Course on Integrated Waste Management for a Smart City
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Module No 07
Lecture 34: Thermal Treatment

Okay, so let us get started with now this is the 4th module of week 7. So as we will as I said towards the very end of the last video this, from this particular module, we will talk about the thermal treatment. Maybe this and the one after this, so these 2 will be required to talk about the thermal treatment. So in terms of the waste treatment technologies, anaerobic digestion, and composting, those are mostly focussed on the organic fraction. And among the organic fraction, the biodegradable fraction.

And when we talk about the thermal treatment, we are talking about things which have a good calorific value. So as part of a Smart city initiative, say if you want to build a waste to energy plant which is very getting very popular in Indian context to have the waste to energy plant. We have to 1st of all the foremost thing we need to know is okay what is the calorific value of our waste? And when I say the calorific value of our waste, it is a waste which will be coming to the waste incinerator.

That is again very very critical. If you think about the waste that is produced in the home, if you take even the recyclables that most of us keep separated for our kabadiwalas who comes and take out the newspaper, take the magazines, newspapers, old books, kids schoolbooks, school notebook, textbook, whatever, if you are throwing them away, you do not really throw them away in a trash can. You try to sell it.

You may get whatever, Rs. 4 per kg, Rs. 6 per kg, Rs. 10 per kg, there are different rates for different items but we do get some money out of that. So people have a tendency to sell it and most of those material actually end up in the informal recycling stream and then finally goes into those recycling places. So they do not really show up in the municipal solid waste in the municipality dumpsite. And same thing with the plastics. Most of the good quality plastics actually end up there.

But we still have some papers, we still have some plastic, we still have some packaging material, we still have lot of things which can potentially be recycled but the technology is not out there right now in Indian context or it is economically does not make sense to recycle those or it may be contaminated with something else. You have that pizza boxes which is actually very good, can be recycled but then if you have the pizza sauces and everything mixed up with that, it does not get recycled and comes to the waste stream.

But out of, in the waste stream also, what comes to the primary collection point and then to the secondary collection point, and then to, finally to the dumpsite or to the incineration plant, the amount of, the nature of the waste also changes a little bit. Even at the primary collection or the secondary collection, we have these now rag pickers who will try to take out some of these valuables, specially some good plastic, some good paper which could be there and then again these plastic, papers, have good calorific value.

So what I am trying to say is that we need to be really careful in terms of when we go for waste to energy design, to know realistically what is our true calorific value of the waste. Many times what the mistakes that we have done is we have actually taken the calorific value to be too high because we take even the waste we are trying to I think maybe my suspicion is that even at some places, the amount that is given to the kabadiwalas is also included in the, in those calculations because some of those calorific value data that I have seen is like 5000 kilocalories per kg and those numbers are too high even from the context of the Western world where they I would say there are those kind of kabadiwalas and rag picker system is not that much common.

So you do not see them over there and then most of these waste does end up in the land flow or in the recycling stream. So for the thermal treatment calorific value, like have a very good understanding of what is the real calorific value and the calorific value of not the waste produced at the homes but the waste which will actually show up at your door at that thermal treatment plant. So that is like if once we figure that out, that is where we are making mistakes and that is why we have many times, our waste to energy plants does not work because our calorific value gets diluted.

1st of all this ragpicker and the kabadiwalas takes away papers and plastics, good quality which is very good in high calorific value. Then we have mixing of non-calorific rich waste like street

sweepings, construction and demolition waste, bricks, concrete, all these things are mixed into a our dust, dirt, those are all mixing with our regular MSW which is goes to the dumpsite and then if you take the same waste and take it to a waste to energy plant, effectively you are mixing so much of the waste material which are very low in calorific value that your effective calorific value goes down.

So make (())(5:12) what does that mean? That means that we need to improve the system. 1st of all we need to, the problem is many times we do not acknowledge the problem that we have. Most of the municipalities and ULBs, they know on their back of their head but they are afraid to put it in the front, on the table that hey, we have this problem, we have this collection issue where all the waste is getting mixed up and for this mixed up waste, your waste-to-energy plant is not going to work which we know that but still we go ahead with the project because somebody wants us to go ahead with the project and then the project fails and unfortunately, the technology gets the bad name.

