Life Cycle Assessment
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Lecture – 40
Tutorial II

Hello everyone. I am Pubali Mandal, I am one of the teaching assistants of this life cycle analysis course I welcome you all to the tutorial session of this life cycle analysis course. So, here we will discuss about few problems we will solve basically few problems based on IPAT equations and some (Refer Time: 00:35) analysis problems. So, IPAT equation is based used for measuring it is an equation which is used for assessing the magnitude of sustainability challenges that our societies are facing like in terms of energy uses or material uses or some other environmental emissions.

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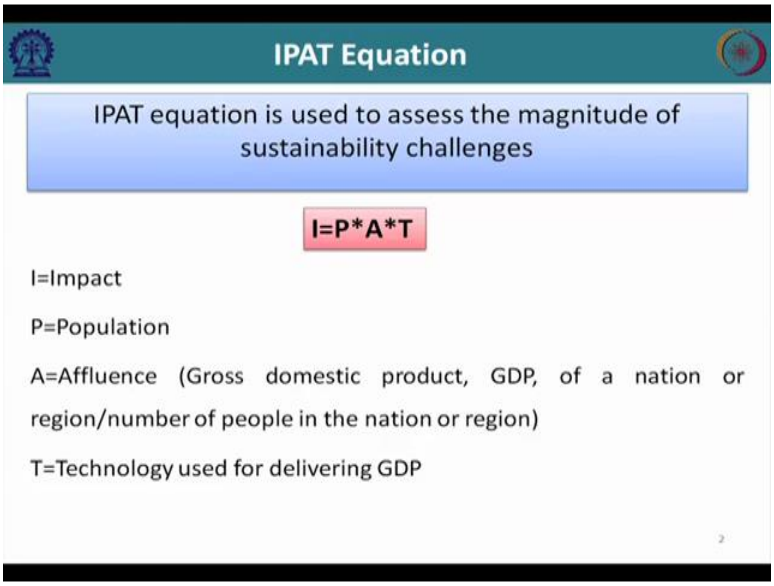

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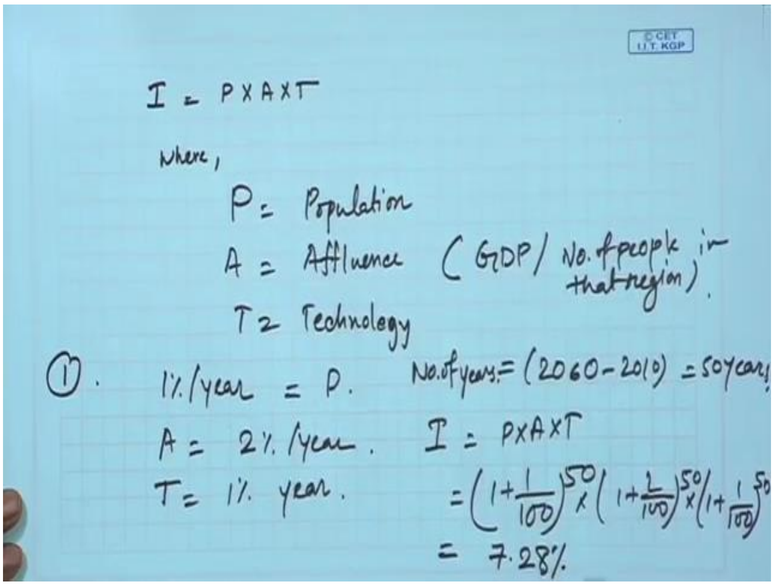

So, coming to a first numerical problems; IPAT equation is basically I is equal to P into A INTO T. So, here P is equal to a population, A is here are affluences which is basically gross domestic product divided by the number of people in that region and our T is technology which is used for delivering our affluences.

