System Design for Sustainability
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Week – 05
Lecture - 02
Sustainable Product-Service System Design – Definition, types & Examples

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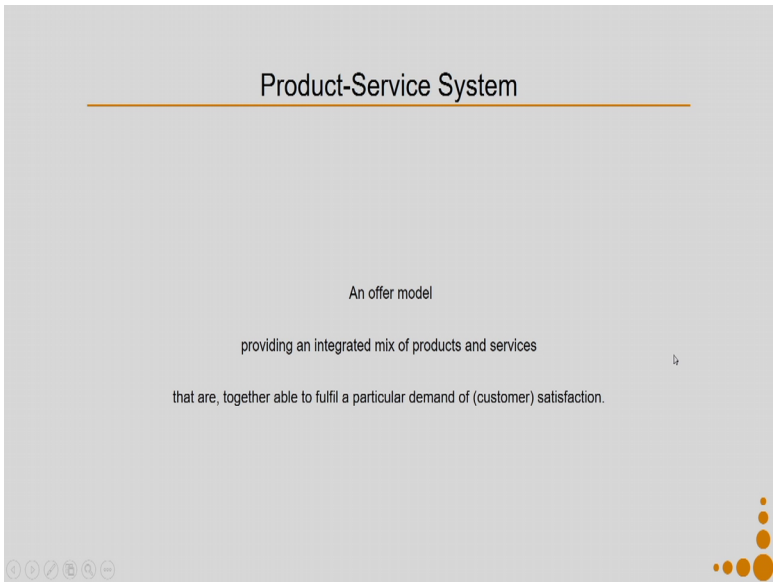

Welcome to today's lecture. Today, we will be talking about sustainable product-service system design with its definition and some examples. So, this part of the lecture will be taken in two parts today, and in the next lecture. So, what is a product-service system design that is what was the topic for our lecture in the last class. What we learn from last class was a product service system is an offer model, providing an integrated mix of products and services that are together able to satisfy a particular demand of the customer that is the unit of satisfaction.

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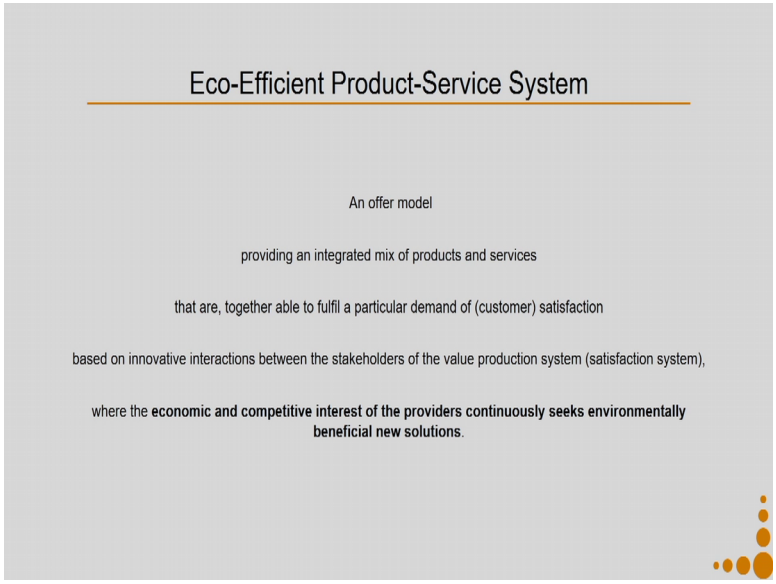

Now let us try to understand, what is a sustainable product-service system? So, before going into sustainable product service system, the level one that we will understand is what is eco-efficient product-service system, then we will go to sustainable product-service system.

So, for an eco-efficient product service system is an offer model, providing an integrated mix of products and services, that are together able to fulfill a particular demand of customer satisfaction. Based on innovative interactions between the stakeholders of the value production system that is a satisfaction system, where the economic and competitive interest of the providers continuously seeks environmentally beneficial new solutions.

So, eco-efficient product-service system model is a product service system model of course, but with an added feature that all the providers that is all the stakeholders, who together, come together, and provide a particular satisfaction to the customers. Their economic and competitive interest is to be eco-efficient to continuously seek environmentally beneficial new solutions.

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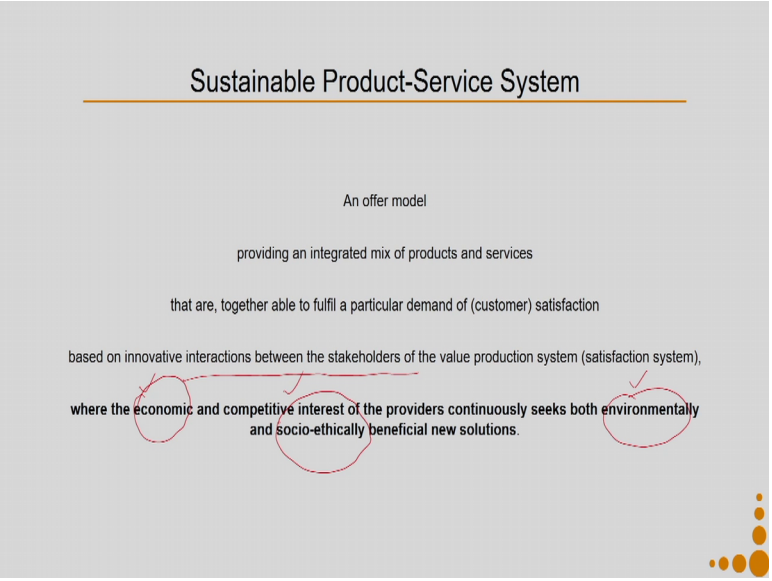

Coming to what is sustainable product-service system to the same very definition, which was the previous definition an offer model providing an integrated mix of products and services, that are together able to fulfill a particular demand of customer satisfaction. Based on innovative interactions between the stakeholders of the value production system that is the satisfaction system, where the economic and competitive interest of the providers continuously seek both environmentally and socio ethically beneficial in new solution.

So, in this definition what you can see is because of the economy interest and the competitive interest, which means economy. So, you can see here the economic interest, which is economic sustainability is achieved along with environmental sustainability and social sustainability. So, sustainable product service system is an offer model is a PSS, wherein the economic and competitive interest of the providers continuously seek both environmentally and socio ethically beneficial new solutions how do they do that is by and interactions between stakeholder. We will understand each and every part of it in the subsequent lectures. So, let us go to examples first.

