Advanced Green Manufacturing Systems
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Lecture – 33
Life Cycle Assessment, EIO-LCA tool

Good morning. Welcome back to the lecture on design for environment where we are discussing Life Cycle Assessment in the course Advanced Green Manufacturing Systems.

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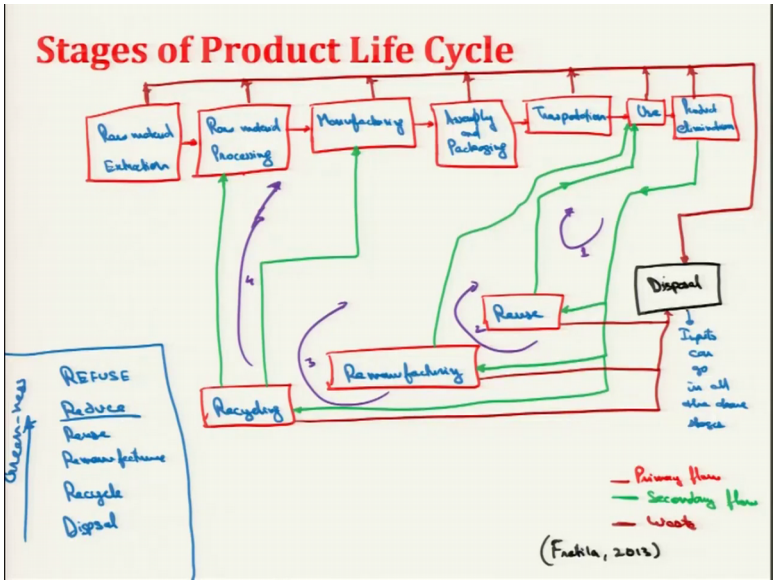

I like to discuss the online tool EIO-LCA in this lecture. Before that, I will just like to show that in an economy, how does the product flow move? If you recall, this was the illustration that we discussed two three lectures before in which I showed you these returning circle in the purple color; circle 1, circle 2, circle 3 and circle 4.

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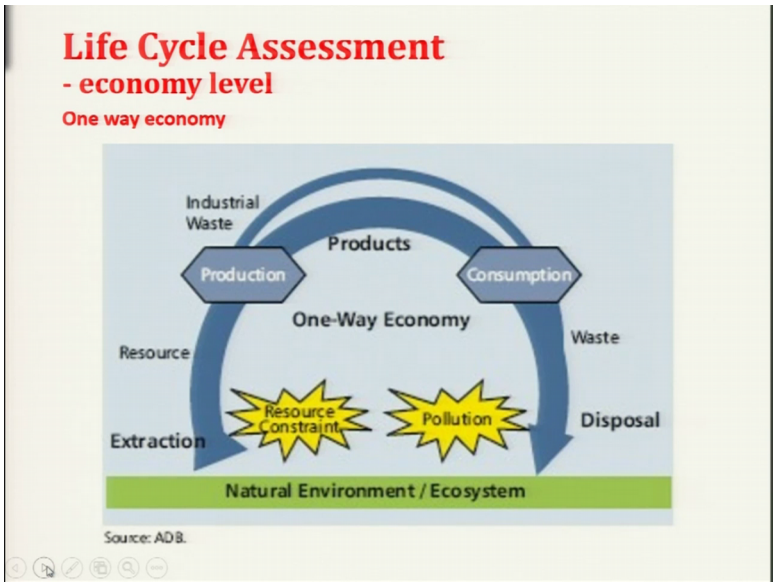

So, if we look at them from the economy view point, this is one way economy where the extraction happens and the resources production happen and industrial waste is there and products are produced by the manufacturers; the consumers use the products. These are consumer here, consumptions and after that waste happened and finally, the disposing happen.

So, the resource constraint is there. This is one thing. The resource always come from the natural environment of ecosystem, this is one way economy. It always comes from here ok; and final disposal is here with a lot of pollution happens. So, these were the two major drawbacks of one way economy when we did not recycle or reuse anything.

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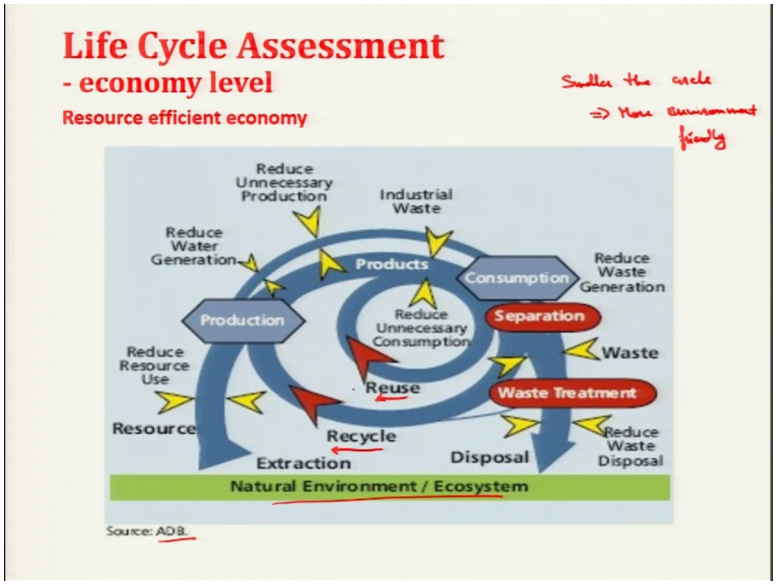

But when we reuse, the more resource efficient economy is like this; which we had seen in this condition as well. We reuse, we remanufacture, we recycle. This is the same presentation. This is the same way of illustration given by ADB, Asian Development Bank; get first the section happens from natural environment itself and resources are there.

So, we reduce use of resources is because we can recycle, we can reuse and these are the circles. As told you the other day as well, the smaller the circle is, smaller the circle implies more environment friendly, right. Reuse is the first step, then we have recycle, then we have disposal. I also put those here. First is reuse, reduce after reuse, recycle comes here. So, this is greenness or environment friendliness here. So, the same thing is replicated here in this resource efficient economy in which the separation of good happened after the consumption, it goes to the waste treatment.

And it also can be a recycle, metal parts can be recycled all etcetera go to the lubricant treatment cum industry where waste treatment happen and finally, smaller disposal or lesser pollution is there. But this is the thing that is desired, that is point of time.

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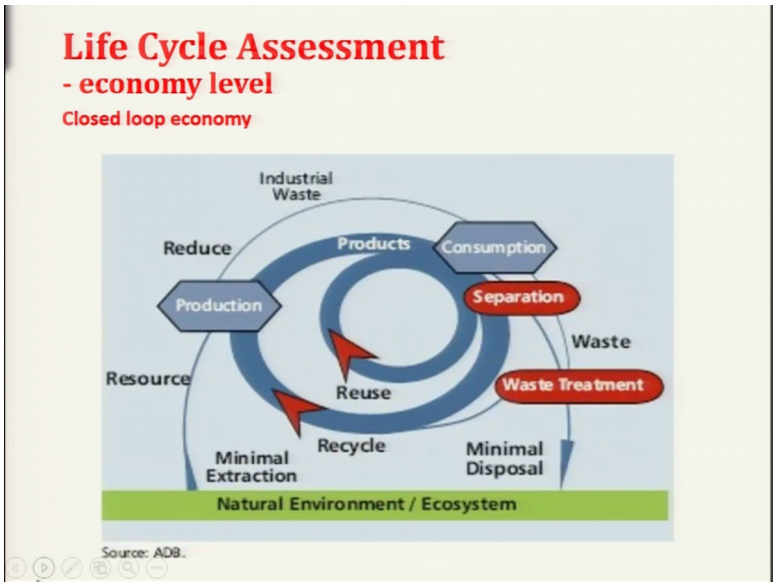

For, the ideal thing is the closed loop economy. In closed loop economy there is a minimal extraction. You can see the widths here is decreased in a way to present that extraction is minimal, only if the closed loop. It is between the production and the consumption and separation the waste treatment is moving in this direction again and again. So, these are closed economy in this way.

So, in this case the extraction from natural environment and ecosystem is very less. This is minimal and pollution is also minimal, it is already is written here; minimal extraction and minimal disposal ok.