You all know those of you who are working in the waste to energy waste management area, you know the example of the Timarpur plant which was the 1st waste-to-energy plant built in India in 80s and you know what happened to that. So we do not want to repeat the Timarpur mistakes again and again and again. We should learn from those mistakes and be honest about the situation. That is the major problem we have is many times we are, we know what we knows the details but we do not put it in black and white on the piece of paper that we are, I do not know why we are afraid to do that.

Unless we acknowledge the problem, then only we can solve the problem. And so and then that is a big thing in terms of waste to energy plant. So talking about that, with that things and background, let us look at why this but again waste to energy is a very good it is a good component of integrated waste management and it is being used in many countries, many like Western European countries, Japan, Korea, those places, they are doing a lot of waste-to-energy, China is building waste-to-energy plants like many waste-to-energy plants are coming up in China.

So that is something could be done in India too. There are now technologies which can work with a low calorific value, at least they claim to work with a low calorific value. We need to test

those claims. And the places like IITs can be used to test those claims. So we have the expertise to help ULBs, to help the industry or the government or whoever wants the help. To to test those claims whether that technology is really going to work or not going to work at least and then we can go ahead with those projects.

To make it successful, ultimately the goal is to solve the problem of waste management. It does not really matter which technology which you use or who mad RW are against Modi battery-e the decision, who does not made the decision. At the end of the day, if our garbage is managed properly, it will lead to less impact on water, less impact on air and less impact on our water and air means less disease for our fellow citizens and that means better productivity in the economy.

I think people were talking about that as I think I have said that earlier as well that there cannot be a healthy economy without a healthy workforce. To have a healthy economy, we need a healthy workforce and to have healthy workforce, we need to clean up the environment because that is environmental pollution issues are one of the I would say big problem that as a country we are facing today and it is going to even multiply in future if we do not start addressing them in a very big scale. We have to start things happening on the ground.

So with those things in mind, let us start talking about this thermal treatment, what are some of the basics of that and how it could be applied in the Indian context, how it can be and what are the pros and cons and what are the things we should be careful about when we are trying to use it in country like India.

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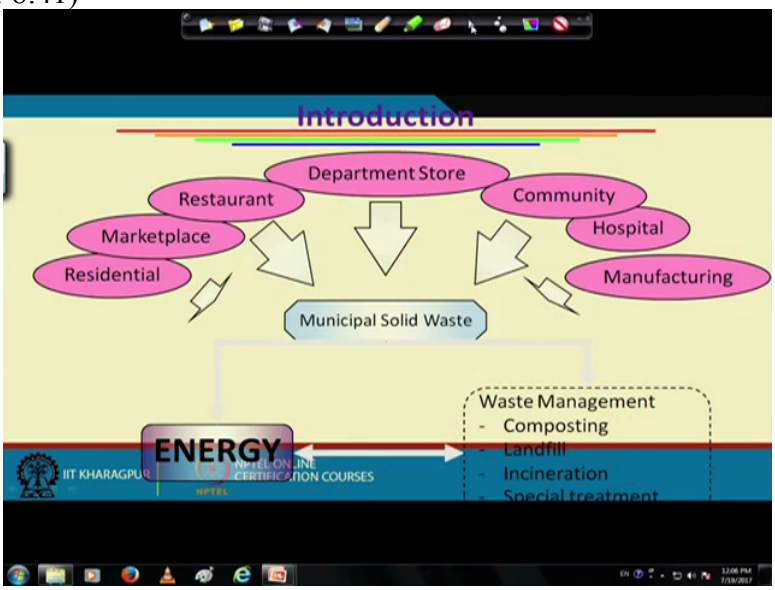

So as you know the municipal solid waste it comes from variety of sources, we already kind of talked about that. So initial few slides are just a recap of what we have been talking about so far and then we will go into specifics. So we get waste coming from variety of sources, these are some of the sources were our municipal solid waste comes in. Municipal solid waste, it can go for composting, we talked about that. It could go for anaerobic digestion, we talked about that. Then, landfill is there. Incineration is one part where it could be used.

So for these, for some of these processes can produce energy, some of these processes use up energy. So as part of the incineration, of course it uses energy and also produces energy. So we have to look at what is the net energy gain. How much is the additional energy that could be produced using a waste to energy plant. So that is, is the part of that.