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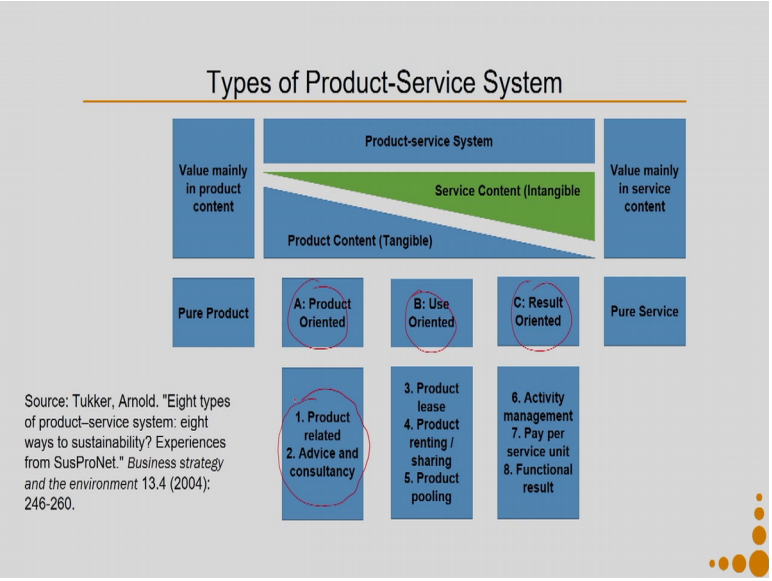

So, as we discussed in our previous lecture, there are different types of product service systems; product oriented, use oriented, and result oriented, because there these typologies for product service system. The same typologies are applicable also for a sustainable product service system or an eco-efficient product service system. A sustainable product service system, because it includes both the environmental and the social sustainability, hence its sustainability potential is very much higher as compared to a eco-efficient PSS, where only the environmental and economic sustainability is being spoken about.

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So, let us take the first example. We had shortly mentioned about this example in one of our previous lectures. So, this is the Kluber lubricants service, it is a product oriented PSS. So, how let us discuss more about it.

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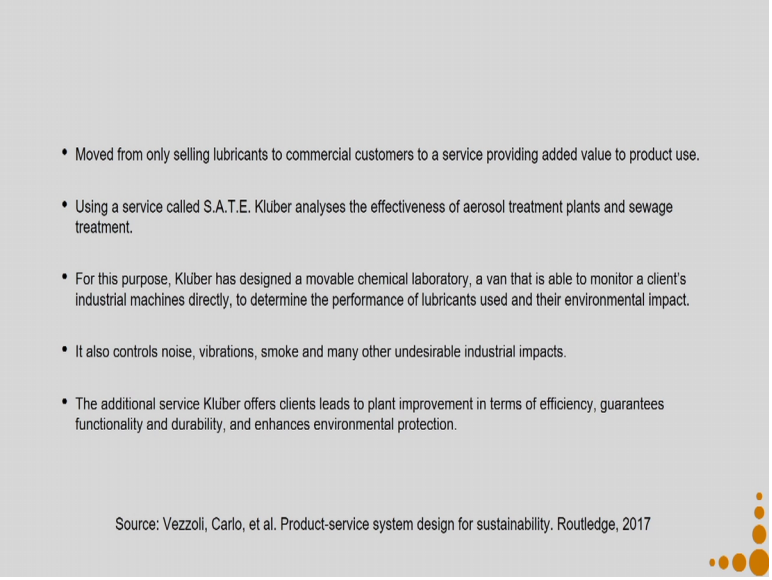

So, Kluber was a seller of lubricants to commercial customers. So, say for example, if someone has an industry, they will be having many machinery, each of these machinery will require some kind of lubricants, so they would buy the sellers of lubricants to commercial customers.

So, they decided to switch their offer model that is the business model from selling lubricants to commercial customers to a service providing added value to product use. Why do we call this as a product oriented PSS, because even in the new PSS model that they define, it was product oriented. So, they sell the lubricant along with that they sell a service, which helps the industries to utilize lubricant that they have purchased from Kluber in a more efficient manner. So, if you can relate to it product related and advice and consultancy related, hence it is in the product oriented category.

So, using a service called S. A. T. E Kluber analyses the effectiveness of aerosol treatment plants and sewage treatment. For this purpose, Kluber has designed a movable chemical laboratory, a van that is able to monitor a client's industrial machines directly, to determine the performance of lubricants used and their environmental impact. So, now what happens is first as a company I sell lubricant, then with this van which is equipped

with a chemical laboratory, the van goes to the client's industry and does a proper check of the lubricant.

What it will ensure is that the lubricant is used to the optimum offers lifetime, it is not discarded before, its life time is over, and it is not used for at lifetime, which is more than what it is permissible limit is. This will ensure that there is less amount of wastage of lubricants, and also if I use the lubricants which are not good enough anymore, I cause damaged by machinery. Since, I am doing optimal usage, the chances of damage to my machinery because of lubricant not being appropriate is also reduced.

It also the service also helps in controlling voice noise, vibrations, smoke, and many other undesirable industrial impacts. The additional service Kluber offers clients leads to plant improvement in terms of efficiency, guarantees, functionality and durability, and enhances environmental protection.

How does it enhance environmental protection in many different ways, say for example, because my lubricant is not discarded before time, which means precious material which is also a toxic material is used towards optimal degree environmental protection to certain degree. Because, my lubricant is being used optimally, it also helps to reduce wear and tear of machine, production of noise, vibration, smoke and so on, which and this way also it helps in protection in the environment.

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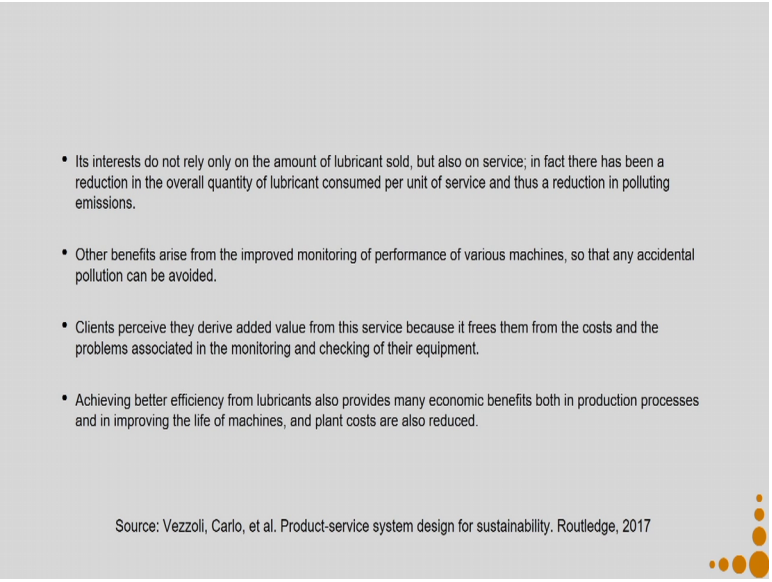

So, its interests do not rely only on the amount of lubricant sold, but also on the surface. In fact, after the launch this particular service, because now the lubricant was use so much more optimally, because they are the experts, the industries do not have an expert to check the lubricants. This company Kluber, they have the expertise.

So, now since these experts are doing the job, they actually notice that their sale of lubricant in terms of volume reduced, but they did not reduce their income, because the income came from this additional service. So, the clients, the industries, they were supposed to purchase the lubricant plus the service, which is the PSS. So, other benefits also arise from this improve monitoring of performance of various machines, so that any accidental pollution can be avoided.

Clients perceive they derive added value from the service, because it freeze them from the costs and the problems associated in monitoring and checking of the environment or their equipment in this regard. Achieving better efficiency from lubricants also provides many economic benefits both in production processes and in improving the life of machines and plan costs are also reduced.

