

Flagship Seminar Series

Towards a Strategy for India's Decarbonisation

Centre for Social and Economic Progress (CSEP)

New Delhi

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Chair:

Rakesh Mohan – President & Distinguished Fellow, CSEP

Presenters:

Montek Singh Ahluwalia – Distinguished Fellow, CSEP & Utkarsh Patel, Associate Fellow, CSEP

Discussants:

Lord Nicholas Stern – IG Patel Professor of Economics and Government and Chair of the Grantham Research Institute of Climate Change and Environment at London School of Economics

Amitabh Kant – CEO, NITI Aayog

Indu Shekhar Chaturvedi – Secretary, Ministry of New and Renewable Energy, Government of India

Mohua Mukherjee – Former World Bank Head of India Solar Programme

Moderator:

Laveesh Bhandari – Senior Fellow, CSEP

Special Participants:

Jamshyd Godrej – Managing Director, Godrej & Boyce

Ajay Mathur – Director General, International Solar Alliance

Arunabha Ghosh – CEO, Council on Energy, Environment and Water

Ulka Kelkar – Director, Climate Program, World Resources Institute, India

Rahul Tongia – Senior Fellow, CSEP

Agenda:

6.00-6.05 PM: Welcome and opening remarks by Rakesh Mohan

6.05-6.35 PM: Presentation by Montek Ahluwalia and Utkarsh Patel

6:35-7.00 PM: Remarks by Discussants

7-00-7.25 PM: Panel Discussion

7:25-7.30 PM: Concluding remarks by Mr. Ahluwalia and Vote of Thanks

Watch the event video here:

<https://www.youtube.com/watch?v=m0h8lqNOG3o&t=4875s>

The following is an edited and revised transcript from the event. It has been generated by human transcribers and may contain errors. Please check the corresponding video for the original version.

PROCEEDINGS

Rakesh Mohan: I'm Rakesh Mohan, President and Distinguished Fellow of the Centre for Social Economic Progress, formerly Brookings, India. We are about to reach our first anniversary in about a month. So, let me welcome everyone to this ninth Flagship Seminar of CSEP on Trends Towards a Strategy for India's Decarbonisation. We are very grateful to Mr. Montek Singh Ahluwalia for agreeing to do this and the great hard work that he has put into this particular issue. I just want to welcome, of course, all the very distinguished panellists that we have in this webinar, and discussants. And of course, the whole audience across the world. All I will do is to introduce the moderator, that is Dr. Laveesh Bhandari, who's currently a senior fellow at CSEP. His Wikipedia, among other things, describes him as an environmental evangelist. So, I thought that he would be the best person to moderate this session on decarbonisation. He was also founder of India Indicus Analytics, and director of Integrals Foundation. And prior to that, I had the privilege of working with him in the National Council of Economic Research. So, over to you, Laveesh.

Laveesh Bhandari: Thank you, Dr. Mohan. I got everything, but the last part of it. So, thank you. Welcome. And we have quite a rough day ahead, I think, because it's not just the fact that we have a scintillating set of panellists, but also, we have a presentation, which is fairly partner-working. So, I will lay out how the next one-and-a-half hour are going to go now. Right after me, I'll ask Mr. Ahluwalia to make his presentation. After that, we'll have a set of expert comments, which will go on for about half an hour by Mr. Amitabh Kant, Mr. Chaturvedi, Miss Mohua Mukherjee and Professor Stern. After that, we'll have another session of the panel discussion with Dr. Ajay Mathur, Dr. Arunabha Ghosh, Mr. Jamshyd Godrej, Miss. Ulka Kelkar, and Dr. Rahul Tongia. If we find the time, we'll also take a few questions from the audience. And after that, I'll hand it back over to you, Dr. Mohan. So, without further ado, I'd like to ask Mr. Ahluwalia, our distinguished panellist and former deputy chairman of the Planning Commission to make his presentation.

Montek Singh Ahluwalia: Thank you very much, Rakesh and Laveesh for giving me and my co-author, Utkarsh Patel this opportunity to make a presentation on the subject. I also want to thank the very distinguished panellists and discussants who are giving their valuable time to add to the quality of our understanding of this complex issue. Now, I've been given a very tight deadline. I mean, I and Utkarsh have been told that we cannot spend more than 30 minutes on something in the order of 24 slides. So, introductory remarks have to be kept to a minimum. But I think I just want to make two introductory remarks. The first is that we are not presenting the results of original research. So, you know, it's not as if we have a new model, and we're going to outline its assumption and so on. We're actually reviewing a large number of models that actually exist. And that gives a sense that a lot of what we are saying, has a basis, not just in our work, but in other independent work being done in India. The second point that I want to make is that, the end result of all this for us, has been to come to the conclusion that India needs to change its traditional approach to climate change negotiations.

Historically, we have resisted any acceptance of a commitment to reduce emissions, for very good reasons. And I think technology has now changed, and it makes it possible to pursue a development objective and to increase energy use – I mean, that's crucial, but not necessarily to be generating emission. So, the whole analysis is putting together of what evidence we have on whether this is possible. But at the same time, it also tries to highlight the fact that while a great deal is possible, it involves very profound structural change over the next 30 years. So, in order to get it done, we need to anticipate those changes and be ready for them. So, with those very brief words, let's go on to the presentation.

So, Utkarsh, can you put on the slides? Okay, yeah. Okay, the presentation is in five parts. We begin by simply presenting a very simplified picture of the current state of global warming. We then address the question that, is the reduction of emissions, does it conflict with the development objective? We then go on to the third part, which is what is the evidence on how much emissions reduction could India hope for and on what timeframe? We then look at the issue of the problems in transiting to renewable energy, again, over the next couple of decades. And finally, we end up with what we think might be an appropriate strategy for CoP 26 in November. Now, it's very clear that the world is not on track to meet the Paris target, limiting global warming to 1.5°C, ideally, and current policies suggests that we might end up with more than three degrees warming by the end of the century. We also know that this will be disastrous, and that India will be among the countries most affected. So clearly, it's something that should concern us. We also know that the IPCC has estimated that to achieve the 1.5°C target.

The world as a whole, must reach net zero in terms of CO2 emissions by 2050. CoP 26, will undoubtedly focus on the need to ratchet up the emissions reduction commitments, because there is a view sometimes expressed that this is not the time to do it. And indeed, earlier, there was some agreement that this reviewing would be done in 2023. But in the most recent G20, Hensel government level, which included our own Prime Minister, the G20 agreed that in CoP 26, we will look at the ratcheting up of emission. So, we're kind of committed to that, and therefore, we should be ready for it. And the factual position is that, several countries, the US, EU, Japan, Korea, and also developing countries, have adopted or proposed reaching net zero by 2050, China's aiming at 2060, and the US and EU have also announced near-term targets, that's actually in a way more important than longer term; cutting emissions to half by 2030. So now, let's look at what we think India's position should be. You know, traditionally, we have taken the position that our per-capita energy use, is a third of the global average. And we have a lot of development to do; our income levels are low; you can't have development without increased energy. And therefore, we have argued that we have to be allowed room to increase our emissions. And the targets for reducing emissions should be applied only to developed countries.

Now, there's a lot of logic in that, but we also have to recognize two things – One is that as the fourth largest emitter, we will undoubtedly be under pressure to accept some trajectory of emission reduction. And the other is that technological developments now make it possible to switch to a renewable energy to meet the energy needs of development, which means that you can actually upload more energy and at the same time, reduce emissions. So, in this

presentation, we're going to look at what is the scope for pursuing this approach. You know, any emissions reduction strategy requires in our view, action on three fronts. One is of course, raising energy efficiency, which will reduce the total energy requirements or GDP. This will help reduce emissions to some extent, lower than they would otherwise be, but it cannot eliminate. But switching from fossil fuels to electricity wherever possible, combined with generating electricity from renewable sources, this will actually make a big difference. I mean, electrification alone, wouldn't help.