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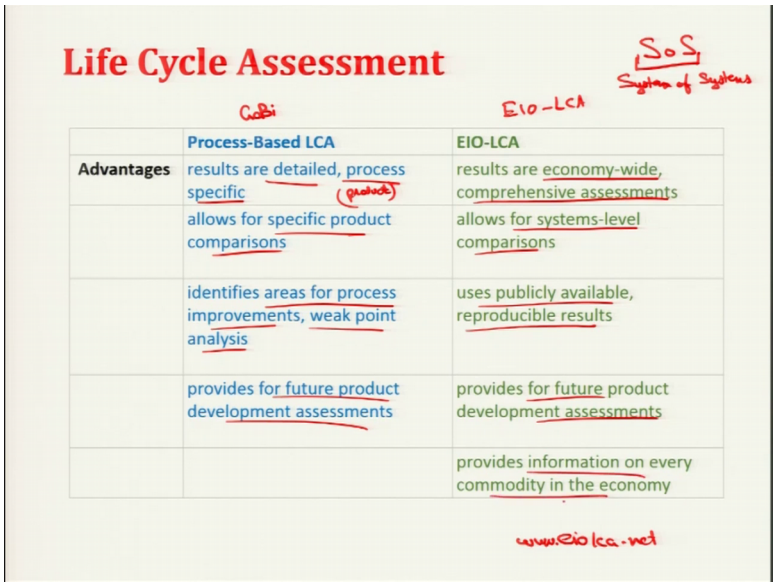

We are going to discuss the tool EIO-LCA; Economic Input Output Life Cycle Assessment where two kinds of life cycle assessment; those I will discuss. One is process based life cycle assessment; another one is economy based life cycle assessment, specifically EIO-LCA that I have put here.

Process based is whereas, when we are talking about the specific product, specific process like manufacturing of this pen, what are the waste components of the pen, plastic, rubber, metal, ok. These are only the three materials then ink, yeah fourth material is there, fluid is there. Then what is the, this is a manufacturing of pen, what are the various industrial sectors those are considered in EIO-LCA. In, I am talking about process based LCA actually. In process based LCA, we will see what are, what is the energy consumption, what is the pollution that is produced (Refer Time: 04:56) manufacturing etcetera that we will discuss when we will see GaBi Software.

This we are discussing the EIO-LCA tool, where we talking about the economy. This is economy level. So, the results here in EIO-LCA are economy wide and comprehensive assessment. If you know the specific assessment, it is a comprehensive assessment; economy wide or that from the big system or we also call it as SoS. As we are talking about advanced remanufacturing systems a factory is a system, but a factory can also be called as system of systems. A system of systems means a factory has different units. It

has additive manufacturing unit, it has machining unit, it has packaging unit, packaging unit in itself is a system.

So this system, small systems makes a big system that is a system of systems. Now, we are talking about economy. Economy means system of different systems where each small system is different factory, different sectors. Different sectors are mineral sectors, mineral ore sectors, agriculture sector then may be in manufacturing, we can have machinery manufacturing, computerized computers manufacturing, semiconductor manufacturing and here what we think; these are different systems which are brought into a big system that is known as SoS. This is system of systems.

But in process based, the results are detailed and process specific. It can be process specific, it can even be product specific. But product also has some processes with it. So, let us first take the process based advantages only. It allows for specific product comparisons. Like we can compare the pens; those are made from metal and plastic and a pens which are made from only plastic. That we did in the subjective study, we did in value engineering. So, this is the complete energy input database is there and pollution that is produce at. All the database is you know, this both is tools. One is the software tool another is an online tool; and based upon a databases.

This is better databases are provided by different companies, different economies like, EIO-LCA is mainly developed by American institutions and Canada, Spain, Germany has also put their data in to provide people to do some assessment on the different products. So those are the databases provide by the companies that, what is the total impact if I need to produce a pen. What is the total plastic that is produce, how would that impact different companies? For plastic, what is the total material that is extracted, what is a energy get use in that; and all those are term or presented in the terms of the money. In process based LCA, this identifies the areas for process improvements, weak point analysis. It provides for future product development assessments.

The economy based or the EIO-LCA allows the system level comparison which I just mentioned here system of systems used publicly available and reproducible result. Publicly available, this is an online tool which is publicly available only the thing is that we need to quote whatever they say here. This is also taken from the eiolca dot net

website, right. So it provides for future product development assessments as well. It provides information every commodity in the economy.

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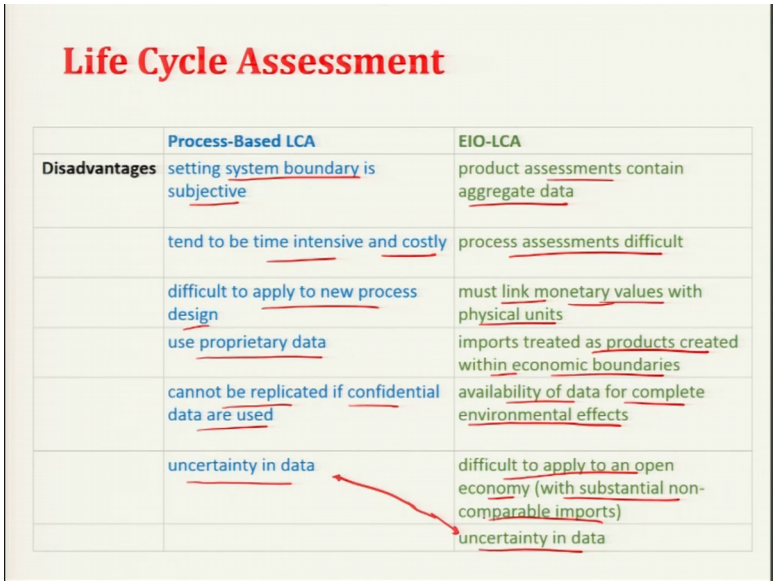

Disadvantages are also there for both the kinds of the life cycle assessment. In process based life cycle assessment, setting system boundary is subjective. We do not know what is the system boundary but we have to limit it to some extent. We need to tell that ok, this is only system boundary. We need to only work till the manufacturing or till the packaging or till the transportation to the customer etcetera.

So, this tend to be time intensive and costly because an engineer or the systems engineer have to work on this and work on the different databases or different input has to give in. This is difficult to apply to new process design in general. Use proprietary data cannot be replicated if confidential data are used; yes. Uncertainty in data is also there. In EIO-LCA disadvantages are that product assessment contain aggregate data; the data is aggregated for the overall differences for producing pens. It would take the plastic production. It cannot differentiate between different kinds of plastics. Plastics can be polyvinyl chloride PVC, bakelite, ok; bakelite it cannot be (Refer Time: 09:49) pens.

It can be nylon or certain other of polymers. But aggregated data will just tell this is plastic, this is for plastic production. It cannot differentiate between different kinds of

plastics. In a similar way, it cannot difference between it cannot differentiate between the different kinds of the semiconductor devices may be. So, the process assessment is difficult in this because this is system data; must link monetary values with physical units. So, these are monetary values with the physical units and as I said, only monetary terms are given here and the pollution is given in the emissions in the terms of the greenhouse gases.

Now the imports which are there, those are treated here as products created within the economic boundaries. Now the availability of data for complete environmental effects is also a disadvantage. It is difficult to apply to an open economy with substantial non-comparable imports is very difficult. Uncertainty in data is there in both the cases because we are modeling and, as I said, this is kind of a simulating with any model that is there, model is tends to simulate; what is the real situation and when we try to simulate or replicate the real situation. The second assumptions, EIO-LCA also has certain assumptions and those assumptions bring in the uncertainties. So, those uncertainties are here in both process based and EIO-LCA tools.

So now, I like to take you to the online tool. So, I type EIO-LCA and the very first link is EIO-LCA dot net; that is there in Google.

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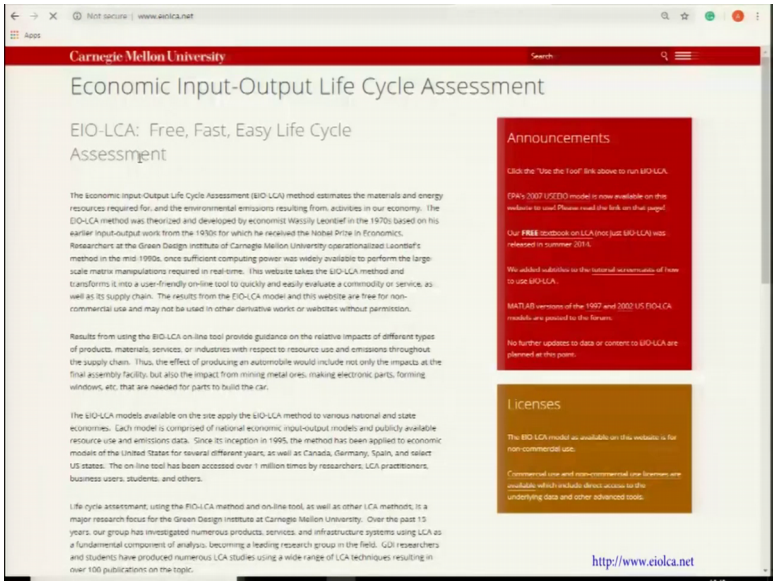

So, it is giving the information about the EIO-LCA software. The economic input-output life cycle assessment method estimates the materials and energy resources required for the environmental emissions resulting from activities in our economy.