So, now you can see in this particular example both for the company Kluber as well as the client, the industries who are purchasing this lubricant plus service from Kluber, it is in their economic interest to be environmentally friendly. Kluber can also make these lubricants very long lasting lubricants, because in that particular case, they are all though they have volume of lubricants sold will be reduced, but the income coming from the service will be much more higher.

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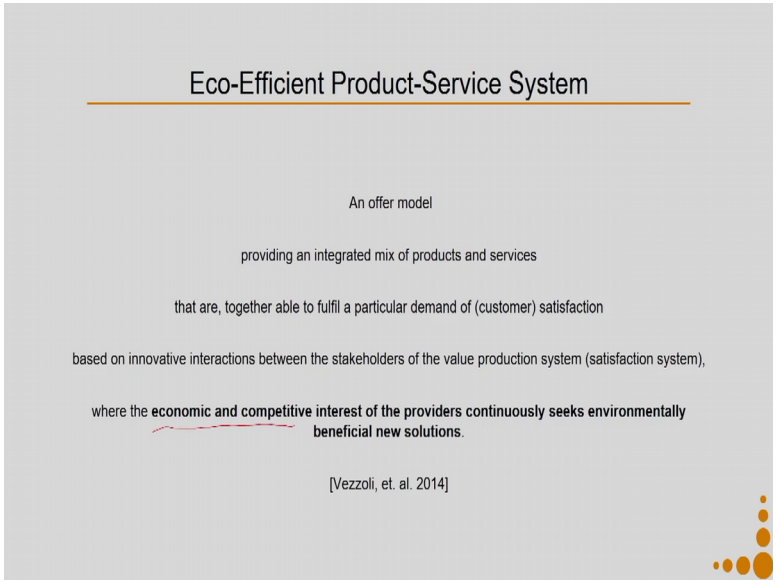

So, our definition of eco-efficient product-service system, an offer model, providing an integrated mix of products and services, that are together able to fulfill a particular demand of customer satisfaction. Based on innovative interactions between the stakeholders of the value production system, where the economic and competitive interest of the providers continuously seeks environmentally beneficial new solutions is proven in this particular example, the Kluber lubricant example.

You must take into consideration that many peoples assume people assume that to be sustainable one has to spend more money or sustainability can be achieved only through aid or sustainability can be achieved only through NGOs, this is not true. You can build in business models in a manner in which it becomes in the economic interest to be sustainable both environmentally and socio ethically. And the aim of this course is to teach you how to design for such particular systems. Let us go to the next example.

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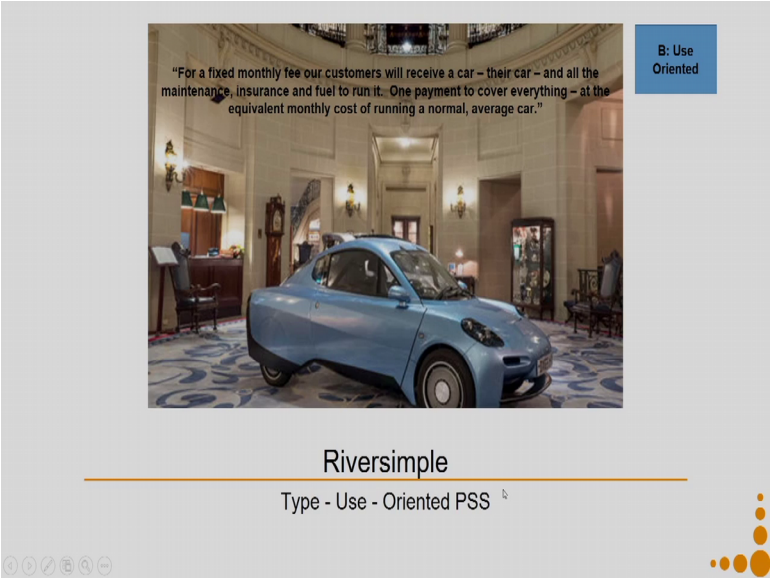

We also spoke about this in the previous lecture, when we were talking about product service systems. This one is a use oriented product service system. Why, because for a fixed monthly fee, our customers will receive a car their car, and all the maintenance, insurance, and fuel to run it, one payment to cover everything at the equivalent monthly cost of running a normal average car.

So, in this particular context, you do not own the product. In the example previous example of Kluber, the client whoever buys the lubricant is now the owner of the lubricant. Whereas, in this particular context, if I hire the services, I do not become owner of the car, I am hiring it for a particular time period, hence it is a use oriented PSS. How it is sustainable? Say the aim of this particular project is so, this particular car runs on hydrogen fuel.

Now, me as a customer, I have other competitive options from diesel cars from petrol cars, hiring a car sharing service like uber or OLA and so on. There are so many mobility solutions. Why will I opt for a particular mobility solution? One of the major criteria for decision might be the average cost that is coming near to me.

So, the aim of this company was to offer a product, which is almost equivalent of the cost of running a normal average car, then people will readily accept it. Also whenever I take a hired service like uber or OLA, there is a short period in which I am hiring. In this

particular case, I am taking the car on the lease for say a months time at a time, so my customers would love to have this, if it is at an equivalent cost of running a car.

If you are owning a car and running a car and a maintaining a car all by yourself. But, in this context, what the company is doing is working backwards. Take this x amount of money, which one needs to spend every month. I want to bring down my cost of operation, which includes making the car, maintaining the car, insuring the car, and fueling the car, at a level so low, that I can still make profit when I give it to a person at this x amount of money per month.

So, in order to do that, it will be in by economic advantage to make this car very long lasting. If I were to sell this car, then I am no longer the owner, I am no longer responsible for the maintenance. For the maintenance, the customer will pay me, and get his or her car maintained, I am not responsible for the fuel. So, I am not considering much on my main consideration is not a vehicle which has a long life. But, in river simple, their economic interest is in a long lasting car, so that there expenditure in the car is low.

There also interest is in a car, which is very low maintenance. Their interest is also on a car, which has very low cost of fuel for running or say very high efficiency. So, in this case, again you can see that it is in the economic interest of the provider that is river simple to be environmentally friendly.

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Coming to the third example. This is an example of a result oriented PSS. Why, because in this particular context, me as a customer, my aim is to get clean drinking water. You as my provider can choose to give me that unit of satisfaction that is clean drinking water by whatever manner, which is most efficient to you. So, this particular example, which we had also discussed earlier, it is called it is by a company Piramal Sarvajal and they have water ATMs and many parts of the country. So, on payment, you can get water, drinking water.

So, these ATMs can be located in many different locations, and people can get water out of it. Very good solution, because this water ATM will be used to the optimal extend, not like owning a water purifier at home which is expensive, so not affordable for everybody. And at the same time, the water purifier remains utilized for a very short time of the day. Whereas, in this particular context, it will be utilized for a much longer time of the day.

Now, in this context of the result oriented because as a consumer, what I am concerned about is clean drinking water, I am not so much concerned about how the company provides me the clean drinking water. Now, from the companies perspective, if they run this particular machine by using say solar energy, their input cost in terms of electricity is extremely low. So, again economic interest is in being environmentally friendly.

