Electronic Waste Management - Issues and Challenges
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Lecture - 17
E-waste Management (Contd.)

So, welcome back, we will be looking at this in this module we will be focusing on the concept of this lifecycle analysis. So, when do I say lifecycle analysis is essentially to find out the environmental footprint? As I said in the beginning of the previous video that in the beginning of this week that there is a parallel course going on LCA; with that say actually a whole 8 week code.

So, we will not going to cover that much detail here; we will just cover that how LCA; what is the basics and how the it has been used in electronic industry and what does that really mean in terms of the future of electronic industry and also the future of how what kind of E-waste will be generated. So, that is because it is all related there based on because E-waste is generated from the discarded product. So, I will the display the product design changes the waste will also change.

So, let us look at that. So, will be talking about the LCA and the sustainable engineering concepts especially from an angle of electrical and electronics industry. So, that is kind of the focus of this particular module.

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So, in terms of; what does it mean to be green; so, many times we say it is a green, but what we are actually what we really mean.

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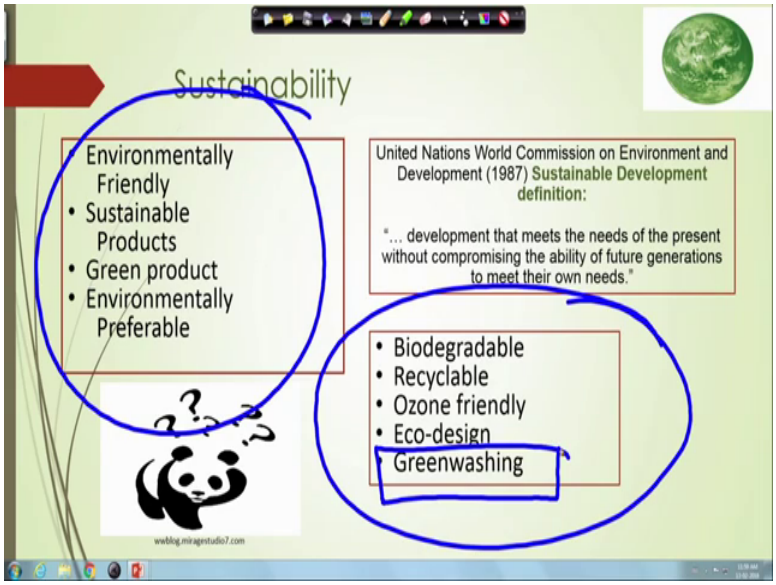

By a green that is will try to talk about that when we say green what is that mean; what is the meaning of this green? What is sustainability? What is this? What do we mean by sustainability?

So, green as essentially we are many times when we talk about green it is say trying to be environmental friendly that is what the green is trying to be more in trying to be environmentally friendly where you can come up with a process which has less environmental footprint and maybe a process which is a better for the environment, but these are all qualitative numbers when we say green or better for the environment.

So, like ok but how to quantify that how to know the number that this is really better and that this process is process a is better than process b. So, those we will try to quantum it to try to see how this environmental footprint could be quantified and then this all get into the big picture in terms of the sustainability which people are talked about all the time in terms of what is sustainable what is not sustainable and those we will be looking at that aspect.

So,. So, sustainability many times you hear the terms here when you look at the sustainability you here the term that environmental friendly sustainable product green

product and those are all different terminology used and there is also it stuff on biodegradable recyclable ozone friendly eco design and then there is the concept of green washing as well there is a lot of green washing going on green washing means people present something to be green, but they are actually not green. So, you may where it is presented as if it is a environmental friendly, but when you do a LCA exercise when you try to kind of environmental footprint you will find that it is actually not that much of environmental friendly as it is projected to be. So, that is called green washing and it is also happening with many products and processes.

So, why all this concept is started which again I explained it varied in detail in other class, but here in very simple way, I would say that there is a lot of demand for resources and that demand for resources led to this concept of the sustainable development because the population is going up the well population is going up if the power of purchase power is also going up in within the population. So, there is a concept that we should have a sustainable development.

Now, what is a sustainable development that has been defined if you can see over here the development that meets the present without compromising the ability of the future generation? So, that is what the sustainable development that meets the need of the present; so, without compromising the ability of the future generation to meet their own needs. So, that is what we talk about when we say it is a like it is a sustainable development.

