Life Cycle Assessment
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Lecture – 20
The ISO Framework

So let us look at this ISO framework more in detail we were just we just kind of started it towards the end of the last module. So, we will continue this discussion on ISO framework in this particular module.

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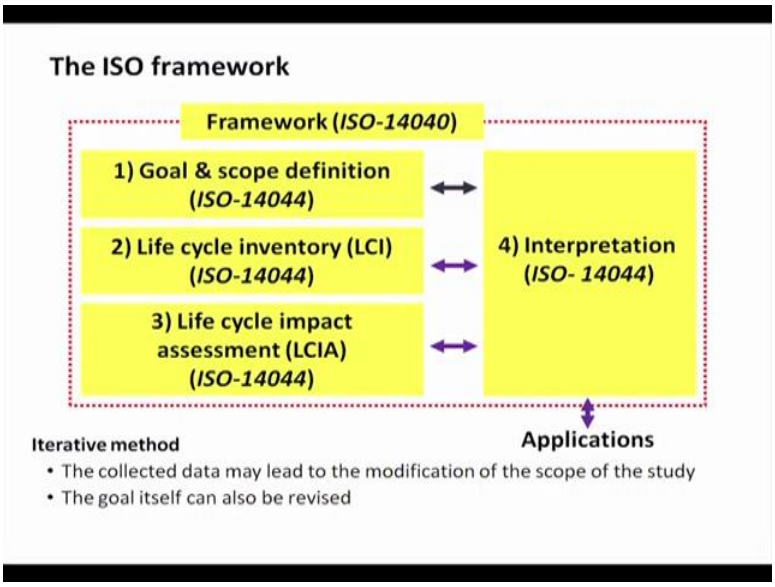

So, again I have put that slide again for you to recap. So, we had ISO framework we have goal and the scope we were discussing this goal and scope life cycle inventory, life cycle impact assessment and interpretation we will go each on of those and I said it is an iterative method; that is why you have the arrow on the both sides. So, if based on how you learn here things may change along this line too.

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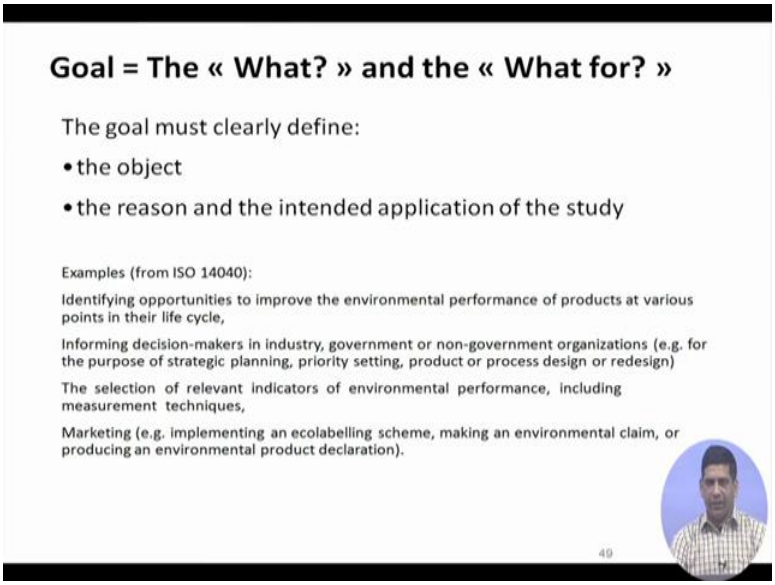

So, we looked at this slide already in terms of you should have a goal means what and what it is for, that is goal must clearly define the objective object of this and as well as the reason and the intended application of this study.