I mean, it will produce a lot of local clean energy, low particulate emission, etc. But if the energy is produced by fossil fuels, it doesn't alter the overall emissions load. And if you can combine electrification with switching to renewable electricity sources, that could actually reduce emissions. And of course, the third element, which probably has to be important over the longer run, is removing emissions from the atmosphere, so that any gross level of emissions become consistent with a lower level of net emissions. And this can take care of those unavoidable uses of fossil fuel where electrification is not possible. Now, what we've done is, we looked at several studies, there may be more, but these four studies, I think, give you a sense. There's a TERI/Shell study of 2021, which looks at the energy sector only. And it concludes that it is possible but highly challenging for the energy sector to become net zero by 2050. That's not the economy as a whole, but energy. The IEA 2021, has done a study which shows that with a GDP growth of around 5.4%, plus a combination of efficiency, and a shift to RE, we can end up with net zero by around 2065 for the economy as a whole. There's a BP study which models growth at about 6% and predicts net zero, or projects net zero by 2070, as reasonable.

And there is a study by CEEW, by Chaturvedi and Maylan which is currently under review, which actually presents alternative scenarios on different assumptions, each of which on their own assumptions, are technically feasible. The interesting one is that it assumes GDP growth at 6.2% between 2020 and 2050, slowing down thereafter. And one of the simulations deals with emissions peaking by 2040 and then, reaching net zero by 2070. So, these are the wide range of studies, which give you a sense of where India could be getting. Now, the next few slides, give you a bit of detailed discussion of CEEW, and I'm going to ask my co-author, Utkarsh to take you through that slide. Utkarsh, can you take over?

Utkarsh Patel: Yeah, thank you sir. So, each scenario in the CEEW study is broken down into further cases, each having cases with and without the availability of hydrogen and CCS technologies. The table shows the share of fossil fuels in primary energy fall is expected from 85% at present, to about 20% in 2070. And further down to 6% in the no CCS scenario. Biofuels are expected to meet some of the demand especially for transport, electricity generation, again, is expected with high electrification, is supposed to increase tenfold by 2070, which would be dominated mostly by solar power plants. Share of nuclear doubles to 10% by 2070, and higher to 12% in the no CCS scenario, but as nuclear would be only the zero-carbon baseload power plant technology available in that case. Back to you, sir.

Montek Singh Ahluwalia: Thank you. Okay, let's move to the next slide. Now, you know, one of the key elements in this strategy is a massive electrification of the system. And so, we thought we'd look at what the available evidence is on the scope for electrification in India.

And as you can see, transport, passenger vehicles and light duty road vehicles and all railways, can be electrified and this actually, in the case of passenger vehicles, that has just begun, railway is quite heavily electrified already. Long-distance freight and passenger transport by road, heavy transport earth moving equipment, ships and airplanes, these cannot be electrified at present with available technology. Maybe hydrogen has a promising use here. I think we have to remember that we are looking at what's possible over the next 20, 30 years, and it's quite possible that these things will move in that direction. But right now, it's not possible. Fossil fuels are going to be hard to avoid wherever high temperature, heat and so on, is needed.

And also, where the fuel itself forms part of the production process. So, steel, cement fertilizers, these will be difficult areas to get rid of fossil fuels. Buildings, both residential and commercial, are already electrified. Cooking, we're currently moving from biomass and kerosene to LPG. So, electrification is really the next level. But I think in principle, if we are looking at 2050-type horizons, one can think if the supply situation is taken care of, that most of cooking could also become electrical. Agriculture, I think farmers could be incentivized to switch to solar-powered pumps, or actually use solar generated electricity delivered through the grid. But you know, our overall conclusion is that, while we can move away from direct use of fossil fuels to electricity, to a very large extent, some use of fossil fuels is likely to continue through 2050. And that kind of, limits the pace at which India could get to net zero by 2050. You know, one of the things that we need to look at is, what are going to be the consequences of transitioning to renewable energy on the scale needed?

Now, one obvious area is the problem of intermittency. This will pose a challenge for grid management, because grids require balancing of supply and demand. This can be done through various methods, but it raises costs and it affects competitiveness. It's very important to add the competitiveness element because, you know, technically, it may be possible to switch to renewable energy, or if that involves a cost that's too high, then at the ground level, there will be resistance to accepting those higher costs. That's one thing. Second, high levels of RE will, because of the nature of intermittency and other geographical characteristics, will require the development of effective electricity markets adapted to this structural change. The third area is the financial position of India's discounts, I will come to that. And finally, the many other problems of structural change associated with this transition. We're not mentioning these by the way to say that this makes it impossible, but just we need to realize that if we are talking about such a massive shift, we should at the back of our minds, be ready to plan for these changes.

And in all of this, the center, the states and the public sector entities belonging to each, have to work in tandem with each other. Let's just look at managing intermittency and what it does to the cost of RE. Now, you can manage intermittency by optimizing the solar/wind ratio; that will reduce intermittency of the combined supply. In principle, you could think of hydro-power being used entirely for balancing. But that's really not a very, very realistic option because the share of hydropower is only 13% of capacity at present, and will fall in future. It's also seasonal, and is constrained by irrigation requirements. So, we don't think that the use of hydropower will make a big difference. The real solution obviously lies in battery storage; this will raise

costs. Costs of battery storage are falling, but you know, the pace at which they will fall in future is uncertain. And possible shortages in key minerals needed for battery production creates uncertainty about how fast these will decline.

So, this is an area of uncertainty. Gas-based plants could be used to balance RE. That will certainly add to cost because a lot of the plants will be underutilized for most of the time, and that will have to be covered by the cost of the power to produce. Coal power plants under construction can be fitted with carbon-capture and storage. This is feasible, but at the moment, very expensive. Again, in the next 10 years, we don't know what might happen; we can hope that things will improve. And finally, dedicated RE can be used to produce green hydrogen, which can then be stored for later use. And also, the role of demand patterns; because while supply patterns are intermittent, can demand patterns also be altered to match supplier using time-of-day metering? You know, this is in principle already accepted. But the degree of sophistication and calibration required in time-of-day metering, have to be much higher if it is to play the role that is now expected of it. Now, the next three slides give you a sense of what we think is the cost situation, and I'm going to ask my co-author, Utkarsh to handle these. Can you go ahead, Utkarsh?

Utkarsh Patel: Yeah, thank you, sir. So, this chart shows that the costs have been rapidly declining of both solar and wind over the past years. The dark region in maroon shows us that the spread of electricity from solar plants that are fitted with storage capacity of up to 25% daily generation are also falling. As we now see, the cost of RE are competitive with coal-based electricity. Even with battery storage facility, the cost of solar electricity is expected to become competitive over the next few years. However, we'd like to qualify at this point, that battery price estimates should be taken with a pinch of salt. This chart shows us the committed emissions from existing coal pipelines, and that amounts to approximately 42 gigatons of CO₂ over the course of next 50 years. If we assume a normal life of 40 years for the existing pipeline of power plants, coal capacity stays until 2070, given no further investments occur, with RE getting competitive as we saw in the previous slide. Some plants could be retired earlier, while those which are permitted but haven't broken ground, could be abandoned altogether.

At the moment, there's also some overcapacity and hence, we may also postpone scheduled commissioning of some plants that are under construction or permitted. Small modular nuclear reactors are state of the art in nuclear fission technology. NPPC and the Department of Atomic Energy can jointly assess the possibility of retrofitting some of the retired or soon to be retired coal boilers at such units. France, US and Russia are already making developments in this direction. Coming back to cost, carbon pricing was discussed in the most recent meeting of the G20 finance ministers. And at the same time, the IMF also released a staff paper that proposed a carbon price flow for the world's top emitters. \$75 for the US and the EU, \$50 for China, \$25 for India. A \$25 per ton CO₂ price will nearly double the price of coal in India, and subsequently, raise the price of electricity. As seen in the chart, all of RE, including storage, very soon should then be cheaper than the cheapest coal-based electricity. This will justify an accelerated departure from coal. Here, we see the expected electricity generation from coal-based power plants based on the existing pipeline.

If we were to introduce a modest \$15 per ton CO2 tax on coal after 2030, owing to certain price elasticity of demand, coal-based electricity demand will reduce to 70% over the period, implying a shift in the metadata dispatch of electricity. This could lead to complete elimination of coal capacity by 2060. Some studies have suggested we would need to maintain a proper capacity in the medium term for flexibility and reliability. Lastly, if there are decisions to be made, whether to build new plants or retire some, this should be taken jointly by the center and the states involved. Back to you, sir.

