

**Indian Institute of Technology Kanpur  
National Programme on Technology Enhanced Learning (NPTEL)**

**Course Title  
Bioenergy**

**Lecture-05  
Road Map of Bioenergy**

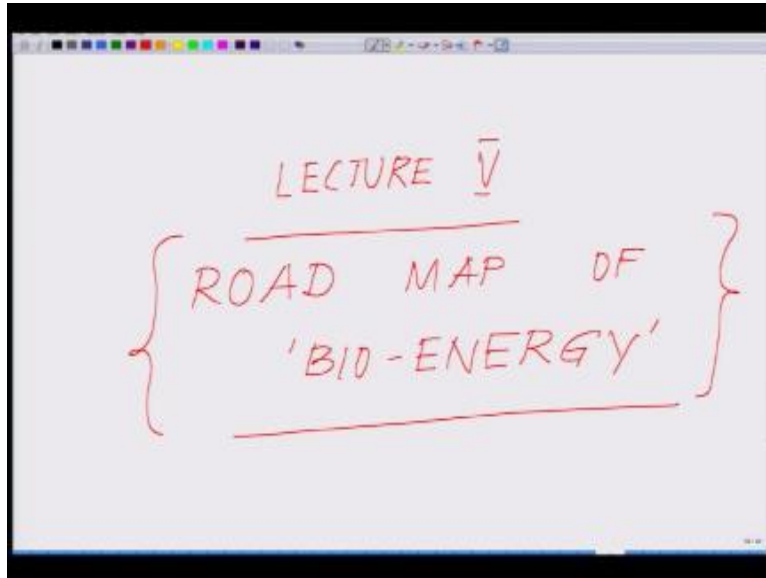
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Welcome to the fifth lecture of this lecture series on by energy so as of now in the last four lectures which essentially being our eight weeks of course, in the first four lectures we have talked about, basic concept of energy and how energy rules global economics. Then we talked about the different forms of consumable electricity, or consumable energy whether it is in the transportation sector, industrial sector, domestic science sector. We talked about different sources of energy, and then we talked about the specific ninja by energy in the spectrum of different forms of energy.

After we talked about how India can exploit its by energy resources in order to attain, energy independence in the global energy economics of the world from there, we talked about the different energy conversion units, or different energy calculation unit and how different thermal energy could be equated to electrical energy. Similarly electrical energy equivalency to the oil energy and likewise and so on, and so forth from there we talked about the basic concept of bio energy and how photosynthesis and chemosynthesis plays a role. The overall outline of how biomass is being produced today is the fifth lecture where the goal of today's lecture will be to give you a complete, roadmap or you can say guide map for the whole spectrum of bio energy.

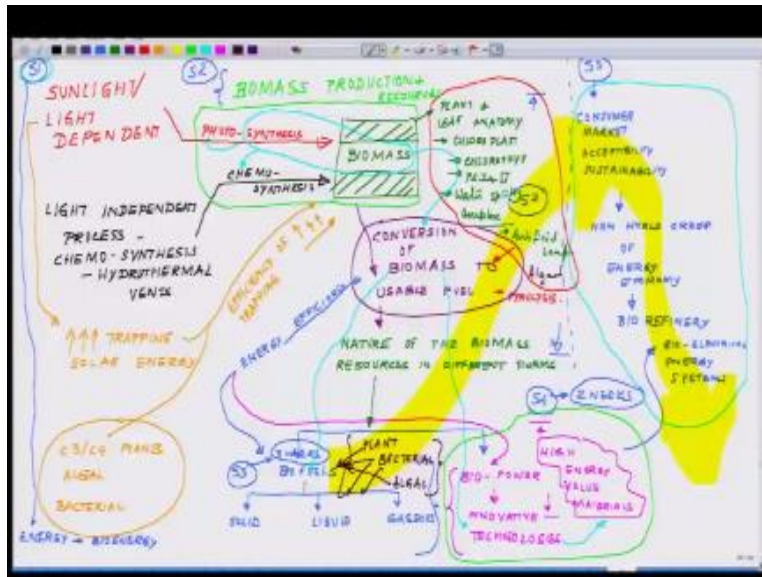
And we will classify the different part of the map of the different sections, what we will be covering in this lecture series so let us start the today's lecture the lecture fifth here okay.