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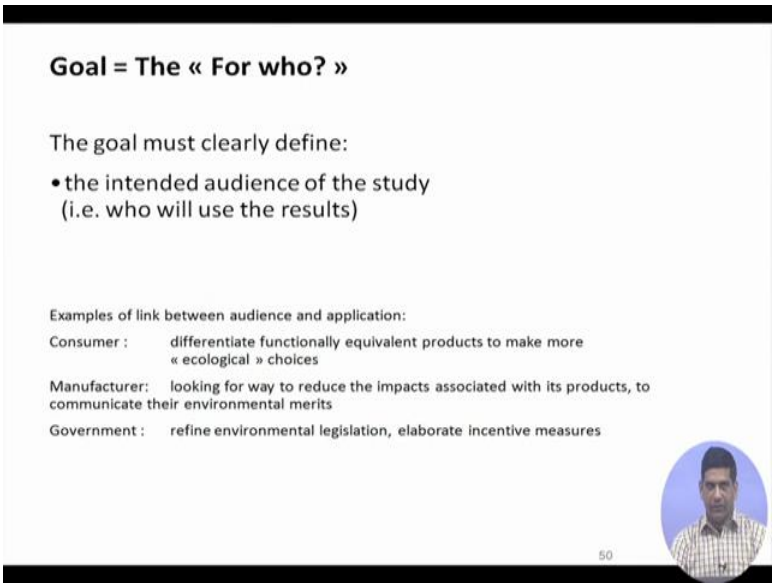

So, goal must clearly define the intended audience of the study as well. So, and the other

part of the goal is for who, for who we are doing this study who is our intended audience. So, again as I said earlier the bottom part of these slides the top part is kind of my summary which will help you to learn it, and the bottom part of these slides are especially the ones with the smaller font are just the copy and paste from ISO document it is just for you for you to help you out. So, the examples of link between audience and applications again this came from the ISO document you can have for a consumer. So, it you want to from differentiate functionally equivalent product to make more ecological choices.

So, this is what exactly I was telling you towards the end of the last module regarding two similar cell phone, two similar mobile which has similar price, similar kind of ram and memory and those these days now you need to have two cameras, one is the front camera back camera, many times I do not understand why you need those kind of stuff, but you have to take a selfie which is the whole country is kind of crazy about selfies sometimes; but these are the these are the products we have to live with product we cannot.

So, these are if we say it is a different differentiate functionally equivalent product, as if in they suggest functionally they are equivalent. So, they can they can perform the same function, but coming from two different brands. So, now, if you one brand is better ecological. So, if doing this LCA exercise if you want to continue you want to do the marketing your goal is to convince the consumer that my product is ecologically better. So, let us go you go and buy this product. So, that audience here is your consumer. Now if the audience is the manufacturer, here you want to reduce the impact associated with it is product and to communicate their environmental merits.

So, that is where the government policies also comes in picture to you, where they manufacture like for example, recently we did a project for it was project was Nalco, Nalco Angul plant some of you may be familiar with it is in Bhubaneswar near sorry it is in Odisha near Bhubaneswar. So, in Angul plant they what they have is they are using they have a co generation power plant also at part of the co generation power plant CO_2 is released. So, this carbon dioxide that is released they are taking this carbon dioxide and feeding it to micro algae, from that micro algae after they kind of grow micro algae

harvest it and they making bio diesel.

So, this bio diesel is used on site itself. So, it is a small kind of a demo pilot kind of project, which Nalco is doing in some of the other agencies are also involved, they are doing it together. So, they want to actually demonstrate. So, they want to and this way they are using the associate, because what they are doing the CO2 rather than getting in to the atmosphere they are capturing the CO2 and producing bio diesel or the and then the CO2 this is like a carbon sequestration project. So, it helps show them a better environmental footprint. So, that is it shows them in a nice environmental footprint with that. So, that is what the manufactures communicate their environmental merits by doing that. So, that is one way of doing it, same thing for a any product they can do it.

