Electronic Waste Management - Issues and Challenges
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Lecture - 04
E - Waste Management Overview

Welcome back. So, we will start from where we left in the previous module. We were looking at the quantification of E-waste, like how to project, how much E-waste to be produced, how to know, because whenever you design something; say if you are an engineer or even you are in doing some management stuff or when whenever we are trying to address a problem first of all we need to know, what is the extent of the problem. So, how big is the problem?

So, in terms of this E-waste management, the one of the core information that you require, is how much E-waste is actually produced, and that depends on how much E-waste is coming to the market. How people are using it, whether they are, after how long they are using it, how long is a shelf life. And as you can see being in, being part of the society, you also observe certain things, while which if you have observed it carefully, previously the E the amount of years the number of years that we used to use certain electronic product was much higher.

Now, it is becoming more and more, I would say throwaway society, where we want to buy new things. Every time there is a new product out there, and the whole market is like that. We have this now, this I phone X is coming, I phone X is already there. So, then by the time this course will be over. There would be new model of I phone, may be before even earlier than that. So, we, there is a lots of new products coming in to the market, and there is peer pressure; like some of your friends, some of your colleagues has it. You want to have it as well, because it becomes like a status symbol. So, all those, leading to all those different factors, the amount of electronics being purchased are increasing. And since they are being purchased at some point of time, they will be discarded as well.

So, in this particular module, we will try to E's, try to find out how to estimate; say if you are given the job of managing electronic waste for a metro in metro city in India. Say Kolkata or Chennai or Bombay or Mumbai or Delhi. So, if you have any of, or any place we have lots of big cities now Bangalore, Ahmedabad. So, if you are in charge, how will you go about it? First you need to know how much E-waste is being produced in that geographical region. So, we will try to do that math right. Now how there are different ways of doing it. So, I will explain you one way of doing it. There are other ways of doing it as well. So, I will take the case study of Kolkata to do that.

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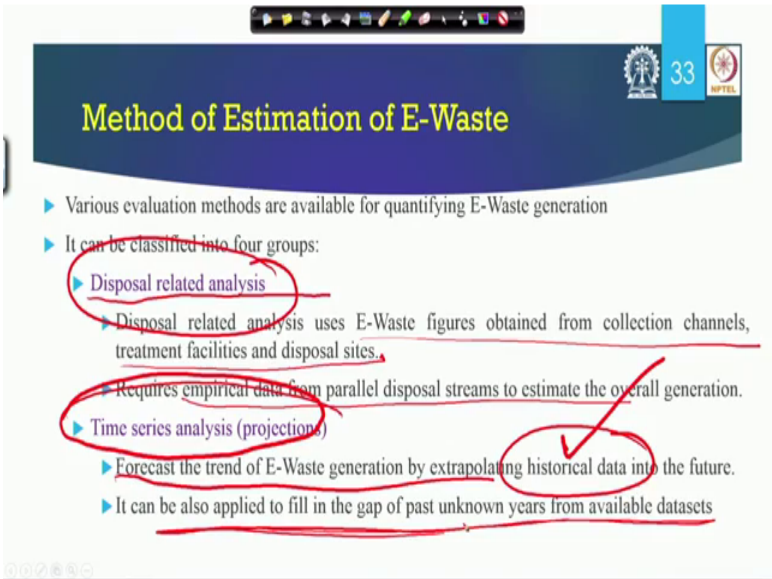

So, let us look at the, where we, kind of started, kind of ended yesterday. So, there are different methods of estimating E-waste. One is the disposal related analysis we talked about. This a little like an brief, we just introduced these yesterday. So, will come back and spend some more time on that. So, we had one is, which is the disposal related analysis.

So, now what is the disposal related analysis in that, what we are trying to find out is we try to find out E-waste figures obtained from collection channels treatment facilities and disposal site. So, you go and try, get the data. You try to collect the data from E-waste recyclers from a dumpsites, or from waste to energy plants, wherever this electronic waste may end up to. So, in that geographical region, you go and collect the data from different places, where this electronic waste may end up, and then you take the data and then you use it for kind of having a estimate of how much E-waste is actually produced. You have the older data, then you project it in future. You can do the future projection as well. So what it requires, it requires empirical data from parallel disposal stream.

So, we have to look at the parallel disposal stream, it could be a. Of course, it should not go to a compost plant, but it can go to waste to energy plant. It can go to landfill, it may end up in recycling centres, and different types of recycling centres so that is where we need to find out the data, and try to estimate based on that. That is one way that is the disposal related analysis that is a one way of doing the other. There are several other ways of doing it too. We will explain four ways here, and then do the case study using one method, which is the time series analysis. So, this Kolkata case study that you will see in a minute or minute in a half, is on time series analysis, which is basically which is use to do a projection.

Like how much E-waste should be produced in future, taking the data from the past. So, here what does time series does. We try to forecast the trend of E-waste. So, we take the historical data. So, will try to collect the historical data for last, as long as you, if it is better say, if you have for last several years, best like if you can go for a decade or 15 years more the data, more the historical data, better it is for future projection. As you can, it is obvious is not it, if you have done little bit of math, little bit of statistics, you know that more we have the background data to project something. We can come off with the model which will model, we can use certain, even for population forecasting for that matter. Whenever we talk about population forecasting, we take the data for last several census, and then taking. Say for example, if I want to project the population of Kharagpur town, for say 20. Right now we are 2017; so for 2021 or 2020.

So, what all do that, look at the data for, from the earliest census that we may have it available, say 1980s 1990s 2001. So, taking these three, we can come up with which method will work best in term of forecasting. Then using that forecasting method, we will project what should be the population of 2011. We have the data of 2011. So, we can match to see, whether it works good or not, and whichever method works best, we take that method and project it for 2021. So, that is how it is done. So similarly here, but that requires having lots of data. So, that is why you need to have good amount of historical data, which needs to be there, and then it can also be applied to fill the gap of a past unknown. So, if you have, this is also used, if you have some data, but there is in between certain gaps are there. We can use this; we can use this historical data set to find out to, if to get the data in between.

So, if the, will fill in the gaps in between for that, so that is the. There is the two ways, and then we will look at two more ways of doing it, which is the factor model, where we use the determinant factor for correlation. So, here what we try to do is, we look at the population size, we look at the income level, what is the population, what is the income level.