The EIO-LCA method was theorized by and developed by economist Wassily Leontief in 1970s based on his earlier input-output work from the 1930s for which he received the Nobel Prize in Economics. So, these are some information they have given. This is a tool where in the result from using EIO-LCA online tool provide guidance on relative impact of different types of products, materials and services or industries with respect to resource use and emissions throughout the supply chain. So, it is then (Refer Time: 12:25) the whole supply chain. So thus, the effect of producing an automobile would not only include the impacts at the final assembly facility, but also, the impact from mining ores, making an electronics parts, forming windows etcetera that are needed for the parts to build the car.

So, you can see we are taking automobile manufacturing for the final assembly. It is taking into consideration the extraction of ore, making of the components, making of the subassemblies; so it is taking all those components. So, this EIO-LCA models available on the site may apply to EIA-LCA method to various national state economies. Each model is comprised of national economic input-output models and publicly available resource use and emissions data. Since its inception in 1995, the method has been applied to economic models United States and the now, the countries like Canada, Germany, Spain and select US states that provide us the data and the online tool has been accessed over 1 million times by the researchers, LCA practitioners, business users, students and others.

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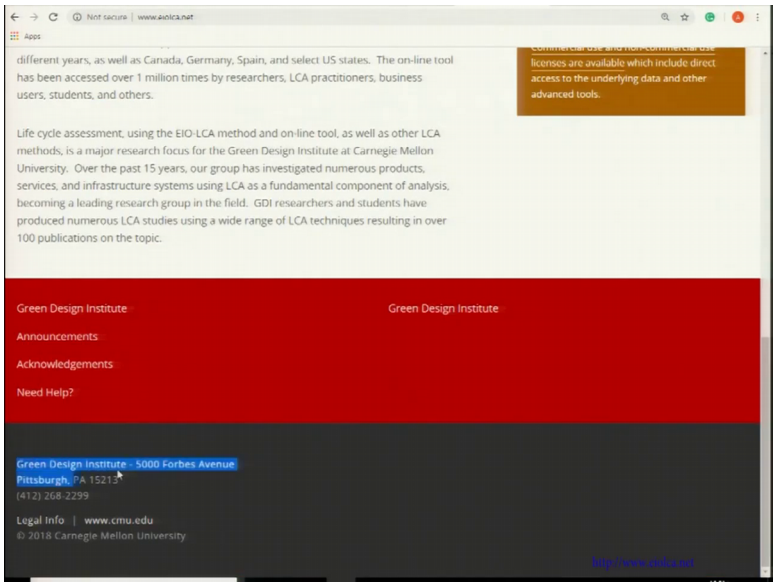

So, this is a information on that. It is designed by Green Design Institute, Carnegie Mellon University.

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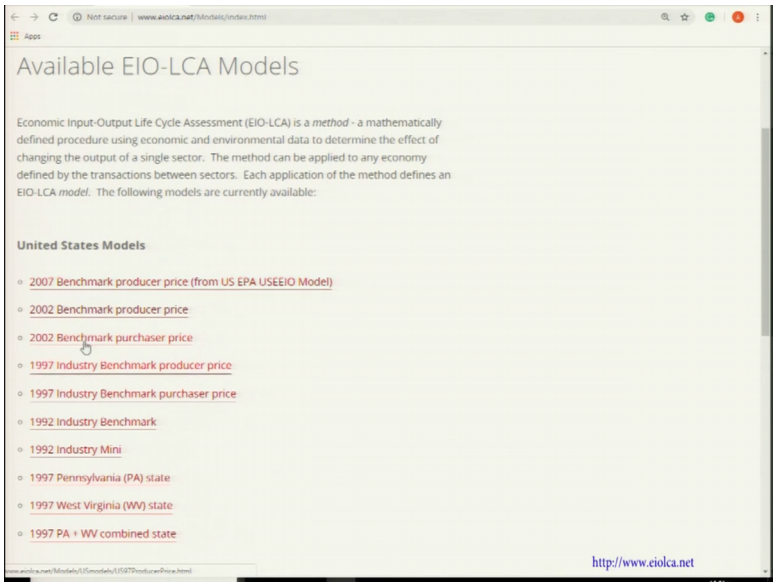

So, before coming to the tool, let me tell you what is the method ok. There are certain models which are available. These are the models which are developed; these are the 1997 PA W plus WV combined state. Different states are (Refer Time: 13:58), West Virginia, Pennsylvania. Then 1992 model then from 1992 onwards, industry benchmark

purchaser price and producer price models are coming into play. Say 2002 has two models purchaser price model and producer price model. As I told you, in the producer price model, only up till the manufacturing point is considered that producer produce the good, what is the price that the producer has to pay. So, the distribution or the transportation is not taken into consideration, but the customer has to pay the price when distribution is also taken into account. So, that is the purchaser price model. So, the producer price and purchaser price models are there. The recent model 2007 benchmark model is there, they are different models which have that linked databases. How the models are different? A different sectors associated with them.

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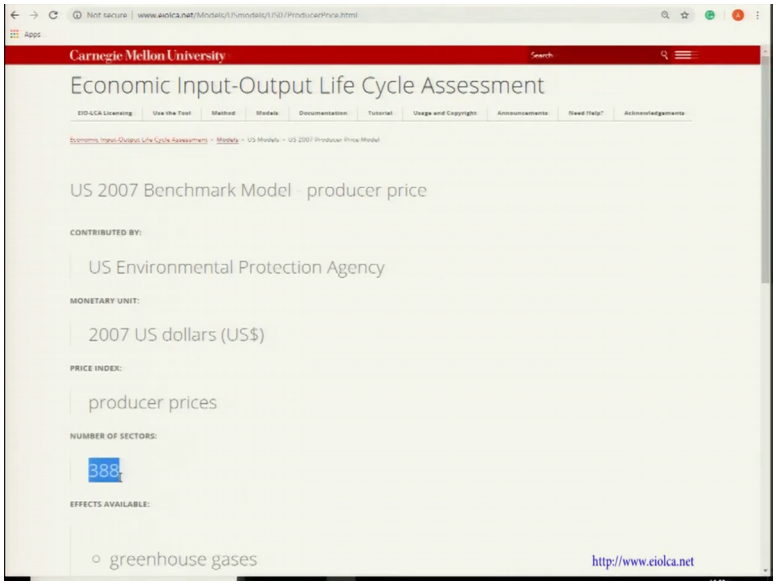

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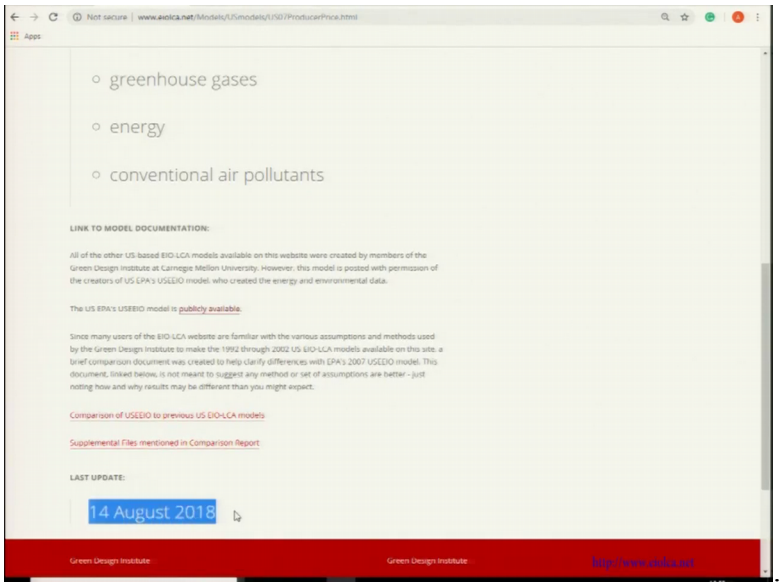

If I see this 2007 benchmark model, it has 388 sectors. So, the effects which are available are green house gases, energy, conventional air pollutants. It was last updated on 14th August. We will definitely use this model only this is the most recent model.