For the government can take this LCA study and refine the environmental legislation, they can refine come up with and also elaborate incentive measures. So, they can come with incentives to people to the companies to the manufactures who are more environmental friendly. So, to make it things more environmental friendly, and some of these international organizations and some these governmental organization in the western European other countries are already doing it. In India we are little bit behind just last year that time, like a environmental minister who is now our HRD minister, he did mention in one of the gatherings that in India also we have to start looking at LCA more like a seriously. So, that is hopefully the things will grow. So, that is the reason why I am offering this course

So, like in Indian context LCA is a still it is an outside it just we kind of just started looking doing LCA in India there are some studies already done and there are some papers already published, but things are again just started if you compare with the western European countries, but things will pick up. So, if you are if you get to know this concept if you can understand how LCA is done, since it is a newer topic not many people are aware of it and not many places this course is also offered.

So, I think this will be the first one of the first course offered in this topic in the county especially on the online mode. So, it gives you an opportunity to learn this course and then learn something which you can help you market yourself, although it does not sound

very nice to market yourself, but unfortunately we are in a era where all I should not say unfortunately say unfortunately this is how the things work these days, you have to really show that say if I want to hire if I am a company and I want to hire a person and you should have that skills set which help me run my company better, which can help you run the things which I need to do and most of the companies these days have to have their sustainability reports.

Sustainability reports so far has been just kind of making a very nice beautiful report without much technical mean there, but the government is also getting very careful, the government is being pushed by international funding agencies as well that you need to look at these environmental footprint things in more carefully; we have so many international laws are coming up. So, saying from that perspective somebody who is familiar with this LCA exercise who knows how to an LCA, will have a better chance of getting a job as supposed to somebody else. So, that is the reason if you do not see any other reason to take this course at least that is a very valid reason for you to take this course and on credit. You should not only take this course do all the assignments and also take the exam which we will offer towards the end of the course. So, take the exam so that you can get a certificate that you have successfully completed this course and also tell your friends about it

So, the in terms of the goal, goal must be intended to audience the consumer the government based on who is our audience we can tailor our LCA study accordingly.

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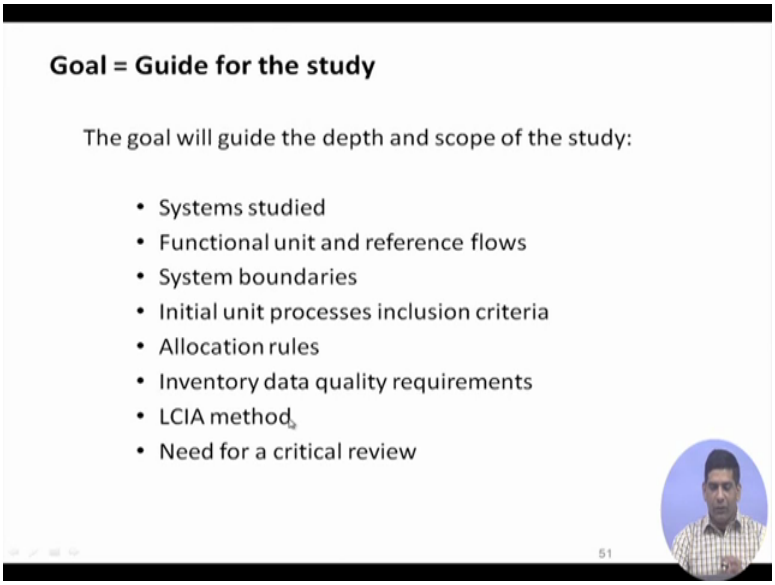

So, for the goal, what the goal does. So, this is kind of goal will guide us in terms of the depth and the scope of the study. So, based on the goal that we have we want to will what should be the system boundary, what should be the system we want to study for, what will be the functional unit and the reference flow. Remember that function and functional unit we kind of already showed some examples. So, what kind of functional unit, what would be the reference flow, the functional unit for those light bulbs was to provide the light? We did not worry about secondary function just the primary function we took over there then reference flow we took 10 bulbs and one bulb. So, that is what we are talking about what should be the reference flow to meet the functional unit requirement.

