Carbon Accounting and Sustainable Designs in Product Lifecycle Management

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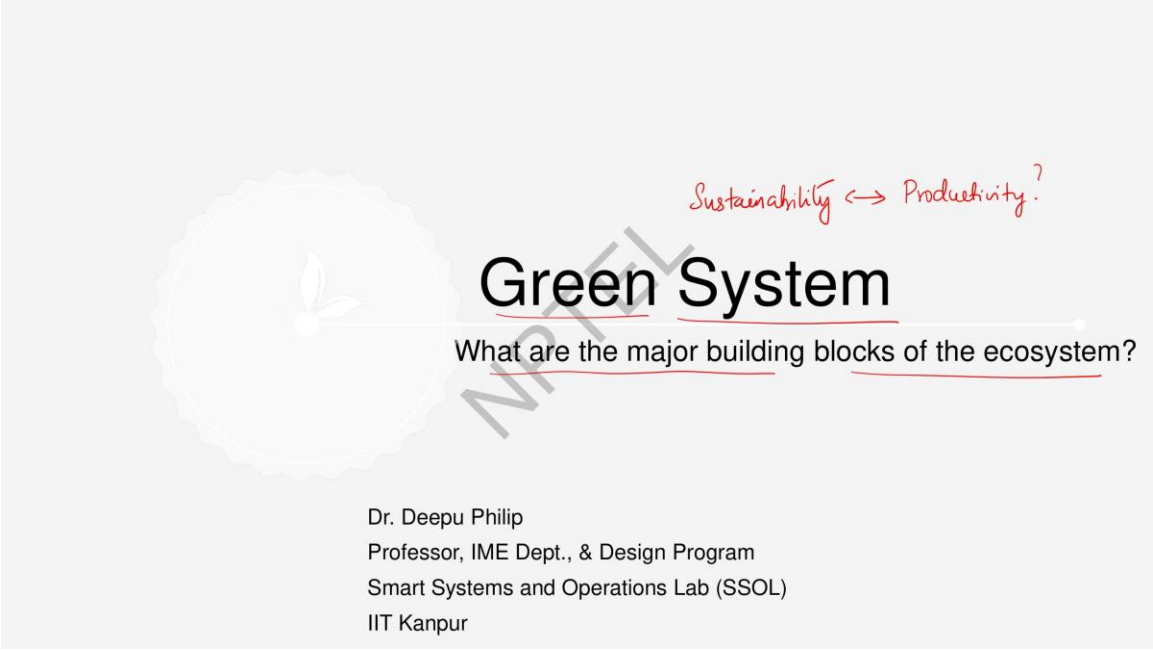
Week 02

Lecture6

Green System

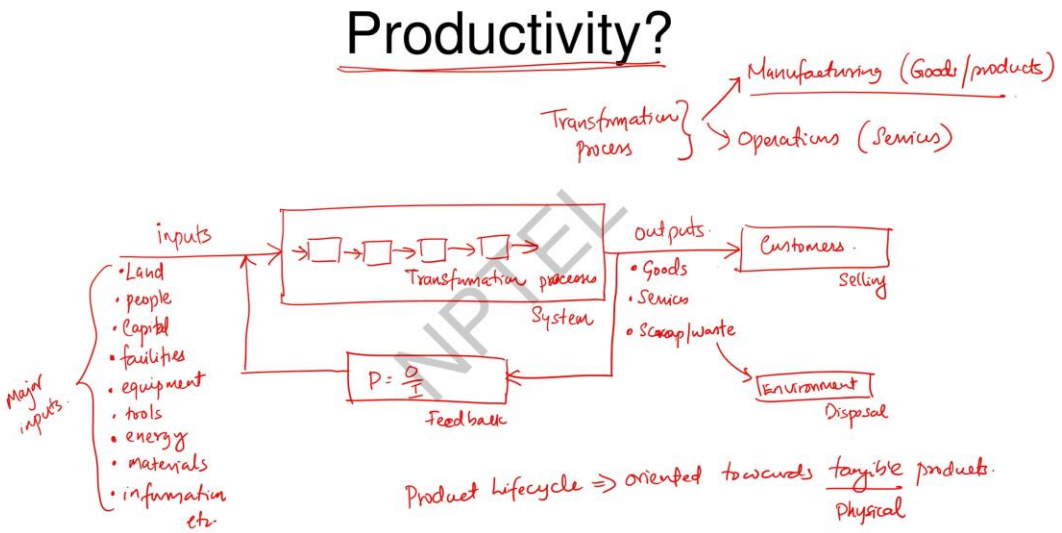
Good morning, everyone. Welcome to yet another session of the course, titled Carbon Credits and Sustainability for Product Lifecycle Management. This is a course that is being offered under the NPTEL MOOCs. And I'm Prof. Deepu Philip from IIT Kanpur. I'm a professor in the Industrial Management Engineering Department.