Again, where this ATM can be a good product, say for example, if I am a middle income or high income customer, I would not like to go to a water ATM and collect my drinking water, I could rather afford a water purifier at my own home. And at the convenience of my own home, which also has running water supply, I will collect my drinking water. But, consider a context like a slum or a rural area, where most people cannot afford to have a water purifier or they do not have a supply of water connection in their homes for them, this is a very good solution.

So, if you locate such water ATMs in these kind of locations, this is where the company can make its money. So, again you can see in this context, it is in the economic benefit of the provider that is Piramal Sarvajal to locate these water ATMs and to charge it appropriately in base of the pyramid locations. So, economic interest in is in being socio ethically sustainable.

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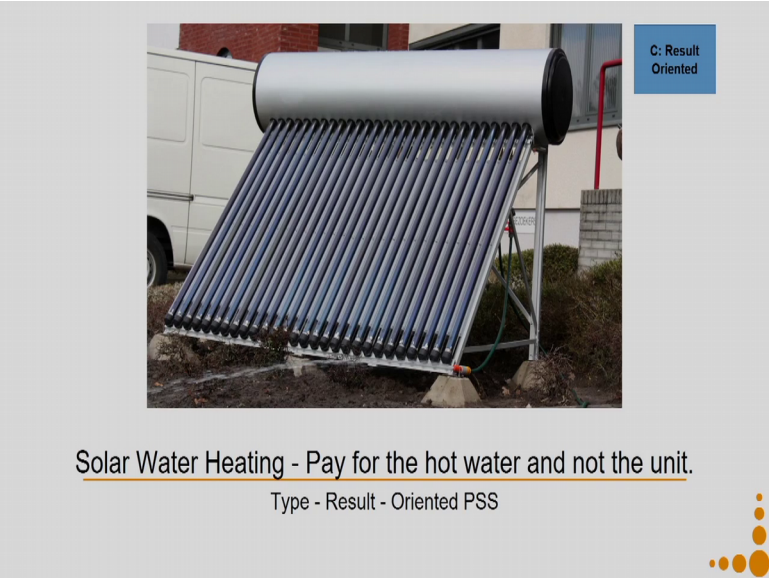

Another example, say solar water heating; a solar water heating is a very good solution, because your electricity bills will come down drastically, but owning a setup of this sort at your own home is expensive. So, most people would not like to own a solar water heater. The amount of the number of years, which is required to offset the money that you spend on buying the solar water heater versus the money that you will be paying to heat water using electricity the electricity bill that number of years is quite large.

So, people usually do not like to buy solar water heating units. Mostly hotels or say paying guest accommodation kind of arrangements, where the cost of electricity is very high, because the number of people living and the per number of people consuming hot water is very high. For their context, it is the investment makes sense, but in normal homes, people usually do not want to make this sort of an investment. But, say for example, a company comes, which says that you do not own the set up, what you own is the result, which is the hot water. So, what I buy from this company is hot water, whenever I need hot water, I open my tap and I get hot water and I pay per unit of hot water used.

Now, this company owns the set up for making hot water, they can make hot water in any way, they can heated by burring coal, they can heated by using electricity, they can also heated by using solar energy, wind energy, whatever. Now, it is in the economic interest of the company to do it in a manner that is most efficient for them. So, in case the use

solar power, the energy expenditure for them is there is no recurring in energy expenditure, because solar energy is free.

So, again in this context, it is in the economic interest of the provider the company to be eco-coefficient also, because the company owns the solar water heater, it is not the client, not the consumer. So, it is in the company's interest to build a solar water heating in it, which has long life, which requires very less maintenance, which is not the context in case the ownership had been passed on to the customer, because every time you need to do a maintenance, the customer pays for that maintenance.

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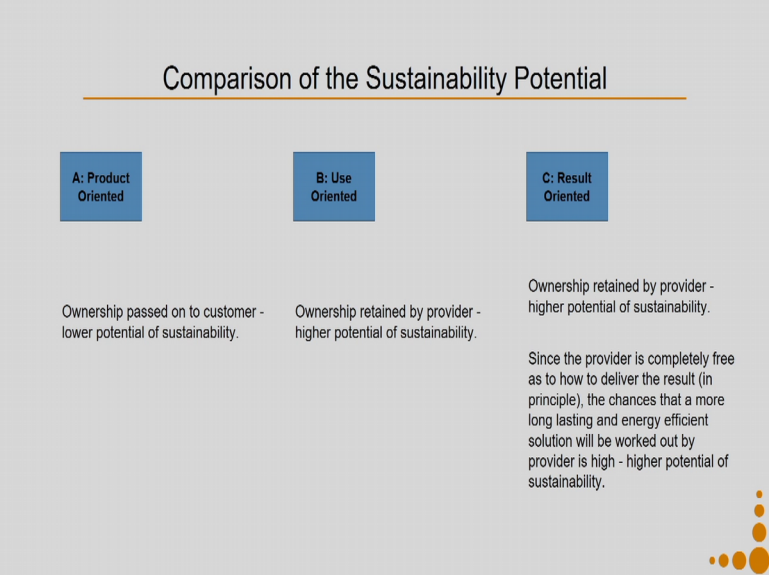

So, now let us compare the sustainability potential of product oriented versus use oriented versus result oriented. So, in product oriented, the ownership of the product is passed on to the customer. As a result, the potential for sustainability is lower, not that it is low in absolute terms, but it is lower as compared to use oriented or result oriented.

Why, because since the ownership of the product is transferred, which means also the maintenance, longevity of the product, all that is transferred to the customer. And now, becomes the cost of the customer, the provider is not very incentivize to create long life products, to create low maintenance products that is not much in their economic interest. But, yes, because they are selling this product plus service system yet a product oriented PSS can build in certain characteristics of sustainability into it.

In use oriented PSS, since the ownership is retain by the provider. As well as in result oriented PSS, since the ownership is retain by the provider, the potential for sustainability grows up exponentially. Why, because now the provider it is in the economic interest of the provider to have a long life product to have a low maintenance product. Also a product, which runs on which if it consume certain things like electricity and water, it is consumed more efficiently.

In result oriented PSS since the provider is completely free as to how to deliver the result like in our example of hot water and clean drinking water. (Refer Time: 22:28) chances that a more long lasting and energy efficient solution will be worked out by the provider is high. Hence, the highest potential of sustainability lies in the result oriented region. But, be careful, if we do not carefully build in elements of sustainability, which we will learn how to do it. Both all these three, product oriented, use oriented, result oriented, can be heavily environmentally polluting, they can also be unsustainable on the social ethical dimension.

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So, not all PSS are sustainable. For example, mobile phones now a day's mostly come so, you have a mobile phone, plus a finance plan, plus a data plan, but does that make it sustainable?

