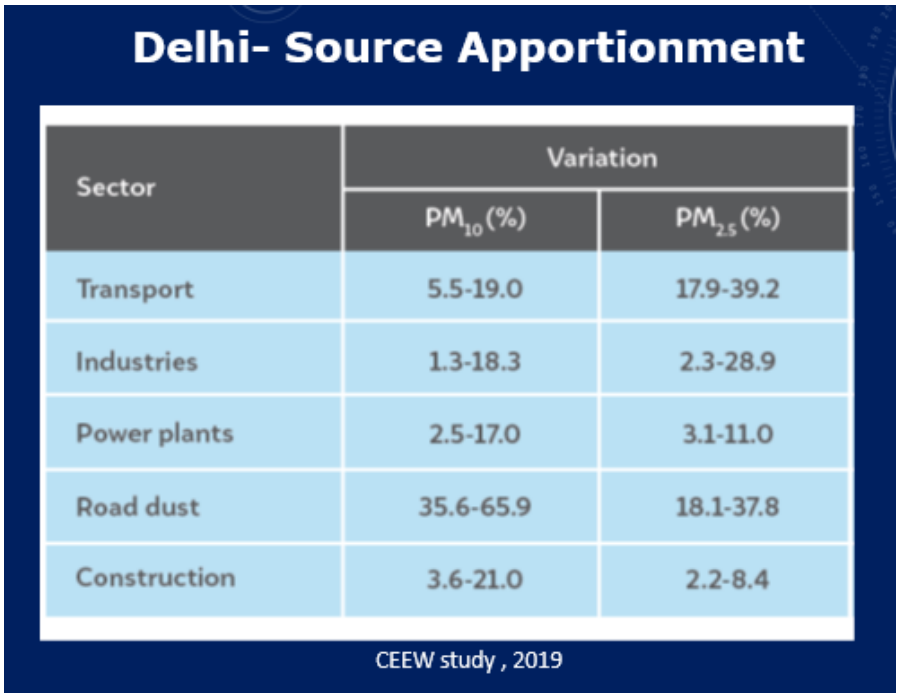

If you look at this in terms of the numbers, in terms of PM 2.5, which is the one that we are most interested in from a health point of view, because those are very small particles, and that gets into our respiratory tract, transport accounts for between 17.9 to 39 %. And so that is quite a wide range. So, whether it is 39 % or 18 %, and it will make a lot of difference in terms of the final impact.

Industries again, in some studies, it is going to as high as 29 % and this is very small and so this is the kind of thing road dust 18 to 37 %, construction 2.2 to 8.4 %. And there is an interesting spike which happens, this spike has been attributed to the stubble burning or biomass burning in the nearby regions in the fields.

And the interesting thing is that the change in the patterns or the policies related to agriculture and the water use have resulted in a slight shift in the harvesting and because of that, this stubble which has been burnt in the fields coincides with the winter and has created some of this problem. Of course, there is an uncertainty in some of this and there are papers.

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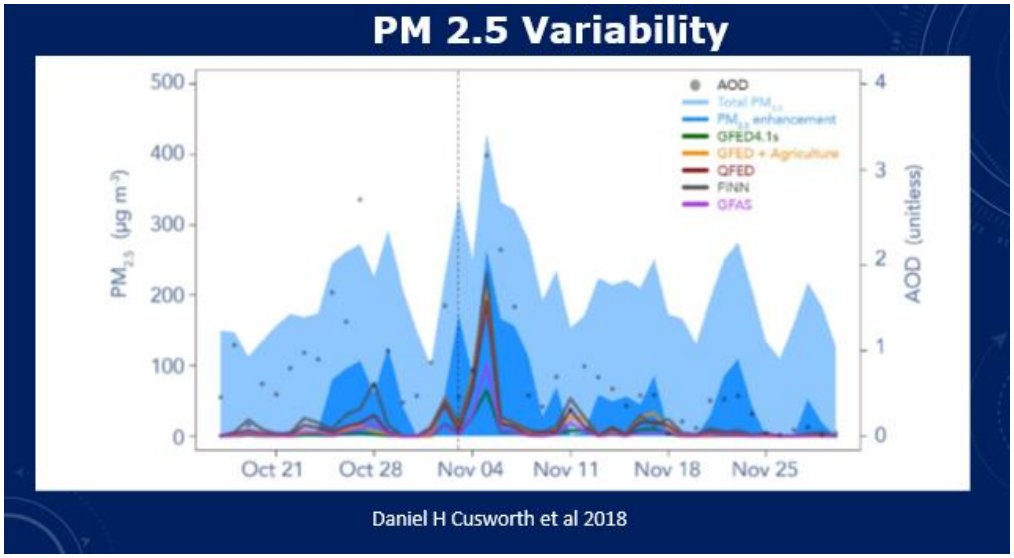