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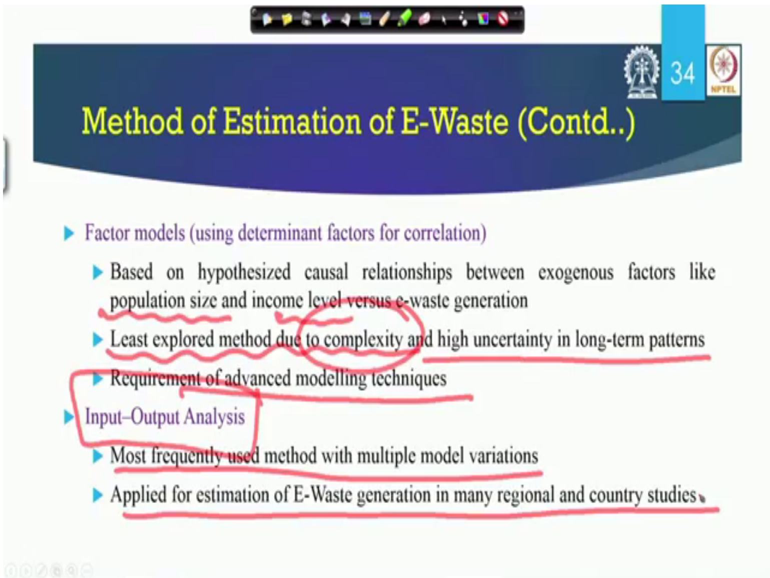

And based on the income, how much electronics the population, certain population will be able to buy, based on their purchasing power, and looking at the shelf life. The use of a useful life of that particular electronic product we will have. We will make certain assumption that after 3 years, and those assumptions are based on certain survey. It is not just we take certain numbers all the numbers, that you will use has to, has some basis. So, that lot of surveys are done. You go and talk to people like last time you had a laptop, how long you used it, and ask.

And you do it for several different areas of the city, different types of people, young, old and like a teenagers, or who are just in early 20s, and then you go into the middle level, like 35 to 45 someone in, like my age group and then you go further in terms of the older people. So, it all depends on how you get the data, and then you have to get the variety of data, and then you project based on that.

So, here we look at population size, income level, then this is the, its a complex. So, we do not, you do not see many peoples, or many reports done, using this there is a lot of complexity associated with that, and high uncertainty, because it all depends on how people respond at your questionnaire. So, it there could be a certain problem, and then you have to do some advanced modelling technique. So, that leads to a certain problem, in terms of doing, using this model, but this is also one method available. You may find some literature out there using it, and then input output analysis. This is the most frequently used when multiple variation like you do a mass balance input output analysis.

Essentially you do the mass balance, how much is the electronics coming into say city of Kolkata, and how much of electronics going out of city of Kolkata, people buying it, and then how much is being used with in. And then how much E-waste is being produced. You try to do a mass balance, try to find out the numbers for some big cities; like a Kolkata, Bombay, Delhi, those places we need to be careful that many times electronics may be purchased over there, but maybe used somewhere else in a remote village, in other parts, the parts of the country. So, you need to be, we need to, kind of somehow find that fraction, and to when we look at the input and output analysis. So, that is, it is a, it is also applied for the estimation of E-waste in many regional and country studies.

So, when they do the, when we go, when your, when your area or geographical area is much bigger, this works a little bit better, because you are taking, you are taking into consideration the local movement of electronics around that particular area, because your region is pretty big and, but if you are focused on one particular city. This method you again can be used, but you have to be careful in terms of all the data that we will go in there.

So, being said that, let us try to do a quantification example for Kolkata city.

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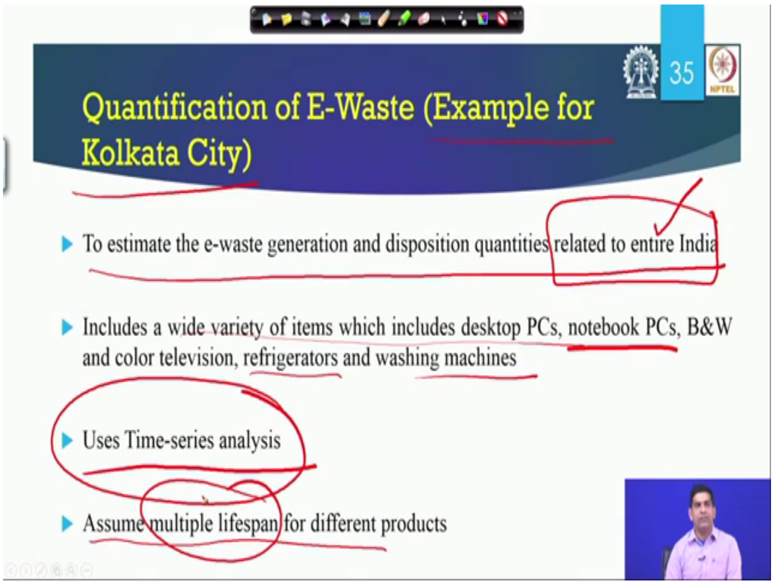

And as I said earlier, we will use this time series analysis. This is you can do it, you can do it for your city as well. You can see what kind of data is required; you can get those data for your city, and then try to project. It would be a good exercise for you to do. Especially those of you, want to do some research or a some further study in this particular area. I would encourage you to do that, and of course, if you have some questions, put it on the discussion forum and we will be happy to answer that

So, we will use the time series analysis and. So, we will try to estimate the E-waste generation and disposal quantities related to. So, we basically will, its essentially we will take the example of Kolkata city, and then using that Kolkata city data, will try to. After doing the Kolkata city information, we will try to extrapolate it to the entire area, assuming that Kolkata city kind of gives a representative number. Again that is an estimate so, but right now our focus is Kolkata city. We will include wide variety of item, which includes desktop, computers, notebook, black and white, and colour T Vs, refrigerators and washing machines.

We will look at the variety of material, and we, since there are variety of material, there is multiple lifespan for different product. So, different products have multiple lifespan, and we will talk about that, as well high income group, low income group, and all those, how this lifespan also changes.