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Lecture 5 okay, so today we will be talking about the roadmap, of bio energy. So this is today's topic what we will be dealing with.

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So let us move onto the next slide, where we will talk about, so initially what we talked about in our last class is so the prime source of our energy is sunlight okay. We talked about it so from sunlight or you can call it a also you can call it a light, dependent process so we classified light dependent process and there is another thing we talked about in the last class which is light independent process. And the name for that was chemosynthesis in the hydrothermal vents where we kind of completed the last lecture hydrothermal vents. Where as we talk about light dependent process or photosynthesis and the light independent process we talked about,

The chemo-synthesis temperatures okay these two processes are the major source of biomass production. So this is how all the biomass present on the floor of Earth is being produced now this light dependent process what we talk about is basically, a process of trapping off solar energy okay. Trapping solar energy and the strapping of solar energy depending on the efficiency of trapping you decide how much biomass will be produced efficiency of trapping will decide what will be the level of biomass okay.

And this is dictated by whether the plant is c3 or is it a c4 plants it is an algal or bacterial or something else so this section what we are talking about as of now, so this synthesis process out

here the photosynthesis, and chemosynthesis together, and the process of biosynthesis of biomass is what we will be dealing with what we talked about the nature of the biomass and the difference biomass, biomass we chose technology okay biomass production and resources this section we will be dealing in our next fragment which will be section 2.

I am just putting S2, all the conversion process which are involved in photosynthesis, and chemosynthesis will be dealing there so s1 which we had as of now dealt with okay. We have started with coming back yeah as of now we have covered s1 we have introduced about we have talked about these topics, we have talked about energy to bioenergy section 2 will deal with by mass production and resources as I have shown you and from there we will talk about some of the conversion technologies. So where we will be talking about conversion of biomass to usable fuel so this is the section.

Where we will talk about different form of conversion process which are inspired as I told you in the previous lecture, many of these inspirations are being drawn from the evolutionary story of formation of course, formation of fossils, Wells deep underneath the earth in the absence of oxygen in high pressure, and high temperature. Those things are being developed in a factory or industry setting after of course before that the pilot studies are being conducted in the laboratory trials and they are taken to the pilot plant from there and from there the big industries are being developed which led to the concept of bio refinery, and byways oil production okay.

So that part will come under broad heading of conversion of biomass to usable fuel so let us get back to the slides again. So here we will be talking about the nature of the biomass resources on different form nature of the biomass resources in different forms okay. From there we will talk about that so this part this section what I just now talked to you about the different form of biomass resources and their overall conversion processes and the inspiration will draw from the formation of fossils will falls under our section 2.

Section 2 will have two parts one part will cover back, to it for this part to this part will cover our section two so you see you could really deal in it so this is all the way up to s2 from here we were after the different form of conversions we will be talking about two different fragments or

two different segments okay. So you can convert them convert different biomass into different kind of fuels which falls under the area of bio fuels it could be biodiesel it could bio-ethanol could be other different kind of materials which are highly inflammable.

And could be used for transportation sectors as well as for cooking and for domestic use as well as other industrial use apart from it we will be talking about, another series of innovative technologies so let us classify in the slide splits getting back into the flight what all the two segments will be dealing at this stage one segment. We will talk about your bio fuels and this bio section will be divided into solid liquid and gas okay. Solid fuels solid by fuels, liquid fuels, and gaseous right field okay, and the other idea will be bio so basically when we talk about this conversion, conversion technologies.

So here will we talk about several energy efficiency and this energy efficiency of conversion will be highlighted by different form of bio fuels which will be formed or different form of other energy materials what will be developing okay. So the next will be bio power where we will talk about several innovative technologies, where which includes conversion of biomass into high-end one second high-end graphing like materials and several other battery materials okay. High energy high energy value material so this will fall under the bio power whereas the other section will follow at the bio fuels.

