Life Cycle Assessment
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Lecture – 14
Environmental Data Collection and LCA Methodology (Contd.)

Welcome back. So, with all the background information that we covered in last say, last two weeks and part of the few modules of this particular week now we will get into the LCA methodology. So, how we do life cycle analysis? So, you already had good background on, we did cover some of the LCA concepts of the very beginning now we will start getting into what LCA is, how it is done. So, we will recap some of the basic stuffs related to life cycle analysis and start looking at some examples.

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So, again if you remember we talked about this green and sustainability that is how we started this course, that what is sustainability and what is what does it mean to be green. We define sustainability as the use of resources today in a way in such a way so that our future generation can make use of resources and as you can see at like this and then what does it mean to be green? Green and it is green and sustainability or you can say environmental friendly these are all interchangeable terms and you can use it

interchangeably like.

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But why in terms of sustainability again you see the same definition which we saw earlier is the United Nations world commission on environment and development they come up with this sustainable development definition, development that meets the need of the present without compromising the ability of future generation to meet their own needs. So, this is what the sustainability and of how it is defined and there are other ways the people got about environmental friendly, sustainable products, green products environmentally preferable. So, lot of these things are used interchangeably as a kind of where we try to convey the meaning of sustainability.

So, there is a difference between sustainability and durability. Sustainability something durable it may be good for sustainability, but the sustainability does not mean durability, durability is something different. So, something biodegradable considered maybe it is good, but we need to again find out whether it is really good. Recyclable ozone friendly, but in terms of biodegradable and recyclable, recyclable is specially say if you have to end up using lot of energy to recycle it that may not be really sustainable then ozone friendly we it is a ozone friendly means we have a ozone hole on top. So, we want to make sure that it is a product that we have is ozone friendly does not creates climate

change and those kind of problems.

Eco design, eco design is again where you have a more like a environmental friendly design and the last bullet over there is what is known as a greenwashing, greenwashing is where people claim things to be things to be growing green people claim things to be environmental friendly, but they actually are not. So, how will you find all whether things are environmental friendly or not we can do that by doing this LCA exercise which you will see example pretty soon.

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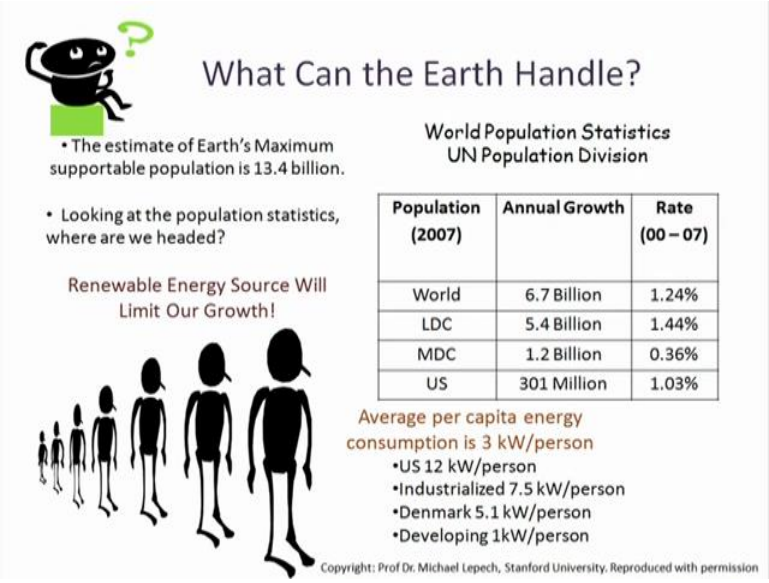

So, again why we are worried about all these things, what can our earth handle that is our earth has a there is a capacity that our earth can handle, population its annual growth, population this is almost like a 10 year old data right now our population is more than 7 billion and 6.7 billion they we do not worry too much about the absolute number, but if you kind of compare, the low income low income company the lower developed countries they have a nearly 5.4 billion out of 7 like 6.7 billion. So, that is you are looking at almost a like 70 to 80 percent population or nearly 80 percent 70 percent more than 70 percent population of the world stays in low developed countries. So, that is where and the medium developed countries around 1.2 billion then US is around 300 million.