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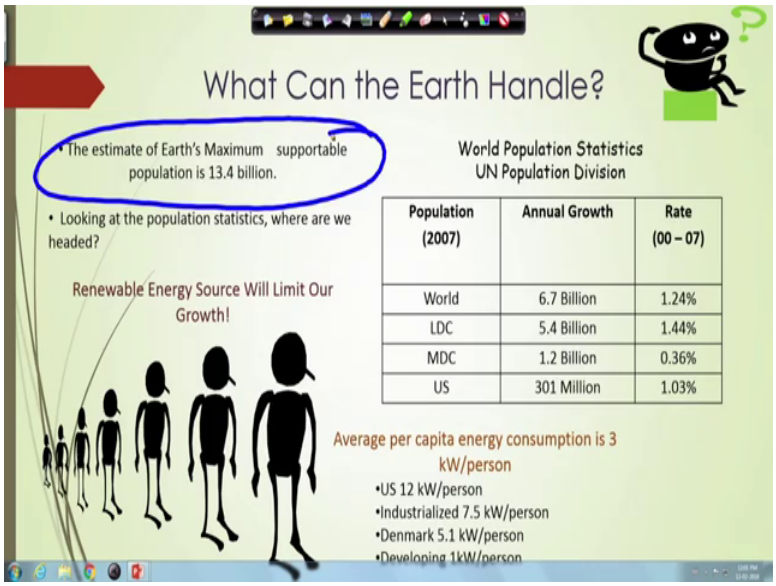

So, within that framework of sustainable development we have the concept of this sustained like life cycle and other things have started. So, it and then it all goes back to home what can really the mother earth can handle because it is there is a certain things it is even the elements which are an abundance they are they also have a certain x number of quantity. So, if we keep on using them the way we are using it we will run out of that unless we start recycling replenishing and all that. So, keeping those things in mind what is that what is the earth maximum handling capacity how much how much things that are the mother earth can really handled.

So, there is a estimate of is population is around thirteen point four billion that is what people say that estimate that is the maximum population it can is can; so, sustain and looking at the population in statistics where we are headed if you look at the annual growth in terms of in last decade like a almost 10 years back. So, world was 6.7 billion and then annual growth 1.24 percent lower developing country and the middle developing country and an example is given with a US. So, US is 1.03 middle income middle developing country or they have 0.36 and low developing countries 1.41.

So, Asia, Africa, they are actually growing at a higher rate than rest of the world; world is growing at the rate of around 1.24 percent that was almost 10 years back and if you look at if you compare that with the per capita power generation in US, you have around 12 kilowatt per person where industrialized in the developing country, it is 1 kilowatt per

person and the other numbers is kind of in the middle. So, there is a; there is a; if everybody and then in the developing country there is a kind of I would say people have that trying to follow the so, called American way of living that is many times people think that that is the best way of living although now the Americans are thinking that eastern way of living is actually better than the western way of living in certain parts.

So, again certain things in is good certain things and good and waste what we should do is try to take based of the both world rather than taking the worst of the both world for which many hence we do with that is why many people when they say that oh the western civilization is harming Indian kids and but what about the western we are getting very influenced by the western culture, yeah, but you can choose you can put some filter in between and choose the culture the practices of that culture which are actually good like maintaining time being ethically correct when most of the time forget about the politician.

But in most of the time that they are more in general people are ethically correct maintains the office time government offices the way the work ethic take those from the western world because they do not take our car system and then our other tower drawer system and other things they do not take those from us which are our bad things they all they take your they take those kind of good habits even family a joint family culture.

So, that is coming in some of the western countries as well. So, take the best and then and then use that to your advantage you do not take the worst stuff. So, it is a you are given a platter you can choose the different cultural components from there if you are getting influenced by the western world choose the best one same similarly for the westerners when they look at the eastern world, they can choose the best one and the world will be a much better place.

So, and these population that we will be coming, but a future population can enjoy the world are much better than what we are enjoying today so, but what why we got to that discussion is over here.