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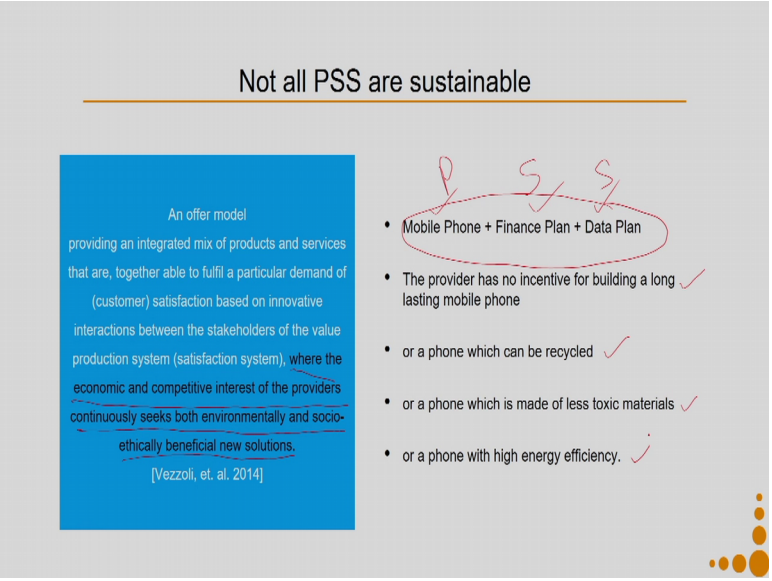

Let us go back to the definition, where the economic and competitive interest of the providers, continuously seek both environmentally and socio ethically beneficial new solutions. Now, mobile phone is my product; finance plan, and data plan are my service. So, I have a PSS system. But, is it in this PSS system, is it somebody's economic or competitive interest to be environmental friendly or socio ethical beneficial? Is not.

So, the provider has no incentive for building a long lasting mobile phone. In fact, what they want you to do is with a finance plans, they want you to buy the newer version of phone each and every year because of the finance plan in place, and because of the plans like take back plans. You can buy every year new phones, every year new versions. They also try in this particular model in the PSS model it is not very helpful for them to build phones, which are recyclable; or phones which is made of leg toxic materials; or a phone with high energy efficiency.

Say for example, a company might be ethical under its ethical responsibility, they might be performing all these activities, but do not get confused with the ethical responsibility aspect and the economic and competitive interest aspect. So, we are talking about being sustainable, because being sustainable is in your economic and competitive interest. If it is in your economic and competitive interest, you will for sure do it. If it is just in your ethical responsibility, you may or may not do it the effectiveness of doing it can be also questioned. So, sustainability has to be designed into a PSS.

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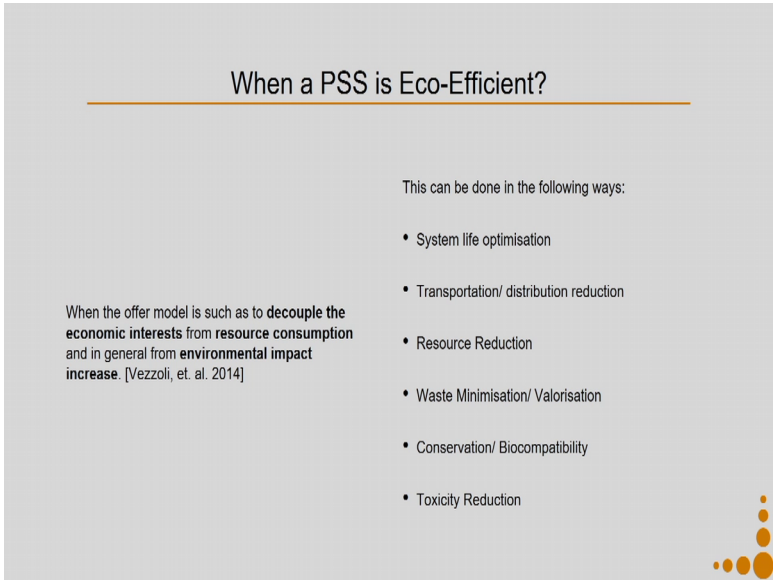

So, when a PSS is eco-efficient? So, when the offer model is such as to decouple the economic interest, from resource consumption and in general for environmental impact increase. What does this mean is in case of the mobile phone, my economic interest is in selling more and more mobile phones, I want to sell as many as possible, and every year I bring in a new version with new features, so that every I can sell more and more. So, my economic interest is in resource consumption, which also leads to environmental impact increase.

So, eases becomes eco-efficient, when I can decouple my economic interest that is my economic interest is no longer in increase of resource consumption. Like you saw in the Kluber, their economic interest was not in increasing the lubricant consumption, but their economic interest became in more efficient lubricant consumption. As a result, they build a competitive barrier. So, any other lubricant manufacturer, who does not have that service, the industries would not like to buy their product.

So, whenever we can decouple the economic interest from resource consumption, and thus bring in environmental impact reduction, we call it as a PSS in which is eco-efficient. How can this be done? System life optimization, transportation distribution reduction, resource reduction, waste minimization or valorization, and conservation of biocompatibility; let us take some examples and the last one being toxicity reduction.

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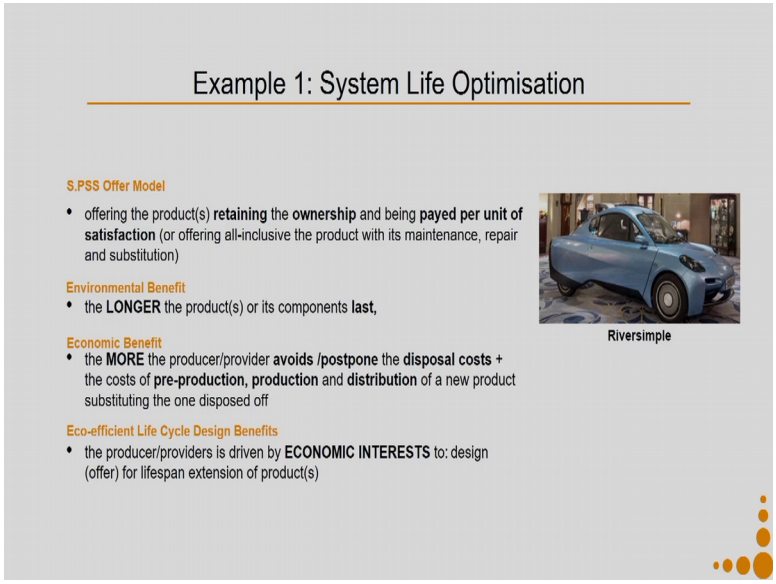

So, this one is an example 1 river simple. So, what was my sustainable PSS of a model, offering the products retaining the ownership, and being paid per unit of satisfaction or offering an all inclusive product with its maintenance, repair and substitution, that is what is being done in this particular example. So, the environmental benefit is the longer the product or its component last, it is good for the that is in the economic benefit.

The more the producer or provider avoids postpones the disposal cause plus the cost of pre-production, production and distribution of a new product substituting the one disposed off. So, eco-efficient life cycle design benefits over here is the producer or the provider is driven by economic interest to design our offer for lifespan extension of products.