So, and there is a in the medium developed countries where it is a rate of growth is also very low, at the low income countries the rate of growth is higher and US is around 1 percent. So, its again population of the world is growing up which we kind of talked about the very beginning of the class as well, as the population grow up we have more people to feed more people more houses needs to be built for the people around the world, then there is a estimate that earth can maximum handle 13.4 million people and we have to look at where we are headed, like we have to start looking at renewable energy source. Because you remember from the earlier slide, earlier videos we saw that we use lot of energy, energy is needed energy water everything was related. So, average per unit energy consumption is 3 kilowatt per person that is the average energy consumption in US they use 12 watt, 12 kilowatt per person and that includes all sorts of energy. Industrialized 7.5 kilowatt, Denmark is 5.1, developing countries is 1 kilowatt per person.

So, say if entire world is a start following the so called US dream where people want to be like big car, big houses, refrigerator, like a air conditioner and all those kind of stuff that requires lot of energy if the whole world starts thinking like having trying to have a lifestyle of what united states has will probably need 3 or 4 of the mother earth to supply that much kind of resources.

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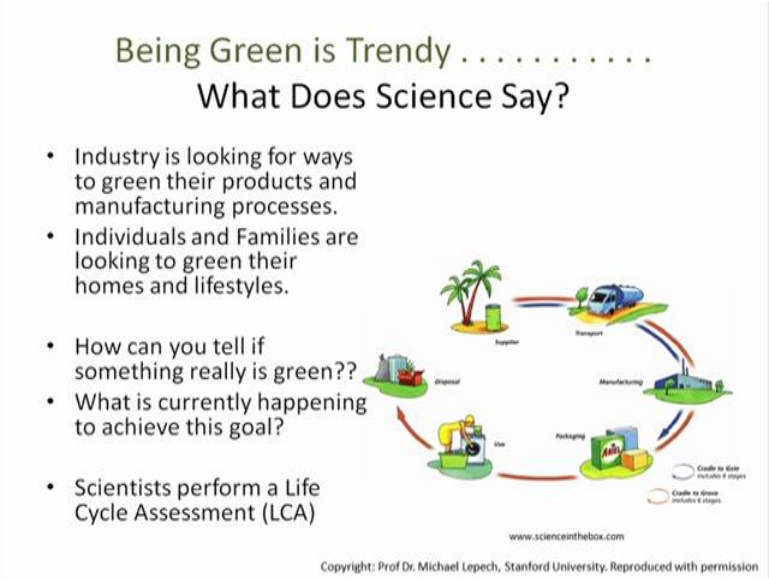

So, it will be all that we kind of talked about that earlier as well. So, what does that mean in terms of science? Where what does the science say? Green is trendy something green is it say it is fashionable people feel good about that, yes it is a green product. So, industries also looking for ways to green their products and manufacturing process, individual and families are looking to green their homes and lifestyles there are so many websites these days out there which can help you to come up with your own carbon footprint on environmental footprint on a day to day basis based on how you live, they can give you a environmental footprint and then you can modify your life lifestyle and then you can reduce your environmental footprint as well. So, that is can be done too.

So, how can you tell if something is really is green? So, that is, what, how to find out if something is really green is it what is currently happening to achieve the goal. So, to scientist for that we perform in life cycle assessment, so that is what we do. As you can see you then the picture over here from the way if you have from the supplier things goes to the transport, goes to manufacturing, to the packaging, then use, then its disposed say if you go from the raw material extraction only up to the packaging that is called cradle to gate, cradle to gate including the four includes four stages.

So, you have raw material acquisition, transport it to manufacturing plant, manufacturing plant makes it transported to the packaging and goes to the malls and super is like a big size stores are the small size stores whatever based on where you are in the world and that is where the your (Refer Time: 07:32) that is your cradle to gate that is not a cradle to grave, but cradle to gate. Cradle to grave that we talked about earlier is you go all the way up to the disposal, you look at the use face as well as the disposal face and that is look at your cradle to grave where you can use it in a cradle to grave concept.

