Sustainability Through Green Manufacturing Systems: An Applied Approach

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Lecture – 24
Renewable energy in India and Industrial Symbiosis

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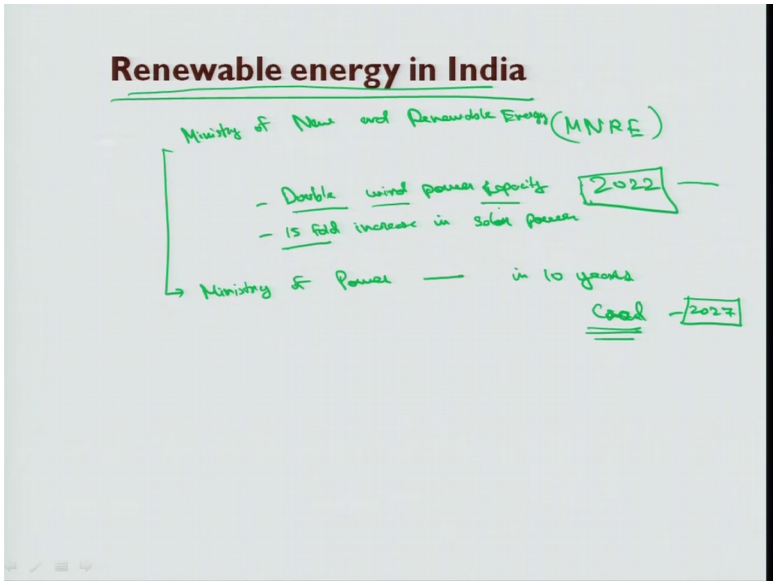

So, in this lecture, I will discuss Renewable energy status in India. So, what we have? In India we have ministry of new and re renewable energies MNRE; that is ministry of new and renewable energy. Now, they are promoting newer renewable electricity and the source is are targeted to grow massively by 2022 this is the recent target by 2022 it is planed to have so many plants at the capacity becomes doubled including a more than doubling of India's large wind power capacity. And almost 15 fold increasing solar power from I would say I put it here all double wind power capacity and 15 fold increase in solar power by this year.

So, this ministry as also working with ministry of power who have recently announced that in 10 years, we would not have any coal that would be used to generate electricity that is by 2027 we are planning to eliminate the use of coal to produce electricity this is thermal power plant are getting closed. So, these grand targets these are the grand targets to closed the coal power plant to have 15 fold increase doubled the wind power capacity;

so, have placed in India amongst the world literatures that are promoting renewable energy.

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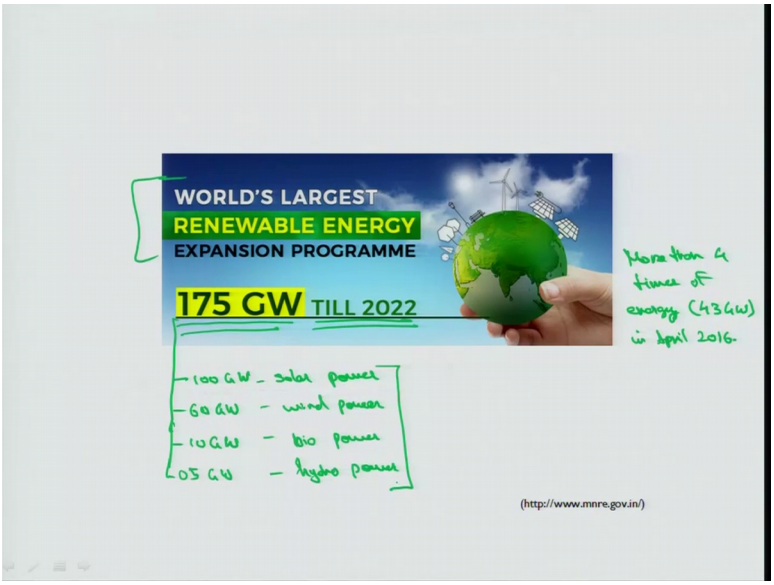

So, in India, it is world's largest renewable energy expansion programme, that is 175 Gega watt till year 2022 which is more than 4 times of the energy that was target of that was 43 Gega watts in April 2016 more than 4 times of energy that is 43 Gega watts in April 2016 if I breakdown this 175 Gega Watts it includes 100 Gega watts of solar power 60 Gega watts of wind power 10 Gega watts of bio power and remaining 5 Gega watts from small hydro power plants.

