Wind Energy

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Lecture 02: Introduction to Renewable Energy (Contd..)

Welcome back for this session and we'll continue our discussion on this introduction of renewable energy sources and their status in the context of the Indian scenario and obviously. So, what we talked so far, i mean we looked at why we need to go for this renewable energy and what are those. i mean positives and some of the negatives of it and then we started looking at different example of these renewable sources, obviously the one which we talked about during last session is the wind energy- so obviously the wind energy we just kind of of discussed about how you can increase the power generation through these wind turbines. i mean very specifically though we have talked about horizontal axis wind turbine but yes so what it shows that if you increase the swept area then the power increases, if you increase the velocity of the wind also the power production increases.

But yes there would be issues like you cannot really keep on increasing the area like that. So now, what we are going to talk is that we look at the second example which is essentially looking at the solar. so solar is another renewable source - so where you can see these solar plants which are kind of installed specifically where you have available sunlight. so one of the precondition for the solar energy is that you need to make sure The installation location should be such that you have enough available clean sunlight so that you can have this production or the, I mean, because this works in a solar radiation.

So these panels are exposed to this particular. So very quickly to mention that Indian scenario, I mean, if you go to the western coast, I mean, obviously, you have more available sunlight and throughout the year, you get more, I mean, the sunlight availability is quite high. So if you install solar plants and things like that, also partly the northern india where you have most of the time apart from the winter season you get the sunlight available - so solar panel or installation of the solar panel is a very very feasible option. this example is a 25.7 megawatt energy park in Germany so this is one of the examples just to show that one can install this kind of solar panels and so what.

Typically, it works is that you have thermal solar panels, which is essentially used to generate the heat energy, and then you have photovoltaic cells, which are made of silicon.

It turns sunlight directly into electricity. And then, so obviously this is a kind of a schematic which shows that the sunlight falls on this photovoltaic cell so which produces this this electricity. 3.4 percent i mean as of today the solar in, I mean 2017 in UK the electricity was through solar photovoltaics.

This is again in a very very emerging area. Because wherever you have availability of the sunlight, solar photovoltaics are very useful option and which can be kind of explored so that this option can be exercised. Now, third which is also called the geothermal, so obviously when you talk about geothermal the immediate question which arises how does the geothermal energy work obviously which are the countries which are famous for this and how this or what is this geothermal energy which are commonly linked with like our plate boundaries or volcanoes, what springs and where does the heat come from. so these are the some of the fundamental question that one could so, this is a picture of a geothermal plant where one can see that so, How does it work? If you try to look at it, then it's a, once you talk about the geothermal energy, the geothermal energy is essentially the heat energy from the earth. So, this comes because it's from the earth heat energy which is kind of the harness in terms of this geothermal energy.

So, obviously your decay of radioactive elements and their residual heat from the planetary formation to i mean last few billions years ago and water is actually pumped down into the hot rock where it is heated and then the steam can then be used to heat buildings directly. So, it's a process where we'll come to that quickly, probably in the next follow-up slide or couple of slides. So, that means you have some mechanism or arrangement where you pour water to these hot surfaces, earth surface, along the earth surface where you kind of try to then extract out that energy which can be used for. So, what happens is that you have a kind of a setup where you have this electricity tower and from there it goes to the supply to the, so, what happens you This is an injection well where actually water is injected.

So, cold water comes here and then this is the area where the cold water which has been poured down, they are getting heated up due to the heat that is available at earth surface. Okay. So, now this water becomes, due to the heat, becomes kind of a steam. And that hot water or the steam comes out, then you have this mechanical generator turbine configuration from which you.

So, it's one way one can think about the typical steam turbine kind of mechanism through which you generate this kind of electricity. okay - so these are this is how geothermal energy works where you use the heated earth surface and then turn that into your favor to produce or harness electricity- it's more like a natural process where is primarily water

being used i mean the cold water that goes inside gets heated up comes out and that steam is used to use that. now moving forward the third one that you will talk about is the hydro plant or hydroelectric power plant or the so, here this is a picture of a power station in scotland- so, in hydroelectric power plant what one has to do you need to build up this dam which you see here this is a dam and obviously then you build this area ahead of the dam where you maintain the certain water level. the important aspect of the hydro plant is that you need to maintain the water height because this is where probably your whole plant is located so, the hydro turbines which are used to generate the electricity, they need some definite water head. If you just kind of install this kind of power plant in a running water, you would not be able to get this constant head, the water head, which is very much essential to produce power or energy through the hydro turbine.

So what it means that whenever you kind of constant with kind of dam, you also have ahead of the dam, you need to maintain the water. Once you try to maintain the water, it kind of get you this constant head, which allows you to get, I mean, allows your turbine to work sufficiently to get the required energy. so hydro energy is also quite handy. And obviously, wherever you have sources of these water resources or you can construct dam. So, this is across the globe.