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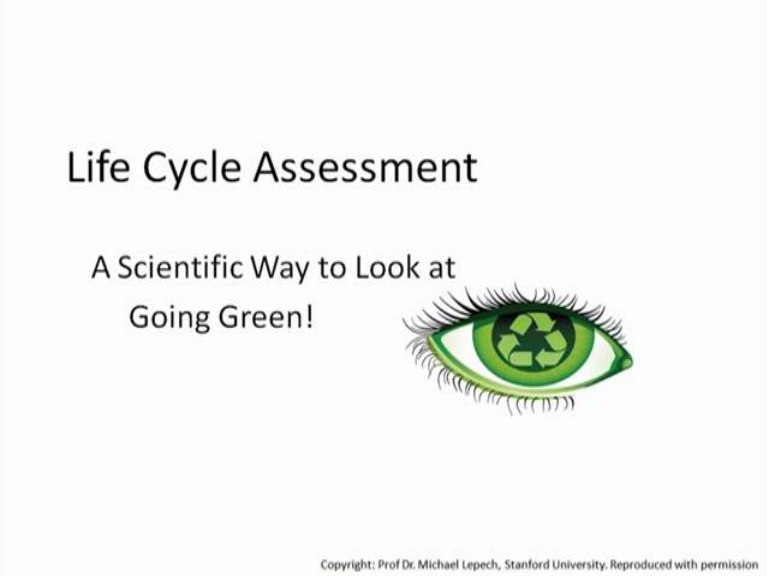

So, life cycle assessment is a scientific way to look at going green. So, when we say we are going green this LCA is a scientific way of looking at going green that is what that is what it all about.

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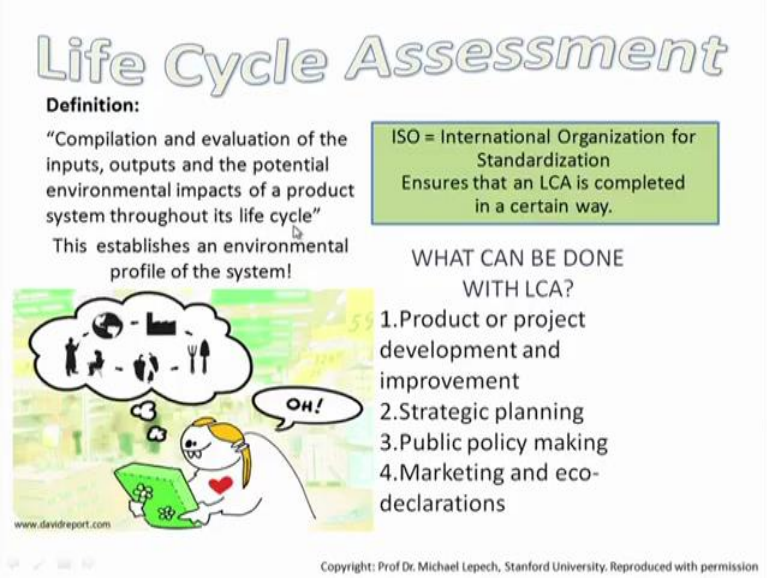

So, life cycle assessment it is what it does it is a compilation and evaluation of input

output in the potential environmental impact of a product system throughout it life cycle. So, what does that mean? It is essentially it is an accounting exercise, it is like an environmental accounting exercise like if you have done accounting if you look at the banks any company's balance sheet they will have how, what is the input coming into the company, how much money came in, how much money got a suspended and where and what are the under different heads. Similarly here we are looking at we are compiling and evaluating all the inputs and outputs and the potential environmental impact of any product or services. So, that is another thing many times when you hear that concept having a systems thinking. So, this is what is systems thinking is.

Life cycle analysis is helps you to have a systems thinking where you are thinking in a systems approach. So, you establishes an environmental profile of the system and then you come up, then you come up with the solution like with you analyse it and find out what is the total environmental footprint.

