Course Name: Architectural Approaches to Decarbonization of Buildings

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Lecture 03

Impact of reducing Operational Energy and Operational Carbon

Hello everybody. In our last class we saw India's initiative in trying to reduce embodied carbon. We also saw a very small case study just to demonstrate that application of measures which is being prescribed can actually lead to good results. Today we will look at the concept of carbon offsetting in building operations. Now, where a building cannot generate all of its own energy and draws energy from the grid, electrical grid, then some form of carbon offsetting would be required to allow the building to be verified as a net zero carbon. Likewise, achieving a net zero carbon construction would currently require carbon offsetting to negate the embodied carbon emissions associated with constructing the building for a project to be verified as a net zero carbon in construction.

Carbon offsetting within building operations plays a crucial role in mitigating the carbon footprint of construction and operational activities. With the global imperative to release approximately 300 GT carbon dioxide between 2020 and 2050, to achieve the net zero goal and secure a 83% chance of meeting 1.5 degree scenario, offsetting becomes a critical strategy. To minimize the reliance on offsets, the primary focus should be on sustainable construction and operation.

This entails a concerted effort to diminish energy demand, transition away from fossil fuels and swiftly adopt 100% renewable energy sources. However, for unavoidable emissions, investing in credible carbon reduction or storage projects is vital. These projects must undergo rigorous independent verification to ensure their credibility, uniqueness, additionality and permanence. Moreover, directing resources towards offsets that not only sequester carbon but also offer tangible environmental or social benefits is essential. Prioritizing offsets with additional nature-based no carbon co-benefits or alignment with SDGs sustainable development goals amplifies the positive impact contributing to a more sustainable and carbon neutral future for building operations.

If carbon offsetting is not the answer, then what role does it play and what are the alternatives? A new building should aim to reduce its energy consumption as far as

possible and install heating equipment which does not burn hydrocarbon fuels like gas or oils. The lower its energy consumption, the more likely it is that enough energy could be generated on site from renewable energy to meet its demands. This should also be the aim for retrofit work to existing buildings. Where a building cannot generate all its own energy and draws energy from the gas or electrical grids, then some form of carbon offsetting would be required to allow the building to be verified as net zero carbon. Likewise, achieving a net zero carbon construction would currently require carbon offsetting to negate the embodied carbon emissions associated with the preoccupancy or associated with constructing the building for a project to be verified as a net zero carbon in construction.

So, The advanced tangible benefits would be direct funds towards offset that not only store carbon but also provide tangible environmental and social benefits. Now let us look at the impact of reducing operational energy and operational carbon. Reducing operational carbon within buildings yields a spectrum of impactful outcomes. Primarily, it significantly cuts down greenhouse gas emissions, aiding global climate efforts and fostering a more sustainable environment. This reduction translates into substantial energy savings and cost effectiveness not only minimizing operational expenses but also enhances the building's value in the market.

Additionally, the environmental benefits extend beyond emission reduction, encompassing resource conservation and a bolstered reduction to climate change. and also climate change induced risks. So, the climate change and its induced risks both has to be tackled. Improved indoor air quality within these sustainable spaces ensures healthier and more productive environment for occupants. Encouraging behavioral changes towards sustainable practices further amplifies these positive impacts.

Fostering community engagement and social cohesion. Compliance with stringent regulations regarding carbon emissions not only ensures no legality but also cultivates a positive reputation as an environmentally responsible entity. Ultimately, this multifaceted approach not only promotes sustainable practices but also creates resilient, valuable and environmentally conscious built environment. If we look at the benefits of reducing operational energy and carbon, The first and the most important benefit is the reduction in greenhouse gas emissions. This translates into reduction in climate change impacts.

due to reduced global warming energy savings happened due to reduced use of electricity and use of energy efficient fixtures. Cost savings happen due to reduced use of electricity. The environmental benefits match with the reduced GHG emissions which is primarily reduced global warming. You have improved indoor air quality because the buildings are better ventilated. because the air conditioning use becomes reduced due to

reduced air conditioning usage.

Encouraging behavioral shift is very important. Behavioral shift in the form of say no switching of contraptions when not in use then switching to a more nature based nature based approach by reducing the use of air conditioners Resource conservation less the materials used which is also linked to the environmental benefit. Then there is resilience to climate change due to reduced GHG emissions. and building value and regulatory compliance is in place which is a brownie point to your property. It adds brownie points to the property.