Now, the system boundary most of the time it will be cradle to grave, but sometimes it could be cradle to gate as well. So, for example, those two bulbs if you think about if you are a bulb manufacturer you may say that I do not to do it for like a use phase and the disposal phase, because I have no control and that is that is a very valid argument as well. Say for example, if you are making a product two different types of soaps for example, let us say like a regular soap or cloth washing soap like your different brands out there like a Rin or there are different lot of brands out there in the market. So, say if you are making some if you are a soap manufacturer, you have sold the soap you have

given the soap to like a multi retailer like big bazaar or if any if a small shop, and then after that you do not really have much control on that product.

So, when people use it that depending on how the people will use it, it may depend and also depends on what kind of water is there it depend what kind of emissions will come out and what will be the rate of release of those emissions, how long the product is last and how the in the water that comes off if you are living in a very nice city which has a very good wastewater treatment plant, the impact will be much less because the soap water that you are releasing while taking bath, that soap water is going to a nice waste water treatment plant. So, it is will have some sort of better kind of control.

Or if you are in a place where this soap is being used there is no wastewater treatment plant impact is different. So, as soap manufacturers you may make an argument that I have no control how this water will be used. So, how why you are penalizing me in terms of what will happen after I have given it to the consumer and, but that is that is not a cradle to grave study, that is a cradle to gate we call it a gate because the gate of the plant that is what we are trying to say. Once it leaves the gate of the plant as a manufacturer, I do not have control on that so that is why we kind of stop there.

So, that is that is the system boundary what should be the system boundary, but usually we try to go for a cradle to study because that is the most complete study; then what should be the unit processes, what unit processes we need to include again that is what unit processes for a very detail say if you want have a detailed study you want to use all the unit processes involved in the manufacturing of any all those product, but this unit process is you may not have data as you will see in subsequent module, for this unit process.

We need to have the data for these unit processes if you do not have the data many times what we do is we club some of these unit processes together for which the input data and the output data. And then allocation rules we did touch up on these allocation part a little bit earlier, allocation is when you are trying to allocate both in terms of the primary function and the secondary function you can allocate 60 percent for the primary, 40 percent to the secondary and will you will see that the little later as well, but that is the

allocation rule same thing you can do the allocation when you are looking at the midpoint indicator to the end point indicator, because remember we had a list of midpoint indicators.

Now, for two midpoint indicators may lead to the same end point. So, one particular midpoint indicator is leading to this impact as well as the one impact down there. So, when you are trying to take the impact on two different scale, how to take how to divide their ratio should we take it like a 60 40, 70 30. So, midpoint indicator point a doing to the end point indicator say b and c, so a taking have a 60 impact on b, and a has 40 percent impact on c or what should be that whether it is a 60 40, 70 30, 80 20 that kind of we need to have for that to make that kind of judgement we need to have some sort of basis for it and based on what kind of data like basis we have, we go for different allocation rules.

For all of these there are some already guidelines out there, so you do not feel that there is all these things are being like a shooting in the dark that is not there are guidelines out there which we use and which we will see as well when you start doing these LCA exercise. Then data quality; data quality is very very very very important we kind of talked about that several times so far in this particular course. So, inventory data quality requirement we need to have a good data then life cycle impact assessment method, that impact assessment how we will do the impact assessment again we have different methodology out there, we can use one of those the ones suits our goal like a in terms of our scope we can use that particular thing. And for all these at the end of day we need to have a critical review. So, it is a one like a onetime thing and then you do it and then you just do not, you need to critically review to see whether you are making a good judgement; if not then you refine it then go for better stuff. So, that is your goal.

So, all of these as you can probably if you have if you have listen to the video or the audio carefully, there are some subjectivity involved as well. It is not always objective things will be subjective and that kind of leads to little bit of different kind of interpretation from person to person, there will be some little bit of biasness coming in to the system because how will you do the allocation rule, how you will do the inventory data, what say the data quality the data quality which I say good you may not say it is

good because so, but we if you follow those standard protocol for example, data quality we have the q a q c, allocation rule there are certain methodology out there; yes methodology a versus methodology b the interpretation may be a little bit different, but of course, there will be a little bit of subjectivity involved as you do the exercise.