So, how you, there is a since for any method remember we talked about when we do the water analysis, wastewater analysis of the solid waste analysis for the environmental sample we have a standard method. Similarly here we have a method as you can see in the green box on top there is ISO method for international organization for standardization ensures that LCA is completed in a certain way. So, there is a ISO method which you can also if you Google ISO method for, I will give you a summary of ISO method as probably in later this week or early next week in terms of module. So, you will see that ISO how the ISO method is employed here, but ISO method is in again it is a method, so that say if I am doing an LCA here in India or somebody is doing an LCA over in US or in Japan or wherever we can compare each other's work, if you are looking at similar kind of product we can compare each other's work if you have followed a standard method if a standard method of doing that an ISO is that is standard method.

So, what can be done with the LCA, why we should do LCA it helps with the product and the project development and more improvement. So, it helps you to make a product more green, more environmental friendly, same thing with your project and also improve you improve your project and you can do for the strategic planning, you can plan say for

example, in recent past I was involved with there is a area called peel region in Ontario Canada where on their it is very close to Toronto and there they were looking at its all together three towns around 2 million population. So, 20 lakhs not too big from Indian standard, but pretty big from a Ontario standard. So, its 20 million population they wanted to have a new, they want they were doing integrated waste management plan where they want to look at for the different options out there which one seems to be more environmental friendly. So, for that in terms of their plan they employees LCA method.

So, I was working on the different options that the city that the peel region came up with I did the LCA on them to say ok, out of these option a b c and d which one has the least environmental footprint. So, that, those helped them kind of make some judgemental on that line we did not do the detailed we just did a quick LCA to find out what, so that once their plan is, so that helps in the strategic planning. So, similarly you can use it for the public policy making in terms of environmental policy to find out whether if you are claiming certain things will be green as I will give you one example of when you do not like how this helps in the policy then also marketing and eco declaration many many many places in the world today people like to buy green stuff they want to use green stuff. So, if you can also be use as a marketing tool it can be used in the eco declaration tool, those things is also pretty handy.

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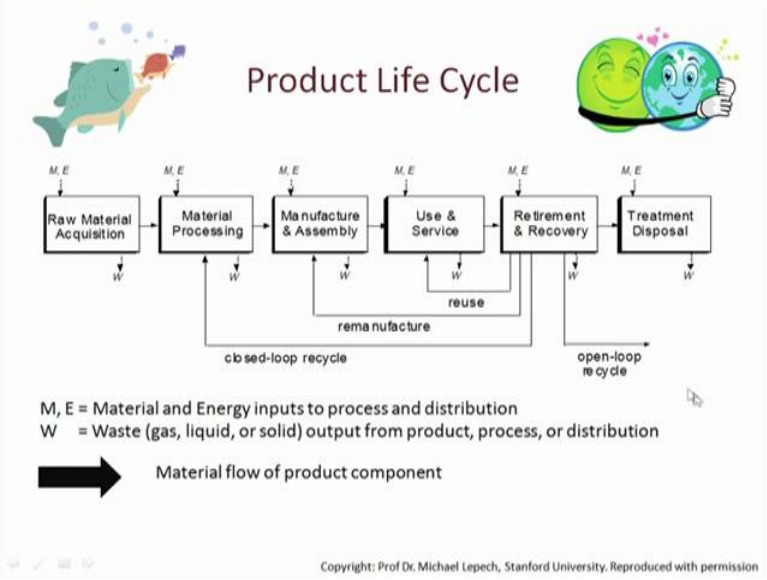

So, this particular slide kind of gives you an idea of what is the product life cycle. So, when you talked about product life cycle you are starting from say raw material acquisition you are looking at raw material acquisition that is the very beginning. So, if you are engineering student you like a kind of this is your mining friends that is your mining friends will help you mine all these materials. So, when you are go for raw material acquisition you haves here if you look at for each of these boxes this is kind of the product life cycle stages and we will go this I will try to explain this to you one by one.

So, here M and E is your material and energy input to the process and distribution, W is the waste and that waste does not have to be always solid waste it could be a gas it could be liquid or could be solid. So, it is basically the waste that is coming out and there other could be some output from the product process or distribution as well.