Now, we move on to Operational energy in net zero energy buildings. We will quickly have a glimpse of it before we move on to a very major topic. So, operational energy in zero energy buildings is a critical focus striving to reduce energy consumption to the lowest possible level and supplementing any remaining demand with renewable energy sources. A study in 2016 highlights the varying share of embodied energy across different building types, showcasing that zero energy buildings tend to heavily prioritize minimizing operational energy. Zero energy buildings achieve this through advanced efficiency measures like smart design, high-tech controls and superior insulation, significantly reducing the energy required for day-to-day operations.

These buildings actively harness renewable sources such as solar or wind power to generate the energy needed for their operation, aiming to either balance their energy consumption or produce a surplus. Additionally, zero energy buildings promote smart user habits and passive design strategies, leveraging natural light and ventilation to further curtail energy needs. This study's findings illustrate that in zero energy buildings, operational energy is minimized to such an extent that renewable source covers a substantial or complete share of the building's energy demand, distinguishing them from other building types with significantly higher reliance on non-renewable sources. So, Here is a comparison of what we mean by a conventional building, a passive building, a low energy building and a net zero building. What happens in a conventional building is the embodied energy percentage, here we are talking only of percentage and we are not talking about the actual quantum only percentage indicated and not the absolute values.

Here you can see in a conventional building that the larger part of the building's energy consumption goes to the operational energy. In a passive building approximately say 90 to 70 percent is no operational energy. Low energy building consumes anywhere between 50 to 60 to 50 percent of its operational energy whereas a net zero building consumes only 25% to can we say 1% 0 seems to be too aspirational so I will write 1% as a net zero building and now We will look at the challenges to achieve low operational energy and carbon. There are social challenges because reducing operational energy and carbon

emission, it encounters a multitude of challenges cutting across social, economic, environmental and institutional domains. Social hurdles include fostering public acceptance and engagement, enhancing awareness and addressing resistance to change while ensuring equitable access and behavioural shift towards energy efficiency.

Economic challenges involve securing finances, balancing cost effectiveness, tackling energy poverty, promoting job creation and stimulating market demand. Environmental obstacles encompass resource sustainability, land use management, water scarcity, waste and climate change impacts. Institutional complexities arise from the need for innovative policies, resolving conflicts, ensuring policy coherence and establishing technical standards conducive to energy efficiency. Overcoming these challenges demands comprehensive strategies that integrate social engagement, economic viability, environmental stewardship and institutional coherence to drive effective energy and carbon reduction initiatives. you can see that there are a number of social challenges to achieve low operational energy and carbon.

Public acceptance and engagement is important. To make the public accept The strategies that would lead to low operational energy is a big challenge and therefore you need to engage the public in this activity. This can happen through public awareness and education because there is always a resistance to change. Equity and social justice is important because this awareness or the rules or the suggestion or the regulation must not be only for any one particular community or people. It must be uniform and universal with respect to the context.

It can change. There has to be a general behavioral change in public which can come about after some awareness is created on the implications of their behavior. Then, the environmental challenges. The resource availability and sustainability. Whether we have enough resource to push a particular scheme must be considered. one question land use and biodiversity yes their conservation is a very important challenge water scarcity and quality either it is a problem of extremes Either there is heavy flooding or there is extreme droughts.

We are also experiencing the impact of climate change and therefore water quality and scarcity is another important environmental challenge we have. Waste management and pollution. So we have to look at strategies for waste management and we have to curtail the pollutants from either seeping into the soil or water or air. Climate change impacts. The institutional challenges are we need to have more innovation policies.

As of now that is not happening but we need to have more innovation policies. Conflicts and reformations must be there. Policy coherence and coordination in the form of having

to the policies must be coherent and there must be coordination between various bodies to implement these policies. Technical standards and regulations must be in place. We also have economic challenges.

One is we need to have good financing and investment because some of the techniques that we need to adapt can be expensive. For example, solar. So, the technology is little expensive and we need some kind of financing, incentivization and someone willing to invest. Cost competitiveness must be there for this to reach the public. Energy poverty must be emphasized on because that is also a reality.

Job creation and economic development and market demand. So, these are the most important challenges to achieve a low operational energy and carbon environment. I will stop my class with this. And we will resume our class with yet another continuation of this topic. And here what we have done or what we have studied is related more to the alternatives and initiatives that we need to take to achieve a low operational energy and low carbon scenario. Thank you.