You can look at this paper, Cusworth et al and you can see in this that the effect, this shows that during a certain period, the effect of the variability which is there and also the effect which can be attributed to the increase in the stubbles and the emissions caused due to that. This is something which is still under research, under progress and there is significant amount of uncertainties.

So, there is scope for you to make a contribution in this area, many of these things for instance stubble burning is something which is avoidable if you had the right kind of incentives and policies for instance, we could classify the biomass waste, but the waste come at a particular point of time. We need to create a mechanisms for taking that waste taking it compacting it, classifying it, generating energy with it, but these are all things where there is scope for doing things.

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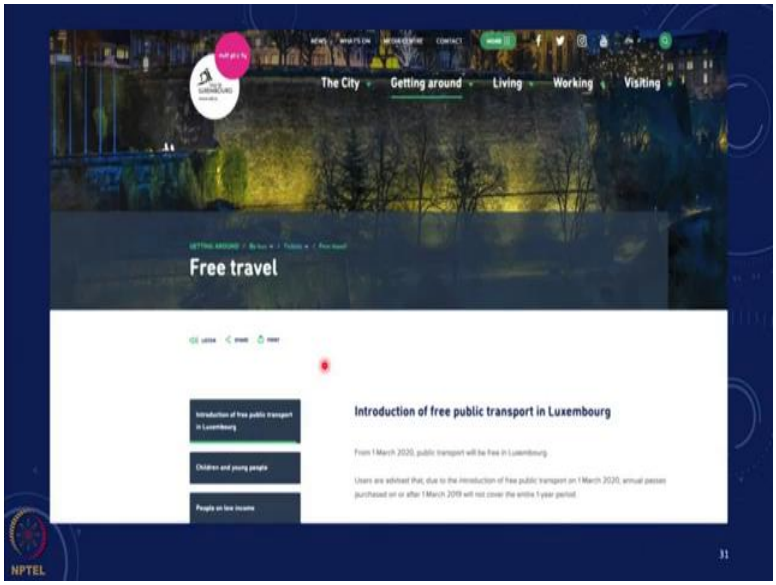

There are other countries and cities which have experimented with all kinds of different policies. The city, the city state of Luxembourg in Europe is planning to have free public transport from March 2020. An interesting kind of thing because if you look at it from a point of view of different stakeholders this will ensure that less cars are being taken out.

And this would reduce the emissions and it would of course increase the burden on the public transport system and we will need to have investments in this. This could, this would mean taxpayers would have to pay more taxes to meet that, it would make it accessible, public transport accessible to all, it may help in, so there is a cost benefit in doing this. So, we have to wait and see what happens.

But it is a very interesting kind of situation and various stakeholders including the manufacturers of vehicles and others would get impacted in this.

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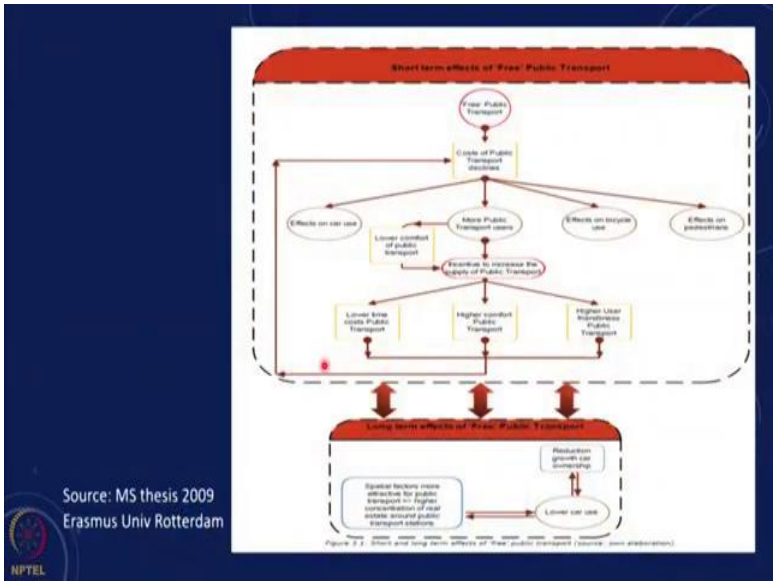