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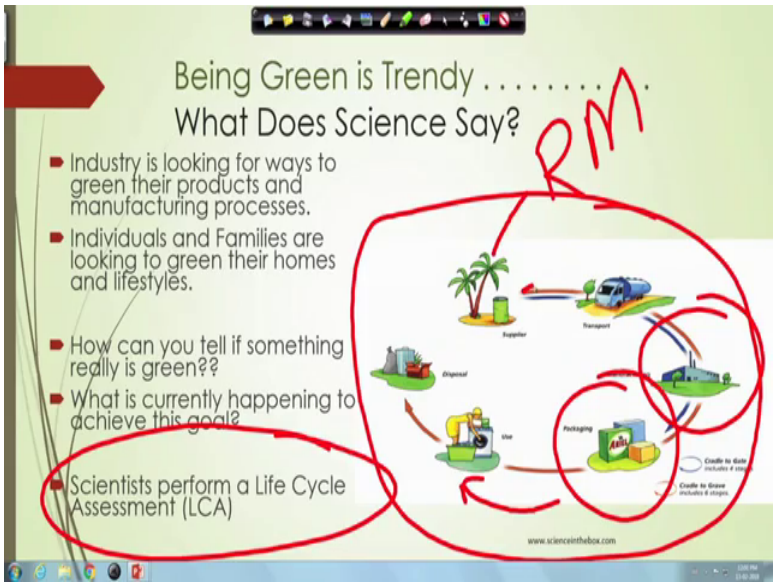

When we look at this average per capita energy generation US 12; 12 kilowatt, US you have 12; 12 kilowatts per person. So, if the entire world starts following that u s lifestyle, then we will have lots of energy requirement energy requirement means lot of coal required whatever fuel, you use coal nuclear was different fossil fuel renewable energy even for renewable energy you need to set up infrastructure that solar power the solar panels uses lot of metals and elements from the periodic table as well and those thing needs to be mine too.

So, when we think about that oh solar is great yes it is great, but all that also comes with an environmental price we need to see that whether we are paying enough way where we should pay less environmental price than what we were paying with the coal based thermal power plant and that is what it should be, but we need to quantify that too and those things we can quantify using this particular tool. So, which will be looking at in this in this particular we look trying to look at in this particular module. So, being green is trendy what does the science say industry is looking for the ways to make it green there are people out there who wants to be more greener, but how can we say that something is green.

So, what is the currently happening to achieve this goal for that to have that to do that as a scientist we try to do what is known as the lifecycle assessment we try to perform a lifecycle assessment which is LCA which we will talk about that. So, here as here you

can see a sketch has been provided to you and if you can look at it carefully and it starts from say your supplier when you get the raw material this kind of shows you the raw material. So, raw material coming from there then it is a transported then it comes to the manufacturing. So, your manufacturing is done then the packaging and then you use it and then after you use your dispose it. So, that is it is what is known as the cradle to grave the lifecycle.

So, you start it from the beginning from the raw material and you can follow this orange the first line from the top it goes to transport package manufacturing again transport in between packaging again transport then you use and then finally, disposed as a waste product either liquid waste or solid wastes. So, that is your concept of cradle to grave where from the very beginning to the very end there is the another if you look at the there was if we can erase this part and then if you look at the blue power line which kind of starts from the raw material then goes to the transport and then it ends after manufacturing one it reaches the packaging.

So, that is what is a typical factory when they are making any product they have supplier transport manufacturer and they send it for packet they do the packaging and then the thing is out of their gate. So, that concept is known as cradle to gate as you can see over here. So, the blue one is your cradle to gate. So, as soon as it leaves the gate of the plant thus it is we stop there the other is cradle to grave which we kind of look at the entire lifecycle from the very beginning to the very end. So, that is these are the 2 different concepts cradle to gate and cradle to grave which is important.

So, whenever you look at the LCA report, you need to be careful whether it is a cradle to gate LCA or cradle to grave LCA some stuff is actually more harmful as you can see cradle to gate has four stages if you look at that it has four stages where our cradle to grave has six stages now if something has bigger environmental footprint in the last 2 stage and they are pretty good after fourth stage like first four. So, it make good cradle to gate LCA may look very good in terms of the environmental footprint.

But you go to cradle to grave LCA, it does not look that good even it looks it may look much worse because the impact is much higher during the use and the disposal during the water the wastewater that is produced in the use or the electricity consumption is very high or for whatever reason, it has a irritation on the skin and the disposal when it comes

out in the environment what kind of impact it has. So, based on sometimes you need to be really careful like what LCA report you are looking at whether it is a cradle to gate LCA or cradle to grave l c a. So, will talk about that in a in this as well when and we also talked about that functional unit and all that system boundary.