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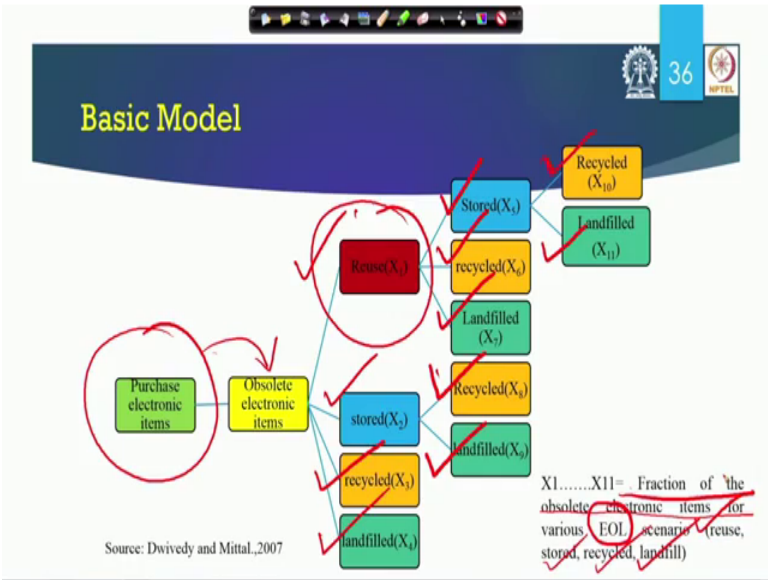

So, the basic model is this, and I would expend. I will expend some, I will try to explain it in detail, make sure that you understand this, if you, and if you need to replay this part of the video again and again, until you get it, because if you get it, then it is much easier. If you do not, then you will, it will be difficult to follow the next few slides. So, what happens; like somebody purchases an electronic item? So, this is where we are starting purchasing of electronic item, is what is happening. So, we are going to start from there. People are purchasing an electronic item, then after certain lifespan it becomes obsolete. So, obsolete means people are not using it. It is no more being used, it is an obsolete electronic item.

So, once it obsolete, becomes obsolete, say for me it can a still be in a usable forms. So, I many times what happens is, you have a some obsolete old electronic, old mobile phone your. Probably may be your first smartphone, which is, it is a smartphone, but not as smart as you want a newer phone to be. So, you may give it your some people. Like your drivers, sometimes we give it to the maid servant, or even to say auto [FL] rickshaw. [FL] Whoever is there in the society, who you think will may benefit and then you.

So, that is becomes, it reuse part and that also happens. Many times you may select to reuse shop, and then reuse shop owner will use it. So, they will refurbish it, make a look little bit nice, or clean it, and then if needed change the screen and other stuff, as and then sell it as well. So, that is sold as refurbished much cheaper, and they also make price. They also make profit out of that. So, there is a different ways things could be reused. So, that is one particular option is there, where things could potentially be reused, then other option is. Since it is obsolete, you store it for a little while, because I was telling you in the previous module. We always have lot of emotional attachment, unfortunately to many things in our life.

So, it is may get a stored. We have assumed that thing over here, which in the next slide we explain that. I think we assume that maximum 3 years. So, 3 years people will explore, and then. Sorry store, and then after that it would be get thrown away or it could be send it to a recycler and recycled, either informal or formal recycler, and then or it may end up to the landfill. So, this is what potentially can happen. So, from obsolete electronic items, and then in terms of, it can further, if it goes to the reuse. Now it is again being used as a product. So, it can further be recycle stored or recycled or go into the landfill; like you saw the choices here. So, its same thing can happen on that scale, if its stored for certain number of years, then again it can go either to the recycling centre or to a landfill. So, that is another scenario, and here again reused item after reuse for few years. not again if its stored, it can go to recycle or to a landfill.

So, this is a, this is what we have assumed of, what is happening, and its logical as well. This is what, and this is I, what I say, we have assumed the people who use this time series analysis, the way the time series analysis have been developed. This is the basic model of a time series analysis, and it is true for electronic waste, its true for other ways to stream as well. It is true for other thing, other projection, whatever projection we do, using this time series analysis similar.

So, it may not be exactly, because this store recycle landfill its mostly for waste, but other parameters would be there, but similar concept is used. Similar concept is used for this, and here guys, this x. As you can see for all these boxes, next to those phrases, those next those, what is like recycle stored landfill, we have X 1 X 2 X 3 X 4. So, here X 1 to X 11, this is the fraction. It is a fraction of the obsolete electronic items for various EOL, EOL is the term used for end of life. You will see that being used many times in this course, and other course, other, any landfill any waste related courses. So, its end of life scenario, which is could be reuse, could be stored, could be recycle, could be landfill.

So, this is what we are talking about, and then this X 1 to X 11 that. Now we have to give certain weightage, and that weightage depends on after doing an elaborate survey of how things are happening on the ground. So, you will go and ask lots of question. You prepare questionnaire, you will do lots of questions, you will ask questions from different places, and different street of the society, and then you come up with X 1 to X 11 values. And then of course, you need to justify why you have taken that, say if you are doing a master's thesis, or a P H D thesis. In this area, you are going to use this model, you have to get this X 1 to X 11 values, and then based on your survey, based on your (Refer Time: 15:59), based on your data collection, but you need to again give a very thorough, under very thorough explanation of why if it is being done the way it is being done.

So, being said that let us. So, let see the next stuff on that.

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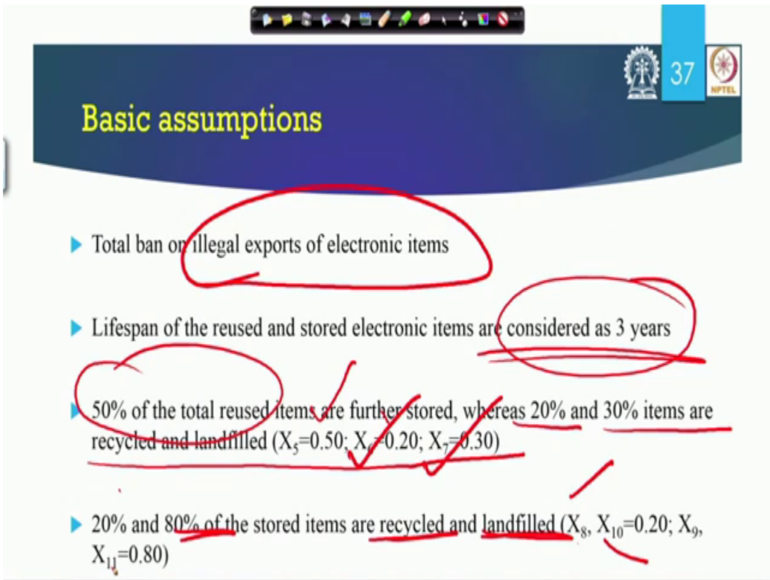

So, next what we will do. We will make certain assumption which is again, where any analysis you do. You have to have certain assumptions. So, what the assumptions are, total ban on illegal exports of electronic item? So, there is no illegal export of electronic items happening in this Kolkata city area. So, no illegal export lifespan of reused and stored electronic items are considered as 3 years. So, we have, I said earlier as well we taken 3 years on this, is this. Again based on all the survey, based on all, some of the data is collected.