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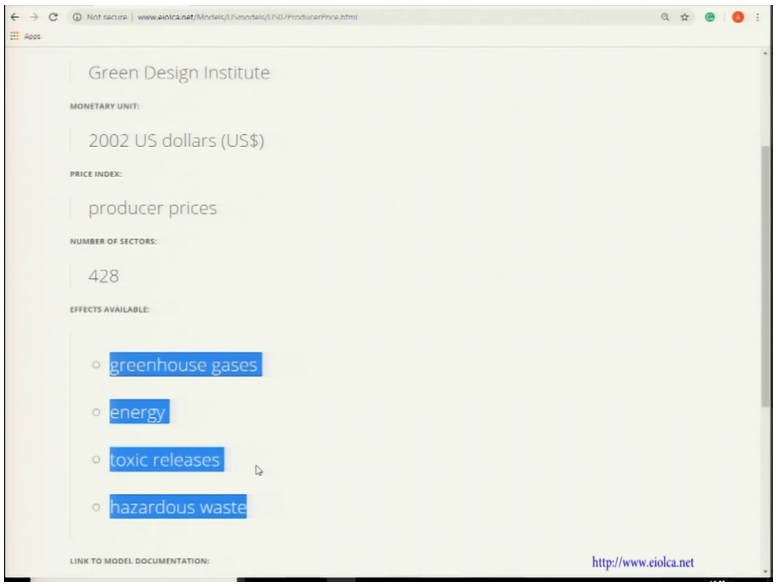

If you see, this is 388 sectors, the other models 2002 producer price model, it has 428 sectors. More sectors are there and more effects are also available there, but the data might be it is still outdated.

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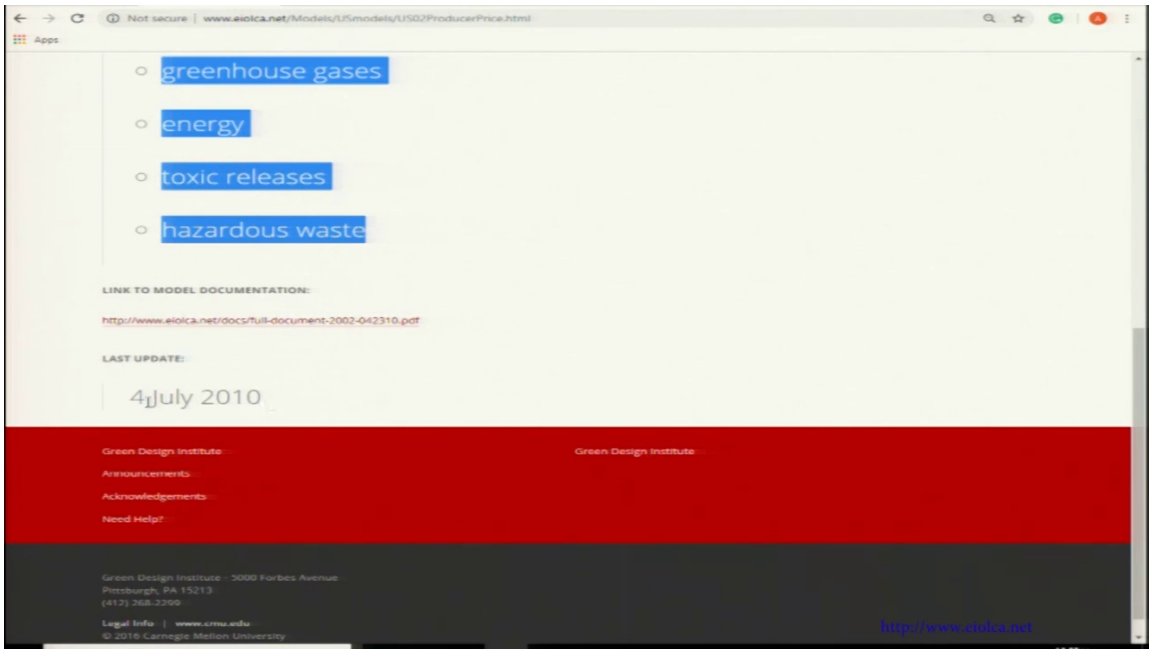

Because 2000, this was last updated on 4th of July, 2010 and this is most used model. These days as well 2002 benchmark model is being used and their previous model as well which have lesser number of factors and the data is also old.

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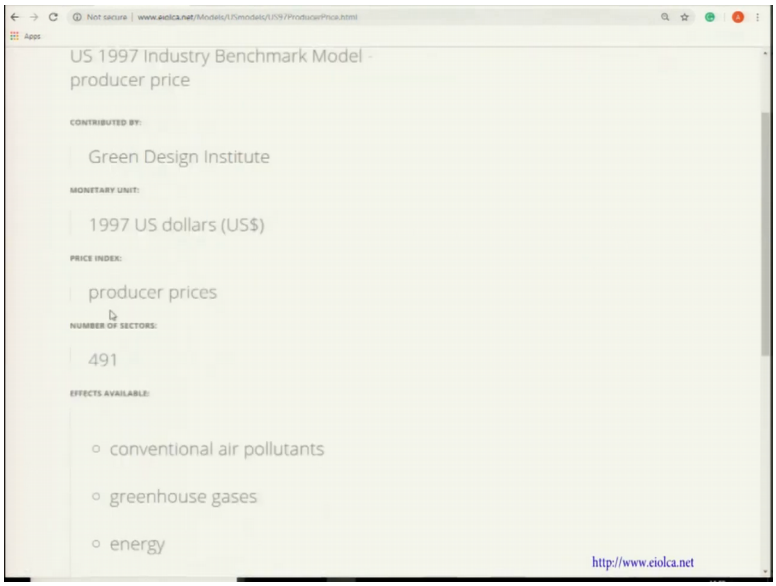

The number of sectors are higher here. In 1997, industry benchmark model producer price the effects are even more here.

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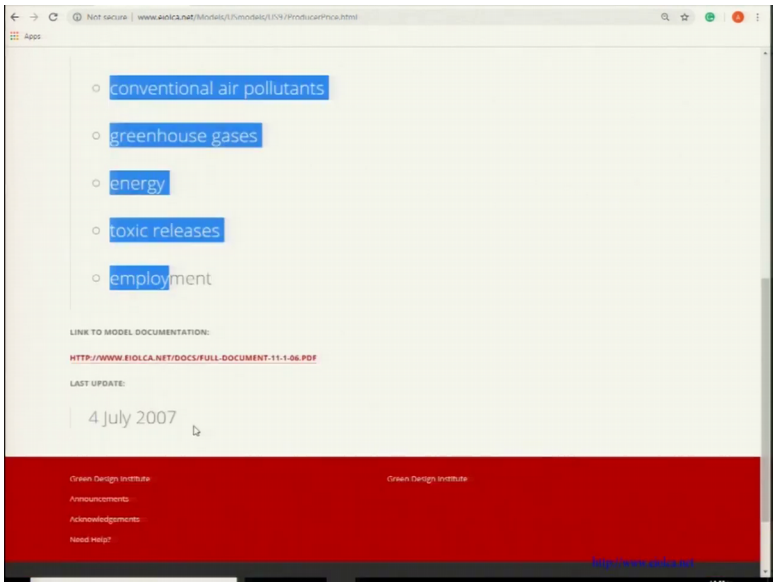

But this is again not updated. It was updated last on 4th July, 2007. So we will work on the 2007 model only.

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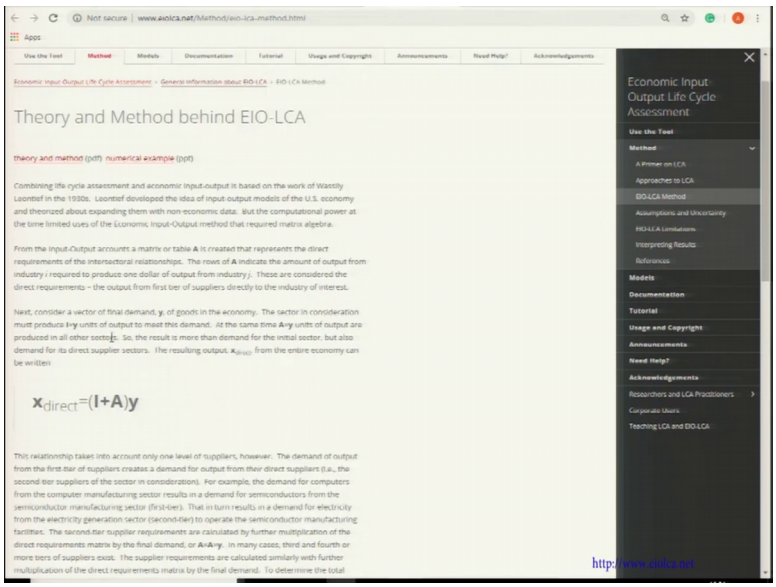

Before that let us see how does this work? Now EIO-LCA works based upon this mathematical relation where x direct is the direct output resulting from the entire economy which is equal to I plus A into y. What is I and A? Here A is a matrix i by j matrix from the input output accounts A matrix or table A is created that represents the direct requirements of the inter-sectoral relationship. The rows of A indicate the amount

of output from industry i required to produce 1 dollar of output from industry j. So, this is a matrix, i into j matrix, where A represents the amount of output from industry i that is required to produce 1 dollar of output from industry j. This is a matrix we need to understand. You can definitely read about this information here.

