EBF 301 - Alternatives & Renewables

PRESENTER: This lesson is going to be on alternative and renewable energy sources. The main types that we're going to talk about are wind, hydro, solar, geothermal, and biomass.

This particular chart shows different types of renewable energy production, as well as the consumption. The key below shows you which types. Hydroelectric power consumption is in blue. Geothermal energy consumption is in the brown and is at the highest level of energy. The solar and photovoltaic production of electricity is in the green and is fairly flatlined, but it seems to be upticking over the last year or so. Yellow is wind energy. And as you can see, it's on a steady uptick. We've obviously had thousands of wind generators installed across the country over the last decade, and we will continue to do so. And then total biomass energy consumption is at the highest level here on the chart.

And this particular chart illustrates the various types of energy produced in the United States. You can see the single largest amount is petroleum. So all the various products that we use from petroleum-- gasoline, jet fuel, diesel, heating oil. All of those. Natural gas provides 26% of our energy. It is a large component of fuel used to generate electricity. It's also used in over 50% of residential houses for hot water heating as well space heating. Nuclear power only representing 8%.

But the piece here that I want to show you is the piece that's been pulled out to the right. 9% of all the energy produced in the United States is coming from all renewable energy sources. So if you look at every one of those, hydroelectric, wood, biofuels, wind, waste, geothermal, and solar photovoltaic power and energy, all of it comprises only 9% of our existing energy production.

Here, again, is another illustration of the type of fuel used to generate electricity. And you can see a steady uptick going forward, and the use of wind generation for electricity. Solar is increasing. A little bit of geothermal. Biomass is not used that much for generating electricity, but you can see it's fairly steady. And then, of course, hydropower. At the present time, there are no new hydroelectric dams being built in the country, so that's expected to be fairly stable.

Wind power once was used for mechanical drives only. It's gaining in popularity as a clean alternative source of electricity using turbine generators. The old windmills, as they were called, were used on farms to draw water up from aquifers, to serve as wells on their land. And way, way back, they actually ground flour, and corn, and those types of things. Today, large wind farms are being built across the country where wind becomes a natural resource. Some of the concerns with these-- obviously, noise pollution in the area for the residents of that area. And there have been numerous reported deaths to flocks of birds flying in those areas. And as you can see, the picture on the left there just shows what are some 750 kilowatt turbines in the state of Minnesota on a large wind farm there.

Hydropower. Basically using water force as energy. Traditionally, it had been used to churn mills. That's why we would have those water mills. And again, they did several things with those from a mechanical energy standpoint. But today, we have hydroelectric generators. We have, most predominantly, hydroelectric dams. But we also have what are known as tidal power turbines, and these are actually utilizing the current flows, generally in and out of a river, or in and out of some type of an inlet. They use these in the North Sea off of Scotland. There's an experimental one in the East River in New York City as well. Again, there are subsurface turbines that actually spin as the current goes in one direction or another, and those drive a generator, which produces the electricity.

Solar energy has been around for quite some time. The interest in it, and the expansion of it, really began with the oil embargo of 1973 and 1974. And then the second embargo in 1979 caused even more interest in it. The idea is to collect heat and energy from the sun and use it for things such as pure heating, generation of steam for electric turbines, or to actually create electricity directly, which would be the use of photovoltaic cells. In a lot of cases, it's used to heat water, even for space heating.

And we generally have two types. The passive solar energy is using the direct heat of the sun. There are solar collectors, and they can direct the heat in a particular area. It's primarily used for space and water heating, and it can also be used to create steam. So some of the panels you might see on office buildings or residences may be doing nothing more than circulating water through for hot water heating. You would probably recognize the difference or the photovoltaic ones that are producing power.

And again, this brings us to the active part. It's the photovoltaic conversion of sunlight to electricity using semiconductor materials. It's dependent on the atmosphere condition and the Earth's position relative to the sun. And obviously, off to the right there you see a photovoltaic array. Small scale use here. But you see them more and more throughout-- they're using them now for traffic signs, communications systems, for instance pipeline companies, or any type of long distance lines, or cables, or whatever else. Signals are transmitted, and the power is coming from photovoltaic cells.

Geothermal energy. We generally think of geothermal energy as natural steam coming from geysers and from other places. And in those cases, it could be used for direct space heating. It can also be used directly for industrial processes. Steam will also drive steam turbines at a power plant or on site somewhere where there is the geothermal steam coming up.

But the flip side of that, which a lot of people are not necessarily aware of, is the fact that you also have geothermal energy that's used for space cooling. After all, if you go several feet below the surface, the soil and the temperatures down there are much cooler than above ground. And so you can literally drill down into a cooler area and draw up cool air to use for space cooling. This is becoming more and more prevalent. I have personally seen large homes that use this, as well as midsize office buildings.

Biomass. These are the various types when we talk about biomass and energy coming from biomass. We're talking about things like wood, garbage, crops, various alcohol fruits, in other words, fruits that can produce some type of an alcohol that can be burned as energy, and then landfill gas.

Biomass. The one form here is landfill gas. Basically, you have decaying trash that's in landfills, and it's going to create methane. All the biological material that breaks down and decays will end up giving off methane gas, and over time, the older landfills will actually have pockets of methane within them. And there are people who will go out, and they literally will poke a hole down into the landfill, and they will get the pockets of natural gas, and they'll use it on site, mostly. They can use it to drive some small turbines or small generators to create power on site. In some cases, they may have a process whereby they need to create some steam, and so they use the natural gas for that as well.

Another form of biomass is to actually take solid waste and convert it to energy, or trash to energy. This is where using solid waste that would normally go to a landfill-- you're using it as a fuel to create heat via combustion, and in turn, create steam from the boilers where the combustion is taking place. The steam can actually be sold for industrial purposes, or the generation of electricity can be accomplished by using steam as well. Now, there's a company in Fairfield, New Jersey by the name of Cogentrix Corp, and they actually build and operate several of these trash to energy, or solid waste to energy, facilities around the United States.

Wood and wood waste. These are normally the byproducts from large wood mills and paper mills. And what they'll do is, again, to be efficient, and to be environmentally conscious, they'll go ahead and use the wood, or the wood waste, the wood pulp-- they can actually burn it, and then it becomes a heat source where they can create their own steam that they'll use in the process, say, for instance, for making particle board or even paper. They can also use the heat source to run small generators on site for their own consumption and operations. The Weyerhaeuser Company, a huge manufacturer of various forms of lumber, and wood, and particle board, and those types of things, does this on location with a couple of their very large facilities they have in southeast Oklahoma.

And most of us are more familiar with this type of biomass where we're making fuel from things like crops, grasses, and biodegradable matter. One of the more well-known ones, of course, is making ethanol that we use as an additive to gasoline in our cars. And the primary food source there is corn, but there's also sugars that can be broken down into alcohol, as well as certain types of grasses. And on the biodiesel front, we could use vegetable oil, peanut oil, soybean oil, and then recycled grease from restaurants once it's cleaned. You can burn any of these in an existing diesel powered vehicle.