Now, the 50 percent of the total, this reused items are further stored for another 3 years, whereas 20 percent and 30 percent of the items are recycled and landfilled. So, for X 5 we are using 0.5 X 6 is point 2 X 3 X 7 is 0.3. So, we are using these three numbers for that, so big, and these are based, these assumptions are based on certain data collection on the ground, and will talk about that in a minute 20 percent and 80 percent of the stored items are recycled and landfilled. So, 20 percent of the items are recycled 80 percent of the stored items are actually landfilled. So, for that, we put this X 8 and X 10 is 0.2 and X 9 and X 11 is 0.8 which is coming from the previous slide.

So, these, as again these assumptions have been made, and these assumptions have been made based on the data collected on site.

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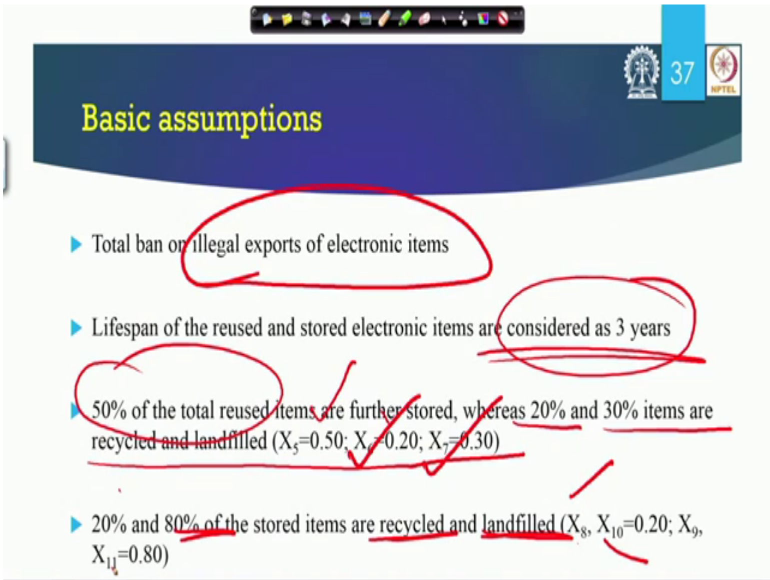

So, what was the date of co, this data collected from these two studies, which was done in Kolkata area, which is first one is by Dwivedi and Mittal. And we will as a reading material, we will provide you the plan, is for this, this course for most of the background reports and papers that we are going to use in. This is study will provide you either the link of that report, if the report is or if it is available on the web, or freely, or we will download that paper and upload the paper as a additional reading material. So, you will have those as we make progress in the course.

So, if you are more interested to go and learn about that go and do that, and again discussion board is there to ask questions. So, based on these two studies, which was one was the G I Z study, which was done in Kolkata G I Z is a German firm, it is not G T Z that should be actually G I Z, which is a. I am sorry; it is a mistake over here. This should be G I Z not G T Z, which is a typo. I am sorry for that, and then here in in terms of basic data, we have taken refrigerators, televisions, desktop, notebook, DVD players. So, average lifespan is 11 years 9 years 7 years for household H H is household 5 years for the business establishment.

As you know, let desktop computers in a offices, they get replaced much quicker in a house setting. We try to use it for a longer period of time, because in a house, we just do some basic stuff, it is still the desktop is good enough to use, and notebook for 4 years, DVD players 4 years, and then the average weight of this is also provided to us, which we can use to find out the in terms of the metric ton. How much waste is being produced then? This is based on like the, based on Dwived and Mittal in terms of the average lifespan, that they have collected. They have tried to provide the data using surveys, and then in terms of the product type, all values the method of disposal, whether it is reuse landfill recycle, or it is stored. We have got these values in percentages from this G I Z study, which is again based on all surveys.

As you can see for different types, we have different numbers, and whether it is being reused, whether it is going to the landfill, or it is going to be stored, and this all, this should add up to, should add up to 100. So, which you can see that, they are, they do end up to add up to 100. So, either 37 percent, take an example of mobile phone 37 percent is reused 7 percent is said to be going to the landfill, 50 percent is recycled 6 percent is stored, and 50 percent recycled is again mostly informal recycling.

Similarly you can see the other ones as well, refrigerator 83 percent recycle. So, we already seeing lots of recycling happening for all the different types of electronic product, but mostly it is happening in a informal sector. So, that is another situation we have. We wanted to be happening in the formal sector at least part of it, which causes environmental and human health problem.

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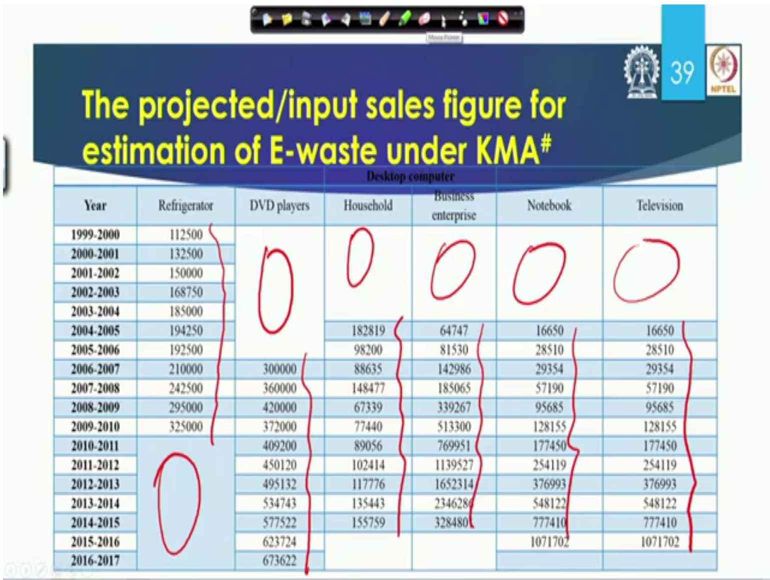