And this is this A into y, what that is; make this what is y here? Y is the final demand vector. Finally, demand vector finally, demand vector goods in the economy. Final demand in the economy right, and A into y makes the output produced in the all other sectors. Y is the final demand in an economy which makes I into y units of output to meet this demand. And A into y units to produce outputs that are produced in all other sectors ok. So, this is written in this way. So, this is for a single sector or these equations stands for a single tier. That is, the demand of computers means demands of computers; how would it affect, the different sectors demand of computer, how, what is the pollution that is produced, what is the energy conducting that is used.

But if we know the demand of computers would mean the demand of semiconductors or the components which are required to be the computer that will also right, this makes it two tiers. You can see the simultaneously, the second tier and for the demand of a semiconductors, it might required to get the metals or the gold and silver which is used there. The demand of those metals that can be 2 tier, 3 tier, those are taken into account by making this model.

X is equal to I plus A into A A this is, this makes, is single tier. This is 2 tier; computer and semiconductors ok. This is computer, semiconductors and metals and so on. So, this makes it a mathematical relation like X is equal to 1 minus A inverse Y for delta X is equal to 1 minus A inverse into delta Y. This is the mathematics behind the modeling. That EIO is based upon.

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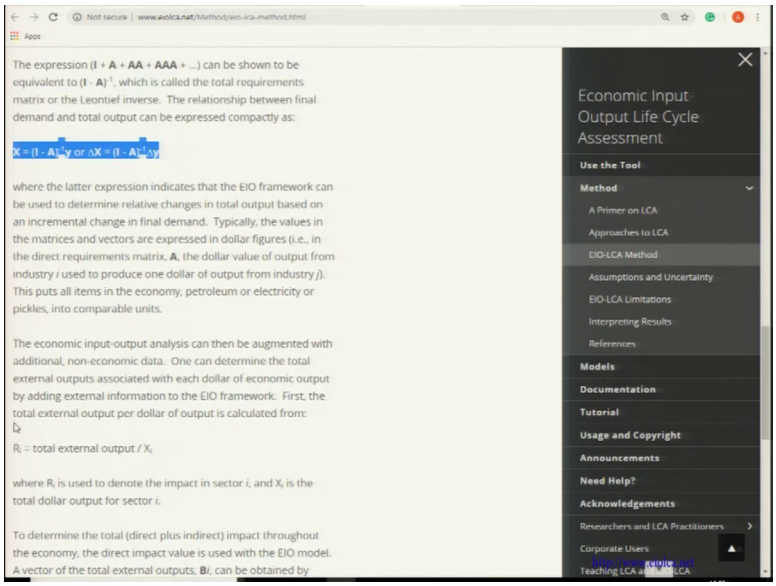

Now here R i is equal to total external output by X i. This X i you obtained from here. This is X i that we get from this model. This model gives that X. X i then R i. What is R i?

R i is the impact in sector i. Impact in sector i is a total external output by the total dollar input. The total external output would be then this R i into X i. So, this total external output is not given as delta Bi is equal to R i into delta X. So, this based upon this, the outputs are given.

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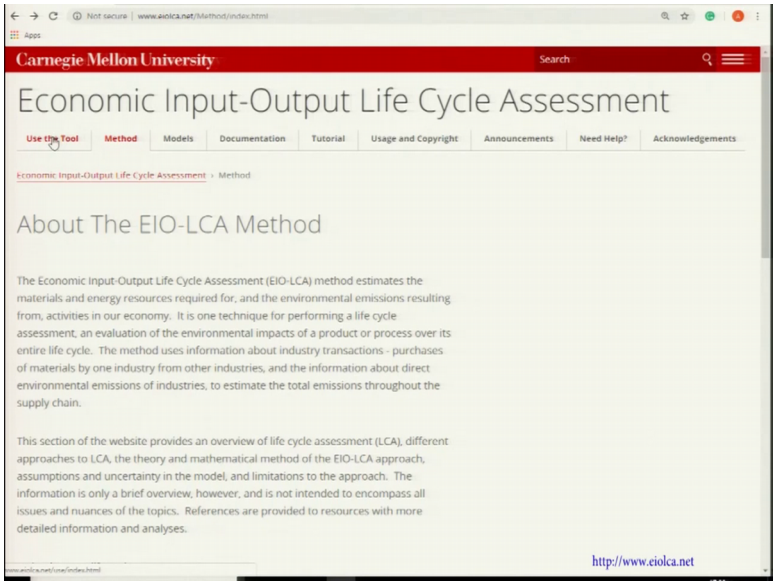

So, let us start using the tool. There is the first page here, use the tool. I am placing at this page, use the tool.

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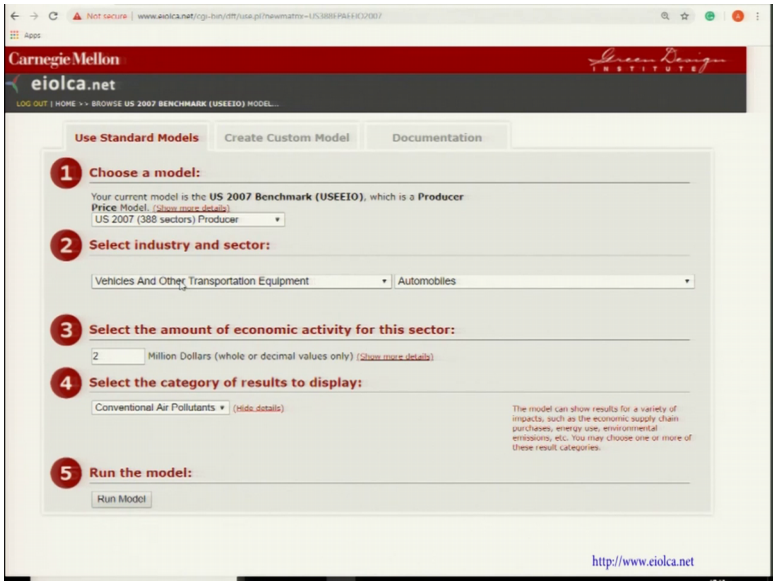

So, when I open this, the 5 step window opens in which the first step is to choose a model. Though they are three options, use standard models, create custom models and documentation is also there, documentation is a information about that what are the kinds of models, we needed to work on this.

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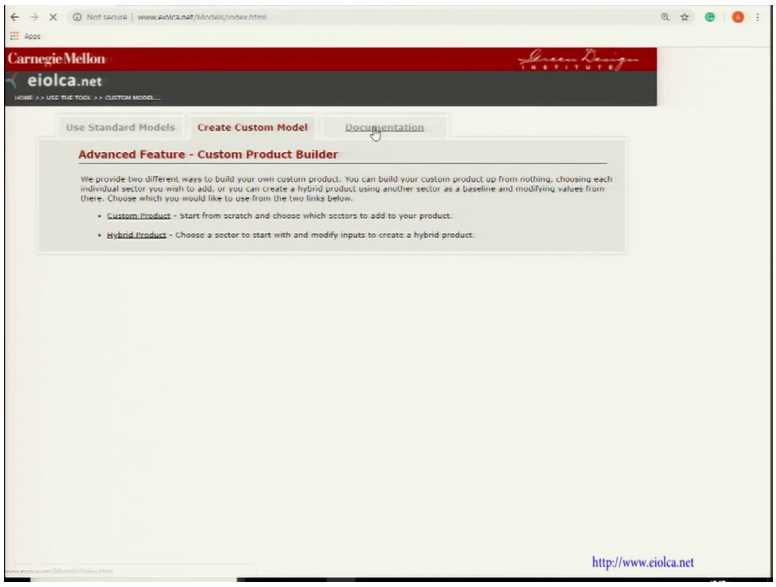

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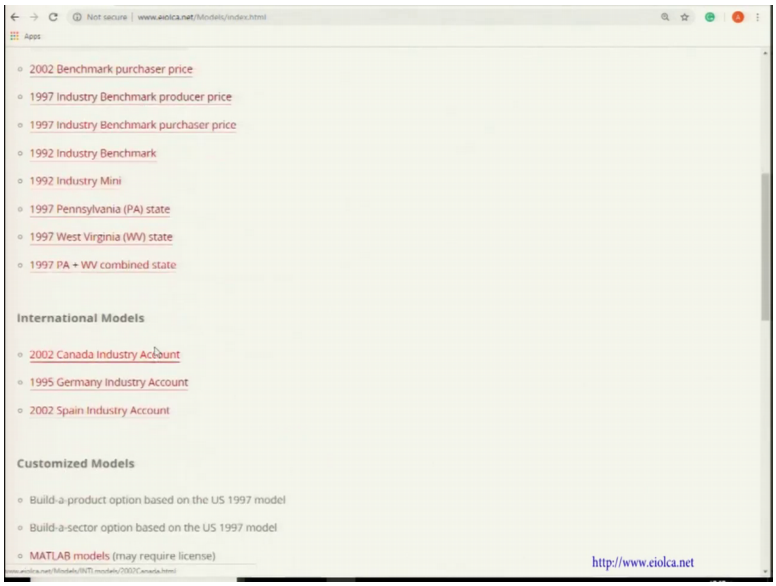

So, let us try to see the standard models and this is the 5 step window is here in which these different sectors are given. So, 450, 445 sectors for 92. These are again same sectors. So I will select US 2007 with 338 sectors and producer model we will choose. Again, we have the producer and purchaser models. These are purchaser models, purchaser price model and these are the producer price models. I have told you the difference. So, let us pick this 2007 producer price model. When I select this, it will ask for the select industry and the sector. Which sector would you like to work on?