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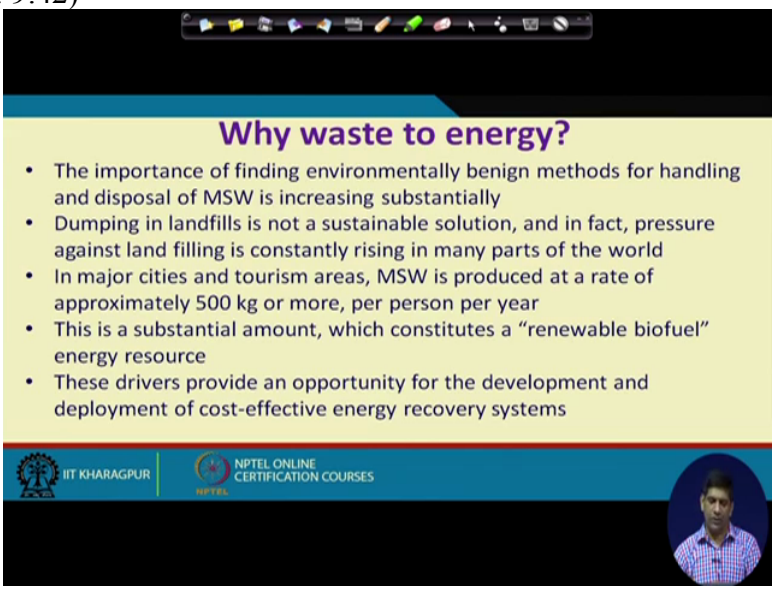

So why? Why waste to energy? It is it is one of the like environmental importance of finding environmental safe methods of handling and disposal of MSW it is increasing substantially. Like we are trying to find how to better manage our municipal solid waste. Dumping in landfill is not not a long-term sustainable solution because I think, I did show you that how the globally waste is managed. If you forgot about it, go to the 1st few videos, I think it might be the 2nd video or maybe in the 1st video itself, I am not sure right now, in the week 1 but where we had the global map and you saw how the waste is managed globally.

That data was few years old, 3-4, I think around 3 years old but still the data does not change overnight. You see that for most of the countries, the landfilling, the bottom part was actually very high. Even in European Union which is doing pretty good, we have the 30 percent of the waste was going to the landfill and UK, 49 percent and US, around 54 percent and India, 91 percent if I remember that. And in some of the African countries, nearly 100 percent waste going to those dumpsites.

So that is not the way to manage the waste because we have that is by putting them in the dumpsite, we are polluting the environment, we are polluting the soil, we are polluting the air, we are polluting the surface water and all those things and potentially groundwater as well. So but that is not the sustainable solution, dumping in landfills. Dumping in landfill is not a

sustainable solution and in fact pressure, landfilling is constantly there is pressure against landfilling is there.

Unfortunately as of today, we do not have technology to not have landfill. I would love to have a day when we do not have to build a landfill. But as I said I think in the earlier, in one of the earlier video as well, unfortunately we do not have that technology available today as even the European Union, 30 percent of the waste goes to landfill. Some of the best cities also send few percentage of the waste going to the landfill because even after waste to energy plant, you will have the residual, the ash, the bottom ash and the fly ash.

Part of the bottom ash and the fly ash, you can use it for certain purposes but there will always be some waste material which has to find a resting place and landfill provides that resting place. So that is why we may not like the landfill but still landfill will be there and at least in next 20, 30, 40 years. So what we need is actually, build engineered landfill. That is one part of the solution but we need waste to energy plant, we need the compost plant, or the anaerobic digestion plant based on the situation.

So everything needs to be on the table and then based on what works better for your city, for your smart city, you choose that because things that may work good for Delhi may not work good for Cochin or what works good in Ahmedabad may not work good for Guwahati. So it depends on your local condition, the type of waste, the weather condition, the rainfall pattern, all those things plays a role in terms of coming up with a better design of integrated waste management plantt.

So landfilling again, we do not want to have but unfortunately, we do not have any other option. We do need landfill at least for the waste after doing all the treatment. I am not saying just take the waste, put it in an engineered landfill. That is not the solution, that is not a sustainable solution. You do the treatment but the residual from the treatment will be there and that will, you will need a place like landfill which can take those material because we have to dispose those material somewhere. That is why European Union has been working on this for last 40 some years.

They still have to have (())(13:29) landfill but the landfills are engineered landfills, not the dumpsites. So in major cities and tourism areas, municipal solid waste is being produced at like a big rate. There is substantial amount, there is lot of renewable biofuels, energy source is there and that is why we need, there is a possibility for development and deployment of cost-effective energy recovery systems. So there is a lot of, there is a interest in waste to energy and there is a waste to energy can be done if done if it is done properly. Only thing is that proper selection of technology and proper homework before to use that technology.