Year	Refrigerator	DVD players	Desktop computer: Household	Desktop computer: Business enterprise	Notebook	Television
1999-2000	112500					
2000-2001	132500					
2001-2002	150000					
2002-2003	168750					
2003-2004	185000					
2004-2005	194250		182819	64747	16650	16650
2005-2006	192500		98200	81530	28510	28510
2006-2007	210000	300000	88635	142986	29354	29354
2007-2008	242500	360000	148477	185065	57190	57190
2008-2009	295000	420000	67339	339267	95685	95685
2009-2010	325000	372000	77440	513300	128155	128155
2010-2011		409200	89056	769951	177450	177450
2011-2012		450120	102414	1139527	254119	254119
2012-2013		495132	117776	1652314	376993	376993
2013-2014		534743	135443	2346286	548122	548122
2014-2015		577522	155759	328480	777410	777410
2015-2016		623724			1071702	1071702
2016-2017		673622				

So, using the data, and this is lots of numbers here, do not worry too much. Again the slides would be provided to you. You can look at. I will just explain it to you, how we got this numbers. So, based on projected input sales figures for estimation of E-waste under Kolkata metropolitan authority, that is the KMA. So, here in from 1999 until 2016 and 17, we try to get the data. And for these data which was available from the different sources on the web, and some data is not available in certain years; that is why you see them blank the data. Unfortunately some data is not available for certain part of the time. So, that is why you see these blank spaces. So, whatever data was available, we have tried to put it in here.

So, for refrigerators, this is the how much was projected or input sales figure. Based on this, this many refrigerators are sold in this many years. This is for the DVD player, and the household computers, business computers, notebook and desk television. So, we whatever data we could find, we have provided it over here, other than DVD players. Most of the data is from 2015, 2016 and earlier, not the recent ones. So now, what? Why this data is important, because they based on this data, using the lifespan of the product.

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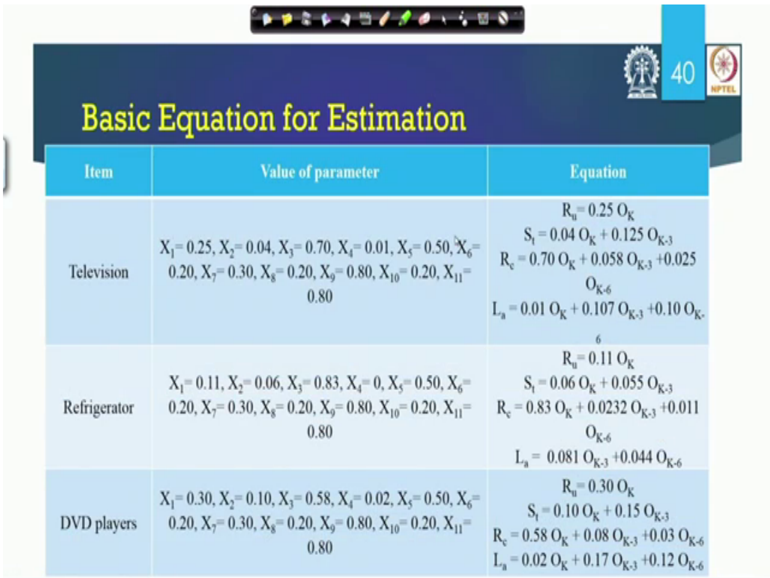

Basic Equation for Estimation

40

Item	Value of parameter	Equation
Television	$X_1 = 0.25$, $X_2 = 0.04$, $X_3 = 0.70$, $X_4 = 0.01$, $X_5 = 0.50$, $X_6 = 0.20$, $X_7 = 0.30$, $X_8 = 0.20$, $X_9 = 0.80$, $X_{10} = 0.20$, $X_{11} = 0.80$	$R_u = 0.25\ O_K$ $S_t = 0.04\ O_K + 0.125\ O_{K-3}$ $R_c = 0.70\ O_K + 0.058\ O_{K-3} + 0.025\ O_{K-6}$ $L_a = 0.01\ O_K + 0.107\ O_{K-3} + 0.10\ O_{K-6}$
Refrigerator	$X_1 = 0.11$, $X_2 = 0.06$, $X_3 = 0.83$, $X_4 = 0$, $X_5 = 0.50$, $X_6 = 0.20$, $X_7 = 0.30$, $X_8 = 0.20$, $X_9 = 0.80$, $X_{10} = 0.20$, $X_{11} = 0.80$	$R_u = 0.11\ O_K$ $S_t = 0.06\ O_K + 0.055\ O_{K-3}$ $R_c = 0.83\ O_K + 0.0232\ O_{K-3} + 0.011\ O_{K-6}$ $L_a = 0.081\ O_{K-3} + 0.044\ O_{K-6}$
DVD players	$X_1 = 0.30$, $X_2 = 0.10$, $X_3 = 0.58$, $X_4 = 0.02$, $X_5 = 0.50$, $X_6 = 0.20$, $X_7 = 0.30$, $X_8 = 0.20$, $X_9 = 0.80$, $X_{10} = 0.20$, $X_{11} = 0.80$	$R_u = 0.30\ O_K$ $S_t = 0.10\ O_K + 0.15\ O_{K-3}$ $R_c = 0.58\ O_K + 0.08\ O_{K-3} + 0.03\ O_{K-6}$ $L_a = 0.02\ O_K + 0.17\ O_{K-3} + 0.12\ O_{K-6}$

We will try to project in terms of what will be the future. Like how much will show up in the disposal history.

So, this is your total, the previous table that you saw was the input stream; that is coming in to the system. Now using those all X 1 X 2 X 3 X 4 figures which we have, based on the assumption that was presented to you few slides back, as well as the data that is collected out there, we have these X 1 to X 11 data as X 1 to X 11, and its different for different items. For television, refrigerators, DVD players, as you can see these values are different. Again we will provide you that paper, we will provide you the. So, that you can get that, if you want to study more about how those X 1 to X 11, where arrived at, you can see that, but the basics are already been explained based on those.

So, we got this different like a weightage values, and then we come up with these equations, and this equations. As you can see this looks lot of, may look little bit clumsy, but do not worry, it is not that difficult, and which I will just, let me show you the equation, and then I will explain couple of them in the next slide. So, that it becomes easier on you, and then this is for the first table we saw for three items; television, refrigerator, DVD players. Here we are looking at desktop and notebook.