I am trying to replicate the presentation which is given in the tutorial in this website only. They have taken a but you production of cars for which one car production would take 20,000 dollars.

And for producing 100 cars, it would take 2 million dollars. So, the input is 2 million dollars and we need to produce automobile. They have taken 2002 model, but I am picking 2007 model. So, our results would be a bit different from them. So in this, we there are certain sectors here or broad sector group here. Broad sector groups are like you can see agriculture, mining, construction, food, textile, wood, petroleum, resin paint, plastic all these are form in several automobiles vehicles. And other transport equipment is the one that we will select here. Now select a detailed sector; they say.

The detailed sector is automobile, right. So, for producing 100 cars with production cost of 20,000 dollars, we are going to set a demand to 2 million dollars worth of

automobiles. So, we will set the value 2 here, 2 billion dollars worth of automobiles. It is important to know that if we are analyzing a product, that has a lower economic value, we might like to put a multiplier because the results which are given are given in the 3 a decimal places. Three significant figures are there. So, if you I put for instance, I am taking the production of pen. I cannot put 10 rupees. I need to multiply into such a big number where I need to get a multiplier multiplied by 200,000 and so on.

I have to use a multiplier. So, as I get the result in 3 significant figures of decimals other than that the result will not be shown. So, 2 million dollars is the value that is put here. Then, we need to select the category like we saw that conventional air pollution, greenhouse gases, energy were the three output or the results that we could see here. Let us try to see first the economic activity. For economic activity the model can show results for a variety of impact such as economic supply chain, energy use, environmental emission etcetera for the economic activity and for only conventional air pollutions it will. So, these are the inputs that we have given in.

So, we need to have workable numbers 2 million dollar would give as a workable numbers. So, let us try to run the model and see what are they trying to tell here.

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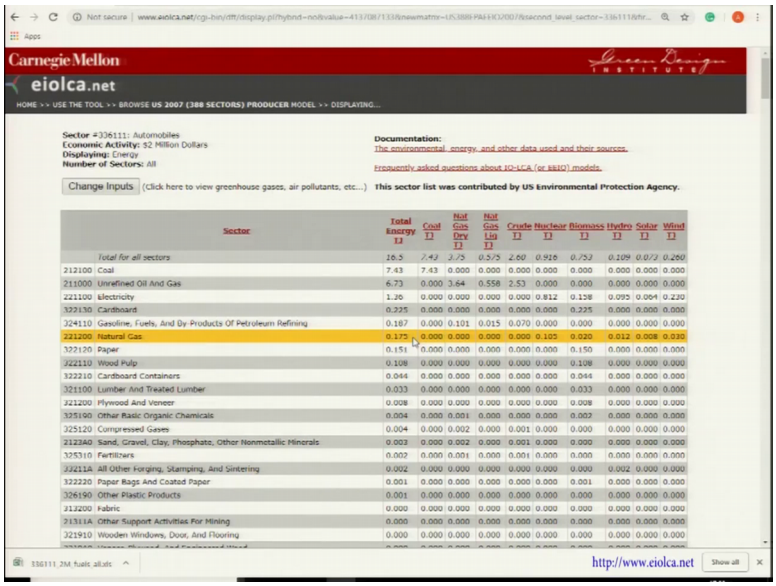

Yes, we have run the model and we have seen that 10 input we can see here. We can even change the inputs. Total 10 inputs displayed here, top ten. Top 10 inputs are displayed. I have select conventional air pollutants here conventional air pollutants. It is showing the

conventional air pollutants which are the mostly measurable or known pollutants conventional which are there PM10 level Particulate Matter 10 which is the all the sizes all the particulate matter which are lesser than 10 microns of the diameter.

It is giving the information here as well. This is a machine of particulate matter less than microns of diameter to air from each sector the value is primary ok. So, this t is small t is the units which is the metric tons ok. So, these are the pollutants. So, truck transport in 2 million worth of the automobile that I am taking into account. The truck transport would produce 0.946 tons of carbon monoxide; 0.0, 0.004 tons of ammonia, 0.538 tons of NOX and PM10, PM2.5 and so on. So, these are for top 10 sectors. I can even see all the sectors.

Or let me first see economic activity. Select or change the input from here. Change input, I change the input to an economic activity. Now, for all the sectors, automobiles worth 2 millions of dollar and the direct economic effect for 2 millions of dollars it is in percentage is here. It is showing that 0.318 million dollars worth wholesale trade would happen. The economic activity will this and 0.161 million dollars worth of direct economic purchases would be made. So this direct economic effects represent the purchases made by industry being analyzed as suppose your total supply chain effects defined above that include direct and all indirect purchases.

So, this is a million dollars. This column below is the complete economic supply chain of purchase is needed to produce your level of output. So, this is direct economic this is direct in economic in percentages. Direct economic effects represent in a percentages made by the industry being analyzed. So, it is showing that 0.161 million dollars worth trade is there. That is, 161,000 dollars worth wholesale trade is there. This is economic activity, right. We can change inputs to greenhouse gases. Let us see that greenhouse gases. So, this is the total greenhouse gases would be 752 tons of greenhouse gases would be produced of which, carbon dioxide is 633 tons and methane is 9.97 tons.

Nitrogen oxide is 70.9 tons. Another greenhouse gases is 37.8 tons. What are the various factors which are affecting this greenhouse gases? Electricity is at the top. This is the amount of electricity 191 ton, this t represent the ton ok. Greenhouse gas is global warming potential is a grating of greenhouse gas emission into the air from the production of each sector. Grating factors are 100 year global warming potential. That is,

GWP values from the IPCC 4th assessment report. So these are models which are taken data basis from different sources and they are put the models in this common work place or the website that we can see.

We can see energy as well. So, this is energy. The total energy in terra joules, t j is terra joules. Total energy is 16.5 terra joules of energy is consumed in producing the cars worth 2 millions of dollars at a 100 cars which of which 1 car is 20,000 million dollars of worth producing. So, all that in coal, natural gas, dry natural gas, liquid crude, nuclear biomass, hydro solar, all these inputs are here right. So, we can even see multiple or more than 10 outputs here. They have 25 outputs. I can even see all outputs here; all select. If I see all; obviously, the top 10 and top 25 does not changes. It is again the coal at the top and define oil and gas at the second number.

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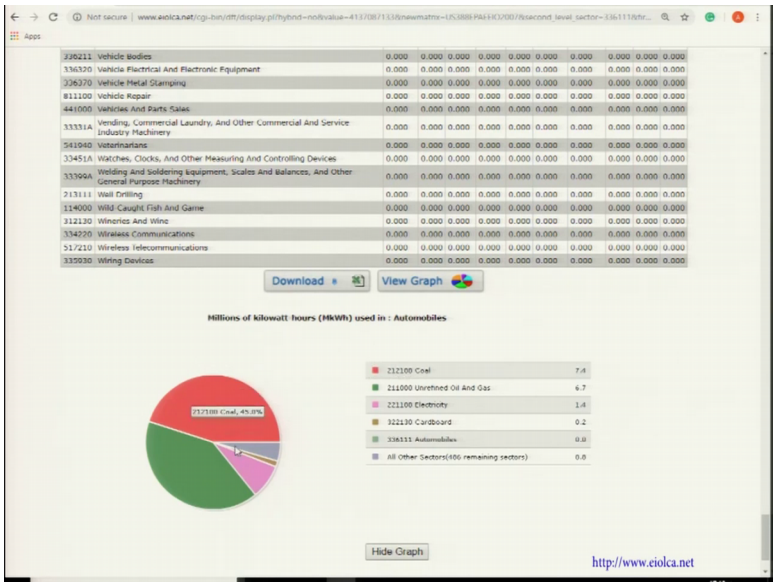

So, it is giving all the outputs now. So, we can even view graph and download here, from here. View graph is like here. So, it is a pie chart that is obtained it is giving the top five sectors with the colors. This is a dynamic chart in which when we go at the color it will show that what is the sector this from coal and what is the amount 45 percent is there; and it is telling the value here and all other sectors are here in grey color. So, we can see that the coal in red color and unrefined oil and gas in green color. These are the two main factors sectors. Two major sectors from which the energy is taken from. In automobile

fracturing in United States this is, that model from that also we can download the data. We can download the data in excel sheet by clicking download here.