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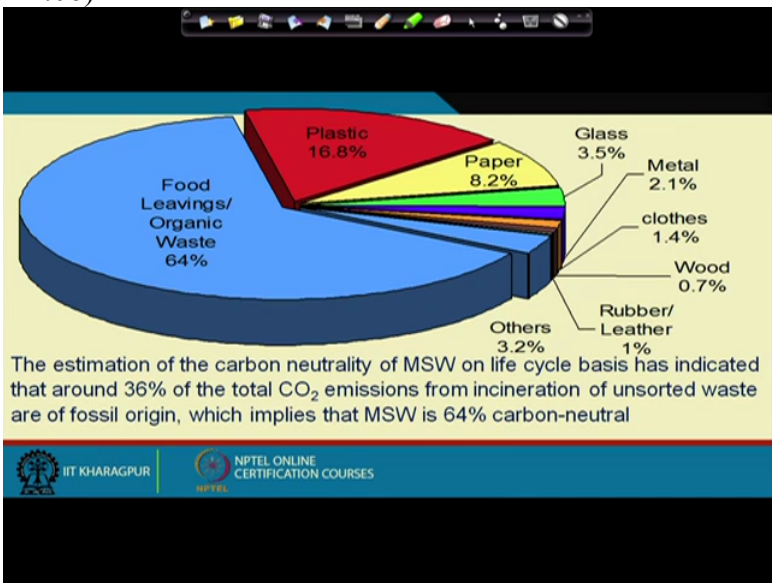

So in terms of MSW if you look at, in terms of the amount of food leavings, organic waste and other stuff, you have nearly 64 percent is organic. So which could be used as a energy source. So in terms of the carbon neutrality, what is the based on the life cycle, as indicated that 36 percent of the total CO2 emissions from incineration of unsorted waste are of fossil origin which implies 64 percent is carbon neutral and this is again, this carbon neutral is kind of a piece of debate.

For now we will just take it that anything which is biogenic carbon, is the carbon neutral and anything which is the fossil fuel origin, is like not this is the CO2 emission from incineration. So in terms of what it is trying to say that incineration even works out better from a climate change perspective and then you have plastics, papers, and other things, plastics, you have the plastics here.

We have the plastic, paper and other material which here is we have the plastic, we have paper, we have wood, we have clothes, so all these materials, we will burn and we will produce energy out of that. So those things can be, has calorific value as well.

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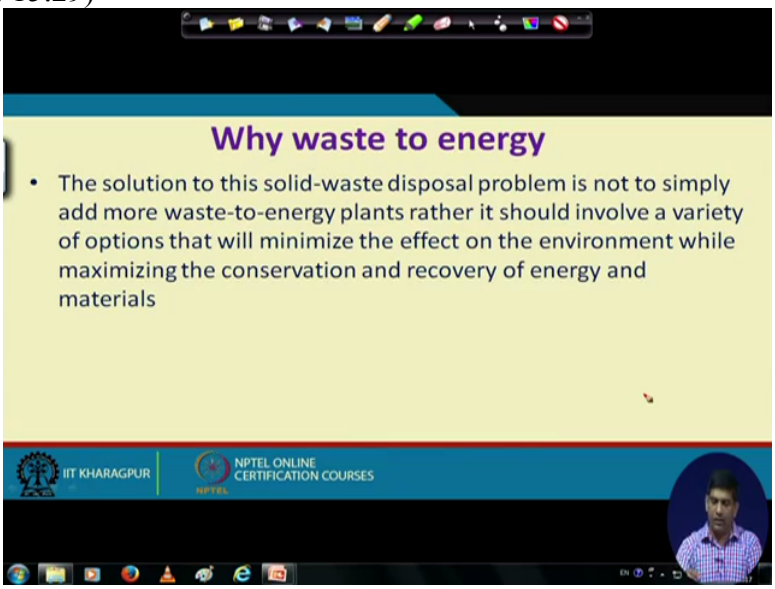

So why waste to energy? It is a solution of solid waste disposal problem. It is not to, it is solution is not to simply add more waste to energy plants. It should actually, there should be a variety of options as we were talking about, we should look at variety of options. And the ultimate goal is to minimise the effect on the environment while maximising the conservation and recovery of energy and material. So waste to energy is part of it. It is one part of the one part of that solution but it is not the only part of the solution.

