Waste to energy conversion

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Lecture – 02
Introduction - 02

Hi friends. Now we will start discussion on the second part of the introductory module; in the first part we have discussed on the definition of waste the types of wastes, the characteristics of waste management, the availability of waste, and the last we have seen that the waste to energy conversion this concept is being developed and in 2013 in Poland the incineration was used for the conversion of waste to energy. In this part we will discuss the need of energy production from waste; energy from waste I will give you some scenario world and Indian scenario and at last we will discuss on the roots of energy production from wastes.

Actually, as discussed in the first part of this module, waste to energy conversion gives as double benefit. One way it meet some energy demand on the other way it gives us some a systematic solid waste management system. In short we can say this concept helps us to achieve the sustainability goal of the society, which is the need of the society of twenty first century. Second increase in generation of wastes and power demand that is also important fact which is guiding us to develop some technology for the conversion of waste to energy, I will give you some statistics on it how the waste generation is increasing day by day and how the power demand is also increasing.

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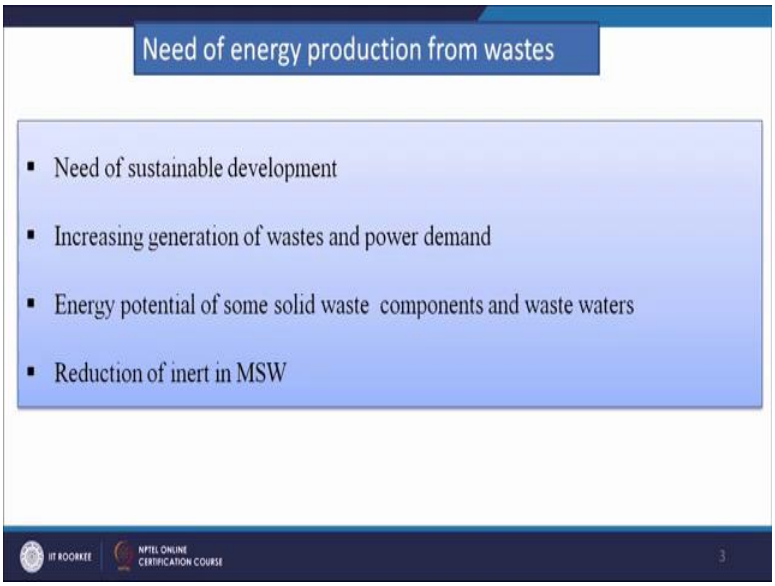

Then the energy potential of some solid waste components and waste water; with the development particularly the economic development the composition of solid wastic changing and it is favoring for the waste to energy conversions. I will give you some statistics and informations on it, and reduction of inert in MSW it is also similar to that that with the development of the economy the inert component in the solid waste is reducing which is not desirable for solid waste conversion for energy. So, all those factors are guiding us for the development of a new technology for the conversion of waste to energy.

Now the first one is need of sustainable development which we heard the word sustainable or sustainability everywhere nowadays, but what sustainability actually means. Sustainability or sustainable system say we can say systems sustainable if the resources available in the system today is available in tomorrow and will be available for a longer time for our next generation also. So, this is the one way of explaining the sustainability, but the most logical way of explaining sustainability is that the system must be economically viable environmentally bearable and socially equitable actually three E; so these three E economics environment and equity.

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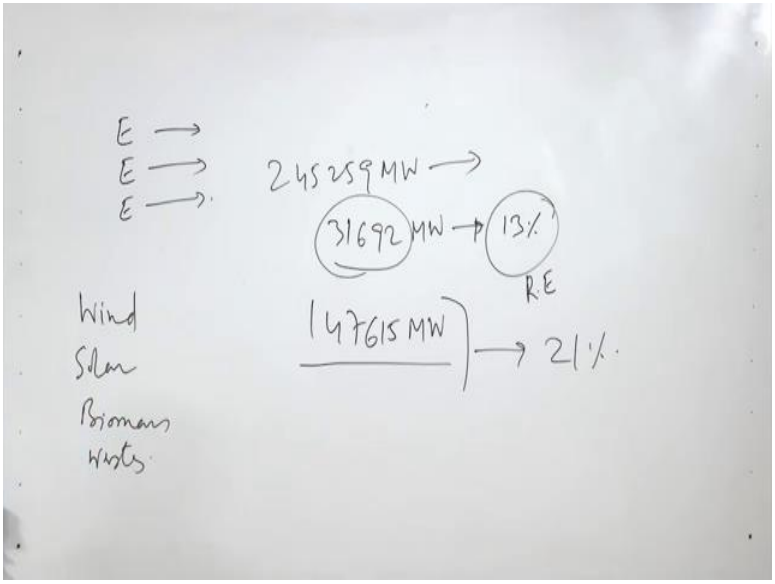

So, these three are very very important to achieve a sustainability goal. So, waste energy conversion helps us to manage the waste in a proper way so that health impacts are reduced. So, it tells to get better environment second it is adding some value or some energy supply. So, economics may improve or may the process may be economic and socially it will create job of different natures. So, all gender people will be involved in this, social equality will also be maintained. So, waste to energy conversion has a good potential to help to get the goal of sustainability to the society.