But then data is been downloaded here. This data is downloaded, after downloading data. We can also interpret the result. We can make various other plots. Only pie chart is given here. We can make a line diagram. So, it is where do certain statistical analysis or have the feel of the data. Data representation can be made in multiple basis when we have the excel sheet with us ok. You can see that for the most of the sectors here, it is showing 0.0000. It might be negligible like it might be 0.00001 something, but as it is showing result only up to three places of decimals, though results are not shown here.

So, this is how we use the e i o l c a. Let me try to pick some other category now. In 2002 producer model, there is also an option to search for a keyword. For instance and again need to work on computers. I can put COMP search; it will show all the possible output where c o m p is used. COMP is in component. It is in computer, it is in compressor ok. So, there is a search option also. There in, this US 2002 model and let us try to pick some other sector here. Let me try to pick maybe machinery and engines; and in machinery and engines I need to produce metal cutting and forming machine tools ok.

In this case, I would say I would like to produce machines which are worth 100 dollars, 100 billion dollars of purchase economic activity which is also giving some details here. The sector is comprised of one or more NAICS sectors. I described below machine tool metal cutting type manufacturing US in the US industry comprises establishments primarily engaged in section metal cutting, machine tools except hand tools. So, it is showing these things run model for economic activity. It will show the results.

So, economic activities telling that worth 212 million dollars of total economic activity happens of which, metal cutting and forming machine tool manufacturing is the major contributor and all are below it. So, we can do multiple assessments life cycle assessments in this way, but this tool life cycle assessment EIO-LCA has certain limitations. Those limitations are mentioned here in the website only.

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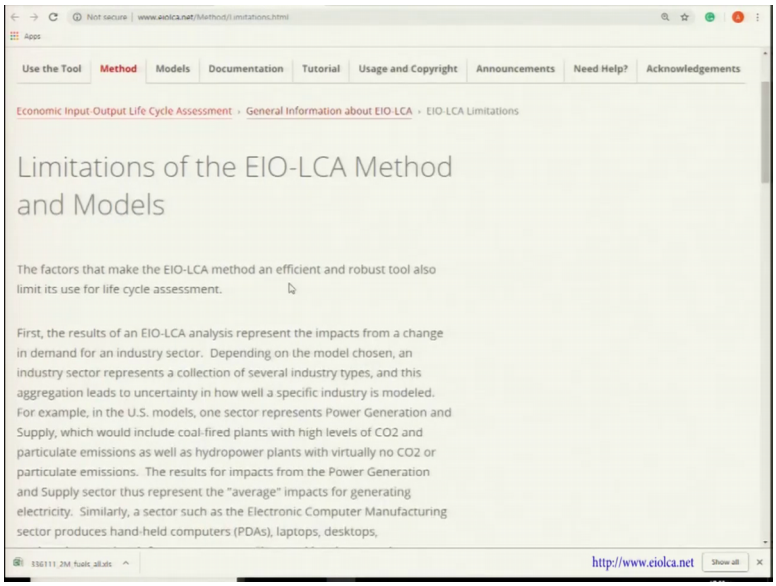

They say, they said that the factors that make EIO-LCA method, an efficient and robust tool also limit. It is used for life cycle assessment though it is open source publically available, we can use it easily.

But, certain limitations are there. First, the results of an EIO-LCA and LCA represent the impacts from a change in demand from industry sector. Depending on the model chosen an industry sector represents a collection of several industry types and this aggregation leads to uncertainty in how well a specific industries modeled. As I mentioned before, this takes the aggregate data. In aggregate data for instance, it has taken an example here. (Refer Time: 32:17) take an example here. For example US models, one sector represents power generation and supply which would include coal fired plants and with high levels of carbon dioxide and particulate emission as well as hydropower plants with virtually no carbon dioxide. It is just taking ok hydropower plant there is no carbon dioxide, but for coal based plants this large amount of carbon dioxide which is taking the average of that which is not acceptable.

Now, what we can do? If we know that we use in hydropower plants we can change the emissions. If know the emissions are significantly different than those are there in the data. We can change those and we can work on that. That can be done in the custom in model.

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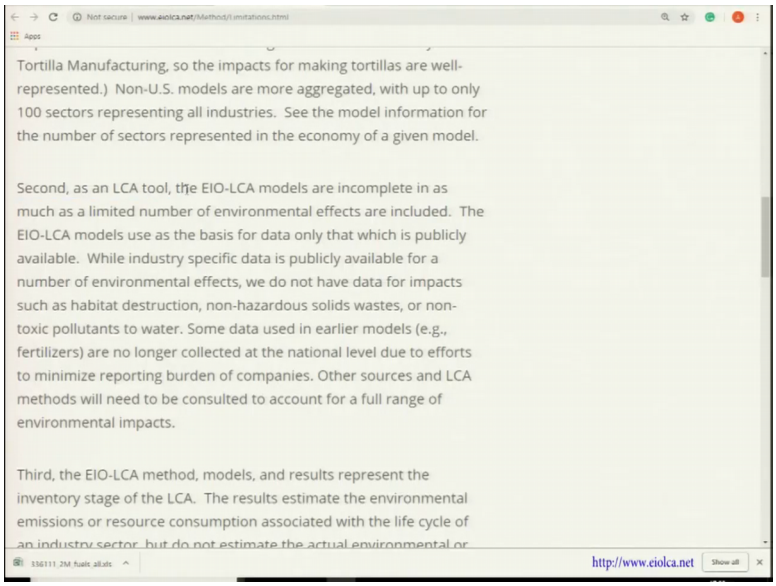

So, similarly the second limitation it is that as an LCA tool, EIO-LCA models are incomplete in as much as limited number of environmental effects are included. The EIO-LCA models used as a basis for data only which is publically available, while industry specific data is publicly available for a number of environmental effects. We do not have the data for impact such as habitat destruction, non hazardous solid waste or non toxic pollution, pollutants to water.

In a way, they are telling that the data is not complete. It is somewhat incomplete and certain other data sources have to be taken into account to complete the assessment. Some data used in earlier models, for example, fertilizers are no longer collected at the national level due to efforts to minimize reporting burden of companies There are certain, this is the limitation of data. The first limitation is that the data is aggregate. First is the data is aggregate, second one is the data is not available for all the sectors like only 488 sectors were available for this model.

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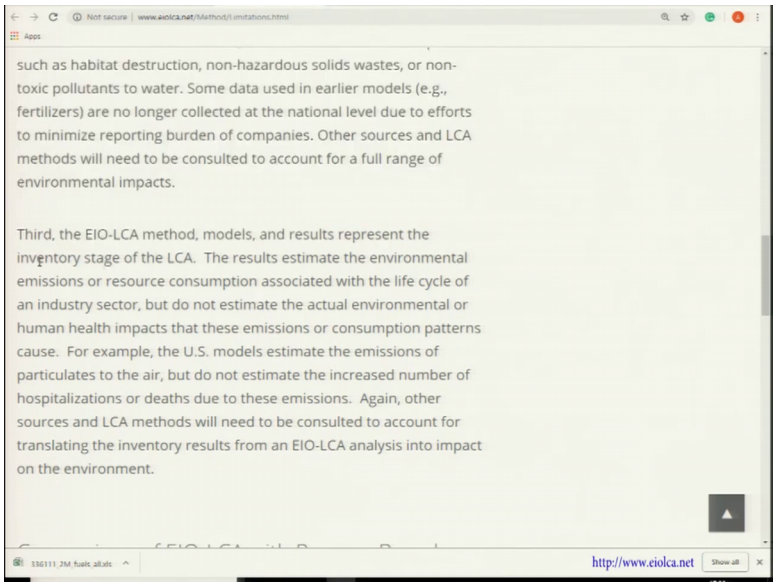

Then third one is this represents the results at the inventory stage of LCA. The results estimate the environmental emission or resource consumption associated with life cycle of an industry sector, but do not estimate the actual environmental or human health impacts that these emissions or consumption patterns cause. For example, US model estimate the emissions of particulates to air, but do not estimate the increased number of hospitalizations or deaths due to these emissions. Again, other sources and LCA method we need to be consulted to account for translating the inventory results from an EIO-LCA into impact on the environment.