But we have to tried to minimize that is why these ISO methodology has been developed to minimize those subjectivity and try to have a more objective as much objective as possible.

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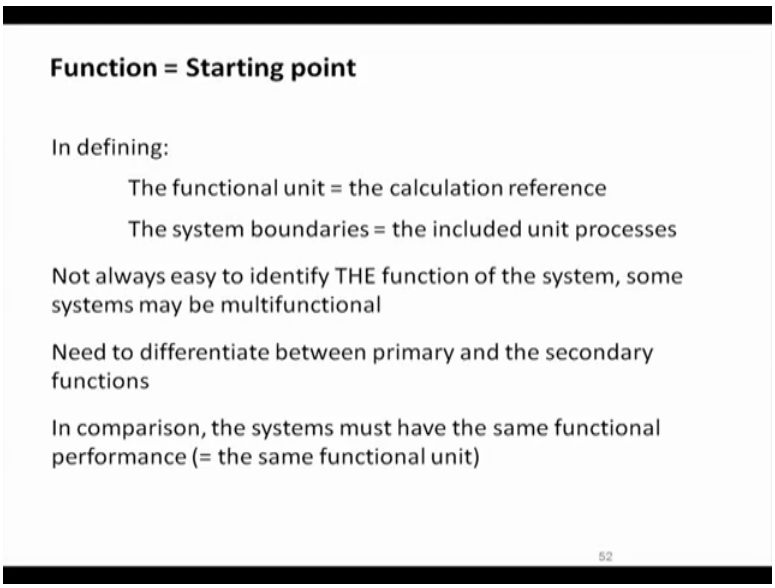

Then function is the starting point. So, when defining we define the functional unit which we already did. So, that is the reason like if you if you think about we looked at that those bulb example in great detail, was the one of the reason for me to do that was when I explained to you this ISO methodology you can now relate to it. Remember that functional unit, the functional unit that we used for those two types of bulb was the calculation reference as well, remember we had from that unit process we took that one k g, for one k g of bulb, one k g of glass or one k g of cardboard, this much different input this much different output. So, that is and then for our functional unit which was 228 grams of glass and 232 grams of cardboard. So, that is 228 grams and 232 grams that is our calculation reference. So, if that is the reference we are calculating that is the base

we are calculating all our input and output. So, that is what we are talking about here that is the functional unit in terms of the calculation reference.

Then system boundary is what are the all included unit process, what is all the unit process that is included that is our system boundary. So, it is always not easy to differentiate identify the function of the system, some systems may be multi functional and if you remember we did talk about that again say if you think about e reader, regular book versus e-book remember we talked about that; most of these e-books like for examples of you have an apple I pad or any I pad Samsung or whichever company you have excuse me. So, that you have this like a way you can read the book say if you have an I pad where you can read the book, you can also do your emails, you can also play a games on it, you can check your you can go on newspaper websites you can read newspaper you can watch you tube videos, you can watch movies and possibly these you can do a face time, and there are lot of things you can do with the same I pad.

Now, it is multi functional device. So, if it is a multi functional device and most of the same thing you can do even on your mobile phone like these Smartphone you can do most of the things as I said can done using this mobile phone as well, but if you want to compare this e reader like a I pad reading a book on an I pad versus reading a physical book see like a is its. It Is so complex now, because it is a although it sounds so easy, but it is a gets so complex because reading regular book of course, you are reading a book it came from a paper and ink got printed all those things are there, but when you go for e-book or a like a I pad where which can be used as a e-book reader as well, now you have to look at what fraction of the time it is being used as a e-book.

Now, that that will change from person to person, somebody who is a voracious reader we probably we using half of the time of reading the book on his I pad, but somebody who does who read occasionally, will read like once in a while. So, how to take the data; you need to kind of do a survey to find out on average people who has an I pad who use read also e-book, use at least two average two to three hours or week or per day or whatever the data comes up.