Montek Singh Ahluwalia: Thank you very much. I think what Utkarsh has presented is that, to my mind, if we can build in an element of carbon pricing, the economics of switching to renewable energy becomes much stronger. It's there, even if we don't, but then it becomes arguable how fast and when do you phase out coal-based capacity, etc? So, this is something that one needs to go into in great detail. I just want to touch here on the fact that, you know, what is the economics? I mean, does it make sense to phase out coal? The other is, recognizing on the longer run, it has to happen. Let's look at the structural changes that will be caused by that and which we should be ready for, and very quickly. Employment. The coal industry employs a huge number of workers in the east, the shift to RE will create new jobs, but this will be in the western and southern states. The royalty of the coal producing states will fall, so, there will be an impact on state revenue.

In the railways, freight earnings from coal will fall, transport of coal will fall. And these earnings currently subsidize passenger fares. So, as Indian railways switches away from earning more money from the transport of coal, it will actually have to have a much faster rationalization of passenger fares, which is desirable in any case. Both the center and the states will lose revenue from petrol and diesel sale as fossil fuels get phased out. So, the tax revenue strategy for both the center and the state; this is again, over a 20, 30-year horizon, needs to take that into account. Solar expansion will require a lot of land acquisition in rural areas. You know, I think it's going to be difficult for private investors to be able to do this on their own. So, some degree of state assistance in acquiring this land, taking care of the interests of others will be necessary. If we move towards raising biofuels, there will be arguments that the use of agricultural land that could impact food security – I personally think our food productivity levels are so low, that over the long period, this should be very easily offset by rising productivity, but this is again, a controversial issue.

And of course, there are positive aspects of moving away from coal and oil, which is the improvement in air quality, and also, the improvements in energy security and foreign exchange savings, not having to import as much oil as we do. So, it's a structural change that involves some difficulty, but we have to factor this into our planning process, so that it doesn't come as a surprise to the system. Now, I mean, one thing is very clear from all this, that if we are going to make the huge change that is necessary in favour of renewable energy, it's going to require large investments not only in generation, but also in transmission and distribution and storage capacity. Transmission and distribution, because the source of this new energy is going to be concentrated, it's going to have to move from the west and south to the north and the east, and storage because of the intermittency. So, we've discussed how much of the storage could be carried by producers, how much could be done by transmitters and

distributors, how much would be behind the meter storage, and all of this, I think is possible, if the pricing system for the transport of electricity is actually rational, and move towards giving the right market signals.

I mean, for example, if as far as RE producers are concerned, instead of having to generate a huge amount of renewable energy, which then they have to deliver in a concentrated period of time, if you can invest in some storage and actually deliver the electricity over a longer period of time, the demand for capacity in transmission goes down. But you know, that has to be reflected in pricing so that it becomes economic and the incentive as that for the generator to actually do what is necessary. Now, let me touch on the issue of the financial viability of the DISCOMs. You know, frankly, I think this is the elephant in the room. And this is quite independent of whether we go for RE or not. The truth is, if we were to do the electrification that is required, the burden on the DISCOMs is going to be absolutely huge. And the present state of the DISCOMs simply does not allow sufficient investment in generation because of perceived high risks.

So, the answer is quite clearly, that the state government has to move on several fronts; I mean, create genuinely independent regulators with adequate expertise to fix viable tariffs, including time-of-day metering capable of dealing with the challenges of increasing RE. Avoid interfering with tariff fixation; if subsidies have to be given, they should be given through the budget to the target groups, not by forcing cheaper tariffs. Now, that's easier said than done, but the only point is we have 20 or 30 years to get it done. I think we need to build this into the system early in the day so that the right signals go out. I personally think that privatizing DISCOMs where possible would be a great help, it will reduce political interference, and most of all, it will enable us to judge whether private DISCOMs end up being more efficient than public sector DISCOMs. And state governments have to avoid arbitrary cancellations of PPAs, which has happened in some cases. You know, there are several regulatory requirements at the present moment, which actually interfere with the growth of capacity of solar, I mean, for example, DISCOMs are forced to buy electricity from solar producers because that has to be a must run basis. If they already have PPAs with thermal power plants, they have to pay for the capacity in any case.

So, I mean, we haven't got a workable system, it doesn't matter very much when the amount of renewable electricity is small. And as it expands, these problems have to be sorted out. Feed-in tariffs for rooftop installations are too low, and they hinder expansion in this area. And I think, you know, central government and PS use of states, will have to undertake investments needed in transmission to manage the large interstate power transfers. More generally, we need to have much more mature wholesale markets suitable for RE. And I think the DISCOMs will need to identify and tap the many leakages that exists in order to reduce their losses. This is not very new, but I'm just saying that without solving these problems, it's difficult to find a solution. Let me look at a slightly different aspect, again, related to structural change. And that is, what's the time frame for electrifying transport? You know, the idea of electrifying transport is now well accepted; manufacturers are talking very positively that they are moving towards EVs. But here, the fact is that for the auto fleets to achieve zero emissions by a target date, EV-Electronic Vehicle sales, have to increase. From 1% of the total or maybe

just are between one and 200% sufficiently below before the zero-emission target day, so that older vehicles can be phased out.

Now, the EU has announced a ban on sales of all IC vehicles from 2035, which is 15 years before their net zero day. If we want to electrify the vehicle fleet to be entirely electric, or let's say by 2060, then our manufacturers have to be told now, that no IC vehicle can be sold after let's say, 2040. And I think that's a decision that should be taken early enough, they will be lobbying against it. But unless we do that, people will simply complain later on that you didn't give enough notice. The other things that the government could do is to announce that all existing cars owned or operated by the central government, will be replaced by EVs starting in 2023. State governments could be encouraged to do the same; state governments could also be incentivized to phase out IC city buses and bring in EVs. Now, some of this is happening already under the fame program. But it needs to be rolled out on a much, much larger scale. So, it's not as if the principle isn't accepted, but we need to put it on a scale that will deliver the results we want. Other issues that need to be faced is that the EVs will have far fewer engine components.

So, much of the component production may disappear over the next two decades. Battery production has to expand – this is a capital-intensive sector; we need to attract battery producers state of the art technology to locate production in India. Standardizing battery components will help to achieve scale and competitiveness and maybe, battery recycling can also be promoted. EVs charging infrastructure needs to be developed. This also needs standardization which has to be done by the government. Charging EVs at home and office will greatly reduce the need for so many fuel stations within cities. Some can be upgraded as battery swapping stations; this is something that the oil companies need to think about now. And battery swapping can actually reduce the upfront cost of EV ownership. China, for example, has innovated in this direction. So, that's something we should also look at. Now, a few words on climate finance.

I mean, I just put it all very in a summary fashion. 600 billion per year is the estimated additional energy investment for developing countries. I believe Mr. Carey has been mentioning this figure. India alone will require about 150 billion per year additional investment on the energy side, which would average about 1.8% of GDP. Further investment, may be of a comparable magnitude, will be required in the areas of transportation and other infrastructure; that's a separate issue. But against this, the climate finance provided to developing countries so far, is much lower than the 100 billion that was promised. As a matter of fact, the 100 billion just won't be enough. And if CoP 26 is to make a significant breakthrough, recognition that even though they haven't achieved 100 billion, recognizing that it needs to be scaled up, would be a major international commitment. A clear signal to the MDBs, Multilateral Development Banks that they should expand financing of RE. And the scale of the requirement, I think we have to recognize as such, that private flows have to have the major share. And of course, the moment you talk about private flows, then the question of perceived risks, which is connected with DISCOMs becomes very crucial.

So, last two slides, I think we're probably just about within our time limit. The last two slides summarize our position. With technology allowing use of non-polluting sources of energy to

fuel development, we should be willing to project a credible trajectory for emissions reduction. This trajectory should emerge from a national energy planning exercise, not from lobbying during a CoP 26 meeting. The India energy modelling forum, presided over by NITI Aayog provides a basis for preparing such a national trajectory building on various innovative individual models that exist, and NITI Aayog could come up with a proposed trajectory and the policy changes needed to bring it about. I think we should make it clear that it is not necessary for all countries to get to net zero by 2050.

I mean, climate justice suggests that developed countries should get there earlier, allowing developing countries more time. And on this basis, we should come up with our own long-term emissions trajectory with a peaking date and a target to reach net zero, which will go beyond 2050 and a short-term target of reducing dependence on coal for generating electricity. So, what does this add up to? You know, looking at the different studies, we, just to put across some points which could be kicked out like a football, I think India could propose a peaking target of 2040 and a long-term target or reaching net zero around 2070. That's about 10 years further than China has proposed. We could also propose peaking of thermal capacity – this is much more critical and controversial before 2030, followed by a reduction in thermal capacity to some fraction of the peak level by 2040. This will give a clear signal of a transition away from coal. And this has to be internalized in our thinking, in the sense that the coal ministry has to be on board.