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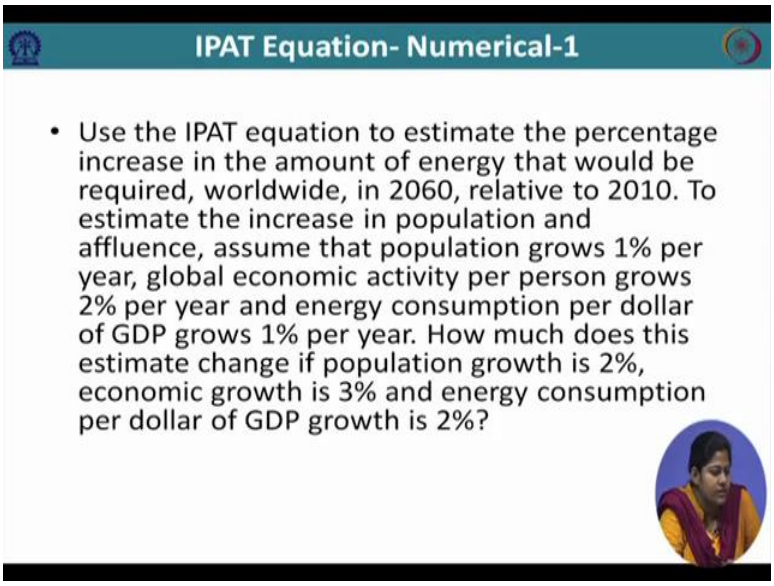

So, coming to our first problems here what we are we have to do is we have to calculate the our impact in 2060 relative to 2010 and our given data is it is given that population growth is one percent per year. So, this is basically our nothing, but P and global economic activity per person grows 2 percent per year. So, this is our affluences and energy consumption per dollar of GDP growths 1 percent P per year. So, this is our T.

So, now we have to calculate our I. So, I is equal to P into A INTO T. So, P will be 1 by 1 plus 100 to the power as we know that our number of years is 2060 minus 2010. So, it will be 50 years. So, this will be to the power 50 into 1 plus 2 by 100 to the power 50 into 1 plus 1 by 100 to the power 50. So, this if we will calculate it will be 7.28 percentage.

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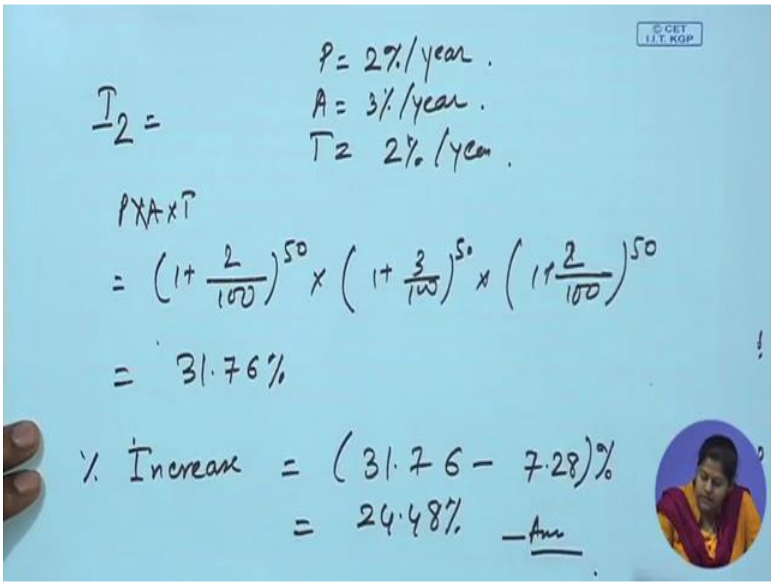

Now, so, if we will consider that this is our I 1 and our I 2 in the second case it is given that how much does this estimate change in the population growth is 2 percent. So, now, our P changes from 1 percent to 2 percent per year and our economic growth is 3 percent. So, our affluences changes 3 percent per year and economic consumption per dollar of GDP growth which is our T it become 2 percent per year.

