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POLLUTION

Karolina Ordon: A clicker is here. Okay. All right, whoever is planning to join the session on pollution, please make your way to the Preston Auditorium. We're about to start. Maybe I should start talking. Let's start talking? Okay. A third and last call. Okay, I think that this is, this is it. Whoever is not here is going to miss the beginning. So welcome to Session Three on Pollution, chaired by Somik Lall, Senior Director and Senior Adviser and Director for Development Policy in the Office of our Chief Economist. In the session, our panelists will share research that offers a comprehensive look at both the challenges and opportunities in using market-based approaches to address pollution and climate change. While our discussant will provide expert commentary and help synthesize the key takeaways. So with that, let me hand over to our Chair and ask whoever is on their way to please take their seats and come over. Thank you.

Somik Lall: Thank you, Karolina, and welcome everyone. I hope a lot more of you join, but those who have joined, thank you very much. I'd like to welcome all of you to our session on pollution. And the title of the session is "Pollution" because when we started thinking about the session and designing it, we were motivated by Professor Michael Greenstone and his 2024 AEA Distinguished Lecture which was on "The Economics of the Global Energy Challenge."

In that lecture, Professor Greenstone highlighted that the global energy challenge is defined by three often conflicting goals that all countries have. And this has to do with getting cheap and reliable energy, having clean air and limiting the damages from climate change. And when it comes to energy use, there's a close correlation between energy use per capita and rising incomes per capita. In fact, there is no country in the world that's become rich without a dramatic increase in energy use.

And right now, there are billions of people in low-income economies and middle-income economies whose aspirations for themselves include the dramatic rise in energy consumption. So, here in America, an average American consumes 13,000 kilowatt hours of electricity per year. But around the world, there are about 3 billion people who live in countries with per capita electricity consumption less than 1500 kilowatt hours a year. So rising energy use has been accompanied by pollution and carbon emissions. And while America now accounts for 14% of global carbon emissions, emissions in middle-income countries, particularly in India and China, have been on the rise, linked with their growing economies.

So here's the challenge. A policy that's telling middle-income countries and low-income countries not to have a dramatic rise in energy use — that is to not develop — is just a nonstarter. It sounds a lot like what Indermit [Gill] told us this morning, the hypocritical statements made by elites in advanced economies. And for all these countries, fossil fuels are predicted to be the dominant source of energy through the middle of the 21st century.

However, there's a case to be made for aggressive reductions of fossil fuel and that's the immediate health effects from conventional pollutants. Michael Greenstone's research that Kaushik [Deb] is going to tell us about shows that air pollution poses the greatest external threat to human health, with the average person losing more than two years of life expectancy. This loss is comparable to that from tobacco smoking and much greater from alcoholism, terrorism or war. So if low and middle-income countries need to take steps to reduce conventional air pollution from fossil fuels, it also provides a shot in the arm for searching for alternative sources of energy.

So we're going to have a real vibrant debate this afternoon because we're going to talk about energy, we're going to talk about clean air, and we're going to talk about reducing emissions. And we have an amazing lineup of speakers. Jan Steckel is the Chair for Climate and Development Economics at the Brandenburg University of Technology and associated with the Potsdam Institute for Climate Impact Research. Barbara Haya is a Senior Fellow at the Goldman School of Public Policy at UC Berkeley and is the Director of the Berkeley Carbon Trading Project. And Kaushik Deb, he is the Executive Director of the Energy Policy Institute at the University of Chicago and leads EPIC's work

in India. And I'm very excited and delighted, my colleague, Carolyn Fischer, who is the Lead Economist and Research Manager for Development Economics at the World Bank. So, Jan, Barbara and Kaushik will give us about 17 minutes each max on their research and Carolyn will kick us off with the discussion as a discussant. Following that we'll have a panel. But I'd love to hear your questions. So be ready to come to those mics and prepare your questions now. So Jan, let's start with you. Thank you.

Jan Steckel: Thank you very much for the kind introduction and also the invitation. I'm going to talk about the effectiveness of carbon pricing. So while I'm in climate and development economics. So this is why I'm interested in carbon pricing and I actually would like to kind of summarize what we know from the existing literature. And then, I would like to discuss a little bit what we can learn in particular for low and middle-income countries. So if you ask an economist, okay, what shall we do, like in terms of rising emissions, etc. Then they probably will answer like, okay, let's put a price on carbon. This is basically the standard idea. Like it is over 100 years old and we consider it to be the number one instrument to curb climate change. And it is not only an academic or rich world exercise; it is also getting increasing attention in low and middle-income countries. So you see in this nice report that the World Bank is publishing every year that like every year you basically see some more spots in the Global South here.