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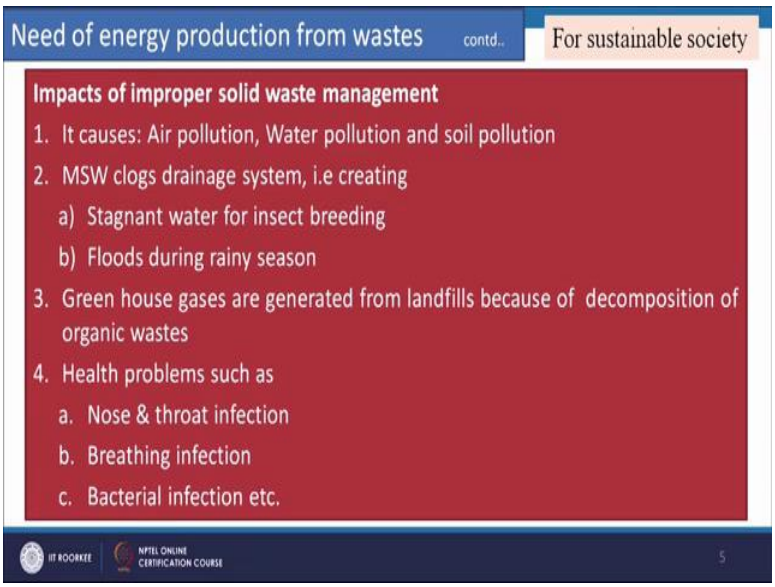

If we can develop some systematic way of solid waste management, so we can avoid some health hazards as mentioned in this slide you see that if we do not manage it in properly the solid waste can cause air pollution water pollution and soil pollution, our MSW clogs drainage system and it creates stagnant water for insect feeding floods during rainy season etcetera, and green house gases can be produced for open dumping and we will get global warming. So, health problems such as nose and throat infection breathing infections and bacterial infections can be spread if we do not have any proper solid waste management; now the increasing generation of waste.

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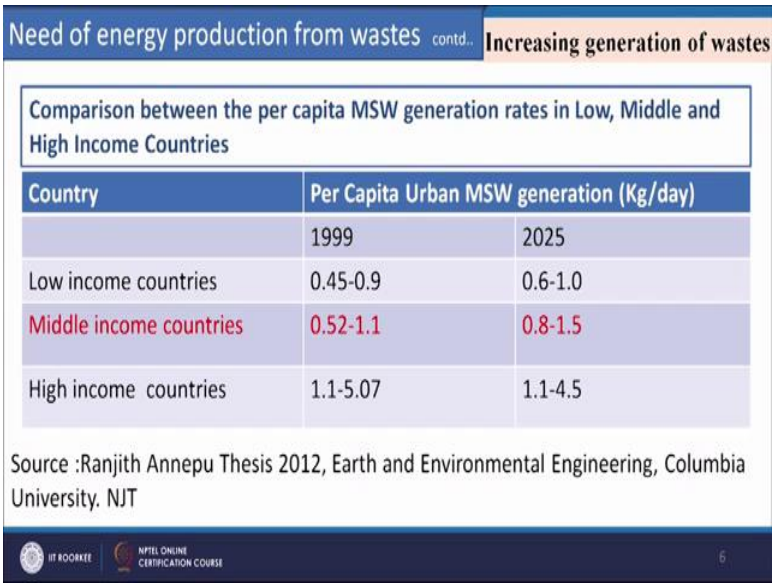

We see here some statistics in 1999 per capita urban MSW generation was 0.52 to 1.1 and it is x k g per day and it is expected to be 0.8 to 1.5 k g per day in 2025 for middle income countries. For low income countries this is this value is going to be changed from 0.45 to 0.92, 0.6 to 1.0 and another for high income countries it is going to change from 1.1 to 5.072, 1.1 to 4.5. So, from this data it is very clear that in future the waste generation is going to be increased the country like India where in between low and middle income countries, we our waste generation productions is expected to be increase in future.