These commitments should be conditional on global commitments to provide long term finance for covering a substantial portion of the 150 billion per year additional investment that India will need in energy. The funding capacity of MDBs has to be suitably increased along with eliminating country limits, which restrict India's eligibility to get funds. The EU is likely to impose border adjustment tax on imports from countries that don't have a carbon price floor. And if this happens, we need to consider whether we should impose an explicit carbon tax on coal, tax on petrol and diesel is already very high and part of it could be seen as a CO2 tax. And of course, in parallel with all this, we have to act on all the many fronts that we've covered in this presentation, which are necessary to facilitate an effective transition to green energy. I think that's it. Thank you.

Laveesh Bhandari: Thank you, Mr. Ahluwalia.

Montek Singh Ahluwalia: Thanks a lot. Thank you.

Laveesh Bhandari: Thank you for that very crisp and concise presentation and trying to keeping to the limits. I would now request Mr. Amitabh Kant, CEO, to share his expert comments.

Amitabh Kant: So, let me first congratulate Mr. Ahluwalia and Utkarsh Patel for a very, very comprehensive presentation. It's looked at all that has been written about; looked at various research work that has been done. And I think it's extremely detailed and comprehensive presentation. My view is that CoP 26 really presents an opportunity for India to present its own development transition which India has taken to achieve its own economic development and how it would help the world secure its climate transition. I don't think we should be defensive, we should be rather aggressive, because from an India perspective, if you are going

to see close to 400 million people getting into the process of urbanization in the next five decades, we need to build up a sustainable India. If India needs to export steel beyond 2030, it needs to produce green steel. If India needs to be a centre for compact car manufacturing, it will have to translate from being a combustion car manufacturer to an EV, to a shared connected and electric and a zero-emission world of manufacturing.

These are very, very important for India's own economic transition. And therefore, I think what India needs to look at is, what it needs to do for itself as it grows and expands its economy in the future. My view is that we've taken several measures already. We recognize the urgency of strong climate action. We have promoted green economy, the country has mandated to integrate renewable energy sources, low energy mix with a very ambitious target of 450 gigawatts by 2030. We have a push for solar-installed capacity has increased by about 13 times in the last six years, to reach about almost close to 36 gigawatts in 2020. Our renewable energy installed capacity is the fourth largest in the world. And our current non-fossil fuel capacity is about 146 gigawatts, which is about 39% of the country's total installed capacity. We have also achieved record low solar tariff; 2.7 Cents per kilowatt hours, or about 1.99 per kilowatt hour in Rupee terms.

And actually, the falling tariff of solar power provides this opportunity to be a game changer for the country. Because my view is that it's not electricity, which is critical; electricity is just 17% of the total energy. 83% of the energy is very hard-to-abate sectors like, refinery, fertilizer, steel, where electricity doesn't work. And therefore, you need to focus on hard-to-abate sectors, and without that, this energy transition would not be possible. And the falling tariff of solar power is critical for India, because that enables you to scale up production of green hydrogen at very low renewable tariffs. And this would help in actually, quite often, India gets into sunset areas of industry and it's very difficult to penetrate global markets. This is one sunrise area where India must get in and it has the possibility of becoming a global champion. And this would help in achieving industrial decarbonisation in very hard-to-abate sectors like refining, gas sector, fertilizer and steel sectors. I think Indu is here, and he will talk about what has been announced as the National Hydrogen Energy Mission to strengthen India's green energy credentials.

But my view is that unlike other new technologies for which new demand has to be created, India is in a very unique position in hydrogen, because we consume about eight to 10% of grey hydrogen, which is all imported natural gas. And if you want to cut down your imports, you should actually be moving towards green hydrogen, using solar to crack water, and then push for this substitute grey hydrogen with green hydrogen and refining and fertilizer sectors, which can make a very substantial impact by 2030. And therefore, we need to create size and scale to become not merely a major consumer of green hydrogen, we should crack green hydrogen, through nitrogen and export green ammonia. And we should be using green hydrogen to build up international relationship with Korea, Japan and leading countries in the far east. And it's possible for us if we are able to bring size and scale to green nitrogen to bring down the prices from close to about three and a half dollars per kg right now, to about \$1 by 2030, and this would enable India to use hydrogen and steel, heavy duty road transport, marine, aviation sectors and many other areas.

But the important thing is that both in solar manufacturing, I mean, if you look at 17% of electricity, 70% of your solar production, and your green hydrogen costs comes from power cost. And power cost is directly dependent on capital cost. If you look at current capital costs for Indian clean power sector, it's very high; it's about close to 10 to 12%. You know, Saudi Arabia has just recently been able to get a bid at about in Rupee terms, it's about 75 per unit solar power cost. The difference between India and Saudi Arabia is just the cost of capital, nothing but the cost of capital. And therefore, my view is that in Glasgow, we don't need long winded multitrack negotiations. India should focus on one single point of negotiation at Glasgow. And that is that, how to use get \$200 billion of low cost or, you know, we are doing a high-speed train with Japan. 50-year lending at 0.1%, which is making it commercially doable. And therefore, if you're able to get 200 billion US dollars at low cost over a 50-year period, it is possible for India to switch over to clean technology to private sector.

I'm not saying government should negotiate it, but there should be hard negotiation of how \$200 billion will be made available to the private sector, to get the best technologies possible. You don't need to negotiate on technology; your private sector will go and get technology. You don't need grants, you don't need technologies; India needs only low-cost capital to fuel the dreams of Indian green intrapreneurs to execute global-scale projects in green hydrogen, solar, wind, the battery, EV or energy efficient cooling etc. And to my mind, we need a very clear, very simple and very tough negotiation gameplan to make this happen, because the developed world has not lived up to its commitment made in 2015 at Paris as far as financing is concerned. There is nothing else to negotiate; this is one single point of negotiation. I would also say that, as far as net zero is concerned, the developed world has given themselves more than 40 years and up to 77 years for that transition. So, we can talk about net zero, but it definitely can't be 2050; it has to be some years in the future, at which very many models are being looked at. And that's something which will be politically decided, but we need to look at various models through which we will arrive at the best possible solution for that. Thank you.

Laveesh Bhandari: Thank you, Mr. Kant. That was truly very enlightening; as both the challenges as well as how the government seeks to address them. May I now request Mr. Indu Shekhar Chaturvedi, Secretary, Ministry of New and Renewable Energy to make his remarks.

Indu Shekhar: Thank you very much. It's a privilege to be here. And particularly because I am in the company of two of my former bosses, Mr. Ahluwalia and Dr. Rakesh Mohan, both of whom I looked up to. So, let me begin by saying that MNRE deals only with a part of the decarbonisation agenda. And as has been pointed out, the share of electricity in supplying India's total energy needs is only 17% out of which we contribute about 11% of the total electricity generated in kilowatt hour terms. And there are other ministries too which are involved in this decarbonisation agenda. So, Mr. Amitabh Kant has pointed out our achievements and I won't repeat them. 2.4 times in the last seven years, the RE installed capacity going up etc. But it would be interesting to take a look at the at the reasons behind these achievements. So, I think there are four broad reasons why we have done well in the in the RE space. One is that, we have a dispensation called the renewable purchase obligations

under which the distribution companies are obligated to buy a certain share of their electricity needs from renewable energy sources.

Now, these renewable purchase obligations are not legally enforceable at present; not at least by the central government, but nevertheless, they have served a purpose in faster capacity addition. The second reason is that we have a very robust demand aggregation mechanism; a very robust payment security mechanism. So, that has resulted in the lowering of tariffs, our central agencies do the demand aggregation and do centralized bidding for the distribution companies; they act as intermediary procurers. And because of the payment security mechanism they have, the tariffs have come down, which would not have been the case had the distribution companies bid out directly. The third reason is, the interest rate transmission waiver. Now, it can be said that the economic rationale behind it is not very clear, but what it does is it makes the cost of it appear low to distribution companies, and that has also sound of purpose. And the last reason is the huge fiscal and financial incentives we gave in the initial years of RE; the feed-in tariffs, etc, accelerated distribution.