So, but I would like to argue in this talk that there are huge research and implementation gaps. And like of those schemes that have been implemented in low and middle-income countries, we see many schemes with very, very low prices. And this raises immediately a couple of questions. I'm not promising that I'm going to answer all of them because it will never actually fit in 17 minutes, but I will try to still offer some thoughts on actually how we can think about this. So first question is, is it actually effective given particular market environment? Second is, is carbon pricing actually the optimal policy instrument given other market failures? So as climate economists we tend to kind of focus on yeah, we need to basically bring down emissions, but what if actually there are not only co- benefits of climate policy but also other spillovers, negative spillovers, for example on increasing air pollution, etcetera. So I think we need to understand this better to then also think of the optimal design of policies. Third is of course a question, why is it so difficult to implement? And fourth is what would be kind of specific design features that can make it work also in environments in low and middle-income countries. But I would like to actually in this talk focus on two questions. One is what do we actually know about the effectiveness of carbon pricing? And the second is can we be sure that this then also applies for low and middle-income countries?

And I would like to start with the first kind of question with the paper that we have published last year which is actually a systematic review and meta-analysis of the ex-post evaluations of the effectiveness of carbon pricing. So we are actually kind of looking into the literature that has, in the causal setting, looked into, okay, there has been some form of pricing instrument, it can be a tax, it can be a trading scheme, what has actually happened to emissions? And the reason why we engaged in this endeavor was twofold. First was, well, it's an interesting question, but second is that basically, there have been a couple of papers that came out, like one, for example by Jessica Green, 2020 in Environmental Research Letters saying okay, carbon pricing has not actually been effective. And this was counterintuitive to us not only basically from kind of the theoretical papers and knowledge that we have, but also based on the primary studies that partly we ourselves have actually conducted. So, and the second dimension, why we are puzzled, was that basically what was labeled to be a systematic review was not at all systematic. It had quite a few gaps in terms.

So we actually engaged in doing a proper systematic review, which means that we have to go through various steps. So the first is that we have to engage in systematic screening, really trying to scrape all the relevant literature databases, including Scopus, RePEc, Google Scholar, basically, what have you. Really looking into with a predefined set of keywords like carbon pricing, emissions trading, ex-post, causal incidence, etcetera, etcetera, to make sure that we identify all kinds of the

relevant literature. So then, basically, we have developed some automated tools to make the sorting a little bit more handy for us. But still, in the end, there were about 4,000 papers where we had to read the abstracts by hand, always making sure that it's not only one person, but at least two persons to basically make sure that we don't miss anything. So in the end, we came up with a specific set of papers and literature effects that we think are more or less comprehensive.

And as a second step then we had to engage and think, okay, how can we now extract the effects? And the effect is we are interested in is the reduction of carbon emissions after the introduction of a specific scheme. And of course, the literature gives all kinds of different methods, diff-in-diff or synthetic control, etc. So this had to be harmonized. Also this, the literature, the original papers look into different kind of timeframes, etc. But all of this basically we tried to harmonize and we came up with a specific sample of existing carbon pricing schemes and ETS that basically have been covered in about 100 publications. And in those about 100 publications, we identified about 470 particular treatment effects, okay? And you can see if you look closely into this table, that those schemes cover like a very different share of the emissions. And also, if you look into the prices, they range from $3 in the RGGI scheme to about $100 in Sweden. So let's have a look into the results.

The results actually are that once we have seen carbon pricing schemes to be implemented, they have on average reduced emissions significantly by about 10%. So this is what the literature says. You see that there are huge differences, like ranging from about 20% in the RGGI to actually a positive effect in the Swiss ETS. So we did some analysis aiming to try to explain what is actually now the differences. And one of the largest differences is actually the sector OF coverage. So when it has been actually applied on energy or industry sectors, we can find that actually the emission reductions have been larger than in other sectors. Also, and this is kind of logical, if the original studies have looked into a longer period, then we also find a larger reduction effect. So you might wonder, and I'm saying this upfront because this question comes up every time, why has it actually been positive in Switzerland? And this is actually the last point, like the kind of how the study has been conducted is also a decisive kind of predictor or like element why these are different. And in this particular study, the authors looked into the difference between the introduction of the Swiss ETS, which has replaced a different scheme, a regulation in the industry sector, which has been actually more ambitious than the ETS here. So it is not so surprising that we find a positive effect here.

But it still relates to an important question that we all know when we are in academia that not every study is of the same quality. So what we also did is that we wanted to know what is actually the effect of particular bias and the effect of statistical power in those studies. And I just realized that the numbers are, I mistakenly swapped them. So when actually controlling for specific biases, so for example, the control groups are not comparable to the treatment groups or there are some omitted controls which we more or less kind of did by hand. So this coding, then we find that, okay, this is actually not really affecting the results. It is still 10.8%. However, if you basically take those studies out that are statistically underpowered, then we find a slightly lower effect of about 7%, but the bottom line remains the same. So emission pricing, where we have robust ex-post causal evidence has been effective in bringing down emissions.