This is from a schematic from a master's thesis, which talks about what is the impact of free public transport and you can see that the cost of transport would decline. More public transport users, it can also increase the bicycle and pedestrian use, it would reduce the car usage, it may also result in pressure on the public transport system where that needs to improve.

And then it will also over time public transport, the costs would go down with the kind of volumes, long term effects will be reduction in car ownership and in other things which are there. So, this is in terms of one example where we will looked at the air quality and the transport system.

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Let us look at a second example which is our INDC, India's commitment in the Paris Agreement, where the goal of course is to limit global temperature rise to less than 2 degrees to compel global consensus, limit CO_2 emissions to provide a voluntary response from India. There are a variety of instruments which are being proposed and this is not outlined in our statements to the INDC.

But subsequently, both in the budget as well as separately through the PMO and through the ministry of new and renewable energy different incentives have been given. Institutions, the ministry of environment and forest which is essentially responsible for Indian governments response at the IPCC, the ministry of new and renewable energy, the IPCC and of course, then the state nodal agencies and the public sector oil, coal, natural gas firms, the NVVN, which is a new joint venture set up for the solar energy and these are some of the institutions which will implement this.

In terms of stakeholders, the government is a stakeholder, the general population is stakeholder, the fossil fuel industry, energy industry is a stakeholder, renewable energy industry and the financing institutions, the banks and the other financing institutions would also be stakeholders. So, this gives us an idea, we know what are the goals, we know what are the different kinds of instruments and the institutions and the stakeholders.

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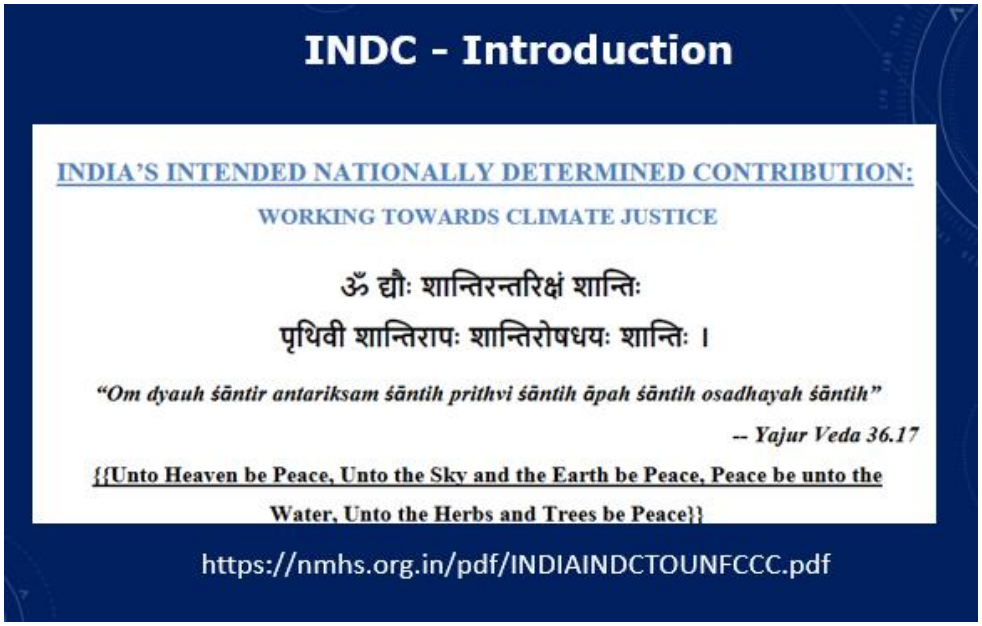

Let us see, you can read Indian representation towards the UNFCCC. And it is the statement talks about our submission actually starts with us Sanskrit shlok and basically saying that we

are committed towards going for a sustainable future even though we are not really the main contributors of this problem. As we saw earlier, our CO_2 per unit population is significantly lower than the world average.