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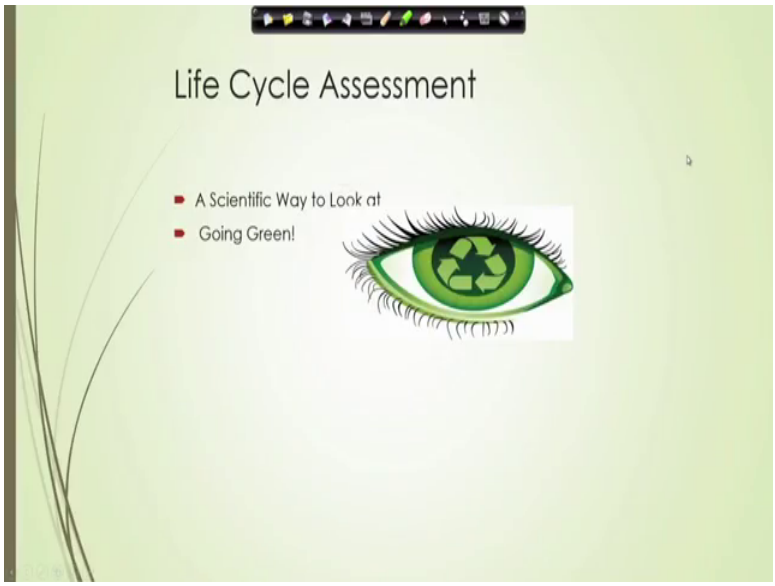

So, lifecycle assessment is essentially a scientific way to look at something going green. So, it is a scientific way to find out if things are really going green that is it; it is whether we are just we are just doing the problem sifting one example I would like to I am not saying I am not like one thing that we should evaluate and some of you who are out there trying to look for a masters project or even for a PhD project right now if somebody would like to do PhD on the topic you are more than welcome.

I can use this platform to do some marketing as well but anyway coming back to this course say what if you have following the news government of India is trying to promote electrical vehicle and that electrical vehicle will be used by 20-30 as per the present government announcement we will be having pretty much all vehicle will be electric vehicle, whether, we get there or not get there that is a different questions, but that policy framework as of today is goal is to get to electrical vehicle by twenty thirty if that is what my understanding was if I am wrong correct me on that you can discuss in forum is where you can raise those questions as well will be happy to debate an answer.

So, if you go to twenty thirty and then we also have some renewable energy goal we also have how much renewable energy will have whether we are walking on fossil fuel or and like a renewable energy non renewable versus renewable cause thermal power plants the solar panel.

So, we would need what I am saying why I am saying all that is presently that majority of cloud cars are running on petrol and diesel now if all the cars will run on an electric vehicle we have to produce lots of batteries at the first place which will go into those electrical vehicle the batteries requires lot of heavy metals and other stuff which needs to be mined anywhere in the world it does not matter wherever because we are LCA is a global we are looking at the global impact work world nowadays is a global village a pollution at any part of the world impacts the people in other parts as well.

So, we cannot just say that; oh it is too far it is happening in Kerala, I am sitting in Kharagpur, West Bengal, I am fine, I do not have to really worry about it, sorry, you will have to worry about that because the things are pretty much global these days. So, in terms of I am just talking about one country, but there are even the impact from other countries goes to does travel. So, looking at that aspect in terms of the electric curve by twenty thirty we have to make all these batteries the batteries will require a lot of heavy metals and other stuff. So, there is an environmental footprint associated with that.

So, that is a; we mean we should try to quantify and at the same time we have we have to look at what kind of energy we will use to recharge these batteries. So, because the batteries has to be recharged; so, the how to recharge those batteries what will those are aspect associated with that what kind of energy will go there whether it will is still maybe a maturity coal based thermal power plant coal base terminal power plant is known to have higher environmental footprint higher emissions and other stuff what kind of coal technology that will be used and so, it is just moving from the gasoline car to electric car.