And this is an advanced course or an augmented course of the basic sustainability and green manufacturing courses that we are offering as part of the NPTEL. So, without further delay, let us get into the new topic today, which is about what we look at this green system. Okay.



And the main thing that we are going to look at is, what are the major building blocks of the Green Ecosystem. When we say green system, we are also looking more towards what you call as the sustainability angle. We have already seen, what is sustainability.

We defined sustainability in the previous class, and we talked about productivity and other aspects. So, we had this, productivity and sustainability and the interactions between them, we already discussed in the previous lectures. So today, look more towards the green aspects of it.



So, as we mentioned in the previous lecture, you might remember about the productivity we discussed. But I just want to remember or remind you guys about how the system works. So, as I mentioned earlier, this is the inputs. As we said earlier, inputs and we had the system and we had the outputs. And the inputs are, we mentioned in the previous, the type of inputs are land, people, capital or money, facilities, then equipment, tools, energy, materials, information, etc. So, these are the major, inputs.

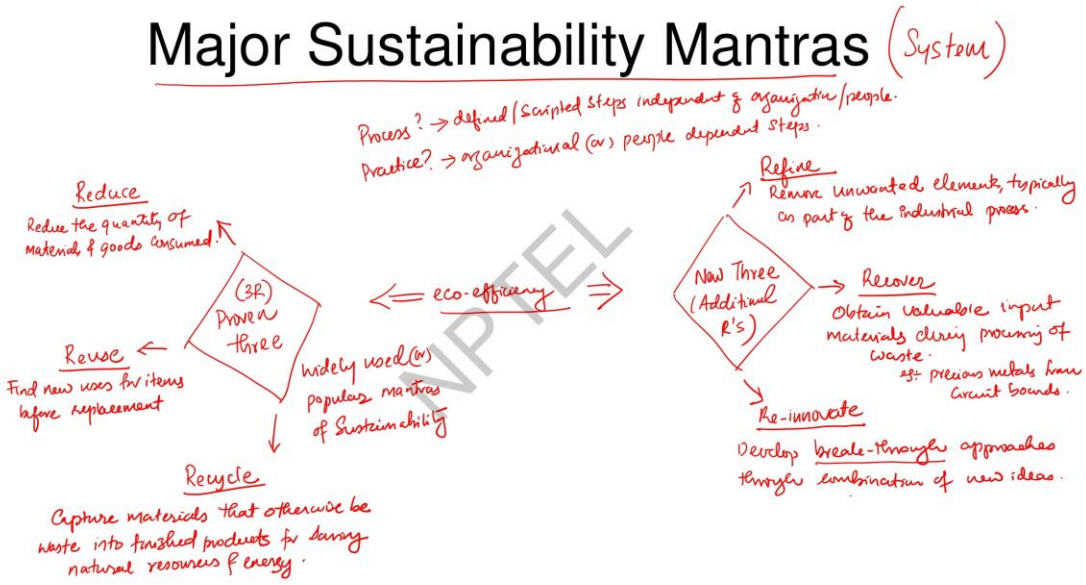
There are many other things, tools, manufacturing, like for example, coolant and etc. are also part of this. So, these are inputs to the system. And then system gives you outputs. And the outputs, major outputs were goods or services. And then we have what we call as scrap, waste. Okay.

So, the goods and services, this goes to what we call as the customers. Okay. And this goes into the disposal or, whatever you want to call it. This process is called as disposal. This is what we call as selling. So, you make money when you sell your goods or services to the customers, and you dispose it to the environment.

That is part of the removal of the scrap. And then we also had what we call as this feedback and the feedback went from the outputs to inputs. And if you remember, the feedback was what we call as the productivity, is what we defined here, the output over inputs. And the system is what we called as, there is a set of processes like this, a predefined process, which we called as a transformation process.