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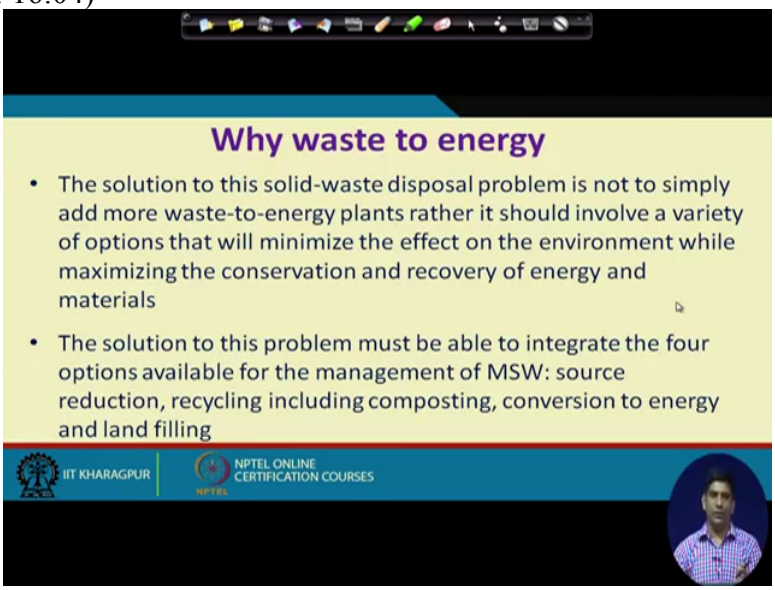

So the solution of this problem must be able to integrate the 4 options. There are 4 options for the management of MSW. We have the source reduction, we have recycling, including composting, we have conversion to energy, and landfilling. So all these 4 options has to be on the table and then based on where you are, which one will work, how is the market situation, what products you can sell a want of recycling, whether the compost can be sell there, whether anaerobic digester can be setup with the production of gas and the gas could be used as the energy source.

Waste to energy, whether we have a good calorific value. So all those things need to be evaluated and then we can come up with a solution which is integration of all the 4 options which is available for the waste to energy.

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And as the population is becoming more and more urban as you can see from this particular graph, this is like a population Y axis shows you the population and living in urban areas and X axis is showing you the year. So we are somewhere between 2016-18 right somewhere over here 17. So if you look at this data we are looking at, I am not using a scale properly here but almost we are slightly more than 50 percent now. So we have more population living in urban area than in rural area globally.

This is a global data. So people living in urban areas are actually more than the rural areas. So what does that mean? Urban areas, more waste produced, more like a more stress on the urban infrastructure, we have more slums and those kind of developing from there. And all these adds complexity in terms of the development of any smart city or waste management system and all that.

So more and more urbanisation, more higher is the amount of waste that gets produced, that is historically what we have seen. So that means more and more waste coming out, more and more ways to handle by these municipalities. And then as we reach around 2040, when say some like our kids will grow up, nearly more than 60 percent, 60-65 percent will be in the urban area and that would be a big challenge in terms of managing the urban infrastructure.

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So that is why development of a good integrated solid waste management plant is very very critical. So this image actually it is coming from US EPA, one of the US EPA document. So when we talk about integrated solid waste management, what we are saying that you need to, you need to talk about waste prevention, you need to talk about recycling and composting and you also need to talk about combustion, landfilling and incineration.

So all these things should be there. So it is all this part of the pie has to be there and then together they give you a good integrated waste management system. And when you try to go about all this stuff, you need to really talk to local people.

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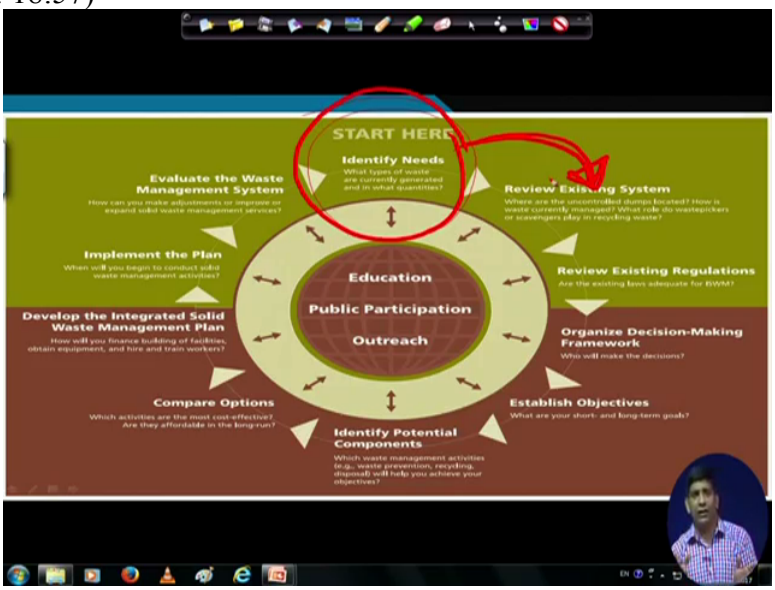