So, in this case, it is system life optimization. Why do we call it system life optimization is because say for example, I have an air conditioner from 20 years back and compare to an air conditioner from today, the air conditioner from today is very much more energy efficient, because our technology has moved very much more forward. So, a product is optimal in terms of its live performance for a particular time span only. Beyond that, it might be consuming too much of energy in its or too much of consumption in its maintenance cycle, hence we call it not as system lifetime extension, but we call it as system life optimization.

So, we have to design the product in a manner, that we can make it long lasting product. Say certain components in this product say for example, in another 10 years, I might expect having a better engine. So, I can design the product in a particular manner, that I can replace the new engine, and the body of the car can still remain the same.

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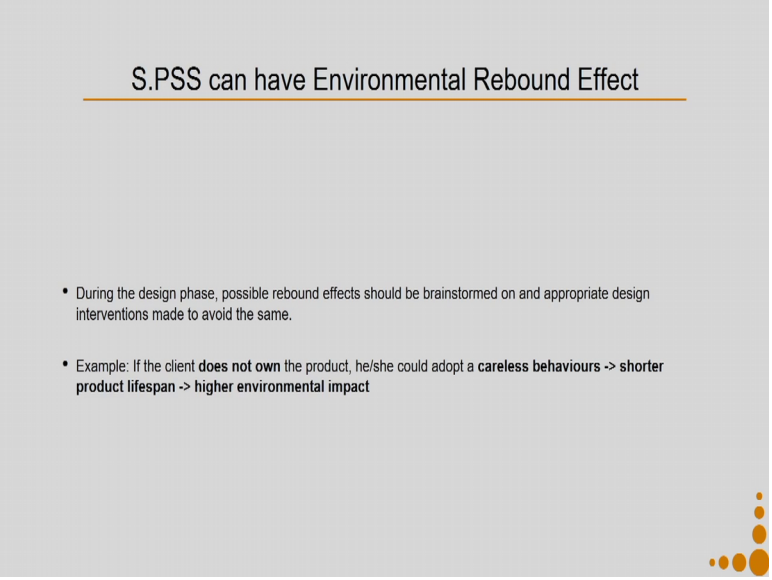

So, S.PSS can have environmental rebound effects also. How? Say for example, because I do not own this car anymore, I can miss use the car. So, during the design phase, all possible rebound effect should be brainstormed on and appropriate design interventions should be made to avoid the same.

Say for in this example of the car, which can be misused, so most likely the company will also take some kind of a insurance policy, this is basically the car is damaged, the economy damage does not have. But, there can be many other aspects taken into consideration during the design phase, so that first we try to imagine what all can be the possible rebound effects, and then we brainstorm appropriate interventions. So, example if the client does not own the product, he or she could adopt a careless behavior reducing the product's lifespan and creating a higher environmental impact.

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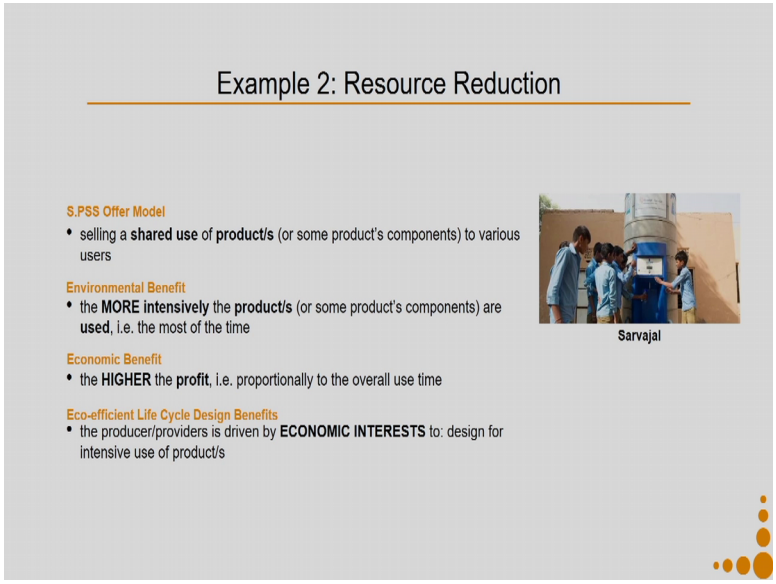

Let us go to example 2. So, in this Sarvajal example, what is the S.PSS offer model. Selling a shared use of product or products or some components of the products are shared to various users. So, in this case, it is shared by various users. The environmental benefit is; the more intensively the product or its components are used that is most of the time. The higher the profit for the company that is proportional to the overall use time. So, by making one device if I put it into a high density usage context I will make more money out of it, as a seller. So, the producer or the provider is driven by economic interest to design intensive use of products.

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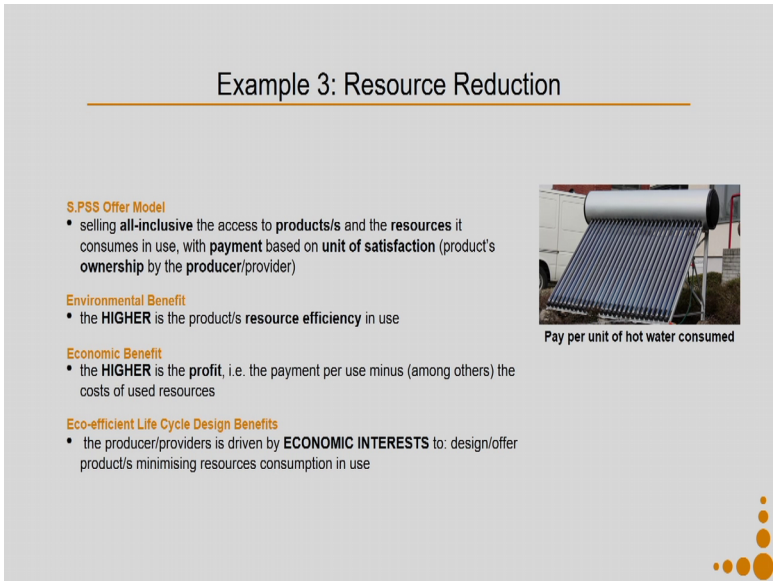

Example 3, which is in the context of this solar water heater. So, the S.PSS offer model over here is selling all-inclusive the access to products in the resources, it consumes in use with payment based on unit of satisfaction. So, here my unit of satisfaction was hot water, so I pay per unit of hot water. So, the company is selling in all-inclusive access to the product and resources. So, what I get in this case is resource reduction.

So, the higher is the products or its resource efficiency in use. In this case, resource reduction is obtained. In our previous example, the Sarvajal example, resource reduction was obtained, because rather than producing thousands of water purifiers to be installed in each and every home, I make one purifier for a certain number of households, which means, because I am producing lesser number of these units, there is a resource reduction. In this particular context, the solar water heater resource reduction is happening in the energy consumption because of the way in which water is being heated, it brings in resource efficiency, which is energy efficiency during use.

So, the higher is the profit that is payment per use minus the cost of used resources. Solar energy is free, so energy for heating water is free, you can also build a hybrid system to ensure that you always get hot water. In case, you are in an environmental context, where you know that only solar water heating cannot give you enough hot water. So, in this particular case also, you are using lesser amount of electricity, because the energy is being observed by the solar energy. So, my payment is minus the cost of the resources. So, in this case, the producer or a provider is driven by economic interest to design or offer products minimizing resource consumption during the use phase.