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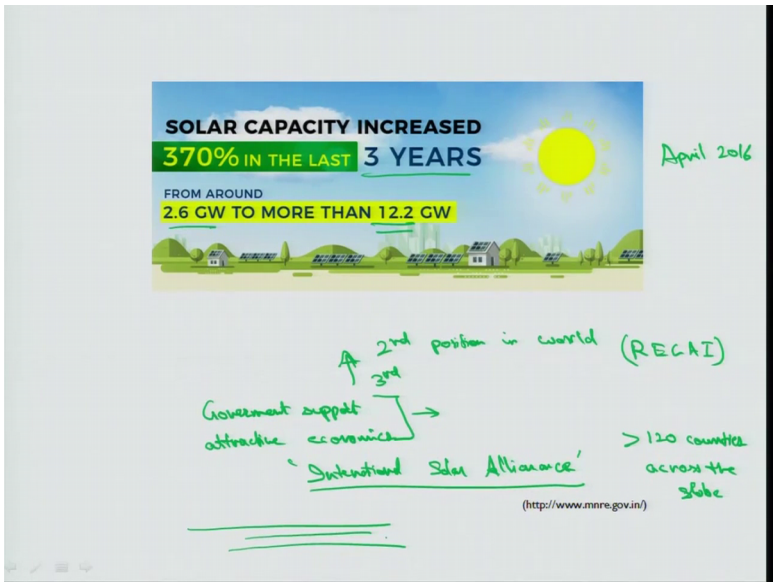

So, from these this is the plan. So, thinks are moving very rapidly in India as well the solar capacity increased 370 percent in last 3 years this is also a report that was introduce April 2016. So, from around 2.6 Gega watts to more than 12.2 Gega watts also there is a push for solar energy in India. India's moved out to second spot like second position in world, it was third from third it has move to second position in energy country attractiveness index energy country attractiveness index in this index India is moved out.

This is primarily due to combination of strong government support and attractive economics as well. So, the people who are working in renewable energy sector or who are working in green technology sector, this is a great we have a great future a head in recent years development is being held and we are the part of it. So, we are working in green technologies this is renewable energy only also in green technologies government is supporting subsidies being given for green technologies for green products as well. So, what we see here that India is very important part of international solar alliance so this what does this international solar alliance due they promote the development of solar power in more than 120 countries across globe across the globe.

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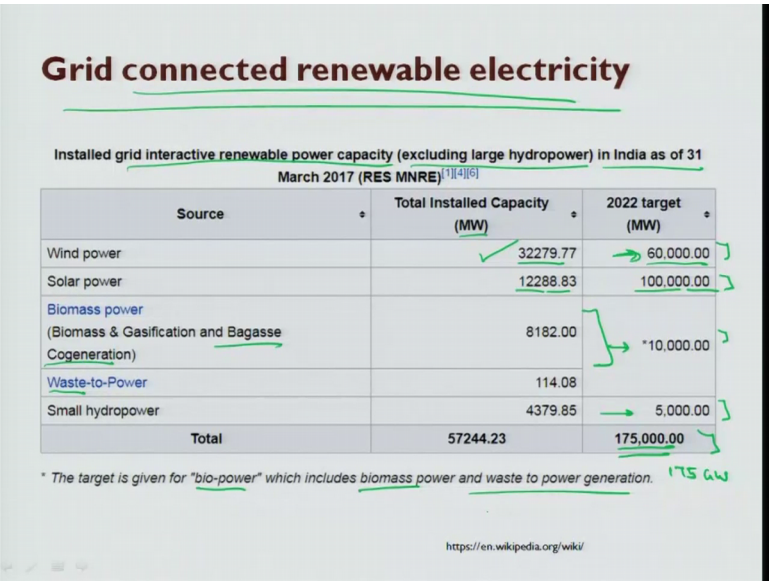

So, this are status here. So, this is grid connected renewable electricity now installed grid interactive renewable power capacity is given here that enclose exclude hydropower because hydropower was all existing in India from way back from many years. So, in wind power the total install capacity is 32000 megawatts and 2022 is targeted to take it to 60000 megawatts. So, it is a kind of a double in solar power we are moving to 15 times. So, it is only 12000 here we have taking it to 1 lakh. So, in solar power also it is increasing multiple folds here so, from 12000 to 1 lakh into 2022.

In biomass power biomass and gasification and bagasse cogeneration so, this is waste to power. So, these two combine would be extended to 10000 megawatts. So, these are the targets small hydro powers also is a little increase in this one. So, this would actually part of 60 megawatt, 100 megawatt, 10 megawatt, 5 megawatt could be part of the total 175 megawatt of energy. So, this is actually Gega watts 175 thousand becomes 175 Gega watts. So, the target is given for bio power as well which includes the biomass power and waste to power generation here. So, this is the status here.