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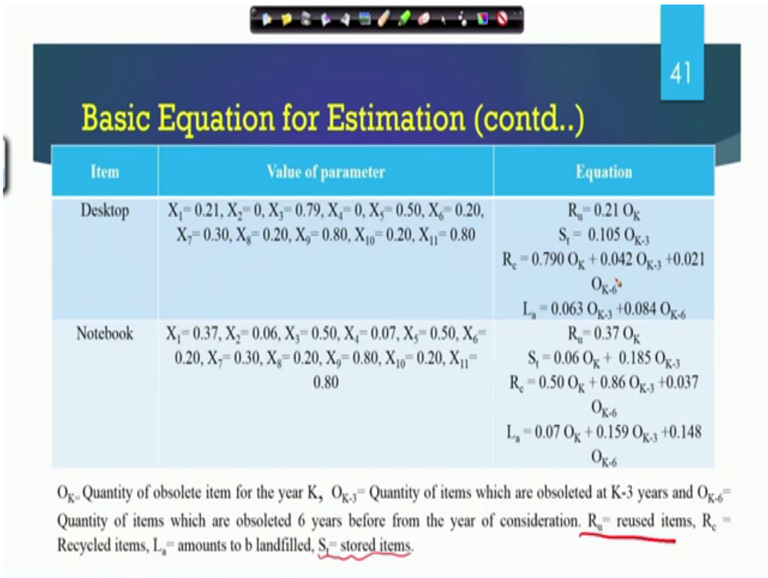

41

Basic Equation for Estimation (contd..)

Item	Value of parameter	Equation
Desktop	X_1= 0.21, X_2= 0, X_3= 0.79, X_4= 0, X_5= 0.50, X_6= 0.20, X_7= 0.30, X_8= 0.20, X_9= 0.80, X_{10}= 0.20, X_{11}= 0.80	R_u= 0.21 O_K S_t = 0.105 O_{K-3} R_c = 0.790 O_K + 0.042 O_{K-3} +0.021 O_{K-6} L_a = 0.063 O_{K-3} +0.084 O_{K-6}
Notebook	X_1= 0.37, X_2= 0.06, X_3= 0.50, X_4= 0.07, X_5= 0.50, X_6= 0.20, X_7= 0.30, X_8= 0.20, X_9= 0.80, X_{10}= 0.20, X_{11}= 0.80	R_u= 0.37 O_K S_t = 0.06 O_K + 0.185 O_{K-3} R_c = 0.50 O_K + 0.86 O_{K-3} +0.037 O_{K-6} L_a = 0.07 O_K + 0.159 O_{K-3} +0.148 O_{K-6}

O_K- Quantity of obsolete item for the year K, O_{K-3}= Quantity of items which are obsoleted at K-3 years and O_{K-6}= Quantity of items which are obsoleted 6 years before from the year of consideration. R_u= reused items, R_c = Recycled items, L_a= amounts to b landfilled, S_t= stored items.

So, now what are these equations are all about. You already know X 1 to X 11 we have talked about that. So, what are these equations, where here R u as you can see R u is the reused items as we have reused R u for reused items and O k is your quantity of obsolete items for the year K, so for that particular year? How much obsolete items is there 21 percent is being reused. So, that is how we are getting those numbers for desktop for notebook 37 percent is being reused. So, that is how we are getting those numbers, then S t is you are like a stored items S t is the stored items. So, we can get similarly S t is a function of how much quantity of obsolete item for year K minus 3 years, because in 3 years we stored.

After the lifespan of 3 years, we are restoring it. So, that is the store item for their, similarly which are 6 years before the year of consideration, there is another O k minus 6 which is quantity of items, which are obsoleted 6 years before the year of consideration and R c is the recycle items, L a is a amount to be landfilled, and S t is the stored items. So, you can come up with all these equations based on that. So, this is how you can do this estimation for different parameters. Again you have to do some self learning in this course too.

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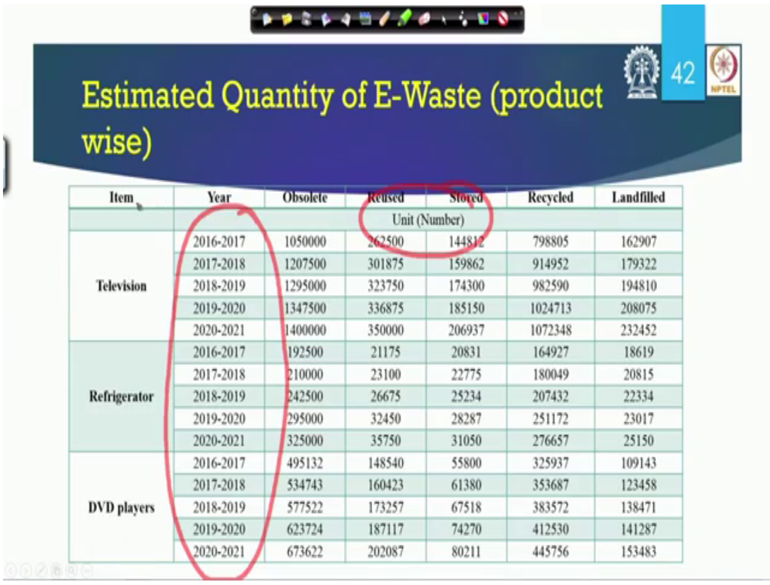

Item	Year	Obsolete	Reused	Stored	Recycled	Landfilled
		Unit (Number)				
Television	2016-2017	1050000	262500	144812	798805	162907
	2017-2018	1207500	301875	159862	914952	179322
	2018-2019	1295000	323750	174300	982590	194810
	2019-2020	1347500	336875	185150	1024713	208075
	2020-2021	1400000	350000	206937	1072348	232452
Refrigerator	2016-2017	192500	21175	20831	164927	18619
	2017-2018	210000	23100	22775	180049	20815
	2018-2019	242500	26675	25234	207432	22334
	2019-2020	295000	32450	28287	251172	23017
	2020-2021	325000	35750	31050	276657	25150
DVD players	2016-2017	495132	148540	55800	325937	109143
	2017-2018	534743	160423	61380	353687	123458
	2018-2019	577522	173257	67518	383572	138471
	2019-2020	623724	187117	74270	412530	141287
	2020-2021	673622	202087	80211	445756	153483