It is may not really solve the environmental problem it may I know what I am not saying that it will not, but I am saying we need to quantify the numbers to see what is the real benefit we are going to get out of that are we getting the benefit and what is that benefit is that benefit worth the effort that we have to put I hope, it will be and as an environmental engineer I am happy that we are going for an environmental electric car,

but we need to look at the other aspects needs to develop along it as well. So, they are reasonable and like a; we need to get into renewable energy where which can support this electric car the type of material that will go to make those batteries has to be environmental friendly material. So, that they have lesser environmental footprint that is all those things needs to be quantified then only we will see the real environmental benefit otherwise what we have seen in some places that it is it just becomes like a problem shifting.

Now, what is that concept of problem shifting will get to that in this module I think, but just to give you a problem shifting is there is a problem in the auto M like a right? Now, why we are talking about this electric car the reason one being is that regular pollution that is happening on the road regular pollution is great, but what about the diesel genets on the mall most of the malls in they are running on diesel genets it is still many times we have we do not have the security of power in many places even in big cities where some of the exams like when we conduct certain exams using this computer based exam we were we were forced to run the centre the entire centre running on DG sets on digit on generator and producing a lot of air pollution issues.

Just because we cannot take the risk of even a 5 minute power cut because if there is a power cut there will be a lot of hues and cries the students are taking the exam and then of course, our unfortunately the friends in media becomes so hyperactive on many of these negative things. They do not unfortunates that is the really bad part I am big fan of media people, but they try to sow the negative stuff too much and the positive is stuff too little there are a lot of positives happening in the country as well that should be highlighted.

Negatives of course, you have to put that into public domain, but do not make it send does not sense analyze things. So, do not that is, where the problem comes in terms of. So, there that is why we like we have run we are even having lots of views running on this these are why how come these views are allowed to run on a diesel so, but and then in their own country like for example, Innova, Toyota does not have a diesel driven car in Japan. So, how come it has a diesel driven car in India?

So, how it was allowed in the first place to have that car it is a leisure car people should pay for petrol why they should take the advantage of that subsidy that is given to further

diesel so, but there are a lot of other issues and then if we go for this electric vehicle and that there is a say substantial less demand for gasoline what will happen to all these petrochemicals refinery companies the jobs there. So, there is. So, all these things have to be looked into that. So, then only we can make a decision.

So, of course, going towards electric is seems to be a positive step, but there are a lot of things that has to go into detail calculation to make it is it really how per much positive is step it is at the end of the day do we find that maybe it is only five percent or 10 percent does it really worth all this effort maybe, but we need to find that out and that LCA will be a very good tool to do that and it is not all it is.

So, somebody again say if somebody is looking for a PhD topic that is a pretty great interesting PhD topic well you have involved engineering environmental policy all kind of merge together in terms of trying to coin and then you do it with the real numbers and it is it is will be a challenging, but this will be really cool if somebody does that and of course, if you need any help with that you can always contact me.

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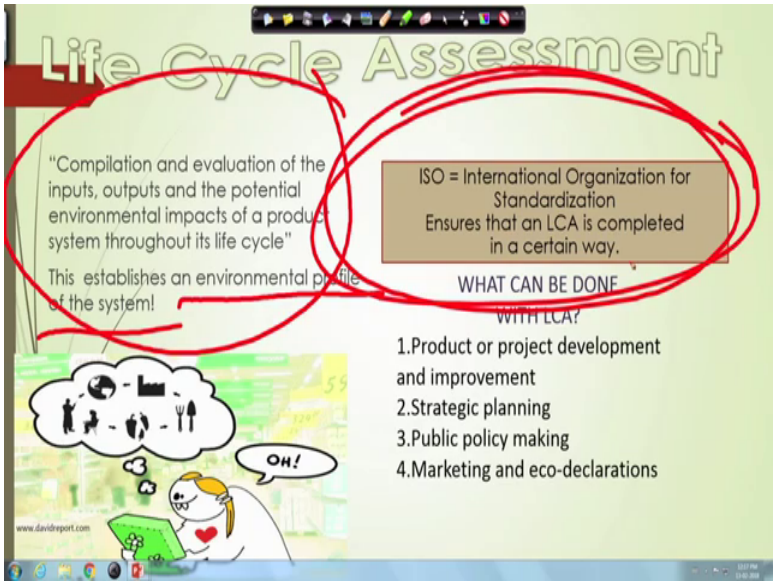

So, in terms of coming back to what is the lifecycle analysis it is a compilation and evaluation of input and output. So, it is an environmental accounting exercise, it is a compilation and evaluation of input output and the potential environmental impact of a product system through its lifecycle. So, you go from cradle to grave. So, essentially what you are doing is a environmental profile of the system you are making

environmental profile of the system. So, anything that we do we are using a tool we are using a method.