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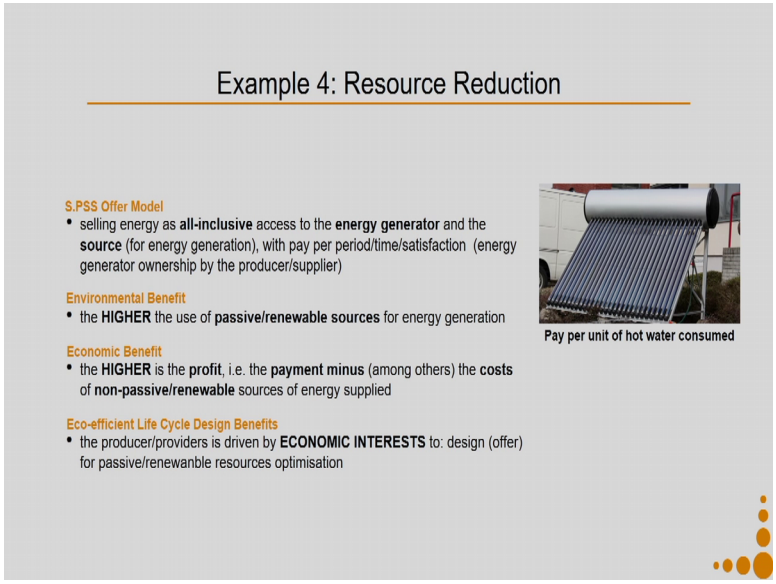

Another example, resource reduction; again, in this particular context, we are talking mostly in the context of energy generation. So, resources in terms of all kinds of resources, and this one is mostly in the context of by using design or offer for passive or renewable resources optimization.

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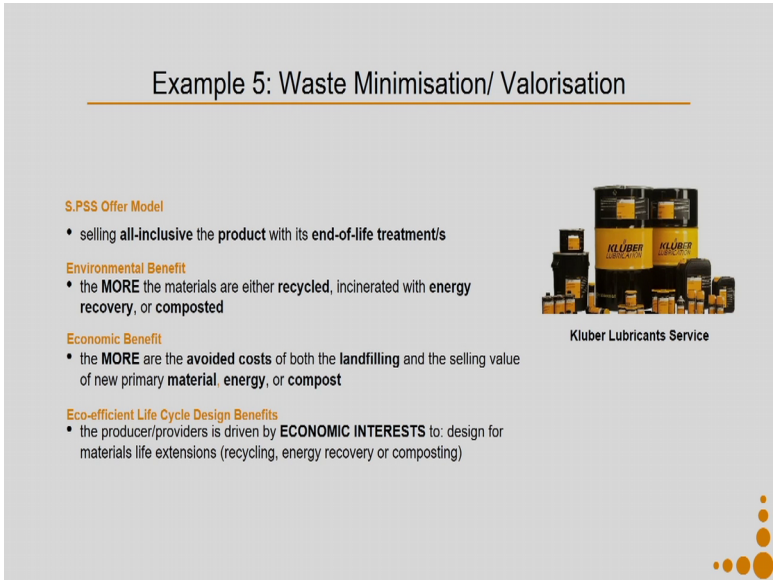

Now, the next example is about waste minimization and valorization. So, like in the example of Kluber, what I am achieving is waste the lubricant from getting waste or my machinery being avoided to be damage. So, selling on all-inclusive the product with its

end-of-life treatments. So, what Kluber does is once the lubricant is no longer useful, it also pumps out the lubricant, and refills the machinery with new lubricant. The use lubricant is taken back by the company, and recycled appropriately. So, the more the so, Kluber is responsible also for the end-of-life treatment.

The more the materials are either recycled incinerated with energy recovery or composted; these are all the options, which Kluber can take. The more are the avoided costs of both the land filling and selling value of new primary material energy or compost. So, say for example, if I recycle this use lubricant for lower grade applications, I am minimizing on the need for new material for those particular applications.

In case, I burn the used spent lubricant under proper condition, so that harmful emissions are minimize, I can produce energy, which is again another offset as we had studied in our life cycle design lectures, and we can also go for composting. So, the producer or providers is driven by economic interest to design for materials life extension, recycling, energy recovery or composting, because Kluber as a company, now cancel them back.

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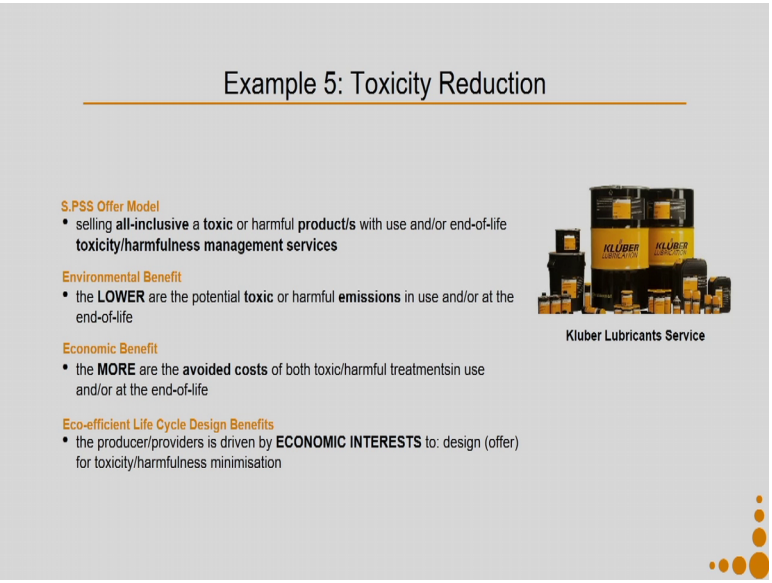

Toxicity reduction; so, again in this particular case, toxicity reduction is also done, because Kluber takes all the lubricants it pumps out all the lubricant in a safe manner, and because they are a company, who knows exactly how to treat this lubricants, and they will also be doing treatment of the lubricant at a large scale. So, economically it is also viable to do good toxicity reduction of their lubricants, the spent lubricants.

So, selling all-inclusive or toxic or harmful products with use and, or end-of-life toxicity or harmfulness management services. The lower are the potential toxic or harmful emissions in use and or at the end-of-life. The more are the avoided costs of both, toxic or harmful material treatment in use and or end-of-the life. So, for the clients, who are buying these lubricants, this is an economic benefit, that they do not have to now spend money on toxic or harmful material treatment or their end-of-life disposal. So, the producer or providers is driven by economic interest to design or offer for toxicity harmfulness minimization.

