Course Name: Architectural Approaches to Decarbonization of Buildings

Professor: Dr. Iyer Vijayalaxmi Kasinath

Department of Architecture,

School of Planning and Architecture, Vijayawada

Week: 02

Lecture 01

India's approach to long term low Low Carbon Development- Part 1

In this class, we have seen what are the initiatives or what are the commitments that India have given towards going carbon neutral. We will continue to discuss this in the forthcoming class too. Hello all. In our last class, we saw what had India committed itself in front of the world. In terms of being carbon neutral, going carbon neutral and India said we will go net zero by 2070. We also saw the strategies that India has to adopt if it has to go carbon neutral by 2070.

In this class, we will look at India's approach to long term low carbon development. So, in the last class, we saw India stand on carbon neutrality, the kind of commitment India has made to the world and the efforts that India has to put and India has to put to meet the commitments and also our role as architects and designers in having to fulfill the commitment. We move on to the next part of India's stand on carbon neutrality. Now, India's long term carbon development system, India's long term low carbon development system, it rests on seven key transitions to low carbon development pathways.

These transitions to low carbon development pathways have already been initiated through various significant and specific policies, programs and initiatives. Low carbon development of electricity system includes the promotion of hydropower and agricultural solar pumps, introducing supportive policies such as net metering and energy banking, enabling bundling of thermal and hydropower policies to support biomass use for power generation, green hydrogen mission, to incentivize green hydrogen production, expanding renewables and strengthening the grid, rational utilization of fossil fuel resources. So, India has already started taking a stance in each of these areas. Now if you see the per capita electricity consumption kilowatt hour per person which we have been talking in the last three four slides that per capita electricity consumption in India is extremely low as compared to most part of parts of the world. though in absolute terms yes the consumption is high and therefore the ghe is also high here if you see here if you see per capita consumption is in kilowatt hours only 1174 for india and if you actually see for the developed countries sorry If you look at developed countries for the United States it is

13,405 per capita electricity consumption per person is 13,405 and for Australia it is 10,550 which is If you look at the average of Australia and United States, that's 10 times higher than that of India.

And if you look at France, it's 8,642. The Russian Federation, the per capita electricity consumption is 7,665. Germany consumes 7,297 kilowatt hour per person. The European Union comprising of 27 countries with all their energy efficiency measures in place yet consume 6502 kilowatt hour per person. China consumes 5233 kilowatt hours per person.

Portugal consumes 5198 kilowatt hours per person and South Africa consumes 4,313 kilowatt hours per person in comparison to India which consumes only 1,174 kilowatt hour per person. What does this indicate? It is not just a number which indicates that the per capita electricity consumption of many other countries are much higher than India. It also shows that it is so difficult to reduce something which is already low. How do you reduce something which is already low? And that is the kind of challenge we have. And the challenge that we have is in combination to the fact that We cannot push our people into further poverty.

This cannot be at the price of the poverty of a layman. What I mean to say is for every person who drives a car we cannot make 50 people ride a bullock cart. the equity will be lost. So to maintain equity, to develop as a country and yet to even maintain or rather reduce the per capita electricity consumption is the challenge that we have. And as we already saw, how do we do that? What are the strategic low emissions development transitions? So low carbon development of electricity systems is one a very important component and how do we do that by expanding renewables and strengthening the grid exploring other low carbon technologies that is where you and i have a major role to play focusing on demand side measures rational utilization of fossil fuel resources with due regard to energy security because this is also linked in a way to the first one where we are looking at having renewables.

renewable energy systems, assessing enablers for low carbon development and determining green taxonomy and optimum energy mix. So, these are the ways in which we can try to achieve our first strategy which is low carbon development of electricity system. The second strategy is to develop an integrated, efficient, inclusive, low carbon transport system. We already saw in our previous slides that transportation sector or energy consumption for transportation is having a major chunk in GHG emissions. Now, transport is a major contributor to GDP directly and indirectly.

Low carbon options are to be assessed in the context of significant expansion needed across transportation modes for passenger and freight mobility. Developing an integrated,

efficient, inclusive, low-carbon transport system includes achieving improved fuel efficiency, use of cleaner fuels, initiatives to reduce mode shift, So, I will come, there are many more, but let us look at each one a little more in elaborate. Improved fuel efficiency, we need technology for this. Use of cleaner fuels, yes, we need to shift from petroleum-based to cleaner energy-based fuels. Initiatives to induce mode shift, so instead of having too many four-wheelers on the road, in a very layman language, we must shift to public transport.

So public transport is the way ahead, though it is a well-known fact that normally no government in the world is able to break even in terms of economics by trying to get into mass public transport or mass transit systems. Yet every government is trying to push this because that shows their commitment towards having to reduce carbon. So, initiatives to induce mode shift, then increase adoption of electric vehicles. Very, very important. I think this is also happening.