Now based on all the functions it does because the energy consumption is not only on e-

book reading. So, what fraction of energy goes on the e-book reading for in terms of the consumption you made those I pad, so I pad is made with different rare earth metals, different plastics, glass then all sorts of things now what fraction of that has to be allocated. So, it gets really the whole thing gets bit complex it is not that easy. So, that is that is why the function has there is a multi functional. So, you need to differentiate between the primary function and the secondary function. So, remember in that in that bulb example we ignored secondary function, because I do not want it make it more complicated, but later on you will see some example where we will have to include this secondary function as well because that is to make more realistic LCA.

So, in comparison the bottom line is that in the comparison the system must have the same functional performance, system should have the same functional unit that is very very important that is otherwise you are not doing an apple to apple comparison. So, it is your comparison is not fair. So, for that you need to stick with the same functional unit and then you need to see how the if it is a multi functional stuff, how to take the other functions associated with that and how to do the allocation for this particular function that you are focussing on. So, that is how it has needs to be done. So, once you have this functional function and functional unit identified, then you need to have the reference flow. Reference flow is the amount of product necessary to fulfil the amount of function specified by the functional unit.

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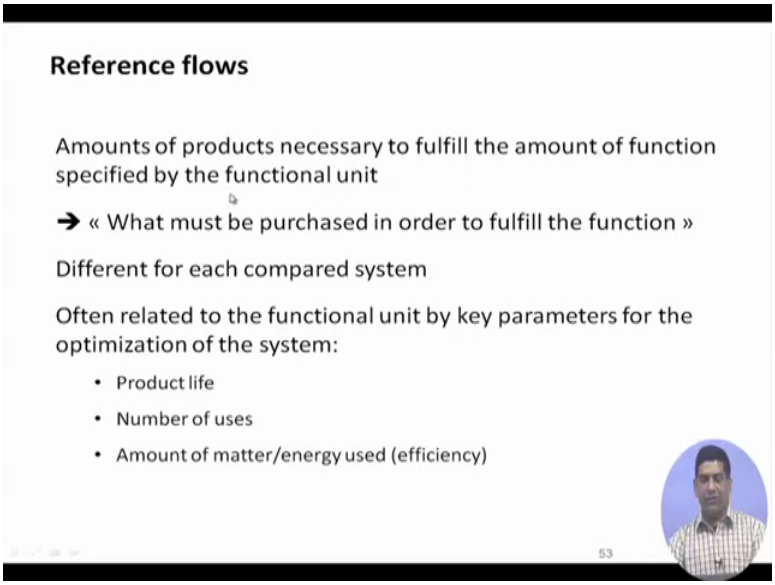

Now, again going back to that glass like a bulb problem; our functional unit was 700 lumens of light or 10,000 hours that is what our functional unit, and for that we needed a reference flow of 10 bulbs of incandescent 1 bulb of CFL. So, that is the reference flow. So, that is have try to understand that. So, reference flow was 10 bulbs of incandescent 1 bulbs of CFL, if you have not watched that video carefully go back and watch it again. So, but amount of product that is necessary to fulfil the amount of function is specified by the functional unit.

So, what must be purchased in order to fulfil the function? So, we have to purchase 10 bulbs of incandescent and 1 bulb of CFL to do that function. So, that is why it was we have to and it will be different for each compared system. See remember even if you think about that china plate versus paper plate we had that example as well. So, china plate versus paper plate is to we have if you remember from the video we said we will say serving of 30 meals that was our functional unit, function was to serve the meal, functional unit was serving of 30 meals. Now serving of 30 meals china plate one china plate is good enough unless you unless you break it.

Over a over a period of 30 days and then or and if you include lunch and dinner both could be 15 days, but for paper plate as you mean that used only once you need 30 paper

plates. So, the function that is the reference flow for this paper plate the flow will be 30 paper plates one china plate. So, that is what it says on this on the middle point which says it should be it will be different for each compared system.