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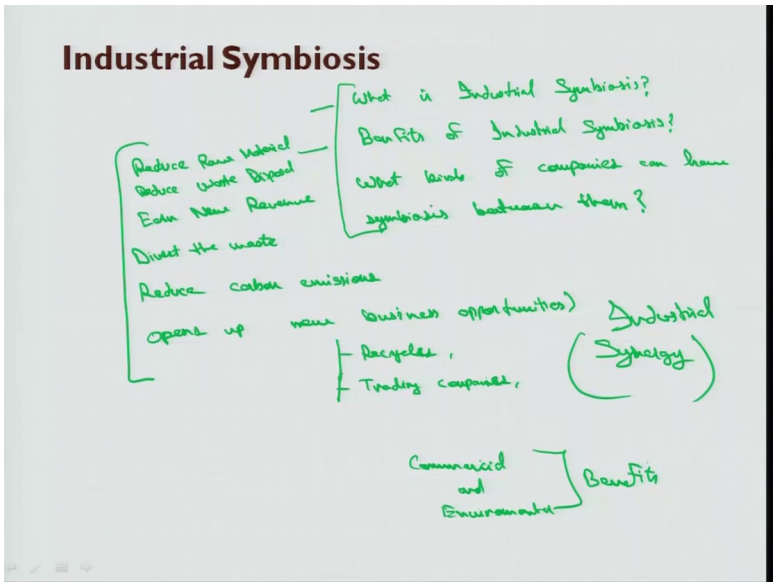

Now, next I will like to move to industrial symbiosis. So, what is industrial symbiosis? Benefits of industrial symbiosis these are the questions. So, what kinds of companies can have symbiosis between them? These are the question. Industrial symbiosis is essentially and association between two companies who are kind of this similar companies in which by-product of one company becomes the raw material of other company. For instance, the materials like tie, shirts, chips fly ash and plastic patents all those are kind of waste material of one company for the other company these can be raw materials. So, if these 2 companies bring the hands together and make an association to use each others to use these products for the benefit is of both that is called as industrial symbiosis.

So, what happens in industrial symbiosis? The benefit is here are reduce the raw material and waste disposal reduce raw material, because the material is obtained from the other company and reduce waste disposal earn new revenue here. Then also we can divert the waste divert from land field and reduce carbon emissions in that case. So, this also open ups this also this. So, this also opens up new business opportunities, for the recyclers, for the trading companies and similar other parties here.

So, actually this type of industrials energy this is kind of energy industrials energy. So, this is industrials energy this kind of energy brings advantages to both the parties here and usually done for both commercially and environmental benefit is commercial and environmental benefit is.

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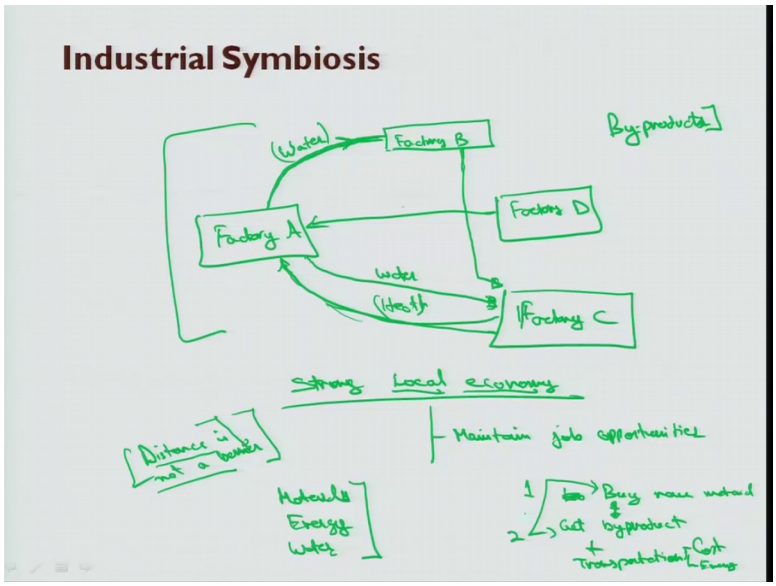

So, what happens in industrial symbiosis is? For example, I have one company factory A and it has some by a product may be it water is being splashed out for example, if water is being thrown out by this company this can be used by some factory B who has water as it is input and also this energy for example, this factory would heat would need heat C which as heat as it is output that can be used by this company this is heat water and may be if I put some more company here factory D. So, it can also have for example, this factories having water this water also go here as well if it is required. So, we can have any these kinds of connections in which the by a products this all water; please note these are by products only in industrial symbiosis only by products are been considered.