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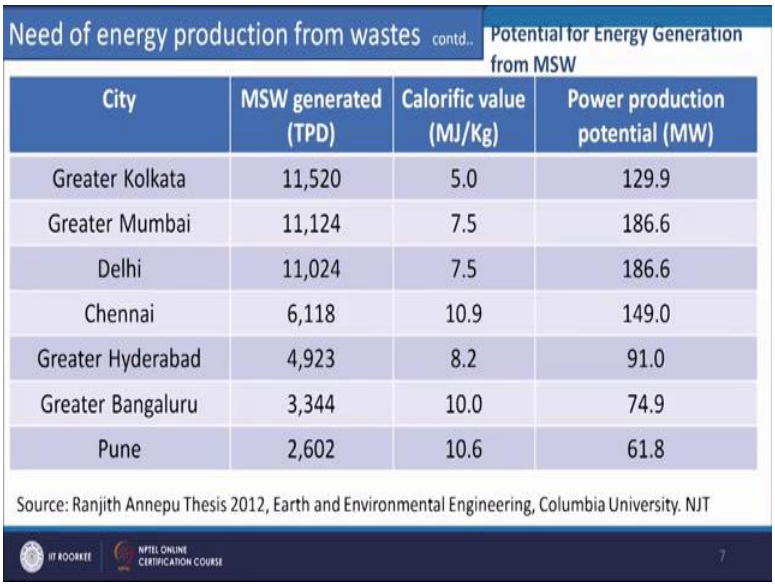

Now, we will see some potential of the MSW generated in Indian cities for electricity production, some examples are given here like greater Kolkata, greater Mumbai, Delhi, Chennai, greater Hyderabad greater Bangalore and Pune. So, MSW generated per day is given here this column gives calorific value of these solid waste and power production potentials is given here. So, some other Indian cities are also given in this slide that is Ahmadabad, Kanpur, Surat, Kochi and Jaipur apart from these we have data for more 59 cities of India, and on average we have 81407 ton per day MSW generation capacity in the cities and which has the capacity to produce 1292 mega hertz of electricity.

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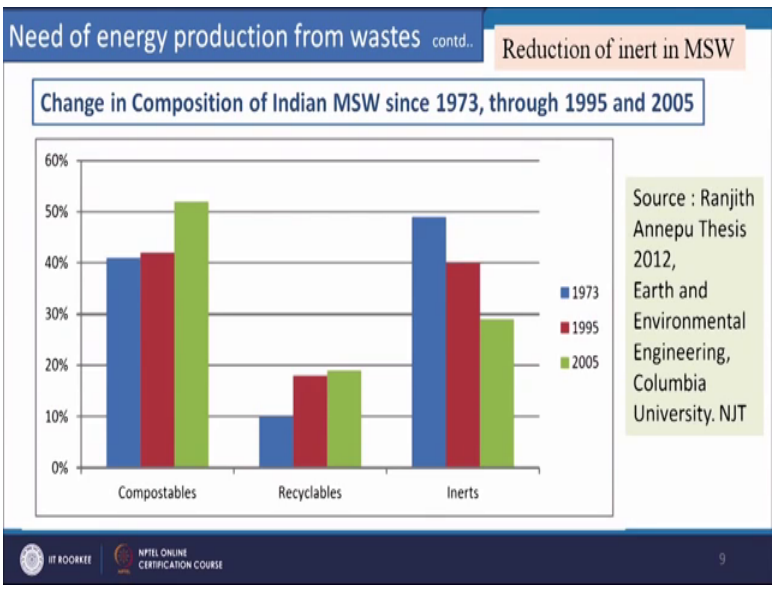

Then I will show you some data on how the inert in the MSW is reduced day by day. If we consider 1973, 1975 and 2005 cases for compostables 1973 it was around 40 percent and 2005 it is increased to more than 50 percent. So, around 10 percent increase within 1973 to 2005, and for recyclables it was around 10 percent in 1973 it is increased around 18 or 19 percent in 2005, and for inerts surprisingly in reverse trend we see here that is inerts in 1973 was around 48 percent, and it is reduced below 30 percent in 2005; and all those changes are favorable for the energy conversion from the wastes.