So, the system contains transformation process or processes and the transformation process is supposed to translate the inputs to outputs. So, the transformation process, as I mentioned earlier, there are two ways. The transformation process, you can think about it as two aspects. One is called manufacturing process where the output is goods or products. Okay. The other one is, what we call as operations, where the output is services.

So, in this case, in this course, we are looking more towards the manufacturing because the product life cycle, is oriented towards tangible products, okay, or physical products. Tangible, you can also think about as physical products. So, this specifically we are looking at physical products, where final product, which you can touch, feel, understand is part of the system, so this is what we discussed as part of the productivity in the previous session and we also looked at how sustainability, how can we improve productivity, all those aspects, we looked into it and also, then as part of that one.



We also studied major sustainability mantras as part of it, we went through, what he called us that six are, so I will give you a slightly different viewpoint, because we are now looking from the system standpoint, Okay. So, the first thing what we will do is we will take it as the, so let us take the proven three sustainability mantras. And the first mantra is we will just do it this way. Okay. So, it will be easy to do. The first one is what we call as the reduce.

The second one we call as reuse. You have already seen this. And the third one we call as Recycle. Okay. So, these are the proven three or the other way to think about as the three R, the original three R. So, these are the widely used or popular mantras of sustainabilities. So, this is what we talked about.

So, what is reduce? So, the logic is one way to do is reduce the quantity of materials and goods consumed. Materials and goods consumed. This is one aspect of reduce. So input side, we already talked about this from the input side mostly.

So, reuse, what it is, is that find new uses for items before replacement. So, if you have a PET bottle, and you are going to throw it away. Maybe you can find a better use for it. Then that would be reuse.

And recycle is in another way to think about is, Capture materials. That otherwise be waste into finished products for saving natural resources and energy. So, things that

otherwise would have been gone into waste, capture them and we convert them into finished products, which may be of different quality and other things, but then use it so that we can save natural resources and energy. So, these are the proven 3R's.

And let us talk about the new three. Okay. New three are, these are also known as the additional Rs of sustainability. Additional R's. Okay. What are these additional three R's? We already seen in the last class itself.

But we will do it little bit more. It is Refine, is the number one. The next one is Recover. The third one is Re-innovate. We briefly touched it.

So now we will look into slightly broader things. So, what is Refine? So let us do refine, what it is. So it is, remove unwanted things, elements, typically as part of the industrial process. So, what we are saying here is, we remove the unwanted elements, whatever, so I think you might have studied about what is a process and what is a practice.

So, there is a difference between, what is process and what is practice. In some of our lecture, we have already mentioned this earlier in other courses, but process is defined or scripted steps independent of organization people. So, these are scripted steps. If you follow this independent of organization, whether you are in car manufacturer or Tata or Mahindra or Toyota, it doesn't matter. If you follow the set defined steps, you will get the same output.

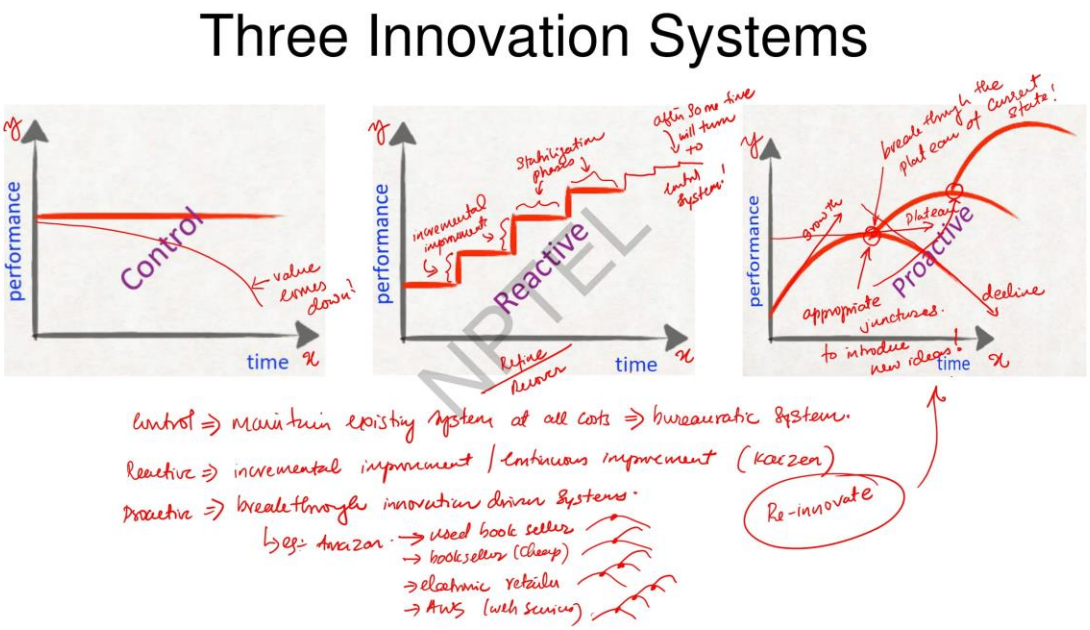
So, independent of who is following it, which organization is following it, process actually gives you a very defined output. Practice is organizational or people dependent steps. So, there is much high variability depending upon who is practicing what, your output may change. So, in refine, we are focusing on the industrial process, not on practice. So, set thing and we are trying to remove unwanted steps out of it.