So, that is for it is different, and then they are related to the functional unit by the key parameters for optimization based on the product life; because the paper plate life was one play one meals serving, china plate you can multiple meal serving you can number of uses how much times you can use it, and also like a efficiency amount of matter and energy used efficiency. So, that is how you look at the reference flow. So, these are these terms are very very important and it is very like that is why I you if you make sure that you understand these very carefully because these are very like these are kind of basics you can say these are like alphabets of LCA exercise.

Once you have a very clear understanding of what a what is the reference flow, what is a functional unit, what is what is function what is the multi function how to take of the multi functional parameters, what is the allocation rules how we do that, and then rest of the exercise is not that difficult because you will be using a soft, but again when we use the software many times I am afraid to say that, because many times when I say oh you will be using the software it will be fine, but do not rely on the software you need to understand what the software is doing because if you do not understand what the software is doing you will make mistake and then many times a student shows up in my office saying that this is what I got from the software my answer to them that software is not getting a masters degree or a PhD degree you are getting the PhD or the masters degree.

So, you need to understand and convince me that what is going on software may make mistakes. So, you as a human like a researcher or you need to be convinced that software is giving you the correct numbers. So, that is I hope the reference flow is clear. So, that is these are some of the very basic staff in terms of function functional unit goal scope. Now we will start looking at the unit processes, unit processes data and LCI database which is next step on that.

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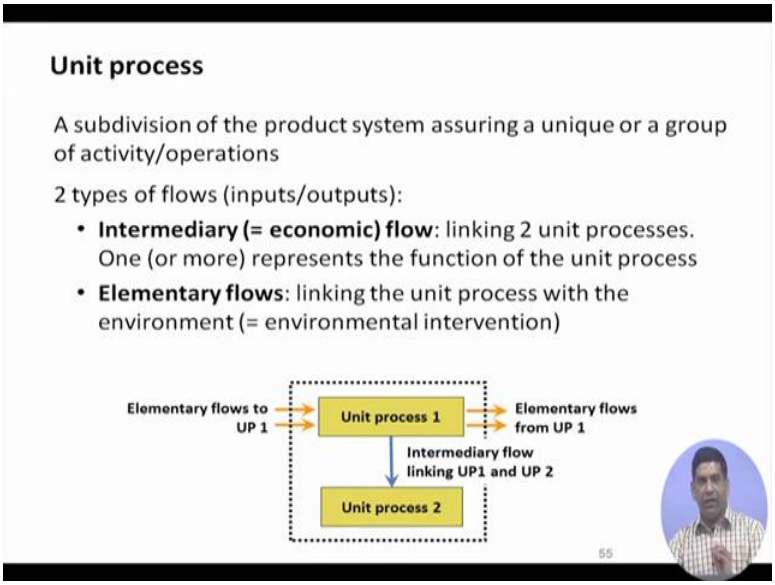

And again we are still continuing that ISO methodology; these are again things are coming from the ISO standard. So, some of these are like some of it is kind of mixture of my explanation of the ISO standard, and I do have some of copy and paste form ISO standard as well.

So, in terms of the unit process excuse me, unit is a subdivision of the product system assuring a unique or a group of activity or a operation. Now if you look at the box at the bottom, so you have a say there are two unit process unit process one and unit process two; now for each of these unit process we have this elementary flow coming in to the system, the elementary flow is your input in put going into the system.

Now form the unit process one there could be some intermediate flow which will link unit process one unit process two, and there will be a elementary flows which is coming out form unit process one. Similarly there could be elementary flow same arrows could be down as well you may have a input to the unit process two and things going out of the unit process two as well. So, here if you look at one unit process it is the subdivision of the products system. So, in a product system there will be multiple unit process going on. So, those of you who are chemical engineers you do the poly pdf's process flow diagram is not you make those process flow diagram.