This has been there. But obviously, it's more popular wherever you have rivers and waters where you can kind of make use of that water by, I mean, establish a dam system and hydroelectric power plants. Obviously, India has quite a few of that. now coming to the last example of that thing so what is important is that the biofuel. So, the biofuel one of the important aspect is that either you directly get from the plants or the from the waste, obviously, the primary sources still remain the which or cooking oil bioethanol is used as a fuel for to as a petrol additive to increase the octane and lower carbon emission.

So, this has been tested quite heavily for different kind of vehicles and things like that or biodiesel which is also used to reduce the level of particulates and carbon monoxide in diesel powered vehicles. So idea here is that typically our automobiles either we use diesel or petrol which are essentially the hydrocarbon based fuel and they produce a lot of these pollutants which are not something is desired. So, to reduce that this kind of bioethanol, biodiesel - but yes these are very good alternative option but at the same time one has to be careful about this because the requirement across the globe the essentially one can say that demand and the supply there is a quite a bit of mismatch, because the production of bioethanol or biodiesel is not that high. So, while talking about all these that means these different kind of renewable sources including your wind, solar, hydro, geothermal or biofuels so obviously you have to look at it from different perspective what are the possible available source, how much you can harness energy using that kind of

particular approach or method, whether they would cater to your need or not. most of the time as of today, the status of the renewable, even in the developing country like US, UK, Germany, the renewable energy is not reached to a level where it can really cater to the demand of that whole country.

So still, people quite a bit dependent on the conventional fuel . So obviously, If you look at the context in terms of India, so the development context. So what it is that developed India emits double the level carbon emission, which is said to prevent climate change scales. Because, since we are growing too fast, so obviously, our emission level is quite high. Obviously, when you look at the developing part, So this is what we talk about the developed India.

That means where you are talking about big cities, that the tier one, tier two cities and all these things where you have large building structures, you have more populations for the work purposes and whatever be the reason, you have more industry, you have more people driving cars and automobiles and things like that. When you talk about the developing India, 80% of the population mostly in the rural areas, but they also emit carbon because they burn most of the time the conventional fuel or conventional resources. But yes, that is compared to the developed India, it is quite less. Obviously, as the urban population increases, the irreversible stress is put on urban infrastructure, heavily fossil fuel developed. In the context of Indian scenario, the situation is kind of different here - which sector is contributing more or producing more this emissions related aspect.

So, when you look at that, what one can really note down here is that we have immense growth potential. Why we are talking about that? you have to actually develop your system, you have to develop your things, so that you can also contribute towards the these processes for moving towards the use of more renewable energy sources so that the can contribute toward the control of the climate change, global warming and things like that. So obviously as per the statistics by 2020 india has 90 roughly 90 gigawatt of renewable energy capacity. obviously out of that around 37 gigawatt from solar and 38 gigawatt from wind - so obviously india is growing fast, they are planning or trying to execute this meet the energy demand to the renewable sources but obviously still a long way to go. So, that's what there is an immense growth potential.

Obviously, there are ambitious targets. I mean 2018 Government of India has set an ambitious target of achieving 227 gigawatt of renewable energy capacity by 2022 and by 2027 it is supposed to be 275 gigawatt. So, obviously this includes solar, wind and

floating solar, offshore capacity. So importantly, they want to achieve by 2030 around 500 gigawatt of power, renewable power. Obviously, these are the quite ambitious targets.

But yes, as a country, collectively, everybody would like to achieve the same. Now there are increasing investment. So, not only from the government side, There are plenty of investment coming from the private partners. So there are FDI also. So these investments are helping for having different kind of growth.

Okay. Now, when you look at that, you have robust demand. So India has relatively low per capita electricity consumption. So as for economic growth, the electricity consumption is projected to be 15,280 TWh in 2020. Then you have, that means since it's growing with this all kinds of growth in terms of population development, whatever, the energy demand is also tremendously high. Then you have competitive advantage.

Now India is ranked fifth in wind power, fifth in solar power, fourth in renewable power installed capacity by 2019. So India ranked seventh on the EI, renewable energy country, attractive index. Power generation from solar and wind projects are likely to prosper. There are increasing investment, which we talked about, then there are policy support. So governments are also, government putting forward a lot of effort to provide support, so I mean obviously as I talked about that Indian government wants to achieve by something 2022 by 2030 so investments are obvious.

So, if you look at the scenario here - you have renewable energy sources obviously one can go to hydro then other renewable energy sources which could have small hydropower, wind power, biopower, solar power, this could be biomass, this could be urban and industrial waste. So these are all different things that one can show. In 2021, there is an energy map for India. You can see these different kind of, these are conventional power plants. Then you have renewable power plants which include solar.

You can see these are the mostly solar, solar, solar. Obviously major concern here is that you should have available solar power or sunlight. Then you have wind. You can see this wind is also more or less concentrated on these areas because you have available wind throughout the year. Then you have scattered biomass, small hydro, waste to energy and the different things.