What essentially they are telling here? They are telling there are three limitations. These are not drawbacks, these are limitations; that means, when we define the goal and scope within that goal and scope there are certain limitations of boundary within which these LCA works. The EIO-LCA tool works. Now to deal with the inaccuracies in the data based upon the (Refer Time: 35:09), if someone is more conversant with the specific data you can use the custom model. In custom model, this start from scratch we choose the sectors we add. Keep adding the sectors and we can work on them. In hybrid model we choose a sector to start with and we modify the inputs to create a hybrid model.

So custom model. Let us start from custom model or custom product. For a product there are three choices here. They say ok use a model. We choose a model here. Then let me say, I pick again machinery and engines; detailed sector is cutting tool and machine tools

or let me pick some other one this time rolling mill and other metal working ok. So here I will select 500 million dollars worth of the purchase of the machinery and engines. So, we need to build the model and we need to keep adding the sectors here. We need to add this sector. The sector is added.

Again, we can add another sector in machinery and engines only we can select a specific sector other than rolling mill and or let me pick what is the effect of special tool die etcetera. So I said, in this it is total 500 million dollars. In this case, I will say ok let me say 50 million dollars add the sector. So, we can keep adding the sectors here. If we have the good amount of information about what are the exact value, these sector would contribute to them and then we can build a model. Now, if we consider these two sectors and build a model, right. So, this is the custom based.

In the same way, we have hybrid product. In hybrid product we can choose a product it has only two steps here. We choose a model and select a sector. Let me say again vehicles or let me pick computers and audio visual. Select a detailed sector. I need to have computer storage and manufacturing ok. What is activity? Let me say 3 million dollars, select. Now when we select this, a page opens where we can change the activities here. Change the values of the activities. If we know that in the production of the computers for 3 dollars of worth purchase, this value 0.84 is quite big and we know that it should be lesser than 0.3. We can change it to like this ok. We can change some other value.

Like for instance, if we know that stone and mining, stone mining and quarrying is not having big economic activity. So we can, if we know some value, a bulk figure is there, we can put some value; like let me put it in 0.25 ok. Now we have changed the values. This is the hybrid model and we can now run it. Continue. So, these are then updated results with the data that we have put in and those are considers

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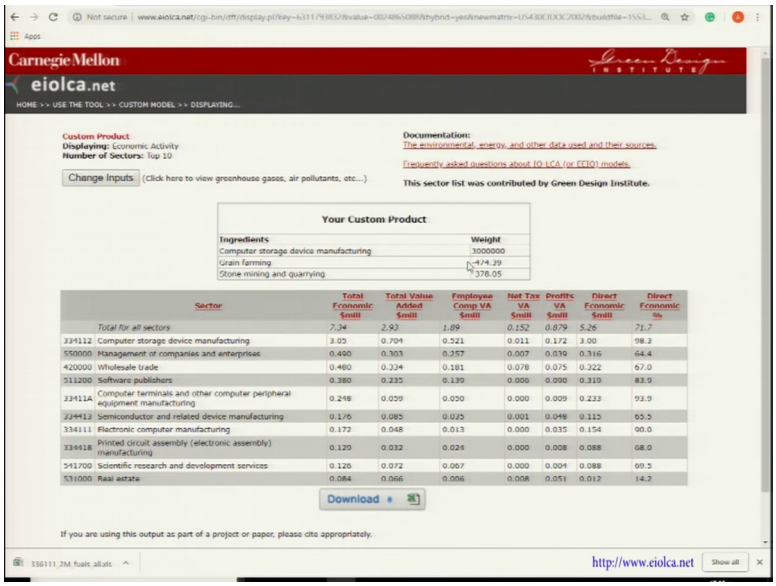

So, this is the telling that your custom product is like this in green farming minus 474 weight is there and stone and mining. This much is reduced than the data which they have in the database. So, this is the hybrid model.

So we can interpret the results. We can have the custom made model; we can get the hybrid models. So, EIO-LCA data can be used in multiple ways to have the life cycle assessment of the economic activity or the activities greenhouse gases. The convention, air pollutants and energy consumption and other toxic gases etcetera in different models can be used for getting the overall feel that how would the specific product manufacturing or specific sector effect my economy.

So this life cycle assessment, this tool EIO-LCA can be used in multiple ways like when can compare different products or just have the field of the data that what is coming or we can just see for instance in the specific sector, what is the impact it is coming. So, overall field of the data is there and we can also, like in India, we know that what is the percentage of the electricity that is produced from coal? That is the thermal power plants and what is a hydropower plant that can be compared with some other model in US. What are the hydropower plants, what are the wind mills and how many percent, what is the percentage of thermo power plants that can be compared?

And for India and American model, we can compare. India and Canadian model can be compared and we can have the data for India and different comparisons can be made. So,

this is one of the methods to have life cycle assessment feel that what is the overall impact or what is the overall energy, greenhouse gases, toxic gases, emissions energy or the economic activity?

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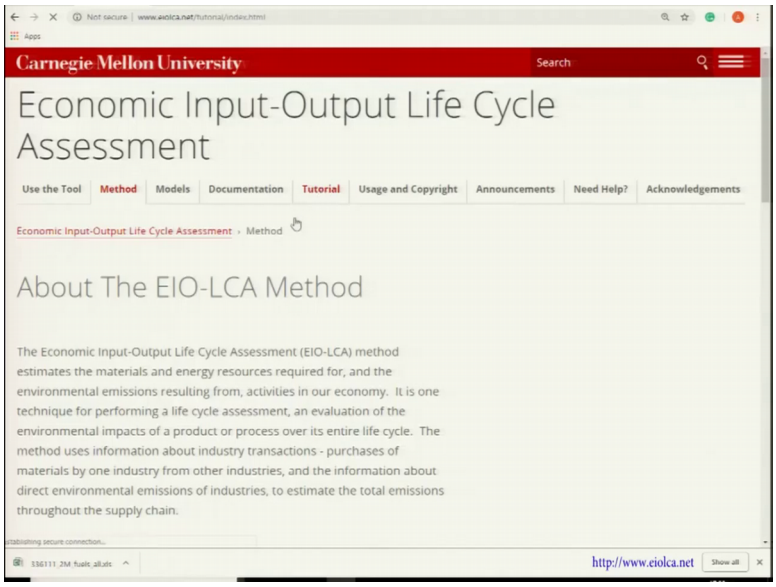

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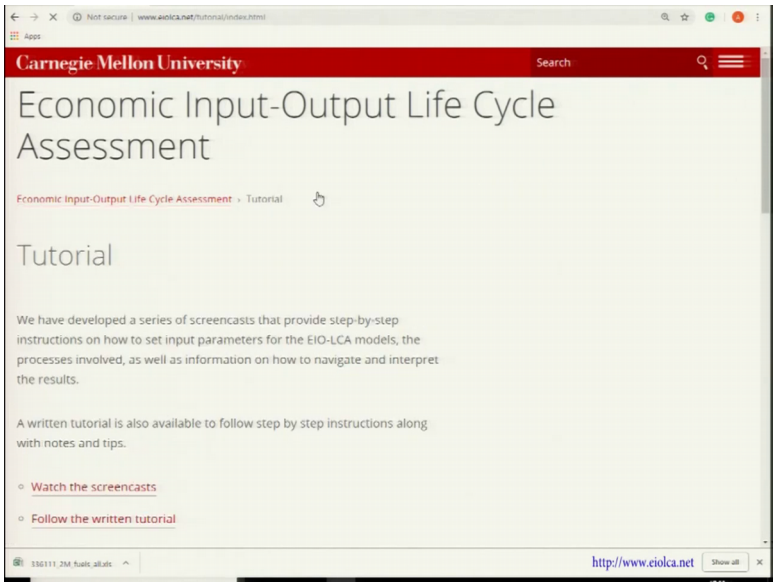

So, how does that work? So, this website has certain or a lot of a information in it like we have the tutorial where I have also tried to application this tutorial. That is presented here. These tutorial section is here so.

We have videos and written tutorial. We have the corporate information, the models and methods, different documentations. So, a lot of information is there and we can excess these two. I would suggest you to pick some sector of your interest and try to see what is the total impact; or environmental effects that is there. There in the product or that would like to manufacture in future or work on in future for life cycle assessment.

So, I will come with the next model G a B i software, GaBi software in which we will pick specific products. For instance, we can pick specific manufacture of a mouse and; we can see what are the various activities. What is the amount of plastic (Refer Time: 41:22), what is the weight of different components and what is the total energy consumption, what is total emissions that is, process based. We will come up with that in the next structure.

Thank you.