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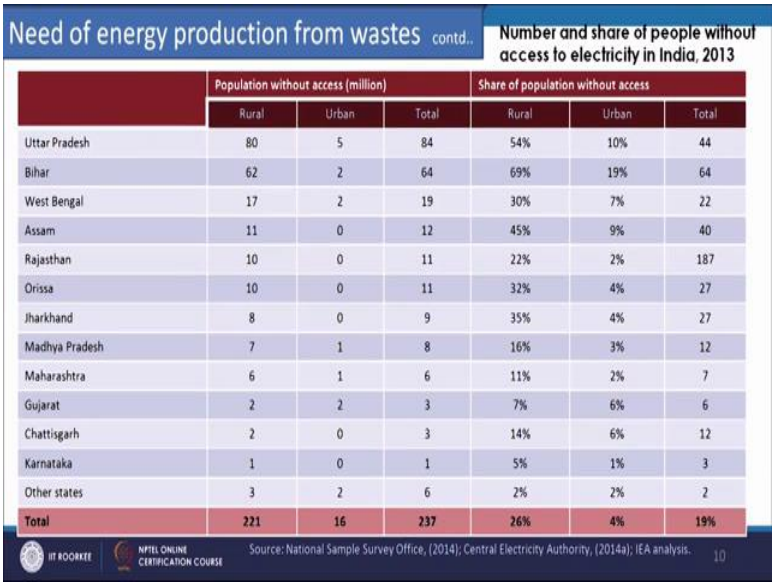

Now I will show you some data which justify the requirement of the energy production the gap of demand and supply. This slide gives the name of different states of India and it gives the millions of people which are not getting any access to the electricity, and in rural area as well as in urban area. And it is also giving the percentage of people not having access to electricity in rural and urban areas, and on average basis on total basis we are getting 237 million people are not having access to electricity in the country which is around 19 percent of the population.

So, we are lacking the energy we need more energy, but recourse and we have the waste generation capacity. So, waste is waste generated in different parts can be converted to energy. So, some sort of energy supply can be made from this.

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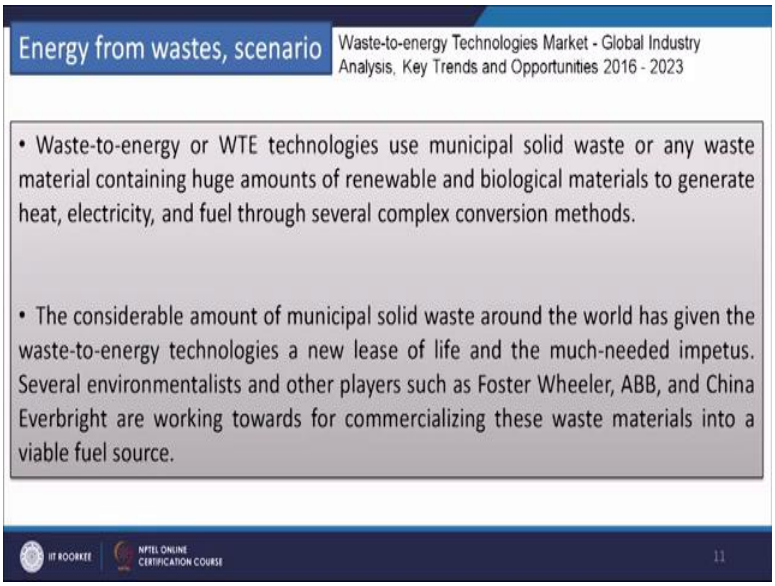

Next we will discuss on energy from waste and we will provide you some scenario. So, this slide is taken from waste to energy technologies market, global industry analysis key trains on opportunities 2016 to 2023 as far this report waste to energy or WTE technologies use municipal solid waste or any waste material containing huge amount of renewable and organic contents, to generate heat electricity and fuel through several complex conversion methods.

The considerable amount of municipal solid waste around the world has given the waste to energy technologies a new lease of life and the much needed impetus. Several environmentalists and other players such as foster wheeler's ABB, and China ever bright are working towards for commercializing the technology for energy conversions from the wastes.