So our bio fuel section is numbered as s3 where we will be covering three weeks, fifteen classes what we will be dealing with different forms of bio fuels, and especially all the case of studies will be relevant to Indian context, where we will be talking about how you could convert sorghum and millet in to bios fields. How we could use different other a moderm abundant crop residues into bio fuels and so on and so forth under different, different generations of bio fuels or doing God and the other section which is the bio power section from back to the bio power section.

So this section what I am now kind of encircling, will fall under s4 which is a fourth module which will be covering for two weeks. We will have around 10 lectures where we will talk about different forms of conversion of getting grapheme like materials using native fibers for energy

production using different kind of dyes available in nature for four different kind of dye-sensitized solar cells and likewise and so on and so forth. So that will cover all s4 so there will be two weeks will be devoting to it so that is two weeks on this and in the bio fuel section. We will have another three weeks what we will be developing on this area okay.

And then we will come to our final segment which is s5 this segment what we will be dealing with is so whatever we developed, what one of the most important thing is that consumer market acceptance, and sustainability. Consumer market acceptability, ability, and sustainability and next we will talk about the New World Order of energy economy, and then we will introduce the concept of bio refinery and different other product related things which will fall undered you know by electrical energy systems okay.

So this is where we will be so this will this is that section we are done now I am encircling what we will be dealing in the, the final week of the course okay. So let us summarize so you have week one what we have as of now finished s1, where we talked about energy, and with respect to energy so after this lecture will be starting s2. Which is the week to where we will talk about the biomass synthesis essentially will be converting this biomass synthesis following light-dependent and light independent route. Then we will talk about the different bioconversion processes where we are converting different biomass either into bio fuels or two different kind of innovative technologies used to make high energy value materials.

And then from there we will move on to the consumer market so this is the overall layout of the course what it is needed to grasp so will be walking you through the basics of photosynthesis in our next class the structures the plant anatomy so if you talk about this section coming back to the slide so in this section. We will talk about the plant and leaf anatomy and we will talk about chloroplast, chlorophyll, photo system one and two then. We will talk about water splitting complex which is all part of the photosynthesis and the inspiration drawn out of it.

And we will talk about the concept of artificial leaf or artificial solar panels and from thereafter once we finish this whole part in section 2 will move on to the different conversion where we will talk about pyrolysis classification likewise there are several processes where the different

conversions are being done of natives biomass which is being produced. So this is the overall roadmap so as I told you in the previous slide so today we will be talking about this particular segment the roadmap or by energy systems.

So this is the roadmap, at any point of time whenever you can kind of get confused, that in which area or in which domain this particular aspect false you always can look through this chart and you can figure out what X Y Z is teaching or what you are learning from a book or a journal where this whole thing falls okay. So that will kind of give you an because I told in a very beginning this is a very vast course so very vast area so unless we classify it in the very beginning in the mind of the listener, or the reader or those who want to pursue research or one wants to go to industry.

If they do not have a very clear picture in their mind that what kind of things we are talking about and it becomes very confusing and half a third so in order to remove any form of such happiness in your brain I just designed this road map for you, which will give you a fairly good idea at water you will be reading and as a matter of fact these are the areas where for next fifty two hundred years mankind will be investing in non merci and gigantically and in this what I was telling you.

So we will be talking a little bit about algae and how I gives such a big resource from the from the world of the water bodies because you always have to remember significant portion of the global area is covered with water and which is ocean water and they have a large, large population of algae which are very, very high oil producers. So we will be talking about them so we will talk about the different resources and how the different bio fuels and again coming back to the chart we talk of top gear here for how the vice is what are the source of biases is it coming from plant sources or is it coming from bacterial sources there are several classifications you can locate or any other microbial sources or it is coming from algal sources.

So the sources will also define the quality of biome its quality of quality of fuel what we are obtaining out of these different sources and what are the conversion efficiency and how it all fits

in the bill eventually it has to fit the bill off or the most important out here is the economics that has to that will take a central stage out here let unless these processes are economically feasible And we have concluded with the roadmap when the next week we will be talking with the biomass synthesis using light dependent and light independent route and the different forms of no one is going to really follow these okay. So I will close in this fifth lecture or as another concluding lecture of the first week where we started the concept of energy. conversion of biomass feasible serve thank you.

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