Now, going forward, the challenges are huge. We will shortly be achieving in the next four or five days 100 gigawatts of installed RE capacity. Now, as the share of RE in the electricity mix goes up, the nature of challenges also changes and as has been pointed out in Mr. Ahluwalia's presentation, grid integration will be a major issue and therefore, there will be much greater importance attached to storage and the storage costs. Storage clearly affects and it will have a bearing on our ability to deal with intermittency. Now, one way of ensuring that even costly RE power with the storage is bought by DISCOMs is to make the renewable purchase obligations legally enforceable, and that is what is being attempted in the Electricity Amendment Act. Now, that can be a substitute for what was said in the presentation about a carbon tax. And the important thing to note here is that as the scale goes up, as you have more electricity with the storage, the costs will also come down. Now, coming to the presentation, the strategy presented is unexceptionable.

The only point I wish to make is what Mr. Amitabh Kant alluded to, that a large part of our energy consumption, at least a substantial part, will have to come from non-electricity sources, and I'm pointing to hydrogen and that is long-haul transport and the feedstock industries. And there, the government has taken quick initial steps. We already have a proposal to mandate green hydrogen purchase obligations on refining and fertilizers, and that is at an advanced stage. So, what the strategy in hydrogen is, is to have demand creation and which would lead to a scaling up of green hydrogen production, which will lower costs and going forward, after 2030, we can have applications of long-long haul transport and steel. So, these areas can be covered. So, that is one thing which will be important going forward. And as hydrogen costs come down, perhaps in the future, we can also have green hydrogen acting as a carrier and as a means of the storage to reduce intermittency.

So, there were a couple of minor points I wanted to make. Now, agriculture. Solarization of agriculture is going to play a major role in decarbonisation of the economy. Our estimates are that if you solarize all existing irrigation pumps, then the capacity needed is about 110 to 120 gigawatts. We have a very ambitious program PM Kusum, under which we have already received demand for 43 Lakh pumps to be solarized. And the model which is being adopted is

feeder-level solarization, so that transmission losses are reduced and reliable daytime electricity can be provided to farmers. So, that is something which will have an important role to play in the decarbonisation study. Of course, once the capacity goes up, once you approach higher capacities, the need for storage and grid integration issues will become important here also.

Now, cooking is something which the ministry has been struggling with for a long time. And for the last seven, eight years, various things have been tried; phase change modules and even electricity induction cooking. So, I think cooking needs are something which are very very uncertain whether we can satisfy these needs from electricity. And the reason is that induction cooking is not only costly, but it also entails behavioural change. A point was made about thermal backing and the costs of RE thermal power. Now, this exercise needs to be done DISCOM-wise because many DISCOMs are already tied up into contracts with thermal power. And if you have renewable purchase obligations, I think there will be a fresh look at the technical limits of thermal backing, as well as, it will also address the problem of inertia because you are tied up into a contract and you don't want to take a real pretty look. So, that is about thermal, vis-à-vis with integral thought.

Laveesh Bhandari: Mr. Chaturvedi, may I request you to [indistinct- 58:17]. Thank you.

Indu Shekhar: So, I think I'll end there. Thank you.

Laveesh Bhandari: Thank you, Mr. Chaturvedi, for both sharing the details, as well as the nuances of how the government is dealing with all the challenges. May I now request next, Miss. Mohua Mukherjee, who's the Program Ambassador for the International Solar Alliance to make her presentations.

Mohua Mukherjee: Thank you very much. I am going to be using few slides; I've just made four slides to just capture, but I probably won't have the time to fully go through. I'll just jump straight in. So, one of the things that I think in terms of getting ready for CoP 26, or how we should be thinking about it, is that compared to other countries, in India, the public discourse is much less. I mean, there's not a general awareness of the vulnerability, it sort of, seems to be that climate change actions are being taken for somebody else's interest. And this coercion is something that should be addressed, I think, by the policymakers. Vulnerability of the economy is not widely understood. I want to follow on some of the preceding speakers, I believe that what one can offer by 2030 is again, this 400 million people or 80 million households moving to an all-electric lifestyle. So, thermal comfort, cooking, transport, either on a two-wheeler, three-wheeler, or an EV, or electric buses, decentralized solar and behind the meter battery. If this package could be somehow made available through cheap financing, which I will get to, to 80 million Indian households, that would end by 2030.

So, by the end of this decade, if we could find a way to do that, as a first step, I think that would definitely move the needle somewhat, as far as India is concerned. These would obviously be middle- and upper-income households; these would not be the people who hardly use any electricity at all. The Just Transition for coal mining and for fuel stations, I think other countries' experience has shown that it takes about 15 years. So, if we are talking about peaking by 2040 and net zero by 2070, then we need to better start right now. It's interesting

to refer back to articles nine, 10, and 14 of the Paris Agreement. Nine is about financing. 10 is about technology development and technology sharing. And 14 talks about the global stocktake in 2023, which Dr. Montek had mentioned that was revisited at the G20, and it's now going to be a little earlier.

We need to also be, maybe coming up with a couple of new presentations of our case. The value proposition. India is unique among developing countries. It has what it takes to be the world's testing lab today; I'm talking about the technologies that are related to the hard-to-abate sectors that have been mentioned several times. So, we have two sets of technologies. One is the ones that are mentioned in the previous quick wind by 2030. Bullet point, all of those are available today and need are ready to go. Whereas, the other ones are still under development, which is the long duration energy storage, green hydrogen, not yet commercialized, in other words. So, those need a lot of testing, data, etc. India can step forward and say that, "We want to be not only the testing lab, but we also want to be the developing world's frugal technology manufacturing". We know that the countries which are working most on these technologies are all determined to sort of, develop their own employment and manufacturing sectors, and they will not be interested in sharing the technologies. We saw this with the vaccines.

However, if they do want to own these technologies for global exports to developing countries, they must find a cheaper manufacturing place, and India should be that manufacturing hub as well, so, present itself as a microcosm. So, it needs a seat at the table as a global technology partner, I don't think it's useful for every country to be inventing everything in silos by itself. India can step forward and say, "We are ready to partner with anybody". Available today and needs to be deployed, we already have those things that we mentioned here; generation plus storage. We have short duration storage that's available today that has developed off the market for electric vehicles. These are the lithium ion based four to six hours maximum eight-hour storage. We have power electronics, we have Internet of Things, we have transport, electric transport, we have agri-voltex. So, solar generation combined with agriculture on the same land, and we have cooling which needs to be looked into. And the others are futuristic, as I mentioned, green hydrogen, CCS, direct air capture, next generation nuclear.

So, what would India need to do differently? This, again, echoes some of my previous speakers, in terms of if public funding and partnership were short, I think Mr. Amitabh Kant said that it's all about funding. Find us the low-cost funding, long-term funding, and we can do everything ourselves. And I'm saying on top of that, let's also have a technology partnership together with that. Here's a little bit of a controversial position. I believe if we get into war-footing, and we say that within the next three to five years, we need an industrial ramp up in India, for example, we need to have produce that many more solar panels, wind turbines, etc., I'm saying that we don't think that the invisible hand is going to get us there. This is probably not pleasing to many people in this meeting, but I'm thinking that we need for a temporary period, we need a command economy to make that pivot, like we recently saw with the Defence Production Act for vaccines. Make the pivot so that, because the invisible hand, carbon tax, etc, will not be fast enough for a three-to-five-year industrial ramp up. We are not

spoiling the market economy structure, we're just making a sort of, learning and cost reduction detour for these 80 million households that I'm proposing the 400 million people after which once they are taken care of and fully electrified, then the market economy comes back. In other words, [crosstalk]. Yes, please. You want to me wrap up?

Laveesh Bhandari: Yeah, yes please.

Mohua Mukherjee: Okay. So, essentially, can I have two more minutes?

Laveesh Bhandari: A minute, if that's okay.

Mohua Mukherjee: So, these cannot be treated as consumer products, and the de-risking strategy is not working, with only private sector capital, we can probably mobilize is from large, private corporates that are committed to running and that need to procure clean energy. And otherwise, we're looking at mainly public funding, because the MDB strategy hasn't really succeeded in mobilizing very much private capital so far. I'm not going to go through this, but I'm just saying that we have some thinking to do along the Indonesian lines, which is, without funding, this is what we can do with our own funds. If you give us some funding, then we can do that – the Indonesian said we will reduce emissions by 29% on our own and 41% if we get the funding we were promised. So, we would say we would have another column with what can we do with base – okay, that table is gone. Sorry, I'll stop sharing. But I basically wanted to say that we can also say whom we want to partner with, and I have a final slide there with suggestions on what technology partnerships we should enter with different governments for basically, accelerating India's transition to net zero. Thanks very much.