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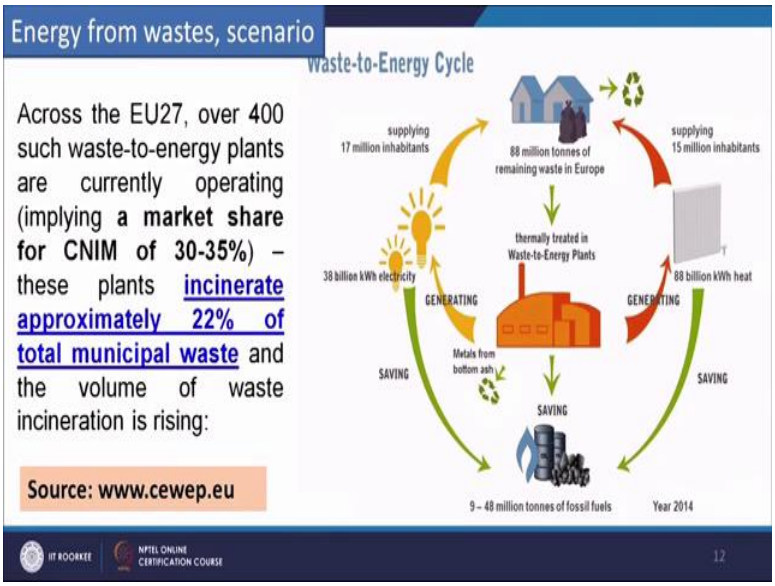

Here we will give you some world scenario first. So, this is some information's on waste to energy conversion in Europe: in EU 27 over 400 waste to energy plants are available which are based on incineration, and approximately 22 percent of the total municipal waste is processed through this process, and the technologies applied by CNIM which is around 30 to 35 percent of their products are here in this region, and we see here interesting information here that is 88 million tons of remaining waste in Europe has been processed through incineration in the year 2014, and through this waste to energy conversion both heat and electricity generated.

So, 88 billion kilowatt our heat is generated and 38 billion kilowatt our electricity generated, which are supplied to 15 million inhabitants and 17 million inhabitants respectively; by this process it was possible to say 9 to 48 million tons of fissile fuels.

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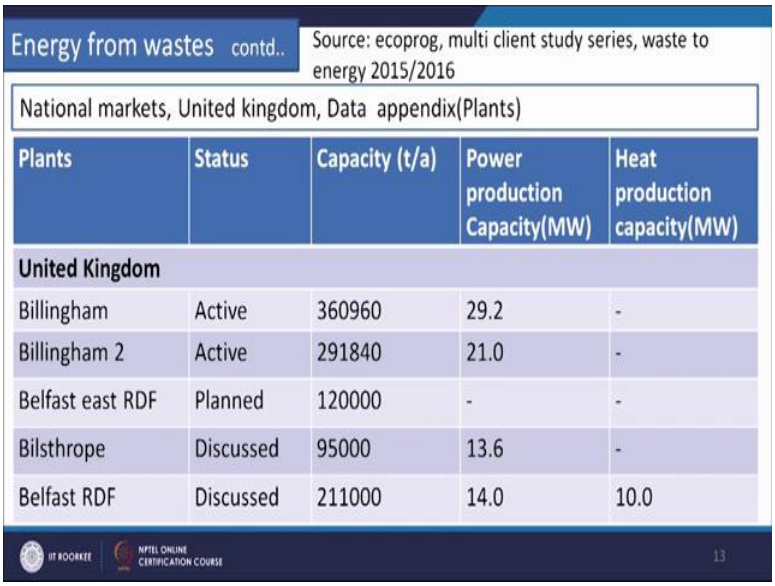

Another information on waste to energy conversions in UK is available in this reference that is ecoprog, multi client study series waste to energy 2015 2016 as per this report it is evident that in UK Bellingham 1 and 2 plants waste to energy plants are in active phase and the capacity is 3, 60,960 ton per day ton per annum and 291840 ton per annum. Other the power production capacity are 29.2 mega watt and 21.0 mega watt respectively. So, other plants are also in plant and discussed phase. So, would which will be using different capacity of solid waste and will produce different capacity of electricity and in case of Belfast RDF both electricity and heat is generated. We will be discussing in later phases in later modules that the cogeneration or electricity and heat generation simultaneously improves the heat efficiency.

Another example is given here the waste to energy conversion activities in China. So, here Feng Yang (Refer Time: 13:47) these three are active plants having the capacity 560076 ton per annum 479232 ton per annum and 300000 ton per annum respectively and their power production is 1230 and 14.8 mega watt, and another plant is also there under construction stage and here also that portion one is using both power and heat as you have discussed this helps to improve the efficiency of the process.