I was working in a consulting company you may be familiar like you guys may have heard the name engineers India limited EIL and there we were doing lot work for petro chemicals refineries and off shore oil platform. So, although I was a civil engineer working as a civil slash environmental engineer there, but many times we have to understand this pdf's. So, we will because that is pdf was kind of the backbone, the first thing that for our any project will be this pdf's process flow diagram. And based on the process flow diagram all the services and all the other stuff will come. So, civil engineer, mechanical engineer all these engineers have to kind of rely on our chemical friends from the department from the company, who will make the process flow diagram and share with us and then we will start working on our part of that.

So, that is the process that process. So, each there would be lot of unit process. So, it is a if you will think about a refinery, I just gave you the talk about refinery. So, think about refinery, refinery if you have even if you driven by refinery or you have gone on a train where you see a refinery or if for that matter even power plant, coal based thermal power plant you see there lot of things in there, they are lot of cylindrical stow lot of pipes going around chimneys, chimneys most visible, you see chimney things coming out and if you walk in to a plant those few lives in a plant kind of environment like a if your parents are working in the plant if you are right now in the plant system, as you walk around a plant there are several things going on, many times you do not really know what is going on in there, but each of them are having some unit process going on.

So, here for each of those units' process as minutely as we can if we can data that is better it is. So, it is a sub division of the product system, where we have a unique or a group of activity or operations going on. So, we are two types of flow input and output. So, if you look at any of these process system there will be things going into the system and there will be things coming out of the system; and the things coming out of the system could be part of the product which will go in to the next unit, which becomes a input to the unit two unit process two or it could be a some emissions going out into that mostly or some liquid coming off or the solid waste being produced. So, those things are there as well.

So, there are two types of flows input and output. Input is we have the intermediary or

economic flow which links as two unit process that is the intermediary flow. The output forms one unit process going to the input to the second. So, that is called intermediary flow or economic flow. The second one is the elementary flow which links the unit process with the environment. So, I say environmental intervention things going it are like a independent. So, things going into this unit process and things coming out of that unit process. So, it has not linked to the other units on which are associated with that.

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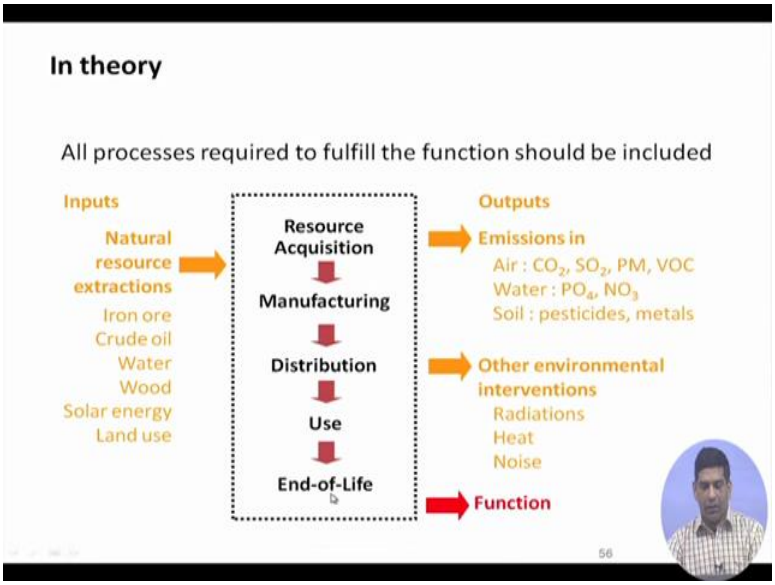

So, those are that is kind of just introduction to the unit process and we will continue this unit process discussion in our next module, because it is again very very one of the very important concept.

So, if you think about in this particular module, we kind of a started again with goal for the ISO methodology waste we looked the function functional unit goal, what how you decide what goal it should be the audience based on the audience how will you kind of refine your goal and scope and all that. So, there is lot of thought process goes in their function, functional unit, multi functional parameters. So, again and I am giving you a lot of examples from that bulb problem that we did because of bulb problem we spent a quiet of time. So, try to understand this stuff these are again very very basic stuff for this for a good LCA. And we will continue this discussion in our next module as well so.

Thank you.