Laveesh Bhandari: Thank you. And thank you for bringing in issues of Just Transition as best technology. May I now request Professor Nick Stern, who is the IG Patel Professor of Economics and the Chairperson of the Grantham Research Institute of Climate Change and Environment at London School of Economics.

Nick Stern: Thank you very much, Laveesh. I'm going to go for a big picture and internationalist view. Of course, detail matters, and we've had very good discussion in detail, but I thought that's where perhaps, I could be the most helpful. But first, let me say that this is an enormously important piece of work. I really do think that it moves the discussion in India along and indeed the discussion in the world in a very important way. So, I welcome it wholeheartedly. And I should also associate myself with the thoughts of Amitabh Kant's in that India should be on the front foot internationally, not defensive, and that low-cost capital on scale is at the heart of the story. But let me go to my big picture points with an international perspective. The first as has been said, India is extremely vulnerable to climate change, whether it be the intense heat, the flows of the Himalayas, sea level rise, desertification in some parts, India is extremely vulnerable.

And further, that India is very influential. So, it's not simply that India is big, India of course, is big, but India is influential in terms of what other people do. And if India is defensive and difficult internationally, empirically, you find that other people hide behind that. So, India is a big power in the world and it is a power that matters enormously. So, this is a story that India's

future through the future of climate change depends in large measure on what it itself does and that is fundamental to this whole story. The second point and echoing what Mohua and others have said, is that we now have a very different growth story. It's not a horse race, as Montek emphasized, between development on the one hand and low emissions on the other. Actually, there's a very attractive new growth story here, including, of course, cities where you can move and breathe, particularly important in India, and ecosystems which are robust and fruitful, also, very important in India. It's a new growth model, and India will be a key demonstrator of that model to the world – another way in which India will be enormously influential. India's private sector here is tremendously creative.

If you look at what India is doing in cement, for example, in Dalmia cement, if you look at the potential for India to be a world leader in clean steel, all these things are enormously important; all the way from regrading degraded land, looking after the forests, through to these hard-to-abate sectors, through to the different ways of generating electricity and creating energy. In all these ways, what India will do in these next two, three decades, will not only be of great importance to India itself, because that's the starting point, but also, will help influence the world. The third major point I wanted to make from this international perspective, is political. This could be and should be India's century. India has a chance to lead in the dimensions we've described, but India also has a chance to lead politically. The world is getting very anxious about China. Indeed, we know that India sometimes, gets anxious about China.

The possibility now, that Indian alliances to the great reward of India with some of the rich countries; the EU and the United States and so on, those returns could be tremendous. But that means India being on the front foot, India is showing way, India demonstrating what's possible. I would add to that, the context of Indian leadership in the G20 in the year after next. If India is to make this century India's century, and all our deep friends of India sincerely hoping well, this actually is the moment. This is not the moment for any expectation, it's the moment for leadership. So, those are my three major international points. Just a couple of points quickly, on the substance of the presentation itself. I've already said that I think it's absolutely first class and a leading part of the story of what happens next. But I want to emphasize what is there, but let me emphasize it still more strongly. 80% of India's infrastructure, including its past structure that will exist in 2050, has yet to be built. India is actually creating its economy in large measure over these next 30 years.

That, from that perspective, there's some advantage in starting late, that India parent carries much less dirty baggage than China. So, there's a sense in which given that India is creating its 2050 economy in large measure, very large measure in the next 30 years, it could actually go quicker than its neighbour; China. This is the time to use the advantage of a late start to follow a completely different route. And the second point on the specifics, Montek and Utkarsh did emphasize this, I think Mohua, Amitabh and the others did too, is that this is a major investment story. And this is a story that is big in scale, big in composition and it will have to be planned. That doesn't mean command and control, but it does mean very clear, strong efforts now to set out the program and look at all the bits and pieces as the paper did to deliver. The implications of what's necessary, the implications of what's set out in this paper

does involve a major big planning story in India over the next 10, 20 years, starting right now. And we shouldn't underplay the size of that; including the institutional changes as the paper very clearly states that are necessary. So, we have to understand the magnitude of all this. I'm just underlining here, but it is of enormous importance.

Finally, on finance, this is not all that much of these very big investments that are necessary, could be financed off the public budget. I've been studying Indian public finances since the 1970s, but you don't have to have done that to work out that investments on this scale couldn't really be financed in a major way off the public revenues. What we do need, is development banking to be expanded and go forward in India. We do need cooperation with the private sector and we do need India to push and push very hard as the paper describes, for the multilateral development banks to greatly expand their lending around the world on sustainable investments, particularly renewables, and particularly, to India – that does involve important technicalities like the single borrow limit, and so on. But I think India can and should right now, up to this annual meeting, and through to CoP and it's G20 and beyond, press very strong, the international institutions to up the scale of what they're doing, including and particularly, around sustainable and climate finance. India can be very powerful and influential in that.

This is a moment where you're looking at CoP 26 or the G20 or the way the world moves on sustainability as a whole, this is a moment where India can and must take a lead, in my view, greatly to the advantage of India in the world. Thank you again for very special, important presentation.

Laveesh Bhandari: Thank you, Professor Stern for bringing in that much needed global perspective. And now, we are on to our third session and we are about 15 minutes behind schedule. May I request the chairperson, will you give me 15 extra minutes so that I can have a more intense third session? Can I extend this by 15 minutes?

Rakesh Mohan: Sure, but just 15 minutes.

Laveesh Bhandari: Yes, sir. So be it. So, thank you. And just another announcement, we have the presentation of which can be downloaded, the link is in the chat, so, you're all welcome to download it and of course, share your comments at a later time. So, we start now with our third session, which is a panel discussion. We have a great group of panellists, Mr. Jamshyd Godrej, Chairman Godrej Voice and of CEEW. Dr. Ajay Mathur, Director General, International Solar Alliance. Dr. Arunabha Ghosh, Founder, CEO of CEEW. Miss. Ulka Kelkar, Director, Climate Program of WRI and Dr. Rahul Tongia, Senior Fellow, CSEP. So, what I'm going to do is, I'm going to initially just call out everyone to give their initial remarks. And then after that, I'm going to just allow the discussion to emerge, and anyone who wants to comment or speak or intervene, please do just raise your hand and I'll call you out. May I ask, Mr. Jamshyd Godrej, to start this off.

Jamshyd Godrej: Thank you. And just in the interest of time, I want to, of course, thank all the speakers, especially to Montek for the presentation. You know, there are two points I just want to make. One is that we need an all-of-government approach. And I think if we do not focus on the governance of the transition, I don't think that we can succeed. I think the way

that our governance structure is with different ministries charged in different areas, which are all interconnected, makes it very difficult to actually be able to have sort of a unified approach. So, my recommendation is that we should have a very sort of, a one-point person type of, bring everyone together under one leadership to make this happen. Without that, I don't see this transition happening. I think that's extremely important, and we have been having a lot of issues to do with inter-ministerial issues over the years. But if we continue with that, we will not solve this problem and achieve what we want to do. The second point I want to mention is, you know, this issue of Just Transition. I think we cannot ignore the fact that this is not just about finance and technology, you know, it is about people. And unless you have really good, well thought of transition, which really takes everybody with you, and especially civil society, and create the right atmosphere for this to happen, I think these are just the two points I wanted to make, in the interest of time, I won't carry on. Thanks.

Laveesh Bhandari: Thank you. And we look forward to your interventions later as well. Dr. Ajay Mathur.

Ajay Mathur: Many thanks, Laveesh, and again, many thanks to Mr. Ahluwalia and Mr. Patel for their presentation as well. Again, in the interest of time, I'm not going to pick up the many, many good ideas that have been put forward in the presentation as well as by the various discussants. But I would like to bring in two sets of issues that I think we need to look at when we're looking at the transition. The first relates to the fact that we are looking at large sums of money, and the financial fact that these monies become front loaded; a point that has been made earlier. I think we need cheap capital, not only for investment in green projects, but also, to pay for the climate justice. We will need to provide compensation to the eastern Indian states, we will need to see how railways can come to a firm footing. Where do we get the money for this? We need front loaded money, which can meet the longer-term needs.