So, now our I 2 will be P into A INTO T. So, it will be 1 plus 2 by 100 to the power 50 1 plus 3 by 100 to the power 50 into 1 plus 2 by 100 to the power 50. So, if you will calculate this it will be 31.76 percentage. Now it has been asked that what is the percentage increase or decrease due to the changes in population affluences and technologies.

So, we can calculate percentage increase is equal 31.76 minus 7.28 percentage. So, it will become 24.48 percentage. So, this is our answer of the final.

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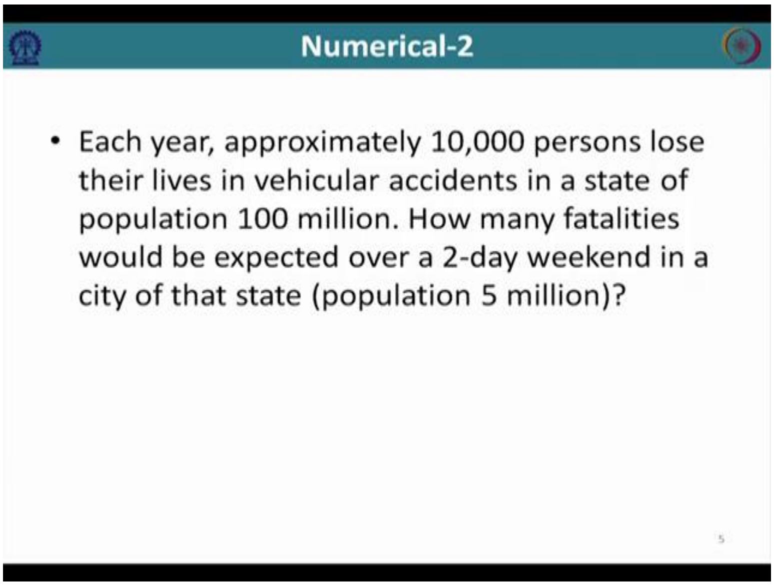

Now, coming to our second numerical problem which said which is actually on risk analysis. So, it has been said that 10,000 person lose their lives in vehicular accidents in a state of population 100 million.

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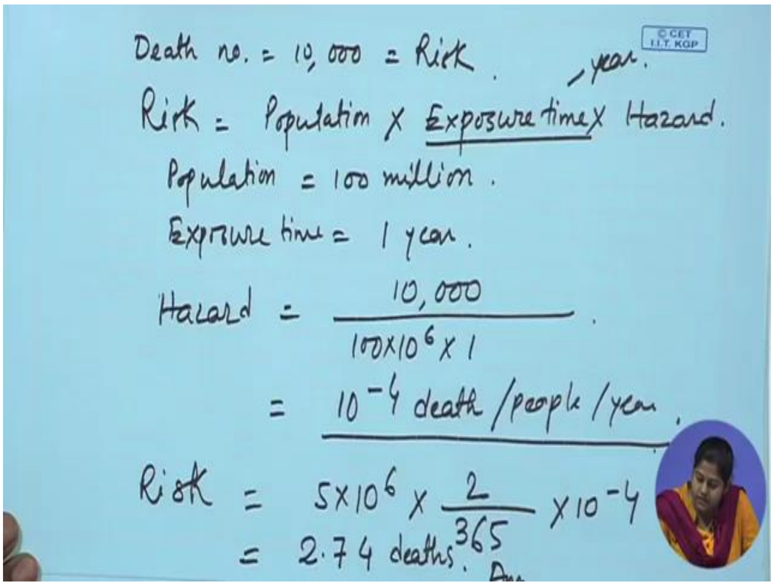

So, here the death of people death number is 10,000 which is nothing, but our risk and we know that risk is our population multiplied by our exposure time multiplied by hazard. So, in this case it is the population has been given. So, population is 100 million and exposure time is also given it is one year. So, you can calculate our hazard because risk is already given. So, our hazard will be our risk which is 10,000 divided by our population which is 100 into 10 to the power 6 exposure time is one year. So, our hazard if you calculate then your hazard will be 10 to the power 4 death minus 4 death per people per year.