And I will encourage you to use those equations, and try to come up with this table that we are showing you. Right now this table that I am presenting you to you, right now this can come up with, we have used the same equation, which is shown in the previous two slides, and come up with these numbers. So, I encourage you to at least do it for either television, refrigerator, DVD players, at least one or two items do it. So, that you feel confident that these numbers are correct, and this is how the numbers or can be arrived at. If you find some problem in our calculation, let us know that as well, because we can also make mistake, but we have tried to check it to make sure that we have not made any mistake. Of course, there are so many calculations involved here. So, it depends, you can I would encourage to use excel sheet and that will help you to minimise any error

So, based on different items, say this is the unit how much numbers. So, this is in terms of the numbers, how much unit electronics are all getting obsolete, reused, stored recycled and landfilled for different period. So, for the different items you can calculate based on the equations that was provided in the previous slide. So, and then you can estimate the quantity again for the other items.

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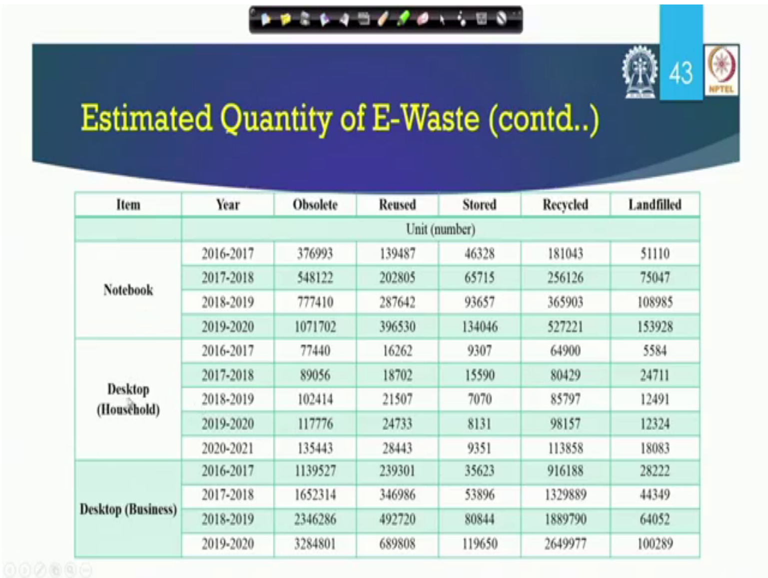

Item	Year	Obsolete	Reused	Stored	Recycled	Landfilled
	Unit (number)					
Notebook	2016-2017	376993	139487	46328	181043	51110
	2017-2018	548122	202805	65715	256126	75047
	2018-2019	777410	287642	93657	365903	108985
	2019-2020	1071702	396530	134046	527221	153928
Desktop (Household)	2016-2017	77440	16262	9307	64900	5584
	2017-2018	89056	18702	15590	80429	24711
	2018-2019	102414	21507	7070	85797	12491
	2019-2020	117776	24733	8131	98157	12324
	2020-2021	135443	28443	9351	113858	18083
Desktop (Business)	2016-2017	1139527	239301	35623	916188	28222
	2017-2018	1652314	346986	53896	1329889	44349
	2018-2019	2346286	492720	80844	1889790	64052
	2019-2020	3284801	689808	119650	2649977	100289

Notebook, desktop, household desktop, business, so that is again we can get that unit number. Similar calculations have been done for that as well.

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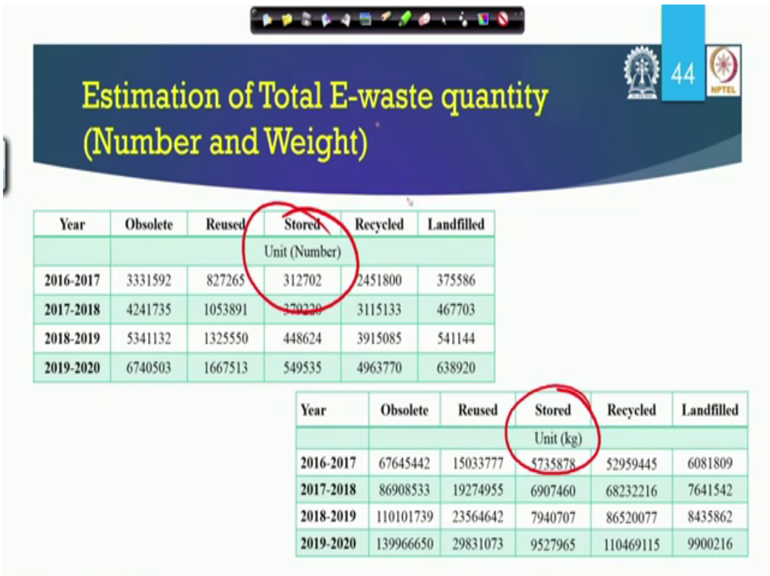

Year	Obsolete	Reused	Stored	Recycled	Landfilled
	Unit (Number)				
2016-2017	3331592	827265	312702	2451800	375586
2017-2018	4241735	1053891	379220	3115133	467703
2018-2019	5341132	1325550	448624	3915085	541144
2019-2020	6740503	1667513	549535	4963770	638920

Year	Obsolete	Reused	Stored	Recycled	Landfilled
	Unit (kg)				
2016-2017	67645442	15033777	5735878	52959445	6081809
2017-2018	86908533	19274955	6907460	68232216	7641542
2018-2019	110101739	23564642	7940707	86520077	8435862
2019-2020	139966650	29831073	9527965	110469115	9900216

So, and then the number and weight, because we also had the weight associated with that. For each one of those, we had given the weight how much they weigh. Remember the previous table we had, where we had the average weight of different components. So, based on that, we can from the unit numbers. We can multiply with that unit number. We can multiply it by the unit, by the weight and get the unit k g.

So, that is also important to know how much kg will go into the disposal stream and as you can see over here.