Consequently, I fully endorse Mr. Amitabh Kant's views that the one thing that India needs to focus on at CoP 26, is the creation of IDA kind facilities, so that low-cost financing can be made available to India and to other countries as they go through the transitions. That is the first point. The second point I wanted to focus on was really on carbon taxes. Let me share with all of you right up front, that I am not a great votary of carbon taxes for very many reasons. You only have to look at the carbon tax that we created in this country. Where do those 400 Rupees per tonne go? We have no idea. What they do is that, the ministers of finance salivate, and it goes into the general exchequer. You could argue that it makes a difference in choices, does it? Not really. If you look at any transition that has occurred anywhere in the world, it occurs because of regulation.

And consequently, I think what has been very successful, is the regulation requiring the introduction of renewable electricity into the mix in the DISCOMs, and I think a future regulatory regime, which looks at the increasing proportion of renewables to the reach something like 70, 80% is useful, because what it does is, it forces the kind of economic viability that the sponsors of renewable energy would seek in the years to come. So, that was my second point. I'll also briefly mention that one of the things that I think Mr. Amitabh Kant talked about, or Mr. Indu Shekhar Chaturvedi did is the issue of solarization of rural feeders. I personally believe that is useful, because not only does it help in solarization, but it also brings

down the economic, the financial losses of the DISCOMs. In my view, this is where the convergence of interests occurs. Mr. Ahluwalia rightly pointed out the financial viability of DISCOMs as a key challenge, and I think the solarization of agricultural feeders is one way in which the losses can be reduced, and we could meet these through non carbon emitting sources. Let me end here, and I look forward to picking up the discussion as we go ahead. Thanks.

Laveesh Bhandari: Thank you. May I now request Dr. Arunabha Ghosh for his remarks.

Arunabha Ghosh: Thank you, Laveesh. And thank you, Mr. Ahluwalia, thank you Utkarsh for your presentation, and many thanks for having me in this important conversation. I love to try to keep it brief, let me start by highlighting something that Professor Stern touched upon, but others, I think, requires a little bit more attention. As we think of our own position with regards to what we see at CoP 26 before or after, as well as what we see domestically in terms of creating a discourse around this issue, I think we need to emphasize a lot more on the climate risks that India is facing. Our estimations at CEEW suggests that now, 75% of India's districts are hotspots for extreme climate events. What is worse, at least in my opinion, is that 40% of India's districts are now showing trends of shifting from traditionally flood- prone to becoming drought-prone, and vice versa.

So, not only is the past not going to be a predictor of the future, the scenario is going to get progressively more complicated. And therefore, when we think about a low carbon transition, whether for the energy sector or the economy, we have to pose a risk calculation. That's the calculus. What is the risk of taking on, say, more expensive low carbon technologies versus what is the risk of not acting? And this is an existential question now, and as long as it remains on the margins of our discourse, we will simply not have that whole of government approach that Mr. Godrej was referring to. The second point I would argue, is that we need to broaden this conversation. And again, Mr. Ahluwalia, and Professor Stern and others have already touched upon it, but I think we need to explicitly broaden this conversation from beyond the energy sector into the economy overall. Here's a simple rule of thumb question for all of us. Can we name a sunrise sector that is not low carbon? I can name two. One is space tourism, and other is seabed mining. And I'm sure we can come up with maybe five or six more. But really, we cannot come up with sunrise sectors that are not low carbon.

And therefore, the question for India is, what is the kind of economic direction we want to go in, which makes us both a climate resilient economy but also globally dynamic, and competitive economy? And we ask ourselves that question, now, a lot of the other question is about where we go without having to kind of, direct investment, there's just the signals we present become a lot clearer. Therefore, my final point is that we need to bring the energy transition a little closer to people. And Mohua has touched upon this, Dr. Mathur touched upon this a little bit. I think as long as we only take a supply-side approach on this, we will keep getting stuck in a conversation around at the levelized cost of electricity metric; you know, is old coal better or new coal better or renewables better or renewables plus storage better? And we'll keep having those debates. We estimate that there is a \$50 billion opportunity in using existing distributed clean energy solutions to power up our rural

livelihoods; not light up a bulb in the heart of a farmer, but actually, power up rural livelihoods; on-farm and non-farm activities, more than \$50 billion opportunity.

Unless we figured out the platforms, the financing, the upfront financing, the working capital for the micro entrepreneurs, and so forth, we will not be able to connect the economic opportunity that exists, the technological opportunity that is available, and to the people who are looking for a very different way forward to drive their livelihoods, to drive their employment as well. And perhaps, if we have time, I can comment on that.

Laveesh Bhandari: Yes, I would like you to come back to this point later. Thanks, Arunabha. May I ask Kelkar?

Ulka Kelkar: Thanks. Thanks, Laveesh, and thank you to CSEP for this invitation. I wanted to echo what Mr. Godrej said and say that not only do we need a whole of government approach, we need a whole of economy approach and a whole of society approach. And the example that I'll give is that with the carbon tax that we've discussed quite a lot, and although Dr. Mathur disagrees with perhaps, what is the right level of carbon tax required to incentivize shifts, our analysis shows that it plays a much bigger role, which is that of putting revenue in the hands of government, boosting spending, boosting GDP and jobs. Without that role of the carbon tax, and the net zero story may not be a positive story for the Indian economy. The second point I wanted to make was really regarding the fact that there are solutions that are hiding in plain sight. So, the net zero transition, there are easy, doable aspects that do not require us to wait for futuristic technologies. And the example that I wanted to do was that of Fleet trucks.

We can talk about electrifying trucks, we can talk about hydrogen trucks, but one of the really simple solutions in our hands is that of regulatory reform that allows a modal shift from road to rail. And it is held back by certain issues of regulations that prevent the railways from being nimble enough in order to meet this sort of mitigation potential opportunity. Otherwise, the transport sector is something that is likely to triple in its emissions by 2050 and become comparable to agriculture and the electricity sector. And freight truck is really the biggest going source of emissions. The other example I wanted to speak about, that we've all talked about, how industry is really at the crux of this net zero transition. We've spoken about harder-to-abate sectors, but there is a potential peril over here again, which is that if we talk about material efficiency improvements, not energy efficiency improvements, but recycling, reuse, there is actually again, a dampening effect on jobs potentially.

So, you need business models that allow value addition, and greater productivity, if you want, again, the job story to be a positive one. I'll end with this issue of sensitivity to land rights and land livelihoods. After all, all the renewable energy that we need to produce our hydrogen, all the vegetation that we need to plant to sequester carbon, is all going to come from land. There are people who own that land, there are people who don't own that land, but depend on it desperately for their livelihoods. So, we need checks and balances, we need sensitive procedures and that is also part of the Just Transition. Thanks, Laveesh.

Laveesh Bhandari: Thanks, Ulkar. May I ask now, Rahul Tongia to share his views.

Rahul Tongia: Thank you. I just would like to share two thoughts and A, of course, agree with a lot of what was said. And if I could even almost steal or paraphrase something that Mohua said, which is almost that incrementalism and the old system will only get us so far. So, we've really got to think of very dramatically new ways of attempting things, and it's okay to fail. I think that's one of the things that's been missing in a lot of our discourse, because we're only going looking for slam dunks or things that are the best. But we also need to take a lot, lot, lot of smaller, medium and different levels of steps.

Two points; one, I want to just pick up on a thread, Montek, you had mentioned, and I'm going to quote you, not to pick on you, that you have states doing an arbitrary renegotiation of PPAs. And the observation is part on about the political economy and structural issues. They're not arbitrary in the current lens and framework that's out there. They actually have a surplus of PPAs on the cold side. And the big worry is, if we just tell them, "Thou shalt buy RE", they're going to have a surplus of PPAs on the solar side, which A, may not meet their peak needs cost effectively in the short run. And second, there's this other problem, which we've seen in the current rounds of "renegotiation", is the competition of RE isn't with coal only, it's with the RE five years and 10 years out. So, managing that, leads me to the larger point, we need the right frameworks to make this happen. I get it, that people want numbers-like targets. A lot of our work has shown that targets can be useful, they give signalling, but they can also be very distortionary.