So, as you have done your water waste water lab at some point of time I assuming that most of you are environmental or somehow you have done some chemistry lab for sure or some you have done some testing. So, every testing has certain method. So, because should make sure that people say in India, we are doing this test the same tests being done in other places within India also at different places we can compare our values together.

So, there is a standard method for doing certain things. So, similarly for LCA there is a standard method there is an ISO method like an international organization that this is this is what is used this is the ISO method with that LCA is completed in a certain way. So, that throughout the world people is doing it in a certain way. So, what; so, we can do LCA on different stuff what can be done with LCA we can use it for product or project development.

An improvement to make it more greener a strategy planning public policy like that that electric vehicle that I said that LCA should be done do you really see what is the benefit and to also modify that policy if we need to it to make it a little bit different to have better, better, better return in terms of the environmental; environmental footprint because that is ultimately our goal; is it not the whole exercise of that is to get to have the less environmental burden and. So, that we have less environmental and human health issues associated with that.

And the things can also be used for marketing and eco declarations to make it how did it say green or not green how much green people nowadays there are some people out there in the to buy green product, but if there if you can quantify and tell them the numbers like how much green it is they are always happy with that.

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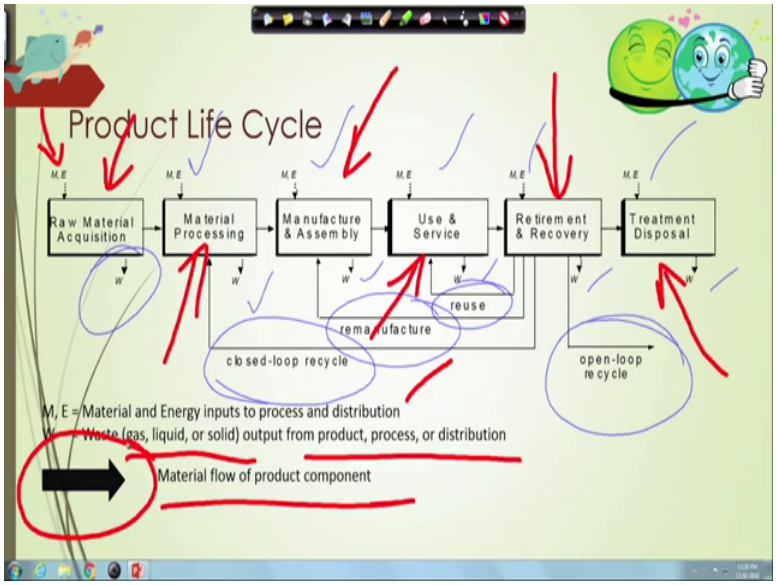

So, in terms of the product life cycle how it is done you start from the raw material acquisition let us see you start with the raw material acquisition that the first one that is basically from the mines then you have to do the material processing manufacture assembly use in service retirement recovery then you finally, have treatment and disposal. So, those are the steps raw material first you do raw material processing manufacture assembly use service retirement recovery and then you have treatment and disposal.

So, those are your steps now in between you say for each one of them you see M and E here. Now what is this M and E? This M and E is for material and energy material energy input and then you also see W at the bottom and your W is the waste that is coming out it is a solid waste liquid waste air waste whatever the waste which is coming out of the system similarly M and E here the W; M and E and then for each one of them you will have those. So, you see that bring up then out of the whole process you can have some which can be reused within the system. So, you have some reused material you can have some remanufactured material you can have some closed loop recycle things being recycled within the plant boundary and then it could be some open loop recycle as well.

So, those are also possible there could be another possibility these are just an example here. So, M and E is the material energy input process for the distribution no that is your M and E; W is the waste gas liquid or solid output from product process and distribution

and this is the material flow how the material is flowing is that this arrow is showing you the material flow from the raw material acquisition to the material processing to the manufacture assembly use and service retirement recovery and then finally, treatment and disposal. So, this is how this whole product lifecycle stuff is done.