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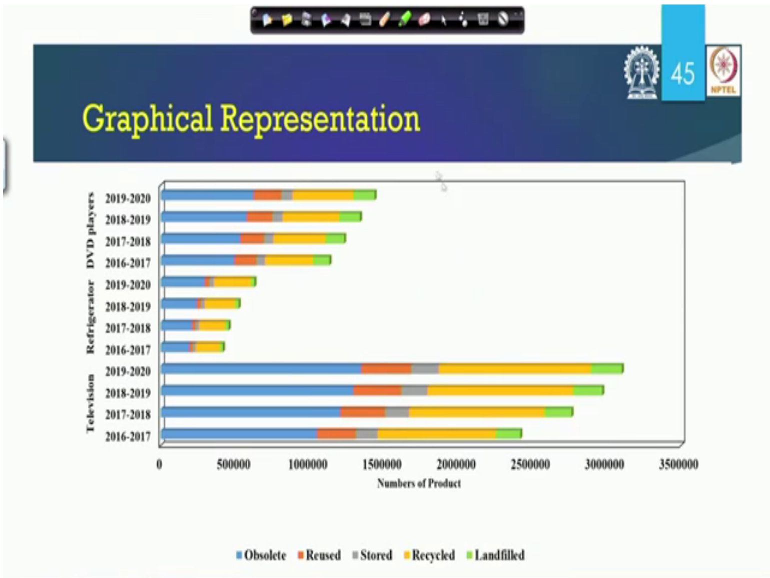

Let us go back to the table for certain items, this is for total. If you look at individual items, you will find that certain items they are; they although, the weigh numbers are very high, but since their weight is much less, they quant even you go in terms of kilogram. It the number goes down drastically.

So, same information has been presented here in graphical. If you are rather than from the table we presented in the graphical in terms of the different years, number of products is the X axis, years is on the y axis, and three items here DVD players, refrigerator and television. What it shows that more and more televisions are coming up in to the disposal stream, as oppose to refrigerators and DVD player. After television, it is the DVD, then its refrigerator, it is about spectatorial description and, same thing for we say that desktop business computers are coming up in very high number.

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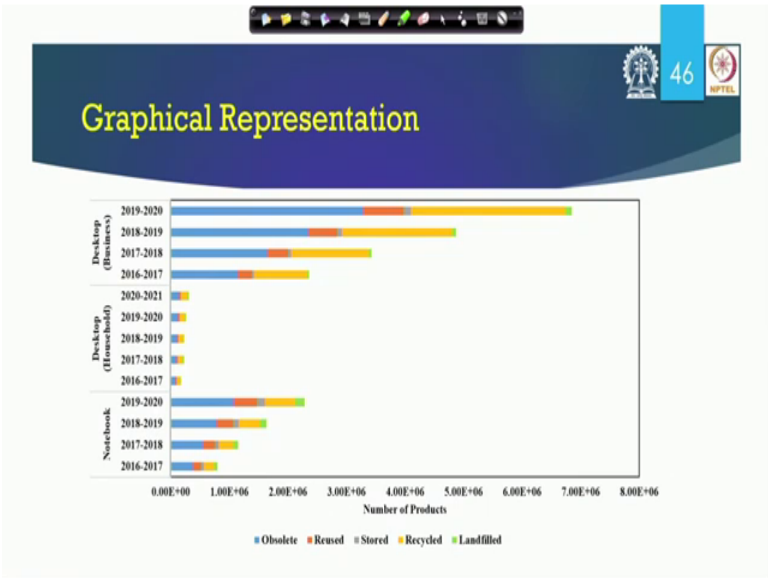

Then we have notebooks, notebooks are being changed more frequently, and then you have the desktop. The blue is obsolete many times you see that obsolete numbers are much higher. So, blue is the total obsolete computer; that is coming out and then the other bars, which is a reuse stored recycle and landfill. They will essentially if you take those numbers again, the reuses orange is stored. The grey recycle is the yellow and green is the landfill, and we see that the yellow portion seems to be much higher in most of these categories, which indicates that more and more of this is being recycle, but mostly in an informal setting.

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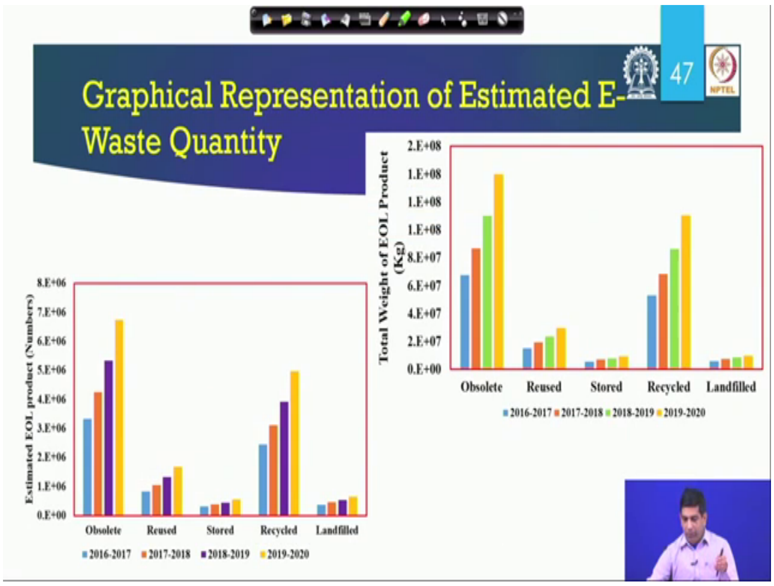

So, again from in terms of the numbers estimated end of life for different years, when they, when we, and when we add these numbers together for different types of electronics, we get again for different years as number of years, we its getting more and more as you can see as the, like the blue is for 2016 17, orange is for 17 18, purple is for 18 19, and then green blue is. Sorry this all yellow is from 19 and 20, and you see as the number of years are going up more and more electronics are being disposed both, and from the weight as well as from the numbers from the point of view.

So, with that this is how we can estimate. This is how we can estimate the E-waste quantity, and that is. So, we had looked at how to do the estimation. There were four different ways to do the estimation. We did a like a quick overview of that, then we all looked a. We took this four, I think with 6 items from. Yes, 3 and 3 6 items we took, and we tried to estimate using the time series analysis for Kolkata city, using the data available in two different literatures, and then collecting those data we have not done our own data collection. We just relied on the data which was there available in these two studies. And then we use this time series analysis to come up with this, to illustrate a case study for you to how to estimate.

So with that, I think you should have understood what, how to say if you have to estimate for your city, you should be able to go ahead and do that and, but again any questions feel free to put it in the discussion forum. We will be more than happy to answer. And again I will see you in the next video.

Thank you.