So, I'm delighted if our conversation today really emphasizes why India is just saying, "This is the date I become net zero" is not the right question to be focusing on. And so, instead of a target, per se, but I will give you one that is worth pushing for India, is really getting the right frameworks in place. This is not just DISCOMs, this is not just RE, but the entire energy system with its distortions. But time of day pricing was one that you had mentioned, and a lot of us agree with, that's just one of many, many things. What India can do, I think, is focus on very high variable RE. This is counter to what some people think. Some people just say, "Well, let's get batteries" or that they're cheap enough. The good news is, there are multiple years ahead for India, where it can just grow RE as is without even the need for a battery. And obviously, after a few years, that won't be the case. But let's first get that to happen, because when you have ambitious 2030 targets for RE, you also have an ambitious 2022 target for RE, which isn't being met for multiple reasons, and we cannot blame COVID alone for that.

So, getting the structural fixes, battery isn't your bottleneck yet, but it is an area of importance. But then, the more futuristic technologies like green hydrogen, I think, are a few years away. So, we have to plan for them for sure, but I think there's enough tools in our arsenal, enough instruments where we can just take forward what's available, but certainly, cheaper finance would be one ingredient for all of the above.

Laveesh Bhandari: Thank you, Rahul. Since no hands are up, so there is no pressing point to be made, I am going to request two people who are in the audience to join in on the discussion. And at first, will ask Amar Battacharya to come in and just very quickly share his views on this.

Audience 1: Okay, great. So, I just want to pick up only on one issue, which is highlighted by every speaker, starting with Montek. And that is how do we get the scale of finance at low cost to be able to meet this intergenerational financing challenge and the upfront nature of it? And I just wanted to say that, you know, in terms of the current positioning of this issue, where India could put some pressure. So, the first is, if you think about the composition of this 100 billion, roughly about, you know, 40% of it comes from the official bilateral climate finance. And at the moment, that level is around 30 billion, and it needs to increase. And Nick Stern and I have argued that the target for that, should be not to wait till 2024 to set a new goal, but a commitment to double bilateral climate finance from the current level, to 60 billion by 2025. Second, we are arguing that multilateral climate finance, which is currently about 30 billion, or 30 billion in 2018, should be tripled to 90 billion by 2025. And we are arguing that there needs to be, as many of you have stressed, a significant emphasis put on mobilizing additional private capital, but ensuring that that capital is of reasonable cost.

At the moment, for every dollar of official capital, we are mobilizing 25 Cents, it should be the other way around. So, if you take that package, you could get a scale of finance by 2025 of about 400 billion in the climate finance space. And that gives you the arsenal to push the kind of energy transition, and then, that we want to push more. There is also a specific issue for India. Because at the moment, you know, India was pushed out of IDA a little bit too fast for some of us, and, you know, India is not able to get the scale of financing that it requires from IBRD because of the single borrower limit.

Laveesh Bhandari: May I request you to round off.

Audience 1: Okay, so I'm just going to close with that. So, I do think we need to have some specific solutions. CoP 26 provides India to actually come to the table with a grand bargain, but it has to be around the kind of elements that are laid out on the paper.

Laveesh Bhandari: Thank you. Very quickly, Vaibhav , could you share your comments?

Audience 2: Great. Great. Thank you so much, Laveesh. Thank you, Mr. Ahluwalia. This is a very interesting debate very close to CEEW's heart. So, I'm delighted to be participating in this. There are so many moving parts. So, it's very challenging to pick up on one, but let me just talk about, I think, the criticality of this net zero thing in itself, you know, because a lot of debate has been conflated, because in India, we have started talking about net zero by 2050. And that is not really the debate at all. I think everybody agrees net zero by 2050 for India's next to impossible. The question is, at some point in the future, we should be aiming to the to net zero, whatever that year is, because we do know that every emission molecule that we're emitting today does stay in that posture as a stock for like, 100 years. And it is going to have increased implications for climate change and climate risks. That that is the reality and that is why thinking about the net zero is critical because policy signals are extremely important. I do take Rahul's point, that policy signals could also be distortionary in nature, but at the same time, the question is always about this choice that, okay, even if there is a bit of distortion, is it worth doing it? So, the question is that, and I think a net zero issue is extremely critical, we should think about something very credible. So, it is not just about saying something for 50 years down the line, it is okay, what is also going to be the peaking thing?

Laveesh Bhandari: I'm very sorry, but I will have to ask you to round off.

Audience 2: Yes, yes. Thank you. So, these are my kind of, you know, some quick remarks. But yeah, very interesting discussion. Thank you, Laveesh for having me here.

Laveesh Bhandari: Thank you. So, I'm at the end of my extended a lot of time, and I again, apologize for not giving everyone enough time for an extended discussion. But may I request Mr. Ahluwalia and Utkarsh to very quickly respond to some of the comments that have been made.

Montek Singh Ahluwalia: Thank you, Laveesh. the best response I can give is really, to thank all the participants for really providing a very rich commentary on some of the things that we've said. And quite frankly, the idea was originally to produce CSEP paper based on this presentation. And what I would like is to be able to take a look at the comments in detail, put them together, see in what way they lead us to do a little bit of rethinking of our position. Overall, there seems to be a lot of sympathy for the idea that India should adopt a positive approach. Nick even talked about leading, leading means but definitely, we need to give the impression that look, we're serious about it and we're positive about it and we're not simply saying, "Oh, it's very difficult, etc. I think some of the comments that Omar made, I'm glad he came in on the financing, we do need to take a little more into account. And, you know, I need to think about a bit surprised that Ajay being so negative about carbon taxes. I mean, my view, he's absolutely right, by the way that, in the past when we imposed carbon taxes, the idea was that they will be used to promote green energy.

And of course, they got used for all kinds of other things. The fact is that if you want to make transition of the kind we're talking about, which is humongous, you are going to have to lubricate it with some amount of money, and I can't think of a better way of raising the money than through some form of carbon taxes. Actually, in my view, a lot of the tax that we have on petroleum, some of which is part of the carbon tax, should be earmarked so that it can be used to actually bring about the new change that we're talking about. But I discussed this with him individually, and, in fact, we will take a very careful look at what's being said, and more importantly, some of the questions that have been raised, and maybe get back in touch with individual participants. At this point, on behalf of both Utkarsh and myself, let me just thank everybody and reassure them that their thoughts and suggestions hopefully, will get reflected in a much-improved version of the presentation, which will become a paper. So, thank you all.

Laveesh Bhandari: Thank you, Mr. Ahluwalia. And now, may I hand it back to Dr. Rakesh Mohan, for his closing remarks. Thank you.

Rakesh Mohan: Thank you very much, Laveesh, for putting this together and doing an excellent job in moderation. You're really hard fellow in terms of keeping everyone in check, but that is absolutely necessary. Thank you very much for doing it. I want to make two substantive points very, very briefly, just something that covers a whole area, which is the challenge for developing countries in general and India in particular, is of course, that energy demand will continue to increase with at least another three or four decades, given the low level of energy per capita demand that we have. And of course, unlike developed countries who essentially have to substitute renewable energy for existing non-renewables, we have

this double challenge of increasing supply to meet the demand, along with all the measures that have to be taken, so that we decarbonize.

The discussion has provided the key parameters and challenges it faces in tackling this big challenge. Second, I do need to make a mention on financing, it's a key issue. As Omar has pointed out, Nick has pointed out, Amitabh Kant and others, that it's not easy at all. We cannot have the illusion of low-cost financing, particularly in the private sector. The cost of financing would be whatever it is in whatever finance costs in the world, except for of course, official financing. And here, I think that we cannot escape greater domestic financing, which does mean higher tax GDP ratios; whether it comes through carbon taxes or other better revenue generation. There is no free money in the world. And now that I've made those two substantive points, it now remains for me to re-thank all the panellists and discussants for very thoughtful and proponents given in very brief fashion. And it's also very glad to see from the government side, very positive approach of not saying, "Look, we can do it" but saying, "Look, we have to do it, and we're going to do it".

How we succeed, of course, is a different matter, but I'm very glad to see that from the government side, we haven't provided a very positive approach. Finally, let me just thank Montek and Utkarsh for bringing to the floor all the key issues confronting us on climate change and decarbonisation. This will, of course, be a continuing debate. And maybe we will have more in-house closed-door debate, among some of the panellists along with Montek here. We'll see how we can do that in a useful fashion. And of course, finally, CSEP will continue working on this for the foreseeable future. So, thank you very much, everyone, for this really very, very interesting session.

Laveesh Bhandari: Thank you.

Montek Singh Ahluwalia: Thanks, Laveesh, goodbye everybody.