So, what we try to do here is we try to do an environmental accounting exercise. So, we try to calculate all the inputs going into the system and also all the output coming out of the system in terms of emissions then we have taken the emissions data and try to quantify that in terms of the environmental impact. So, that is what we will see.

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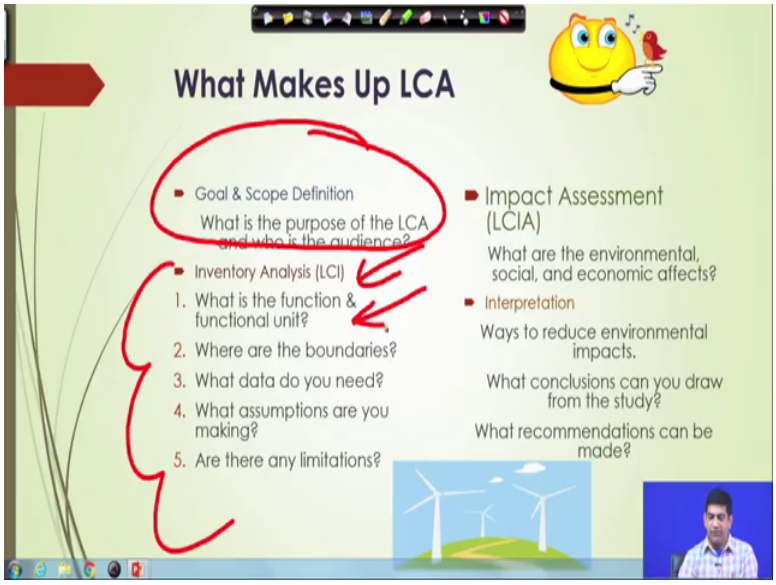

So, to do that goal to do the LCA for what we try to do like to look at their; what is the makeup of the LCA.

How they are in terms of like it; it is go what is the goal what is the purpose of doing the LCA what is the who is the audience who will use this data then we have to once we know what is the goal and scope we have to do what is known as the inventory analysis. So, after you have this goal and scope things worked out sorry after you have this goal and scope things worked out the next is what we try to do is inventory analysis inventory analysis this is the most time consuming part of any LCA exercise.

So, what is the function and functional unit what is the function? Function is for any particular product, but what we are trying to we also use some example and it will make

you clear function is essentially what a product what is that what is it what we will do what is an intended function. For example, if you are if you are for a pen the function is to write for a pencil the function is to write is not it that is the function the functional unit for a pen or a pencil could be writing of one page or writing of 10 page or writing of 100 page.

So, those in is mega with a similar margin and other stuff. So, that is becomes if that is becomes your functional unit. So, how what unit you are trying to compare. So, function the 2 products or process that are being compared should have similar function that is where, then or did we be a proper comparison and then you have to choose a functional unit on the basis of which you will be compared.

So, we will see some example will make you clear and then we have to come up with some boundaries and then what kind of data will be required what assumption needs to be made are there any limitations we will talk about those when we to some l c I will show you a detail example then we have an impact assessment what are the environmental social and environmental. In fact, that is what we try to find out from the emission that is coming in.

What are the environmental impact what are the social and economical in fact, but in terms of LCA that we will be talking about we are mostly talking about environmental for social and economic we do not do that as part of regular LCA, what is called the cost at what is called LCA which is a life cycle costing assessment the other one is the social LCA there are guidelines for that is also coming out.

So, once we do this assessment then why ultimately what we are trying to do is ways to reduce environmental impact that is the goal how to reduce the environmental impact what conclusions can you draw what recommendations can be made. So, this is how this LCA exercise is done in terms of when you in terms of when you try to go for like a making and help like a pretend to calculate the environmental footprint and its application for a product improvement; improvement of environmental performance.

So, let us look at one example and then will be closing this video.