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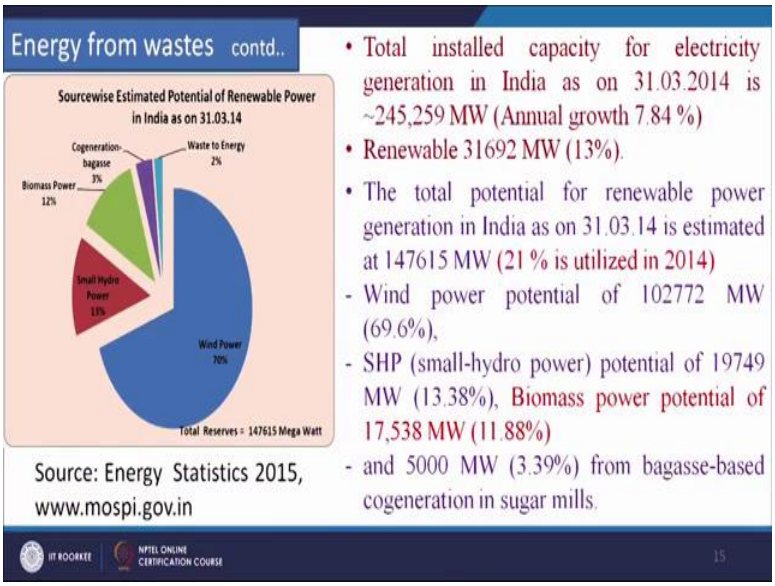

Now we will see some scenario Indian scenario in India in 2014 as per thirty first march 2014 on the basis of energy statistics 2015, it is clear to us that we had energy production capacity of 245259 mega watt total 245259 mega watt total install capacity as per thirty first march 2014, out of it our renewable is 31,692 mega watt. So, what is this? The total is around 13 percent. So, 13 percent is renewable energy in the country as per 2014, but what is the potential we have in the country we have potential of 147000 1, 47,615 mega watt, this is renewable energy potential we have we have producing only 31692 in 2014; that means, we are using around 21 percent of this capacity.

So, there is a good scope for further development on this renewable energy area; here some statistics are there out of different renewable energy like say wind, solar, biomass and waste we see we induce 70 percent potential we have, than hydro powers small hydro powers it has also potential of say 13 percent, biomass has 12 percent and waste has 2 percent and cogeneration that is heat and energy electricity generation using bagasse has 3 percent. So, this 12 plus 3 plus 2, around 17 percent we have the potential out of these 1, 47,615 this 17 percent is from the waste to energy and biomass to energy. Here as per the same energy statistic 2015 we see in 2014 the biomass and waste was used to produce 4,120 mega watt of electricity.

So, this is the total renewable this is the total renewable, and this is the renewable energy from biomass and waste. So, what are the percentage around 13 percent again it is also

13 percent. So, from this information we get that we have very less facilities for waste to energy conversion as per 2014 data, but gradually the efforts are on to increase this activity. And in near future we may expect more waste to energy conversion in the country.

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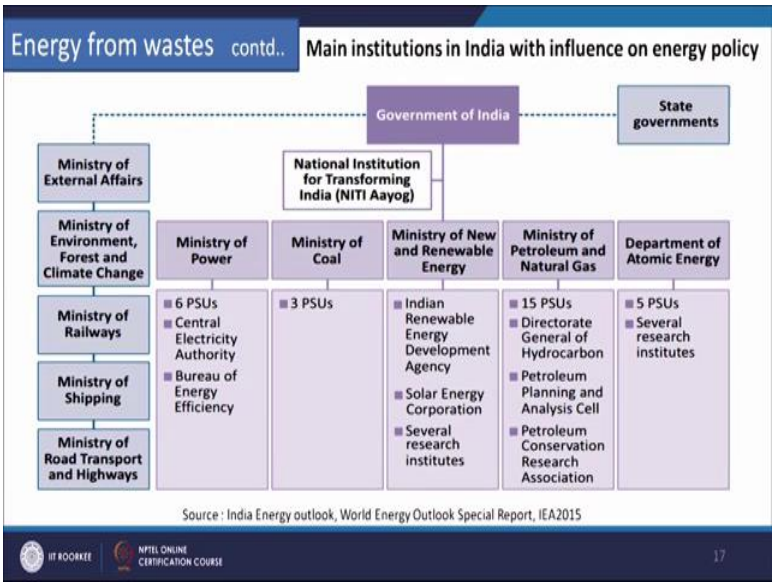

Now, when some new concept is going to be implemented in a country, so we need some policy and those policies has to be framed by the government in our country related to energy when new policies formed different organization, different ministries are involved. So, this slide gives us some idea which ministries are responsible to fix some policy on energy. So, here central government takes suggestion from state government it takes suggestion from ministry of external affairs, ministry of government environment forest, and climate change ministry of railways, ministry of shipping, ministry of road transport and highways and national institute for transforming India that is Niti Aayog.