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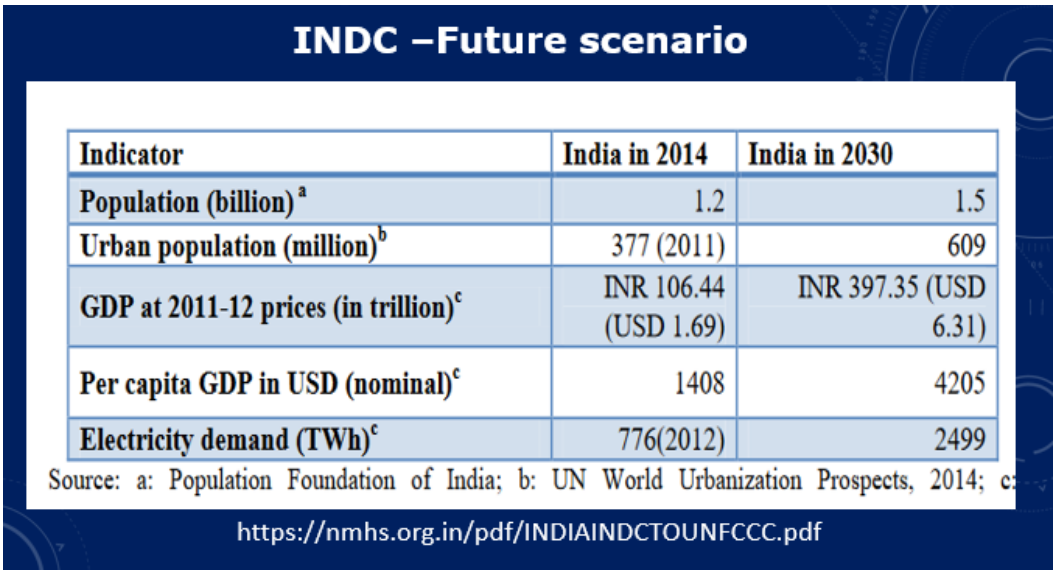

And having said that, in this there is a future scenario which has been built because we have targeted for this in 2015. We have taken the data for 2014 and we have made a target for 2013. We have looked at the per capita, GDP increasing and the per capita income also would increase and we have looked at a per capita electricity demand of about 2500 kilowatt hour per person per year.

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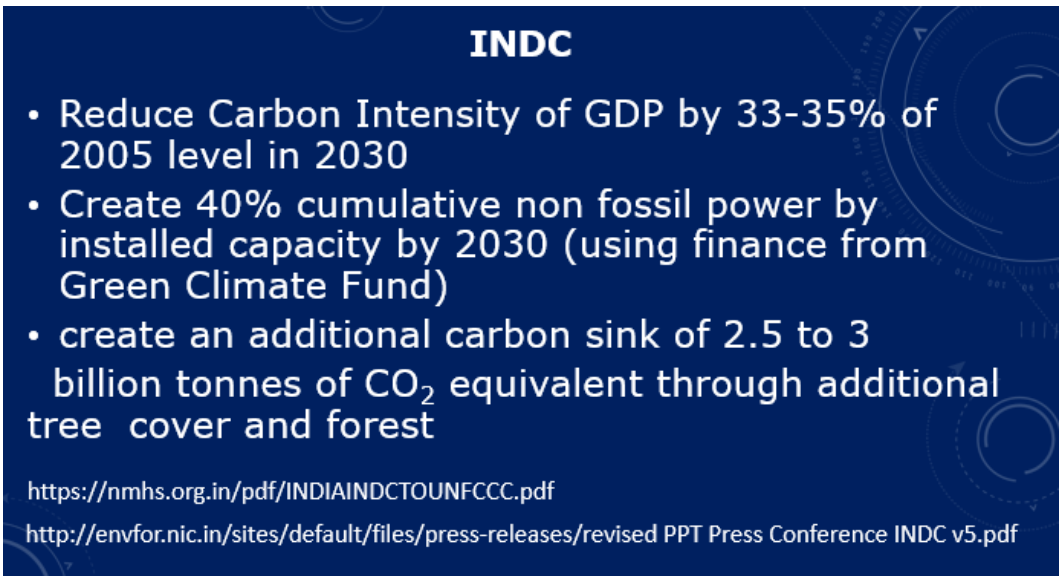