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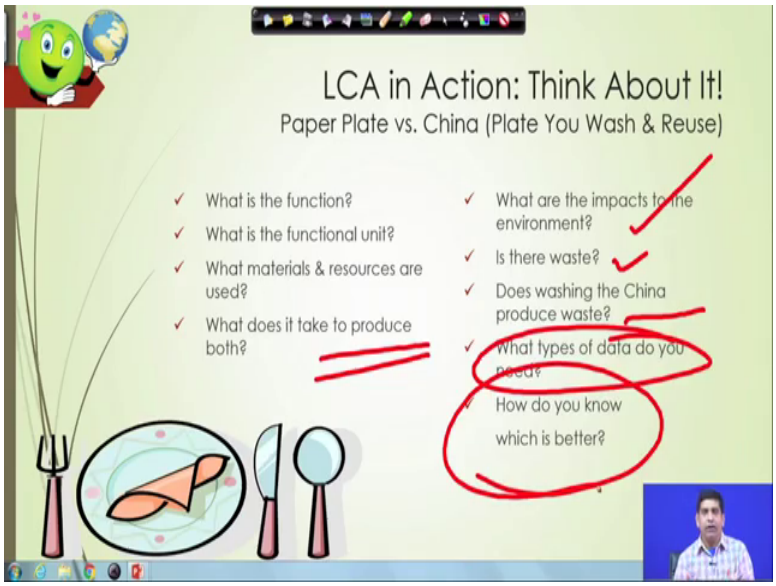

So, if you think about it see; what is that. So, let us say let us look at this example and then will close this particular video. So, LCA in action; so, think about that paper plate versus china plane. So, if you have to compare these 2 categories a paper plate which is that use and throw paper plate china plate is the plate which you have to clean it and use it again now for if you have to compare these can you compare one paper plate versus one china plate is it a fair comparison can is it is it to compare to the answer is no because the we know that if we do one to one competition one paper plate versus one china plate.

Of course the paper plate will win in terms of the environmental footprint because it will take less amount of energy less amount of material to produce it and then it will be disposed it is a paper plate even if it goes to the landfill it will have certain emissions, but if you look at the china plate china plate actually will have even it is a manufacturing requires much more power much more energy and much much more energy much more material and that could be used. So, what we in terms of these kind of stuff is we try to actually give them equal footing. So, there should be fair comparison. So, first thing we talk about is ok.

What is the function there are these 2 products, but what is the function of these products. So, function of all whether you use this plate or the other plate is to provide a meal. So, that is your function; now what is the functional unit. So, how much meal; so,

we can choose say that is up to us we can say 100 meals serving 100 meals serving using method a versus method b method a is paper club paper plate method b is china plate.

So, now we are at equal fitting we are serving hundred meals using either paper plate or china plate now when you are use serving hundred meals you need hundred paper plate sometimes those of you is stay in a hostel you can probably written less you probably use less does not have to clean those paper plate well sometimes it is shelter, but they; you cannot do that. So, as per our problem will assume that you are using a fresh paper plate for every meal.

So, you have you use hundred paper plate for the china plate you have to clean it you will do the cleaning is it. So, you have to do the cleaning of this china plate. So, you have to clean it 99 times to use it first time you used it then you cleaned it out another ninety nine times. So, there is a cleaning the dishwasher use of dishwasher for ninety nine times and all those things we have to find out then.

Now, what material and resource are used to make it we need those kind of information what goes into making these material and how it was produced what was the process then they stuff then we look at the material input energy input and the emissions that is coming out through the whole process then we try to quantify what is the impact to the.

So, we try to quantify in terms of the impact to the environment during the during the production is there waste what is the waste washing of the china plate will produce some waste then the type of data we required we can have a data inventory how do you know which one is better than we have to compare we have to do the looking at the like all these inventory data we can put to try to quantify and in terms of the carbon-carbon dioxide equivalent of these to process whichever is less will be it is better.

So, that is done and how it is done also you are like in the next video. So, this is how typically LCA is thought about. So, we are just going to started this LCA in the next video will try to finish it. So, this is in terms of LCA in action. So, you think about this in this video before you go to the next video think about like if you have I will give you another example if you have to do paper pencil versus mechanical pencil or if you have to do a E-reader which is a you are reading the book on a Amazon, Kindle or an i-Pad the versus i-Pad becomes more complicated will talk about that in the next video.

So, but just think about this Amazon, Kindle versus a physical book how you compare them if you have to do environmental footprint paper pen there like a mechanical pencil versus your or what we call regular pencil those HP Nataraj, HB Camel; in those regular pencil versus the mechanical pencil which has those led in the middle and then has some miss spring and other stuff.

So, if you have to compare how will you do that or there could be other things too like which can come to your mind. So, we will we will continue this discussion in the next video, but think about those questions before you listen to the next video because I will give you answer there so.

Thank you and again I will see you in the next video.