So it is in terms of development of integrated waste management, this particular slide you saw in the introduction video, so you start from for any particular city, say you are trying to have a smart city, you are developing a smart city where you are trying to have a very good waste to waste management plant. That is the ultimate goal is to have a good, working, sustainable waste management plant. So for that 1st of all, the number 1 what we need to do is to, you start with, you identify the need.

1st step is, what type of waste and currently operated. So what is what is the need? what is our need? What is a very requirement? Different cities may have different requirement. Different types of city will have different requirement. So once you have this requirement identified, you review the existing system. So there is something going on, may not be perfect but there is something going on in the city right now. So once you have identified the need, the next step is, you go and look at the existing system.

What are the things that we among the existence system is working? What is not working? Many times people will say, nothing is working. That is not really true. Maybe around 5 percent is working, 10 percent is working, 20 percent is working, we should not be that much pessimistic as well. So but in terms of the existing what are the good things which is working in the so if we have uncontrolled dorms, where they are located, how is the waste currently manage? What role do waste pickers or scavengers plays in recycling waste?

So that is actually in many cities, they are doing a very good job in terms of that. Then what is the existence of regulation? We need to also look at the regulation part. What is the existing regulation? What are the existing laws adequate for integrated solid waste management? Is the law not only adequate, is it really implementable? Many times our laws are really too strict to be implementable. That is also even as a very good environmental friendly law abiding citizen of the country, you may not be able to follow the entire rule of the municipal solid waste because it is you do not have the infrastructure.

You do not, even if you want to follow the rule, the infrastructure is not there to help you follow the rule and then you basically give up at some point of time. So whether the, we need to even have a very critical evaluation of what is the existing regulation. Is the existing regulation good enough? Is it too good to be implemented? So those things, whether it is implementable, that is again another area. I do not know how closely we think about.

That we have to also think about that the rule, we may, we can make the best rule in the world but is it really going to be implemented? The rule of say if we take, if we compare our rule with Western European countries and try to take their rule of today and try to implement that in India as of date, as of today date, it is, I would say it is not proper. I have a strong reservation of that because the European Union worked on this waste management for nearly 40 years and then they came up with a rule that they have today.

This was not their rule 40 years ago or even 30 years ago or even 20 years ago. They are more stricter today because they built up the system. There is a system has to be built up, then you can have a very strict rule. In the very beginning if you make a very strict rule, then the rule cannot be followed and even this easier part of the rule will be ignored because they say okay I can hardly do anything about this rule, so what the point of even following even 1 percent or 10 percent or 20 percent which I can follow?

So let us make the rule which is can be implemented, which people can follow and build the capacity. As the capacity is built up for, for the municipalities, for the ULBs and make this, then keep on, the rule has to go along with the capacity building. We cannot have a rule like at a very high-level and our capacity is at this level, there is a lot of gap in between and that unless those gap is filled up, we cannot follow the rule. We cannot even only always blame the private sector

or this, it is actually to build the capacity itself is a requirement of the, is a government requirement.

We have to build it how people have done it around the world. So it is because that is it is a building of the infrastructure. Those things we need to do. Of course you can have PPP and all those things coming into picture. so regulation, this is again it is very very critical to look at the regulation, how to, what whether it is, how is, then the numerous solid waste management rules, 2016 which we already kind of reviewed little while ago in few weeks ago that simplifies the thing but still there are certain problems which we highlighted during that talk.

And then you organise a decision-making framework, like who will make the decision? That is another, so in my view, the technical decision should be left to the technical people. Or the policymakers and other places should get a very good technical input when they make any policy. Unfortunately, that, it seems that that is not happening very well especially in Indian context. And so we need to have a decision-making from like who will make the decision?