So, these are working with each other and in turn helping each other and having commercial and environmental benefit is. So, industrial symbiosis is not only reducing waste and promoting energy efficiency it is way beyond that. So, waste for one company can be redirected and is user raw material for other company fuels used to generate electricity can provide local heating here less industrial waste needs to be disporting this case. So, corporation improves the performance of the companies involved and this contributes to building a strong local economy. So, this would also help to maintain job opportunities in this local way.

So, note only local economy even the distant companies can share their hands. So, here distance is not a barrier. So, the companies may be close together or for a part producing

the same things or completed different ones and the resource them share make a consist of materials energy or may be water and it is used to be thought that industrial symbiosis work effectively if the companies are closed, but distance does not matter here this is no longer the case though it is not a good practice to use transportation what they transport or transport the material to far away companies, but in certain cases it is beneficial to use the recycle or the by-product materials than to use new materials and the transpotator transportation machines are also compensated in this one.

So, in this case distance is not a barrier. So, always we can evaluate that what is benefit do we a buy new material or get by product plus transportation cost and energy. So, these two again can be evaluated which option to be done 1 or 2. So, what alls energies here having common is that they reduce cost generate new sales for the companies involved as well as creates significant environment benefit is such as reduced land fuel as reduced greenhouse gasis.

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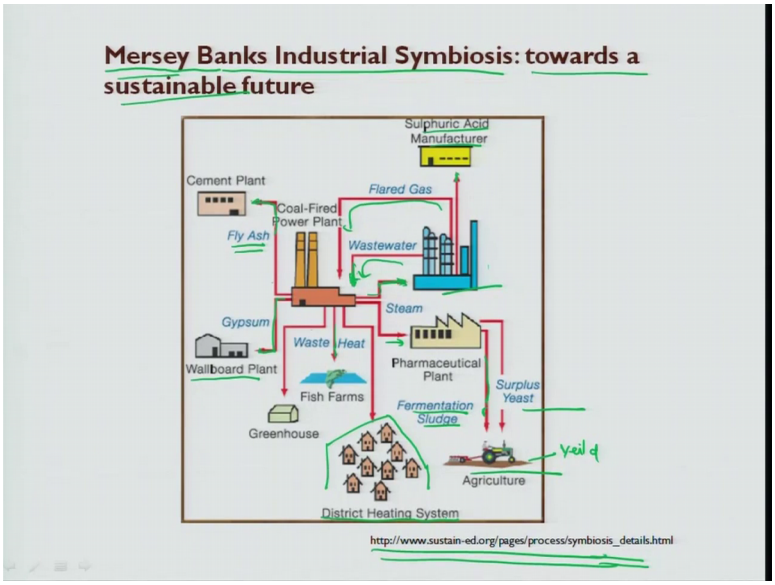

So, here is an example of industrial symbiosis which is there in river Mersey banks that is going to what a sustainable feature this is taken from reference here this is in UK. So, there is a coal fired power plant here which has fly ash as it is by product. So, we know that is cement also as fly ashes some of this continent 5 to 10 percent due 5 to 20 percent of from this cement fly in fly ash cement it is involved. So, this can be used here. So, this is actually the real industrial symbiosis that is happening here a in UK along the banks of

river Mersey. So, in this case gypsum also is used in wallboard plant here. So, also here waste goes to this green house to fish farms heat goes to are district heating system to provide heat in the houses and this coal fired power plant is also getting the flared gases wastewater from this company here and steam is also getting here.

So, this is a 2 way process going on. One way in another way out waste water getting in steam is going out here. So, this steam can also we his also use here by pharmaceutical plant here and this is also giving it is output to the sulphuric acid manufacturer pharmaceutical plant is further giving it is outputs to this fermentation sludge is being given to the agricultural land here the surplus yeast is also provided to increase the yield here. So, this is the kind of industrial symbiosis here.

So, a beautiful industrial symbiosis example is in den mark. So, this is a kind of symbiosis that act acted as models. So, this was not essentially created as a symbiosis, but for only business benefit is it was started in 1959.