So, the first box here is the raw material acquisition see if you want to make anything, even if you want to make a very small like if you want to build this pen, if you want to make this pen for this pen also there are different we have a cap here we have a nib and there are different types of plastics and if you go for a like a different types of material many times they may also have a spring in there which will have metal and you need some ink there to write. So, different types of materials, different types of chemical has gone into making it. So, if you go back and look at this particular chat over here the first one the raw material acquisition is where we look at what are the different material that we need to make any product. So, that is your that is the part. So, once the material has been acquired it will, it has to be processed say you look at your cell phone, you look at your smartphone. Smartphone, most of the smartphone they look cool because that is what their marketing thing is that to make them look cool, but there are lot of metals are there, there is a lot of rare earth metals present, there is a plastic present, many times its a blended plastic, there could be some iron present, but the iron is not as an iron that you will see in iron sheet. So, they get processed. So, that is what is happening in the second box over here.

So, your material is getting processed where it is making into a form, so that it can go to a product. So, in the first you have a raw material acquisition. So, and this M and E in

into the M and E which is the material energy input that comes into each one of these boxes then you have the material being processed that is where your metallurgy friends or your mechanical friends will help you do that as well.

Then after material is processed it will go to the manufacture and assembly here again your mostly mechanical electrical those people will be involved. So, they will be, there will get manufactured and they will it is assembled if you are talking about some mechanical devices if you are talking about buildings and other stuff your civil and architectural friends will help you with that. So, so that is manufacture and assembly again you will have some material and energy input then it will be used and during the use there could be some service that is being provided some repair, some maintenance those things will be there, once the uses is gone then it will go to retirement and recovery and after retirement and recovery after whatever you cannot be recovered then it goes to treatment and finally, to disposal. So, all these steps is what is known as your product life cycle. So, here is your cradle you are the very beginning of where you start acquiring the raw material to make the product and at the end is your grave when you put it into a disposal system. So, this is your cradle to grave product life cycle.

So, that is how we define the cradle to grave product life cycle you will make sure that you understand this, you listen this is video again and again to make sure you get the concept of this cradle to grave because you will be using this concept in subsequent problems that we will be solving in this particular course. So, as part of this step there are certain we have not talked about this aspect here will which will do it right now. So, when you do the retirement and recovery part of it you can bring it back and reuse it if it is a reusable form it can be repaired and we can reuse again part of it can be taken back if it is not reusable, but the material from them can be reused.

So, we can re manufacture, so it can come back into the manufacture and assembly plant where the things can be re manufactured into a new product then some of it can go back to the material processing if we can this we can closed loop, recycle that is call closed loop within the plant itself we are recycling it and there could be some which is an open loop recycle where if you have say some laptops and other stuff where you are metals glass and other stuff from the laptop can go to a material metal recycling plant or a glass

recycling plant. So, that is how it gets managed.

So, this is essentially your product life cycle. So, this is a very very important slide for you in this particular course. So, I would encourage you to make sure that you have a very good understanding of all the different steps that goes into the life cycle of a product because that is what will be referring too many times during the course of this, during the course of this like a 20 course.

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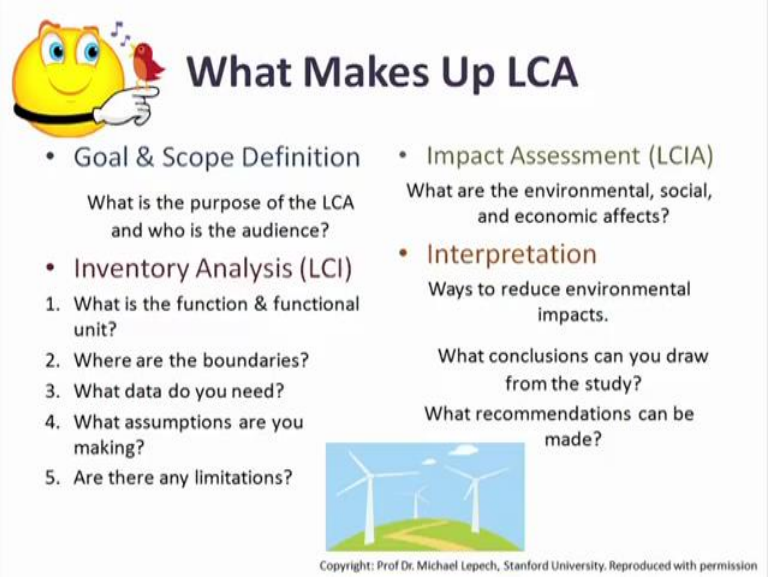