So, once we will get our hazard this one then we can calculate the risk which is asking in that question that how many fatalities would be expected over a 2 day weekend in a city of that state which has a population of 5 million. So, now, we can calculate risk because we know our hazard. So, our population is 5 million. So, it will be 5 into 10 to the power 6, now one thing we must remember that this exposure time is must be in year.

So, you have to calculate our 2 day in year. So, it will be 2 by 365 into our hazard that we have already calculated this one. So, 10 to the power minus 4, if you will calculate this will become 2.74 deaths. So, this is our final answer which has been asked.

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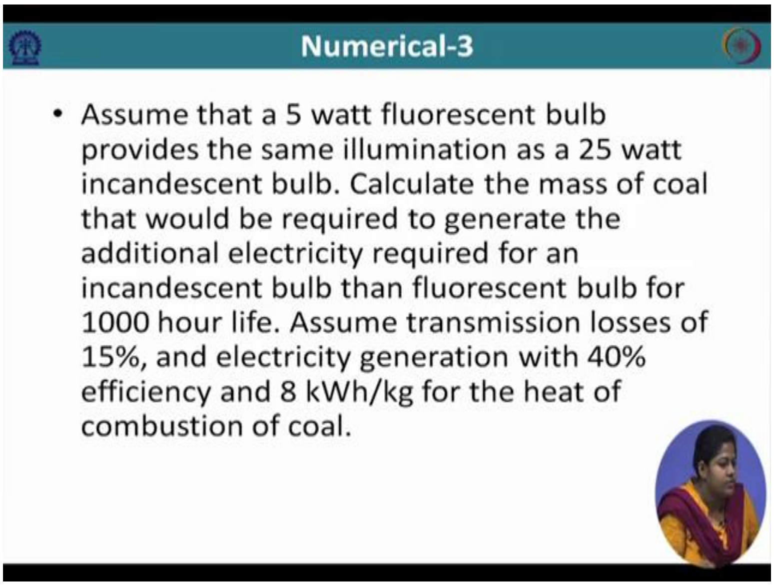

So, we will go to our third numerical problem. So, here it has been asked that a fluorescent bulb has been used and one incandescent bulb has been used. So, in case of fluorescent bulb if we are using incandescent bulb and if we are using it for 10,000 1,000 hour of light then how much additional electricity will be required if we are using incandescent bulb in place of instead of fluorescent bulb.

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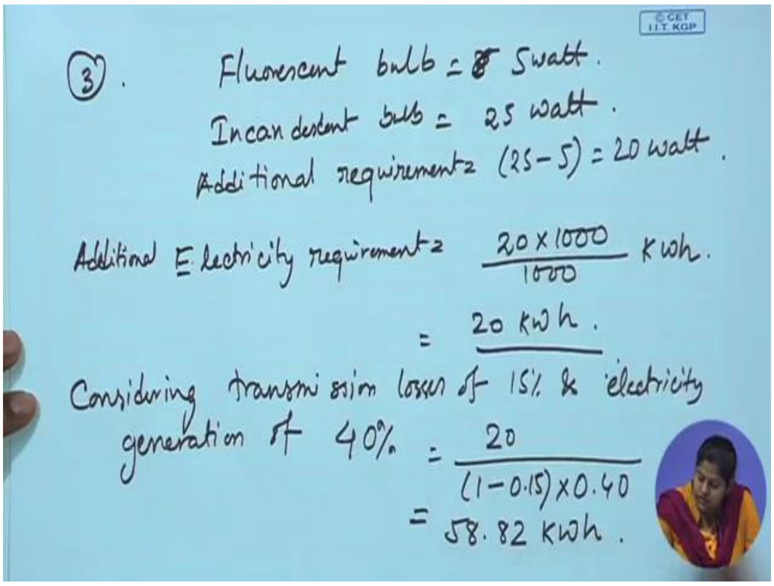

So, the fluorescent bulb it is 5 watt and for incandescent bulb this one is 25 watt. So, additional requirement is about 25 minus 5. So, this will be our 20 watt now what we have to do is we have to calculate our electricity requirement. So, our additional electricity requirement is our 20 watt for 1,000 hour divided by thousand because we want to convert it to kilo watt hour. So, it will become 20 kilo watt hour.