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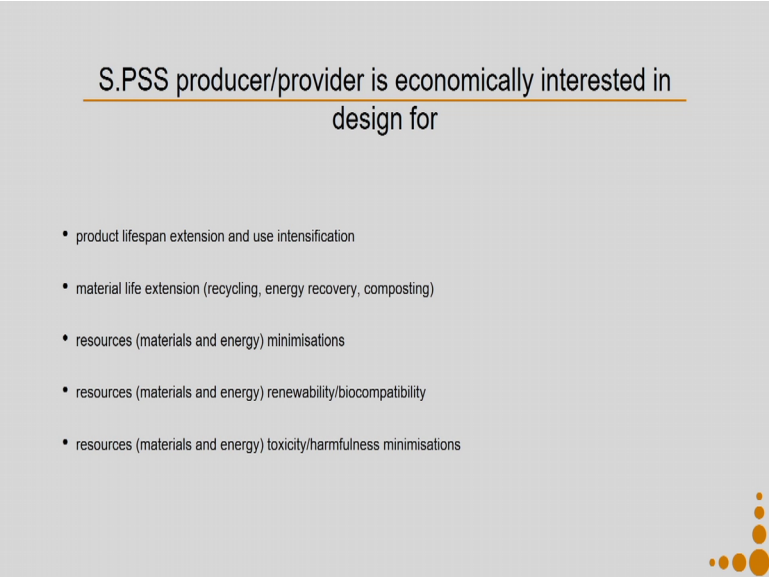

So, S.PSS producer or provided is economically interested in design for product life span extension and use intensification. So, you can extend the life of a product or you can increase the usage intensity of the product. Material life extension, which can be achieved by so one was product life span extension.

The next is when I do material life extension, so that I design with materials, which can be recycled. I design it in the manner that recycling is possible, because I can dismantle them energy recovery or composting. I use minimum resources, which in terms of materials as well as energy. I use resources both materials and energy, which are renewable or biocompatible. I use resources, materials, and energy by minimizing the toxicity and harmfulness of them.

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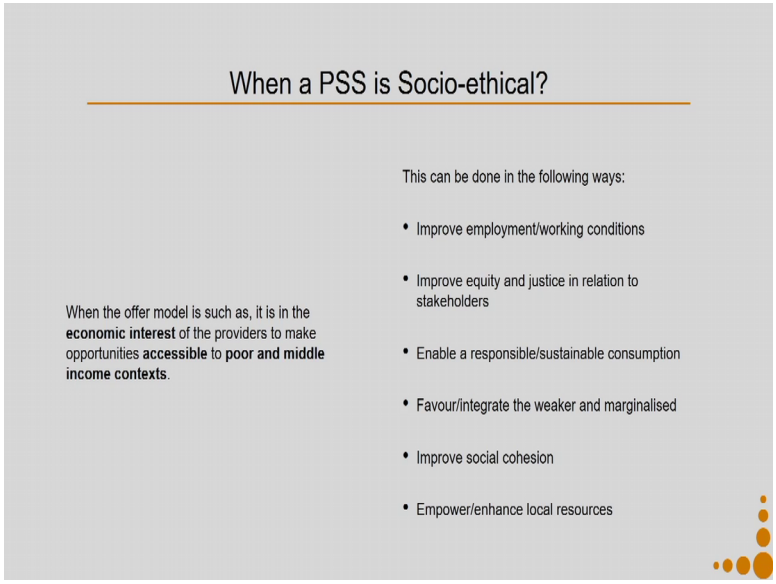

Now, when is a PSS a socio-ethical PSS? So, when the offer model is such as, it is in the economic interest of the providers to make opportunities accessible to poor and middle income context. So, how this can be done? So, firstly, by making it accessible to the poor and middle income context, and secondly by many other factors, which are applicable in every context, so improve employment and working conditions, improve equity and justice in relation to stakeholders, enable a responsible sustainable consumption.

So, me as a customer, I should be unable to do a sustainable or responsible consumption, because I am being given the knowledge, I am being given the infrastructure that I can do it. Favor or integrate the weaker and marginalized. Improve social cohesion, and empower or enhance local resources, these are a little difficult to achieve. In the next lecture, we will be discussing examples, which have done one or many of these, and see how PSS, how in a PSS we can build. This is a socio ethical sustainability dimension.

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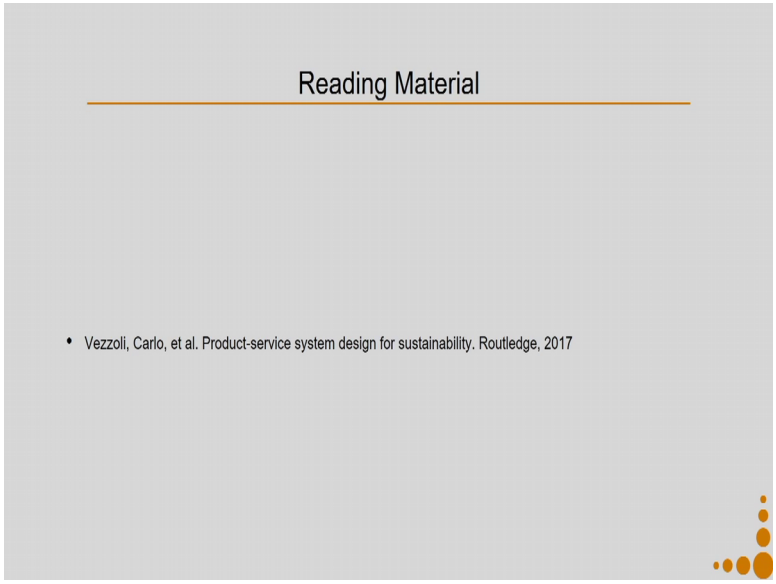

So, for the product service system design, that we will be discussing that we have been discussing in this week, and we will be discussing for couple of weeks from now, you can refer to the product-service system design for sustainability by Carlo Vezzoli.

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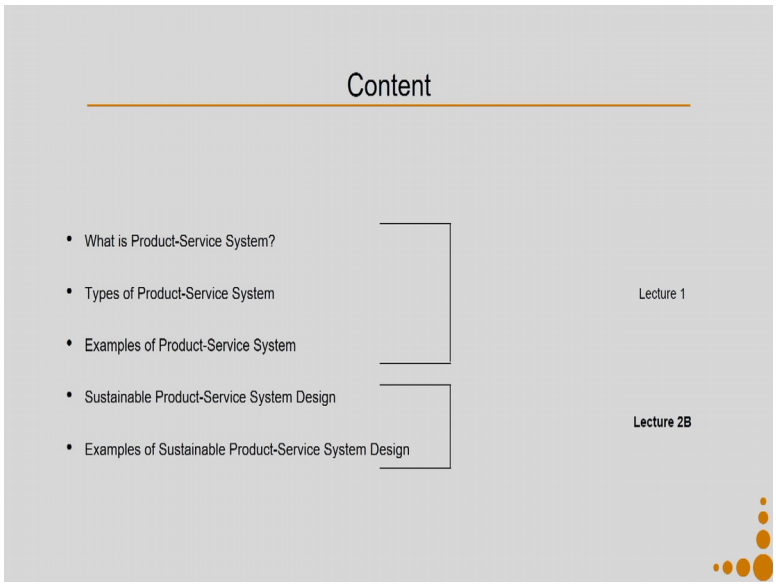

Next lecture, we will continue with the socio ethical dimension of sustainable product service system design with some examples.

Thank you.