So, once you understand that that product life cycle what is in there then you have to do the, if you want to do this LCA there is a method of doing it and this four there are four steps of doing the LCA and these four steps again came from that ISO methodology because as I said earlier we use a standard methods of doing LCA. So, one of what makes up LCA we start with the goal and scope definition. So, you need to define what is an LCA like what is the purpose of LCA, who is the audience, so if you want to make an LCA for example, if you are running a company if you are running a company you produce certain products. So, one option you want to do an LCA exercise life cycle assessment exercises is to find out what is the environmental footprint of your product that you are producing.

And the environmental footprint one thing you can look at your process and you can one in the process you see that process a b c d again your process chain you have unit process 1 2 3 4 5 different unit processes are there, you can decide that out of these 4 5 unit processes that I have this particular unit 3, unit process 3 has a bigger environmental footprint. So, how come I go and improve this unit process 3 what I can do with this unit process 3, you can go and talk to your chemical engineers or all the process engineers whoever is involved and say that this has like a higher environmental footprint how to reduce it, so that could be one goal where you are actually trying to improve your product, you are trying to make your product more environmental friendly.

Because there is already a market out there were people want to have products which is more environmental friendly as supposed to a product which is less environmental friendly, but not a day too much extra cost, little bit of extra cost say 5 to 10 percent people may still may do it especially like upper middle class or some middle class people who are environmentally causes they may still go and buy something which is a slightly more costlier if we can prove to them that it is more environmental friendly. And how will prove them because then if you have a independent life cycle kind of study done by independent agency and then that satisfies that yes this product is better than the other products or competitive products.

So, if you have to pay additional 10 percent or even say 15 percent you may still get away with that, but if the price is too much very difficult because environment is great, but at the same time people look at their purse first because if it is too costly then it becomes difficult to sell those product. So, that could be one option of a what is the purpose of doing LCA other option is you want to compare that you are making a mobile say you are making one particular type of mobile and you want to go and check what kind of other manufacturers are there with a similar type of configuration what is your environmental footprint as opposed to the other competitors environmental footprint and then you come up, you can market your product if its comes out to be a better in terms of the environmental footprint as opposed to your competitor. So, some of their, some of the client tell whichever which things green like to have more green product will be will be attracted towards your product. So, that could be another goal.

So, let us we have to be in terms of like in terms of the methodology that we look at this in the goal and scope definition we need to have a very clear cut idea what is the purpose of doing this LCA and who the audience is, because based on this what is the purpose and who is the audience we will define our life cycle assessment exercise to come up with the information which can be used by those particular audience, which you will see in the examples it will make you much clearer.

So, once you have the goal and the scope definition, the next thing is within that we will talk about some more function and functional unit and all that, but one of the more, the most critical aspect is this inventory analysis, this is the most critical part of doing a life cycle analysis because this inventory analysis is all data data data data data you need to have lots and lots of data. And thankfully these once this LCA concept started we have now databases out there, some data bases are available for free some databases you need to pay, but it is there are databases available which you can use for finding the data. Again since as you will see in any environmental scenario around whenever the environmental initiative has been taken most of the time this initiative say started with western European countries, LCA exercises not differen, LCA exercise did start from the western European countries. So, we have most of the good establish databases actually comes from western European country, but nonetheless there is a effort being made by different companies ecoinvent is one company which is very popular in terms of the data bases and right now actually we are working on a project with ecoinvent to develop some data bases for the Indian contest.

So, here again they ecoinvent is trying to get some data for the Indian context or South Asian area, Southeast Asia, South Asia different they are looking at around the world and they are trying to develop some data bases which can be incorporated. So, inventory analysis is the data data data. So, before you go to the data one thing is that you need to find out what is the function and the functional unit. So, function means for any product when you are trying to because we are trying to calculate the environmental footprint of a product and the product has a certain funds.