Now, it has been said in this problems that our transmission loses are 15 percent and our electricity generation efficiency is 40 percent. So, now, we have to consider our transmission less losses and electricity generation and we have to again calculate our additional electricity requirement. So, that will be must bigger than that what now we are calculating it is 20 kilo watt hour.

So, considering transmission losses of 15 percent and electricity generation of 40 percent, so this will become 20 divided by 1 minus 0.15 into 0.40. So, if you will calculate this it will be 58.82 kilo watt hour. Now in the second part of the question paper it has been said that how much amount of coal is required if the heat of combustion of coal is 8 kilo watt hour per kg.

So, now from this data we need to calculate the amount of coal which we require for amount for generating this much amount of electricity.

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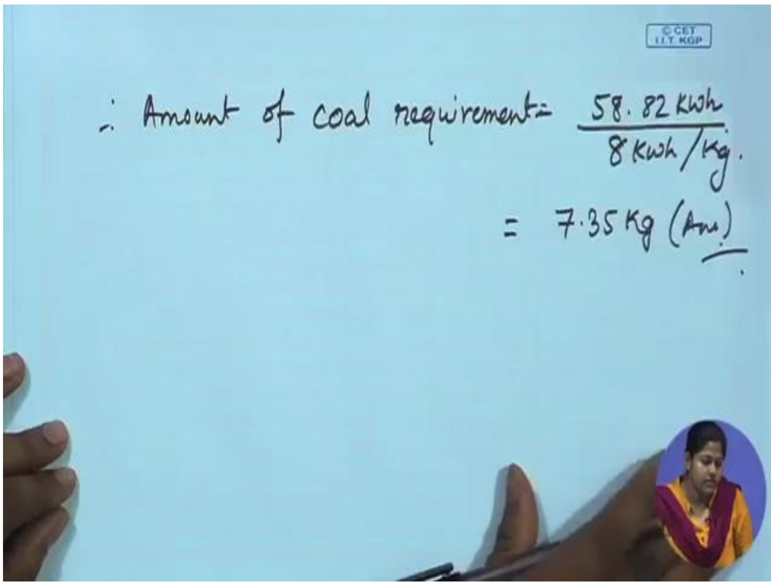

So, the amount of coal required 58.82 kilowatt hour divided by it has been that heat of combustion of coal is eight kilowatt hour per kg. So, our final coal requirement is 7.35 kg for generating 58.82 kilowatt hour of electricity.

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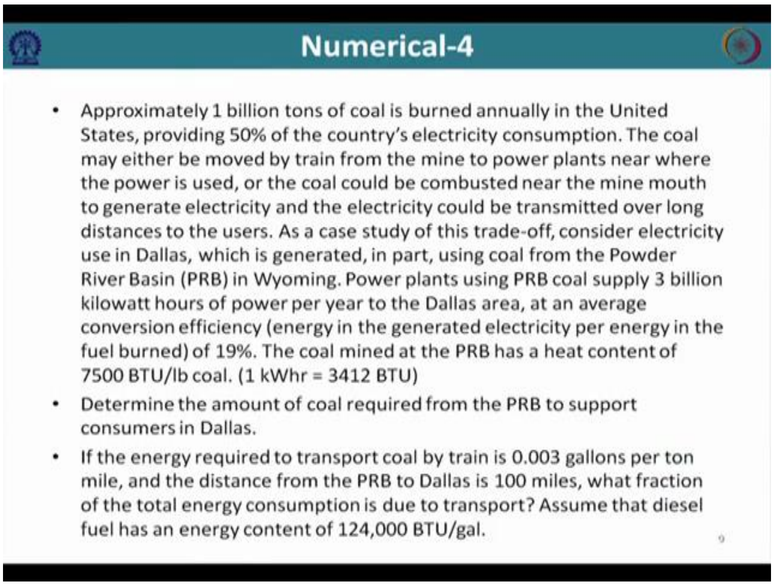