So, Niti Aayog itself contains ministry of power which has 6 PSUs, central electricity authority, bureau of energy efficiency and ministry of coal which has 3 PSUs, and ministry of new and renewable energy which has Indian renewable energy development agency, solar energy corporation several research institutes, and ministry of petroleum and natural gas which has 15 PSUs directorate general of hydrocarbon, petroleum planning and analysis cell, petroleum conservation research association, and department of atomic energy which has 5 PSUs several research institutes.

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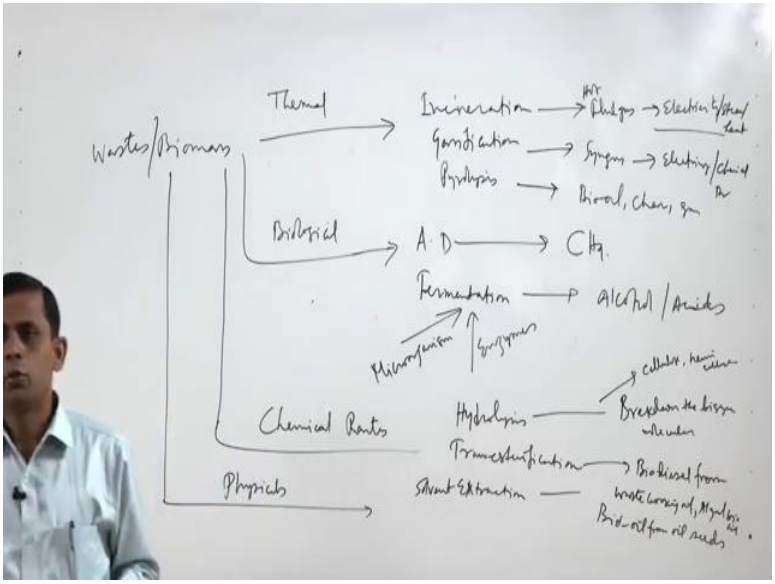

Now we will see roots for energy production from waste. So, we have waste and biomass, we can convert it to energy through different roots one is thermal root that is incineration, gasification and paralysis. So, these will give us flu gas, hot flu gas that will give us electricity steam or heat. Now we will discuss in the next in somewhere in some module how to improve the efficiency of this electricity productions, using different types of turbines etcetera and cogeneration of cells.

Now gasifications it gives us sin gas that gives electricity, chemicals, hydrogens etcetera. Paralysis gives us bio oil char and gas this is the major thermal roots then we have biological conversion root biological conversion roots basically includes (Refer Time: 21:18) digestion and fermentation (Refer Time: 21:26) digestion gives us methane is gas and fermentation gives us alcohol acids etcetera this fermentation can be with the help of microorganism or will be with the help of enzymes.

Next, we have chemical methods chemical roots: chemical roots mainly include hydrolysis, transesterifications and extraction solvent extraction. So, hydrolysis is required to degreed the higher molecule rate organic compounds to lower acids. So, this is hydrolysis to break down the bigger molecules. So, it gives us cellulose, hemi cellulose separation. Transesterification gives us a production of bio diesel from different sources like say waste, cooking oil, cooking oil or algal bio oil or algal bio oil solvent

extracts it helps to extract bio oil from oil seeds; bio oil from oil seeds. We have some other off sense that is physical roots.

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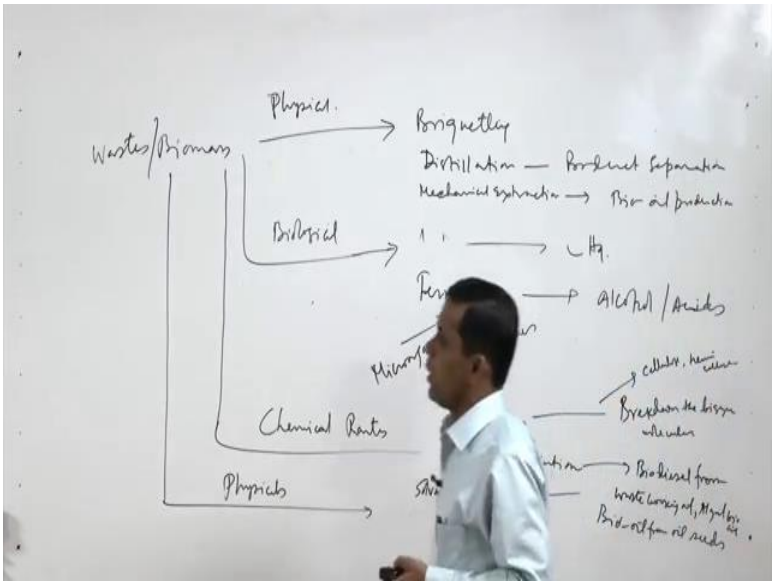

So, physical roots include bracketing this is a physical bracketing which gives densified solids with uniform properties and high strength mechanical strength, this can be having the distillation which is used for product separation or mechanical extraction used for bio oil production.