Many times it gets very difficult to compare the two products for example, if you look at a E reader versus the regular book. Our regular book, both in regular book also you can

read you can read a novel you can read a novel on your Amazon kindle, you can read a novel on your I pad or you can read a novel on your any like a small like a tablet. E reader, but how to compare them? If you want to compare reading on a E reader versus a book it is very difficult to compare all the function for both of them is to read, is to read a book, but and we will talk about that how to make those kind of composites in this in the subsequent module. It gets tricky; it gets tricky even for such just simple stuff. So, that is. So, what we need to assume a function.

Say for example, you are trying to look at a two different types of writing you look a regular a fountain pen, ink pens verses this kind of pen which is your led pen and even some of these mechanical pencils versus your regular pencil, mechanical pencil comes with a spring. So, there are different both the both of them the function is to write, but how to like a how to quantify. So, what is the functional unit what is the how much should be the functional unit. So, based on your function and the functional unit we decide on in terms of the data collection.

Then where the boundaries will be, where we will keep our boundary what would be the system boundary and I will give you a examples of that where we will kind of can find our study and what data do you need based on your system on do you need to find out what kind of data is required, what kind of data is required and what assumptions are you making. Because when you go for the data collection you our industrial processes are not design in a way to for us to do LCA exercise. Say if you want to get the data for example, if you want to go to a power plant and you want to find out there are say n number of unit processes going on.

So, for each of the unit processes you want to find out the material input, the energy input and the output emissions coming out some of the data you may have it, but for some of the data they may not have metre all the after each of the unit processes, say if they do not of the metre after each unit processes you do not know how much energy is being consumed at each of the individual unit process. You may get it for a combination of certain unit processes or for the whole plant, but for the individual unit process is very difficult to get because they are not design in a way for us to have to collect data. So, that sometimes we go and collect data we try to have additional measurements to collect the

data other there are ways to make an assumption, ways to calculate certain things and that we will talk about that as well.

So, there will be certain assumption that you have to make because unfortunately that is how the situation will be and then there will be certain limitations because you may not always have all the data. Some of the data could be based on the theoretical value. So, you may have to use theoretical calculations to come up with some date.

So, that is how the inventory analysis is done. So, inventory analysis is as I said is one of the most critical part in terms of in terms of your LCA ones I this is the most time consuming stuff. So, LCI in terms of the data is what we get it from the databases, but we need to make sure we knew we use the current database. So, once you have the database once you have the LCI data then the last two bullets if you go back and look at that it said one is the impact assessment. So, what are the environmental social and economic effects that we see, we will talk mostly about environmental and we will not we will touch social and economic a little bit, but what are the environmental effects. So, there are different criteria as we look at in terms of the environmental emissions that is having the effect and then we have to interpret what are the interpretation, how to reduce the environmental impact, but is the. So, if our goal is to reduce environmental impact how to do that, what conclusions can you draw from this study what did we learn from this particular study what recommendations can be made.

So, those are in terms of different like a stuff that is used. So, again in terms of this particular slide gives you a very brief overview of the like a how the LCA is done as per the ISO methodology we need these are the four steps, goal and scope, inventory analysis, impact assessment and interpretation. And we will come to these one of all of this in detail as we look at several examples in starting in the next module.

So, in this slide, in this particular module if you remember what did we cover we looked at how the environmental like how the LCA is performed. So, we started with a very brief overview of the basic sustainability parameter we has kind of a recap of what we covered in the first week, a quick recap of that and then we started looking into what is an LCA. We described in great detail the product life cycle stages. So, again I will have

already said many times, but I will say it one more time, make sure you understand that particular slide which is the slide just before it. You make a good understanding of this particular slide because this is a very critical slide for our when we go into the next modules and next week because this is if you have understanding of this the others will become easier for you to understand because we will be referring to this life cycle we will again be saying product life cycle product life cycle. So, you should have a good understanding of what a product life cycle is all about.

So, with that let us close this module and then from the next module we will kind of a start with an example of when we try to compare certain products for LCA and how we go about that, what are the steps, how we do this resource acquisition, how we collect this LCI data and what are the interpreters, what is the impact assessment mean, what are those environmental impact we are talking about and what how we can interpret the values. So, again thank you for watching this video and keep watching and I hope you will learn some good stuff from this course.

Thank you.