And having said that, we then have said and I have talked to you about these commitments earlier in an earlier module, we are talking of reducing the carbon intensity of GDP by one third of its 2005 level in 2030. So, that means that, what are the things that will happen because of this, we can either reduce the carbon intensity of the energy sector, we can also reduce the energy intensity of our GDP, we can change the structure of our GDP.

We are also committed to creating 40 % cumulative non-fossil power by installed capacity by 2030. And in this we have said that we would expect that we will be getting finance from the Green Climate Fund and then create an additional carbon sink by planting trees 2.5 to 3 billion tons of CO_2 equivalent through additional tree cover and forest.

We are on track for doing this 40 % cumulative non-fossil power, please remember it is by installed capacity and we have to add renewables, we have to add nuclear and we have to add large hydro. And when we look at that, we have made a commitment now to do 175 GW by 2022. And we have now, the Prime Minister has announced higher target going forward.

The carbon intensity has been declining over time and a lot of this is because we have not really had significant industrial growth. It is been mainly grown with services, we also improving the energy efficiency. So, we are looking when you look at the climate tracker, there is a global agency which tracks the commitment of different countries and their progress towards the INDC, it looks like this is quite possible.

In the last trapping up lecture when we talked about future energy systems, we discuss what are some of the challenges in sort of moving in that direction, but this is the.

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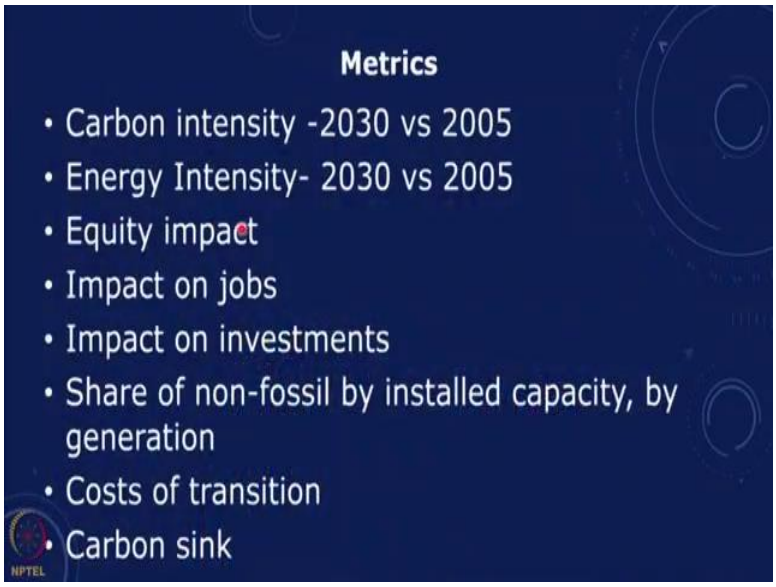

So, what does the carbon intensity depend on we had already discussed that so we can compare now with the matrix, how will we compare or analyse this? We can look at carbon intensity 2013 versus 2005, and energy intensity 2013 versus 2005. And when we want to compare this, we would have to have a model of the economy.

We can use an input-output kind of model or you can even use a sort of in the Niti Aayog you will find that there is already an India energy scenarios framework is there which is an excel based option which helps you generate scenarios for the future and you can put 2030 as a target year, try different kinds of options and different kinds of growth rate and see what happens.

We may also want to analyse these by in terms of the equity impact, what will be the impact on jobs, what is the impact on investments, these are much more tricky and need significant

amount of research to see how we can do that. Share of non-fossil by installed capacity and by generation, this is fairly straightforward to calculate based on what has happened.