Like, technical decision should be left would technical people. Of course, the policymakers, the our leaders, our ministers, they are a ultimately they are responsible so because they are the elected representatives but then the technical people are also there. They also have certain responsibilities. So if there is we need to, the technical input should be solid enough and it should be, if say I will give you a hypothetical scenario, certain minister say if a certain minister wants to get certain thing built but see, Minister may not know the technical detail and if they may sometimes may even get influenced by some vendors coming in and trying to give them a very beautiful presentation.

But as a technical person, people like me who is there in that particular organisation, it is their responsibility to tell that minister or whoever is there that Sir, this is not really going to work because of this this this this problem and then probably we can make it work in this way or the other way. Rather than going ahead with this blindly with that project which that person who is actually implementing the project knows that the project may fail because technically it does not make sense to him.

But he is doing it just because there is a pressure from up. That is why he is going to implement that project. That is really, that is we are wasting money. And then ultimately, everybody gets a bad name. So we have to be, we have to start getting out of that mindset and hold our ground sometimes. It may like look bad for a minute but ultimately, people will realise that this is what needs to be done. So get very critical like who makes what decision and people like my, people should make decision based on their expertise.

Then you establish the objective, what is what we need to do. So than what I am trying to cover is how to go about setting up a integrated waste management plant for a smart city and then you do establish your objective, what what objectives you have in terms of short-term and long-term goal because there are certain things you can achieve in short-term, certain things will take a long-term to, then you find out what are the components, what waste management activities you can do, whether city has certain limitation, whether should we go for waste prevention, recycling and it will help you to find out your objective.

Then you compare the different options, you do your come up with the options, compare the different options and then develop the integrated solid waste management plant. So this is how it should go about. Right now, like I am working with city of Guwahati, GMC, Guwahati municipal corporation to develop their integrated waste management plant and I am trying to follow the same route. Of course, there are certain limitations there in terms of certain logistics and other things but we are trying to follow the same rule.

And that is what ideally I think it should be done. There will always be some variations here and there but we can go around this route and then we can come up with our integrated solid waste management plant. So once we have this integrated solid waste management plant, city should go ahead and implement it and then once you implement, then again you will find out that you have to keep on evaluating it from time to time and then you keep on modifying it from time to time.

So that is evaluation and modification is also needed from time to time in terms of, so then again the circle kind of continues. So this is how it is done. I was, we I used to live in just outskirts of Toronto. There was a city, so I stopped on their city solid waste management plant as a co-chair

of management plant steering committee and we used to follow the same principle like every 5 years, we the city will come back and revise it. It is a dynamic exercise.

You identify your need, go about all the steps, then you come up with the plan, you implement the plan and then you learn something new, you evaluate it, so every 5 years, you come back and revise your plan. So that you keep on improving and improving and improving and that is that is how our regulation also needs to keep on improving. And once we make all those capacity building, then our regulations can become more stricter, stricter, stricter.

So if you make the regulation too strict to start with actually, it becomes too hard. So as we say that in Hindi we say that if you pull the thread too hard, it will break. So that is what the problem here. So if you make the regulation too strict, that that things will break and then the whole system does not work. So I am not saying that make it to relaxed and let everything go to hell in terms of the environmental problem.

But I am saying that we have to look at from a realistic point of view. So that is in terms of I wanted to give you a very quick overview of how these things are done. So we will come back to our thermal discussion in the starting in the next video but these 2 were very very like important in terms of looking at the integrated waste plant. We did talk about this in the very beginning of the class.

So kind of in the middle I wanted to recap and regive you these are very important concepts which you should take away message from this course and probably at the end of the course again, we will talk about something similar to kind because something which is important needs to be told again and again and again so that that stays in your head. So with that again any questions, any problem, any issues related to the course, you are more than welcome to put it on the discussion board.

We will be happy to respond to you and I hope that you are enjoying the course you are and it is helpful to you. If there is certain topics which like you thought that was not covered well, you can always give your feedback as well. Any feedback keep appreciated. You do not worry about that. So just give your feedback, we still have 4 weeks left, we will try to discuss that or if we

cannot do it, at least in the next course, in the next revision of the course, we will try to incorporate it.

So the goal is to make this course better and better. And it is more useful. So if any components which you think as a waste practitioner if you think we forgot to mention, we forgot to talk about, raise that in the discussion board. We will try to bring it to the course and try to address it in the remaining 4 some weeks that we have. Thank you.