So, this is our final answer of our third numerical problem coming to our forth numerical problems this is a one kind of similar problem, but it is slightly deviated from the previous problems. So, here also in Dallas area it has been said that and Dallas area coal supply is from prb. So, we have to calculate again the coal requirement to support the consumers in Dallas. So, what is the requirement of Dallas?

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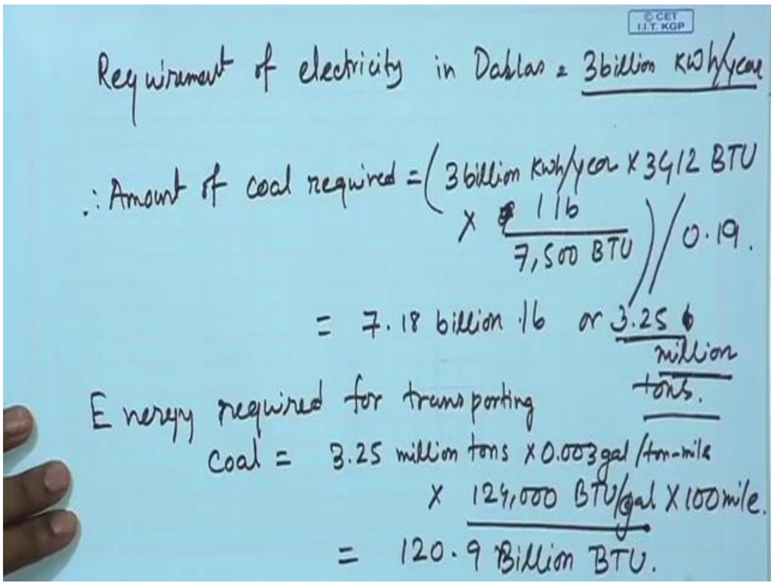

So, requirement of electricity in Dallas area is 3 billion kilowatt hour per year. So, we have to calculate the amount of coal required for generating this much amount of electricity. So, the amount of coal required is 3 billion kilowatt hour we have to generate in one year time and it has been said that one kilowatt hour is equal to 3412 BTU. So, we will convert it into BTU which is (Refer Time: 11:39) thermal unit. So, multiplied by it has been also said that the heat content of the coal is 7,500 BTU per pound. So, it will be one pound by 7,500 BTU and it has also been said and it has been also said that the average conversion efficiencies 19 percent. So, you have to also incorporate this. So, you will divide this whole by point one nine. So, it will become if you will calculate this it will come 7.18 billion ton billion sorry; billion pound or 3.25 million tons.

Now, what we have to do in the second part of our problem it has been said that if the energy required to transport this coal by 10 is 0.0003 gallons per ton mile and the distance is 100 mile then what fraction of the total energy consumption is due to transport. So, now, we are transporting out coal by chain. So, how much energy will be required for in this transporting portion. So, energy required for transporting coal will be 3.25 million ton because we need this much amount of coal you have to transport and 0.003 gallon per ton mile is our energy required for transporting the coal.

So, you have to multiplied this by 124,000 BTU per gallon because this is the energy requirement. So, assume that diesel fuel has an energy content of this much. So, this is the energy content of diesel fuel multiplied by or mile. So, if you will calculate this you will get 120.9 billion BTU, now what has been said that. So, requirement is electricity is 3 billion kilowatt hour per year. So, amount of coal required we have calculated and energy required for transporting the coal is 120.9 billion BTU.