The second one is the recover. So, what is this, is obtain valuable input materials during processing of waste. A classic example of this would be how gold, copper, etc, are taken away from old circuit boards of the places where the old electronic items are recovered. So, that is the recover aspect of it. So, now, if you have gold in the circuit, so, I will give it as example, precious metal, metal from circuit boards, okay.

So, this is an example of recovery and how you don't have to mine and find more gold or copper or etc. like that. Then comes the third one, re-innovate. So, what is re-innovate is, it develop breakthrough approaches. We will tell you, what is breakthrough approaches. Through Combination of new ideas.

So, you keep on coming up with new ideas and in that process of going by new ideas, you combine them so that you actually get a much better coming out of it. So, we will talk about this breakthrough in quickly. But if you have now you've seen the six R's. So, if we think about it this way. And in both sides, combining them both ways, going back and forth, it would be what we call as eco-efficiency.

So, for achieving eco-efficiency or efficiency of the ecology, we can combine all the six, two, three, whatever subset of it, so that we can achieve eco-efficiency. Or we can march towards sustainability or we can achieve more sustainability from what we have.



So now let us look into what you call as this Three Innovation Systems and we want to talk about what is a breakthrough. So typically, if you take the x-axis, so this is the x-axis and this is the y-axis. So, the x-axis you have time and y-axis you have performance.

So, in the first image or first thing, what we call it as the control system, where we try to maintain the same performance as time progresses. So, what we call as the control implies, maintain existing system at all costs. This is also known as bureaucratic system. If you have a good system, you maintain it. If you have a bad system, you maintain it.

But the problem with such a system is that as time progresses, the value of the performance, if you take value of it, then the value starts coming down like this, Value comes down. Why does the value come down? Because there is something called

inflation, and as time progresses, the inflation actually catches up. And since you have not made any improvements or anything, you actually comes down. Your system performance at the end of the day, the value comes down.

That's why if you have bureaucratic system long term, it becomes really painful for anybody. Then comes the second system, which is called as reactive where there is time in the x-axis and performance in the y-axis. But you can see that there is these incremental improvements, Okay. So, we have incremental improvements like this. We make a small improvement and then, what we have here is, this is called as stabilization phases.

So, we have stabilization phases also. You make a small improvement, allow it to stabilize. Make another improvement, allow it to stabilize. So that kind of a system. So, this kind of a system is known as, so the reactive system.

Reactive system means incremental improvement. Some people also call it as continuous improvement. The Japanese word for this is Kaizen. So, this system also looks good, easy. But as time progresses, you will see the step size getting small like this.

And then slowly it will converge to a control system. After some time, will turn to control system. That is purely due to the, what we call as the law of diminishing returns. Now comes the third system, where you have the time in the x-axis and performance in the y-axis. And every idea you have to understand that there is a what you call as a growth phase.

Then what we have is a plateau phase. And then there is what we call as a decline phase. Every, this is typical life cycle of any idea, any product, any organization. The logic in this system is identify appropriate junctures or time points, okay, where you would introduce a, to introduce new ideas, okay. So, when you have a way to add new ideas and at the right point in each time to move towards a new system.

So, this kind of a system is called as, what we call as proactive or, what we call as breakthrough innovation driven systems. So, what are you breaking through? You are breaking through the plateau of the current system. So, this is the break through the plateau of current state. An example of this is, let's take Amazon as an example.