There are certain places also where they have clearly said- certain states have clearly said that they are going to phase out petroleum-based vehicles or they are going to get the fuel must be electric vehicles is the way out. Vehicle scrappage policies like mandatory scrapping of old and unfit polluting vehicles and electrification. So, this also certain states are trying to bring in scrapping of old and unfit vehicles because they pollute a lot. how do you develop an integrated efficient and inclusive low carbon transport system by trying to implement as much as possible using fuel efficiency through policies and programs trying to shift to cleaner fuels then try to push public transport instead of say four-wheeler or two-wheeler and that also adds a lot of burden on the roads electrification across multiple modes increased adoption of electric vehicles improved fuel efficiency and expanding availability and access of public transport this is also very very important that I think that is also a big difference between developed and developing countries and I think India is moving very close to this access to public transport to all and availability also to all. What with some of the governments even subsidizing public transport for certain sections of people.

So if you look at the total number of registered motor vehicles, you can see the exponential growth in the number of vehicles. two wheelers, cars, jeeps, taxis, buses not so much, goods vehicle yes in plenty and others. If you look at this, this clearly shows that we need to shift to mass transit system and the current situation is not a sustainable one. The next strategy is promoting adaptation in urban design, energy and material efficiency in buildings and sustainable urbanization. Now, exploring and encouraging adaptation measures in urban design will be critical in the context of developing urban areas.

And we know that urbanization is something which is not stoppable and definitely India is getting more urbanized. There is humongous migration and therefore this becomes very important under this context. This will be a major focus alongside measures to promote sustainable urban design in the context of expanding cities. Enhancing energy and resource efficiency within urban planning guidelines. So, urban planning guidelines must plug-in energy and resource efficiency policies and bylaws.

Promoting climate-responsive and resilient-building design construction and operation in existing and future buildings, which means that new buildings must become climate-responsive and resilient and buildings which are old must be retrofitted to ensure that they become more energy efficient. Promoting low carbon municipal service delivery through resource efficiency and management of water, solid waste and liquid waste is another very important thing. So, if we are able to focus on urban areas and bring in small changes, it is going to multiply and have a dominoes and cumulative effect overall. I am not saying we need to neglect rural areas because that is not the right way for a country to develop. But the population is so concentrated in urban areas that there has to be specific strategies.

And I think the strategies are in the right place with the third point promoting climate-responsive and resilient building design, construction and operation in existing and future buildings. being completely the hundred percent it is the prerogative of architects designers civil engineers and also awareness of clients let's look at the next strategy to promote economy-wide decoupling of growth from emissions and development of an efficient, innovative, low-emission industrial system. What we need to do is industrial growth. It's a major objective in the near, medium, and long term with policies directed at increasing the share of manufacturing in the GDP. This includes energy efficiency, material efficiency, and recycling.

green hydrogen technology and infrastructure, low carbon technologies for hard to abate sectors, sustainable development of MSMEs, micro, small and medium enterprises. If we can bring all this together and promote economy-wide decoupling of growth from emissions and development, Through energy efficiency or material efficiency like material efficiency and recycling, promoting green hydrogen technology, low carbon technologies and sustainable development of MSCMEs, then the industrial system will be well taken care of. But there is a lot of technology involved, technology transfers and a lot of mindset involved in getting these done. We move on to the next strategy which is carbon dioxide removal and related engineering solutions. In the long term pilot projects may be taken up for coal based methane carbon capture utilization and storage.

This is called CCUS. Carbon Capture Utilization and Storage, coal-based methane,

carbon capture utilization and storage and promotion of technology development for coal to gas and coal to liquid with international finance, technology transfer and collaboration. So, certain areas we can fall back on the wisdom of vernacular India. For certain systems, we need to look up to the technological knowledge. So, we need the information, we need this transfer of technology and this is one such thing. A detailed analysis of costs and probable expenditure for scaling up CCUS will need to be conducted.

The economic and political feasibility of CCUS is highly uncertain. We never know which country will be willing to transfer its technology to us. The emphasis in this field is on R&D and building human and infrastructure capacity to evolve technologies and methodologies that address issues related to high capital costs, safety, logistics and high auxiliary power consumption. The CCUS technology at present is not matured and India can take up only demonstration projects at this stage to assess the viability of the proposed solutions. Retrofitting of existing thermal power generation units of CCUS implementation is not a viable option until the technology is cost effective and less energy intensive.

India requires considerable climate finance and technology transfer with effective international collaboration to enter this arena. If successful and if economic technology and political barriers are overcome, the global CCUS, Carbon Capture Utilization and Storage Program Industry could possibly become a source of growth in the near new long emissions economy. So, the key to CO2 removal and related energy solution is knowledge, new technology, sharing of knowledge and technology transfer. This is the way out and I think it's a good atmosphere now because a lot of promotion of innovation, lot of emphasis on innovation and is given here. Let's look at the enhancement of forest and vegetative cover consistent with socio-economic and ecological consideration.