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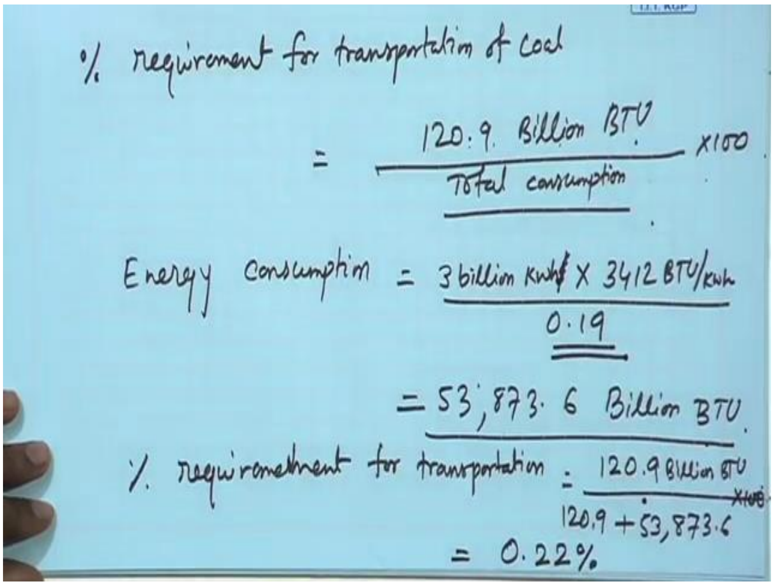

Now, what percent of this transport for this transportation what percent of energy requirement is a total out of the total energy consumption what is required for this transportation. So, percentage requirement for transportation of coal will be 120.9 billion ton BTU divided by our total consumption into 100. So, for our total consumption we need to calculate our energy consumption for generating electricity.

So, energy consumption will be in the first case; so it 3 billion kilowatt hour into 3412 BTU per kilowatt hour divided by 0.19 which is our energy conversion efficiency. So, these will if we will calculate you will get 53,873.6 billion BTU now if we are getting this we have this and we have 120.9 billion BTU for transportation of coal. So, we can calculate the percentage requirement for transportation. So, this will be our 120.9 billion BTU divided by 120.9 plus this 16 billion BTU which will be into 100. So, this will be 0.22 percentage.

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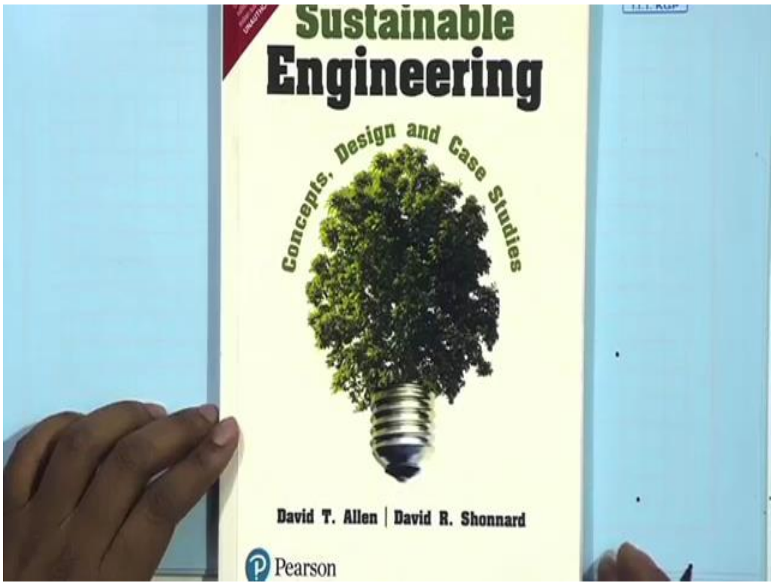

So to see, I am suggesting you this book you can you can solve the exercises your examination the book name is sustainable engineering which it is written by David T Allen and David R Shonnard. So, all the best for your future examination and;

Thank you.