Cost of transition is little more difficult to calculate because we have a certain system which is completely fossil fuel based and we want to move towards renewable future. What does that mean? That will have some of these plants will get shut down, we have some stranded assets because for instance coal power plants which are not being dispatched, and we need to pay for that capital and then we can look at what kind of carbon sink we have created and then.

So, these are different ways in which we can look at the metrics that we talked off and using these metrics, we can actually look at the INDC that we have proposed and what is our progress towards this.

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There are many different policies which support and create the INDC. So, there is a national environment policy set up in 2006. National action plan on climate change and most states have also announced their action plan on climate change. Some of them are in general, some of them are specific with some quantification, so you can look at your state action plan for climate change. Try and analyse and see whether it is consistent with the INDC and how much of it is going to be achieved.

The Energy Conservation Act which has been which has mandated for the bureau of energy efficiency, a role and where we are doing labelling standards and labelling, a whole host of different things including energy conservation award. The National electricity policy, there is a national policy for farmers, the integrated energy policy which was earlier and Niti Aayog

now has an again an energy vision. The Perform achieve and trade and I will talk about this a little more in detail subsequently.

But basically, this is set of policies by which industries, energy intensive industries have to benchmark themselves and have to set targets in terms of how they can improve their performance. We have moved from feed in tariffs now to renewable energy certificates and renewable purchase obligations. RECs and RPOs means that every distribution company has an obligation to meet a certain percentage of its requirement through renewable purchase or procurement.

And they can either actually invest in the renewables or they can buy certificates from companies which are providing renewable energy. So, these are some of the policies there are many more. So, we can look at the policies and we can look at in different years as compared to when we started off in 2015. What has been our progress towards these INDC targets, so this is my idea was to show you how do you analyse the energy policies and provide the framework.

We looked at the different kinds frameworks with two examples, air quality in the city and the national commitment towards reducing climate change.

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There are other policies in the INDC for instance, which are relevant the some of the recent ones. The solar parks, the ultra-mega solar power plant, the smart grid mission, green energy corridor, national mission for energy efficiency I talked to you about standards and labelling

and partial risk guarantee fund for energy efficiency, for smart buildings and energy efficient buildings, the ECBC and Griha and the Smart Cities mission and many more.

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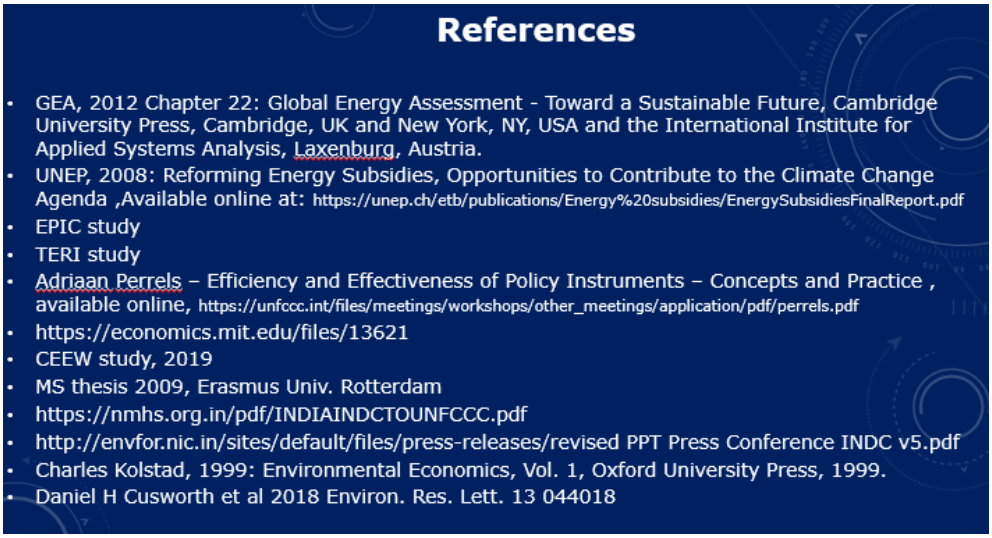

And with this, we conclude this first module on energy policies there are some references here. In the next module we will take on some more examples of energy policy and we will also look at energy access, nuclear energy, energy efficiency and some ways in which we can have, what has been done in terms of energy policy in our country and how they can be analysed.