So obviously there are different kind of perspective of installation. There are different kind of goals to be achieved. What is important is that India is heavily into this renewable energy sector. They have lot of investment. There are a lot of installations, but obviously,

depending on the location, geometric locations and all these things, the installations are accordingly.

So importantly, there are some green energy corridor development in there. So green energy corridor to facilitate grid integration of large scale renewables. So about 33 gigawatt capacity addition is envisaged to this with the solar in next few years. The plan to include transmission, strengthening inter and inter, dynamic compensations, storage, smart grid, establishment of the.

.. So, this is a government India project where they would like to, I mean, have this kind of corridor where it can. Now, if you look at that, there are installed renewable energy capacity. So, this is the data up to Y2021. And then you can see the breakup of wind, solar, bio and small hydro. Obviously most of the contribution is coming from, I think 43% is coming from wind, 41% from solar.

So this is the kind of, right now the map is like that and what one would like to achieve is more and more towards this thing. At the same time, if one look at the electricity generation, then you can see up to year 20. So the power generation from renewable energy resources, obviously, one can exclude the large hydro. India reached almost 127 billion units. So that's what it has been ranked fifth in solar and government.

So the government is planning. 500 gigawatt of renewable energy power sources by 2030, also solar installations across the India by 2020, other installations. So, if you go little bit further in the context of the India scenario and more or less fast distribution different state wise, you can see how different states are contributing to the renewable production. Obviously, one of the major reason or this variation one can quickly see that because the location of the particular state so where you are located and what or not so that's going to play an important role - so now this shows your regarding hydro capacity. So, one is that large-scale hydro, the other is the small-scale hydro. Obviously, the hydro capacity, the large and small, it depends, again, on location and the situation that you have where you would like to install this kind of units. So obviously, more and more Small scale hydro plants could be very handy which are the kind of mission wide.

So obviously the strategies which are adopted. So one has to do full integration, decentralize solar power, lower tariffs, shift towards non-conventional energy. So government has taken certain steps, measure and they are strategies which have been adopted to achieve those goals where you can harness more energy from the renewable sources rather than using the conventional sources. So the growth driver, if you look at it, so there are government commitments. obviously government is aiming something they

are setting some targets to reach by 2030 obviously they are adopting plans or strategies according to that they are installing different plants whether the solar wind or hydro and things like that- so obviously at the same time the investments which are coming from both the private partner government side so more and more investment is taking place in India. obviously there are policies and incentives which are favorable and making things to grow quite quickly so what are the one can look at the government policy so you have repowering policy, then you have wind solar hydro policy, you have renewable energy Purchase obligations, different government schemes, you have energy modeling forum, you have scheme for development of solar parks and ultra mega solar power projects and things like that.

So, these are different side of the policies that government is taking. So, for example, you have wind bidding scheme so that you have national solar mission you have green energy corridor you have skill development so all these are connected because once you try to establish, new plans once you try to establish the new setup then obviously you get more people get to required to be worked then also You need to do a lot of skill developments and all these things. So what is happening is that you have quite a bit of increasing investments. You can see that how that is increasing. So these investments are not only helping to grow faster, also taking India to a position where it can move towards non-renewable.

Now, if you look at the major FDI investments in renewable energy sector, so this is India, Philippines, Singapore, Japan, Netherlands, Germany, USA. So, these are some of the numbers. which you can get from the CEA database that what are the major investments which are taking place. Obviously, you have huge uncapped or untapped potential. You have small hydro sector, you have the bio sector, wind and solar.

You can see how one can grow and then achieve something. Obviously, you have rising power demand. India's power demand has been rising at a very, very fast rate. So India has to establish additional power supply to meet that demand. As we have been talking about that, so once you have more development, whether in terms of population growth, you have development state, So the energy demand also would go high.

So you have to cater to that demand because without the energy supply, nothing would happen. So to cater that demand, you have to make sure that also you somehow have mechanism to produce that much. So move towards renewable sources, which India is now targeting to achieve. They have these solar emissions, green corridors, hydro plants, all these are in place so that you can have more and more move towards the renewable sources and obviously most important thing here to kind of note here is that whenever one has to install such things then one has to identify where to install whether that

particular location is favorable or conducive for a particular installation or not. so there are key industry contacts or key industry players which are playing big role here.

Obviously national institute of solar energy in the NISE- so they are playing very key role then you have SSS-nibbe, Solar Energy Corporation of India, National Institute of Wind Energy, then the Indian Renewable Energy Development. So these are the different key industry contracts on the industries. Obviously, there are other private partners which are also playing important roles. So that gives you an overview of the whole thing. Like, I mean, at least that answers why We need the renewable energy.

Why we need to harness more and more renewable energy or energy or why do we need to fulfill our energy demand going or moving towards the renewable sources? What are the possible sources and what is the present status across the world and where India stand at this moment? So that kind of an introduction. We can now move to the discussion of, obviously, the scope of this particular course is that we will be talking more and more about wind energy system. But before doing that, we will do some other fundamental stuff like fluid mechanics and things like that. Okay. Thank you.