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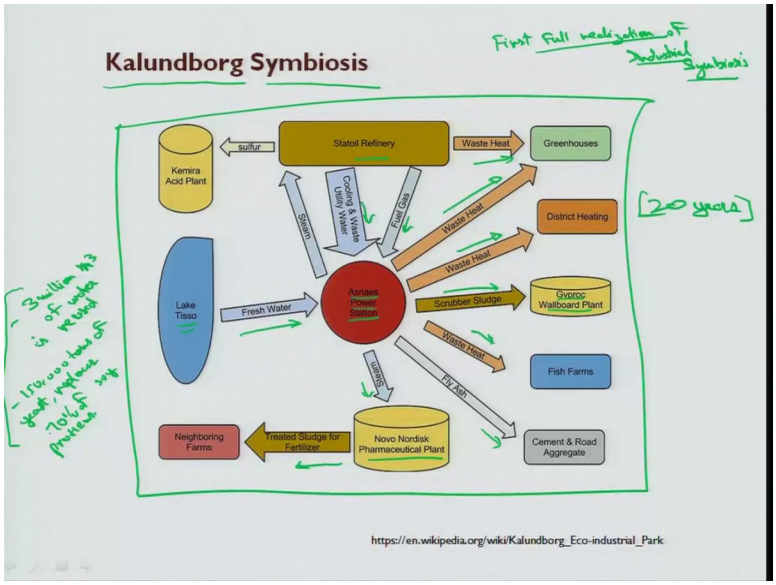

So, what is this? This is Kalundborg symbiosis. So, in Kalundborg symbiosis, the industrial power was not originally planned for this industrial symbiosis, but in 20 years it developed as this type. So, in the present state we have honest power station that is getting fresh, water cooling waste, utility from late resources getting fresh water then from this refinery it is having cooling waste fuel gases are also from this refinery and waste heat is going out here and for distinct heating also it is used the scrubber sludge is

their going to are gyproc wallboard plant waste heat is again going to fish farms as well fly ash is going to the cement factory here and this pharmaceutical plant is also getting steam from this one and this treated sludge is also going to neighbouring farms. So, this was the model industrial symbiosis in den mark Kalundborg.

So, this was the first full realization of industrial symbiosis. So, in this 3 million cubic meters of water is saved and reused 3 million meter cube of water is reused and is saved through recycling as well and 150000 tons of yeast this replaces is 70 percent of soy protein in traditional field mix of more than 4 more than 80000 pigs here. So, 70 percent of soy protein to see the benefit is here these are only a few examples here and certain other benefit is of similar kind are obtain from this industrial symbiosis a; this was just a block diagram kind of few industrial symbiosis.

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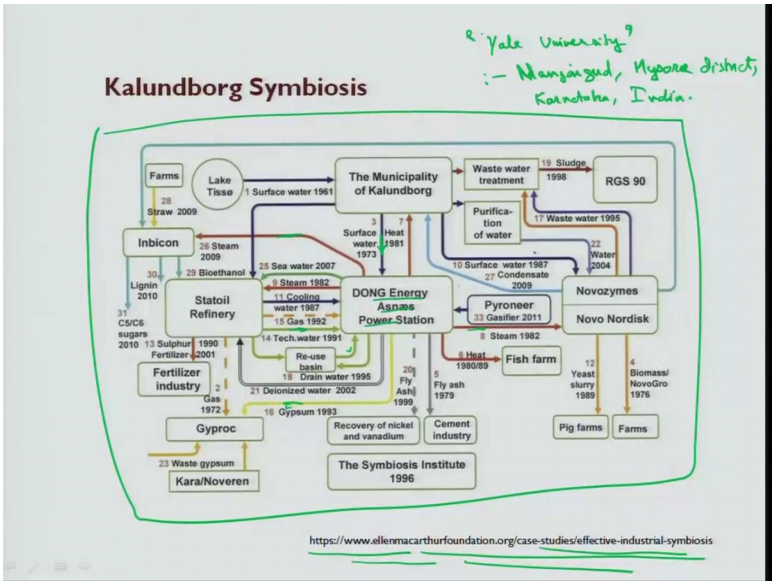

So, I have I also a location view this is also taken from reference here. So, this is the same power plant. So, this is a actually drawn to scale here.

So, this all in this red colour we has steamed steam is go here and in this blue colour we have water. In green colour we have gases going here, in yellow colour we have gypsum in red colour again the steam is here. So, we can see that this is a beautiful example you can go to this reference and read more about this industrial symbiosis. So, I would recommend here to read this study that was carried out in Yale University US about an industrial symbiosis study in India. So, this is regarding the town Nanjangud which is

their in Mysore district of state Karnataka India. So, this is also a very good example of industrial symbiosis in India; so, specifically the name of the studies industrial symbiosis and residual recovery in the Nanjangud industrial area. So, you can go through this and see the beauty of industrial symbiosis. So, with this I would like to stop here and would I would come with my lab demonstration on and other sessions in the coming lecture.

Thank you.