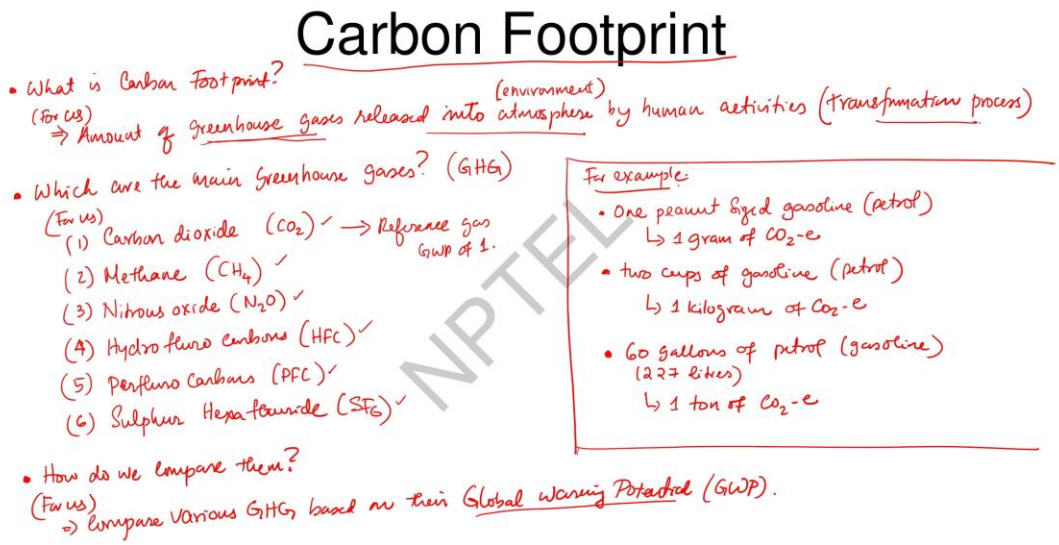
Amazon started as a used bookseller. Okay. And then they became popular. So that is the first idea. So, this is what happened at that point. Then they became a bookseller. Okay.

Cheap or cost efficient. So that idea, so that became in the next phase like this. Right. From that point, then they became an electronic retailer, okay. So now you have like this. So, this is a used book, then the electronic retailer.

Now Amazon is AWS, Amazon Web Services. So, this is web services. This is a new business model. So what Amazon is doing is doing this. When one product is dying out, they bring in new idea and move towards a new business opportunity.

So, this is the logic behind the three innovation systems. So, when we talk about re-innovate. Okay. We are trying to say that focus towards bringing in new ideas so that your system becomes proactive and take it forward. So, this course also embeds all aspects. So, in the reactive kind of a system, when we talk about, we can do refine and recover.

All these kinds of things actually get refined, recovered. That kind of stuff can be easily added as part of the reactive system. But then, the re-innovate, typically you would need a proactive system as part of this. So, the systemic viewpoint of all the three systems are probably of, you would understand as part of this.



Now, we will go to the next topic, which is the important part of our discussion is called Carbon Footprint. So, the first question that we need to understand as part of this is, what is Carbon Footprint? Okay. There are many, many, many definitions associated with this.

But for us, okay, how are we defining it? It is the amount of greenhouse gases released into atmosphere by human activities. In our case, it is the transformation process because we are talking about the manufacturing side of it, the goods side of it.

So, the carbon footprint is the amount of greenhouse gases released into the atmosphere. If you do not like the word atmosphere, we can reuse the word, we can use the word environment. Okay. It's up to you. Okay. How do you want to think about it? But either in the atmosphere or the environment, the amount of greenhouse gases that is being released. Okay.

So, the question is, the second question is, which are the main greenhouse gases? Okay. So, the greenhouse gases in normally known as GHG. Okay. So, the abbreviation of it is GHG. So, which are the main greenhouse gases? Okay. So, for us, let us see which are those ones.

There are six of it for us. One is carbon dioxide, which is also known as CO_2, carbon dioxide. Then the second one is methane. Okay. Methane is CH_4. Then the third one we are talking about is nitrous oxide.

It is denoted by N_2O. Then fourth one is hydrofluorocarbons, normally known as HFC. Then the fifth one is perfluorocarbons, perfluorocarbons, known as PFC. And then the last one is sulfur hexulfuride. It is SF_6. So, these are the six main greenhouse gases that we are going to do as part of this course.

So, with this, what we will do is we will take a small break and we will take the next session. How do we use, because these gases are different and how do we compare them, will be part of the next lecture, and we will start from this slide itself in the next lecture? Thank you very much.