So, these are different roots which can be used for the production of energy from the solid wastes; there are some roots for liquid waste also before that we will see our of these conversion roots the biological and thermal. So, biological and thermal these two roots are widely used for direct conversion of waste to energy and this slide gives us some comparison. So, thermal comparison thermal root is effectively applied to almost any biomass feed stocks, but biological root will be applicable for selected feed stocks, and thermal thermo chemical root relatively higher rate of productivity when biological roots the productivity is very slow and very less.

Multiple high value products can be separated through the thermo chemical roots, but biochemical roots are very very product specific and no effect of ambient temperature on thermo chemical root, but biological roots mostly susceptible to ambient temperature and (Refer Time: 26:09) sunlight for algal ponds, because micro biologica micro micros are susceptible to the change in temperature and p H of the solution.

So, mostly complete utilizations of biomass takes place in thermo chemical conversion processes, but in biological processes all biomass is not converted completely it gives some sludge. So, these are the basic difference between thermo chemical and biological conversion methods and we obviously, the thermo chemical conversions methods has more advantages than biological, but there are some specific conditions when biological methods will be more appropriate than the thermo chemical conversion methods, particularly when moisture content is very high. Then we started as a source of energy as we have discussed that somewhere the VOD, COD values is very high and somewhere they are very less say.

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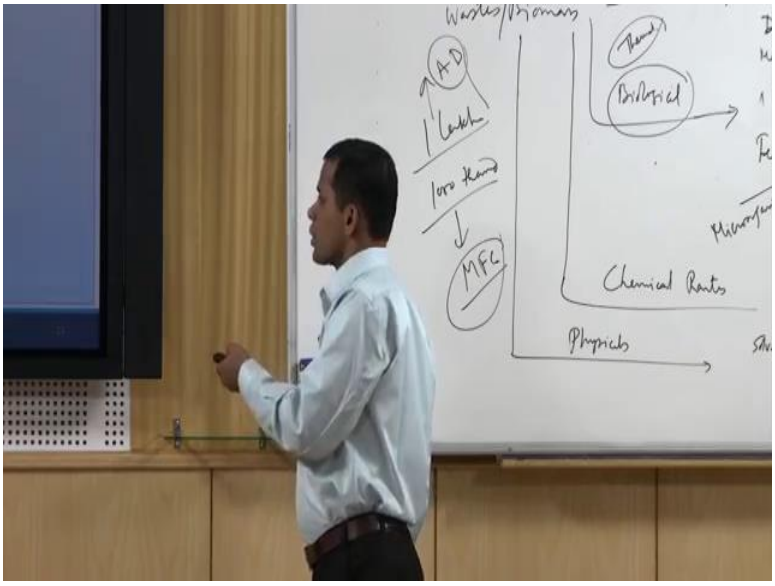

Somewhere it is say COD is 1 lakhs somewhere say 1,000. So, in these cases we will go for anaerobic digestion and for this case we may go for microbial fuel cell MFC. So, microbial fuel cell is a very new concept, but this concept is a d is a developed concept. So, these are the different roots on the production of energy from the different types of wastes at last we will see the some risk of this waste to energy conversion.

The first one is all technology options for waste to energy conversions is not matured; the second is residual disposal whatever may be the process we use there will be some residue (Refer Time: 27:59). So, we have to dispose it off. So, proper mechanism we have to adopt how we will manage the residual part and environmental regulation the

gradually the strict environmental norms are coming up, but as the technologies are not so well developed and mostly many technologies are in lab scale in pilot scale etcetera.

So, what will be the requirement how those environmental requirements will be achieved that is a challenge and lastly the economic feasibility, whether these will be this process waste to energy will be economically feasible because we have seen that the energy content of waste is not very high, but still will it be economically feasible may be or may not be because this is a new concept very large applications is not has not taken place except incineration. So, there is a some question mark this on this economic feasible of the different processes like say MFC whether it will be visible, but one important characteristics is that if we do not use this waste to energy conversion root we have to develop some waste management roots which is costly it will be having its own cost. So, it is expected that waste to energy conversion process will be having some economic visibility in future and in and the people will be forced to do something to manage the solids.

So, after this we have given you some introductions on the subject. And I thank you very much for your patience and we will start discussions in the next module.