Now, why is this important? This becomes important because we have been talking of carbon sequestration, we have been talking of a need to have more forest, we need to have carbon sinks and this is the way out. So India has the 10th largest forest area in the world. and constitutes approximately 2% of the world's forest cover occupying nearly 10% of the geographical area of the country. Trees outside forests are also significant natural renewable sources and they make a vital contribution to the agroecology and socio-economic circumstances to not only rural areas but also residential areas in urban places and environmental amelioration of the urban areas. We should also consider the cultural impact these trees have on residential areas.

The impacts of climate change on the forestry sector can be attributed to a series of cumulative factors such as loss of habitat due to global temperature increase and changing rainfall patterns which may lead to prolonged droughts. Such conditions enable

with lower resilience which may have been endemic to the region. Hence, forest cover, density and biodiversity are affected, which in turn also affects the ecosystem services accessed by the local people and the industries based on forest products. So, what happens is you need to consider two types of greenery. One is the actual forest and another is the non-forest areas in rural areas and some in urban areas also.

And all of these add together. What I mean to say is there is no point in having an afforestation. which is outside of a human settlement because forestation is not something to do only with climate change and using it as a heat sinks. But it has socio-political and in the Indian context a very strong cultural context also. So what is it that we need to do? We need to have policies and programs in place. We need to have elements of a long term low carbon development strategy.

We need to bring in restoration, conservation and management of forest cover including mangrove forests. We need to bring in restoration, conservation and management of trees outside forests and green cover. There is a huge impact of this. I can give you an example. If you look at Coastal areas or areas along water bodies, mangroves protect the people from the water tide which could come up the water levels which could rise.

Now what happened is, the ecosystem is very strong. If we are not going to protect the inhabitants from the climate change and climate change one aspect of dissipating it or reducing it is through afforestation in the form of being heat sinks for GHG. We are going to have humongous number of climate change refugees. Who is going to cater to the climate change refugees? No country is in a position to adopt innumerable number of migrants as climate change refugees- not to speak of the psychological impact the refugees would have.

And all of us have a key role. Most important being, most of the countries which face the risk or damage risk due to climate change are all very small developing countries and they end up falling back on larger countries or stronger countries. And hence, every aspect of what would lead to carbon neutrality has to be dealt with in a very strong manner. If you look at the projected impact of climate change on different forest types and regions of India, you can see that there are a number of grids which are under change. So you can see that most of these are tropical forest areas. Tropical deciduous forests are the ones which occupy the largest amount on the map whereas plantations are very few in number except probably in Kerala- somewhere in Kerala and also somewhere in the NorthEast.

So, there are the grids of change have been increasing in number over the years. The next strategic low emission development transition strategy is the economic and financial

aspects of low carbon development. When we have our priorities of poverty eradication, increasing employment opportunities, having to better the income of people, increasing resilience to climate change and reaching to a new level of prosperity, low cost international climate finance is essential to achieve the objectives of low carbon development. A transition to a low carbon development pathway will entail costs pertaining to the deployment of new technologies. How do we procure the new technology? That is one.

And then how do we deploy the new technology? Development of new infrastructure and other transaction costs. Meeting finance needs require mobilizing and scaling up financial resources internationally. We also have to mobilize domestic finance along with international finance. International sources include multilateral and bilateral sources, dedicated climate funds, international institutional investors and the private sector. There needs to be a significant enhancement in the scale, scope and speed of climate finance from public sources to enable ambitious climate action in developing countries.

Now these days there are certain international financing corporations who are very clear about having to become carbon neutral and the way they finance at subsidized rates to activities which will aim at carbon neutrality that is already the economic environment of the country. What needs to be done in various domains? Assessment of financial requirements in various domains. What are our low carbon development needs? Which sectors need? Which has already been identified numerically. Adaptation and resilience. And who is going to finance this? Because for every finance, we need to produce an output.

So, what would the finance be? What would be the output? International public and private finance sources, domestic public finance sources, you need to mainstream resource for climate action, monetary policy in the financial sector and linkages to international trade. Probably combined with knowledge transfer from the source so if all these are taken care then to a larger extent the economic and financial aspects of carbon development will be met so we have seen in this class about seven strategies for low emission development transition Some of these are directly related to architecture, building construction, design, civil engineering fraternity while some are indirectly connected. We need to translate each of these strategies and give it an architectural and a construction dimension if possible to ensure that we as a fraternity do our complete 100% to support the nation's commitment to go net zero by 2070. We will deal more on this topic in the forthcoming lecture.