So one thing that you immediately realize when you look through these sets of schemes that have been studied is that there's very little evidence on low and middle-income countries. And I won't have time to actually go into this in detail, but this is exactly what we are doing in my lab, that we try to provide this primary evidence. And I just would like to give a very, very quick insight on a study that has just been published as a working paper by one of my postdocs, Johannes Gallé and they actually look into the effect of this South African carbon tax, which has come in effect in 2019 in the South African industry sector. And they actually find that they cannot prove any robust evidence on emission reductions in this particular scheme.

But I would like to actually go one step further and this is why I decided to actually introduce another paper. I haven't been the co-author here, but my colleagues at PIC have actually published this last year in Science. And they ask the question the other way around, right? Like if we basically do policy evaluation, then we often pick our favorite policy instruments, emission pricing, and then we do an evaluation, has this been effective? But actually, the question that we are interested in is what has brought down emissions. And this needs a slightly kind of different research design. And this is what they have been doing. They have developed basically a framework where they, for different countries and sectors, look into how emissions have developed by a synthetic control framework. They look into emission breaks. And whenever they detect a significant emission break, not just a random 1% dip, but like at least 5% up to 10%, they say, okay, this now actually is an emissions break in a particular sector. When applying this, they find in, overall, 69 breaks with an average emission reduction of 19%. You can see like all across the board, like in Europe, in North America, Latin America, Asia and Oceania. So we have actually seen those breaks everywhere. What they do next is that they assign specific policies to those breaks. So they actually use a database from the OCD on policies, all kinds of policies, not only price policies, but also changes in the building code, for example, or air pollution standards, etcetera, and they assign it to those breaks. In the end they come up with this very complicated graph. I don't expect you to understand it at all, but basically it gives you all the various policies and countries where we have actually seen some policy induced reduction. If we just zoom in one example, China, for example, so this has been a break detected in the industry sector. And they can assign the pilot ETS in China and a fossil fuel subsidy reform to this effect. Doing this for many, many countries, they can then also actually look into specific differences between developed and developing countries by sector. And I think this is really interesting to look at because the first result of this paper is that generally policy mixes have been much more affected than single policies. And they have, in particular, been effective if there has been some price instrument actually in place. But there are some differences. So if you look into this graph the different circles here show you what policy has been affected. So for example, here some 27.3% of the successful interventions were regulation alone, but you see that most were actually combined with some subsidy, with some pricing, etcetera, etcetera. So what they find is when in those sectors with private consumers, they find the most complementarities, if you like, then the pricing instruments have in particular been affected. And this is a quite similar effect, quite similar result to what we have found also in the systematic review. Like where we actually see profit maximizing firms at work. And this is true both in developed and developing economies, there basically pricing instruments have been in particular effective.

So now the most interesting difference is in the electricity sector. So you see in developed countries actually it's been mainly been pricing instruments that have managed to bring down emissions in the electricity sector. In developing countries, they could not find any emission break that can be traced back to pricing instruments alone. It's only subsidies and it is regulation. And this, of course, immediately gets us to the question, so what are the conditions for pricing interventions? Can pricing too work successfully? Like looking into the electricity sector of developing countries, a couple of things come to mind. It is the role of liberalized markets and other price distortions that might be at play, the role of specific sequences of policies. For example, a liberalization of an electricity market might need to come first before we apply a pricing instrument. And then, of course, the role of institutions, state capacity, etc. to regulate. And last but not least of course the role also of state-owned enterprises that might be particular salient in the electricity sector.

So now I have another talk of 17 minutes of what we can expect and I won't give it to you, but I just wanted to mention a couple of things for discussion. So why should it be different from theory? One is the effectiveness and, I think I have talked about this. I would like to say two words more about the interaction with other externalities, including health because we have been doing quite some work to look into the effects of cooking fuels when, actually, people are exposed to price changes by subsidy reform or by a carbon price. And this is, actually, in the fact that in developed

countries nobody would actually think of, but in developing countries it is highly important because we want people to use more fossil fuel in terms of LPG, in terms of lowering exposure to indoor air pollution, etc. And we find that this might actually counteract. So the introduction of a carbon price might actually lead to more indoor air pollution because people are pushed down the energy ladder and actually use more firewood or charcoal, etc. with the related health consequences. And when thinking this through and then looking actually into the comparison between social costs of carbon and these health costs, we find that in many countries, including India, actually for the country itself, I've seen you, it would actually not be optimal to apply a carbon price.

So then it comes to the last point that I would like to make, and this is, are countries actually, because you could think of design schemes to alleviate this effect, but the question is, do countries have actually the institutional means to do that? And who would actually need to be compensated? Do we need to think of specific design features, etcetera? I think all of this is highly relevant when thinking about carbon pricing in developing countries. And with that I stop and thank you very much.

Somik Lall: Thank you. Thanks so much, Jan, for those excellent insights. Barbara, over to you.

Barbara Haya: Okay, now let's turn attention to carbon offsets. It's a very different story than carbon pricing. So offset programs are often appended to carbon pricing programs. They allow an emitter to pay someone else to reduce emissions instead of them reducing their own emissions under a cap or sometimes instead of paying a carbon tax. And I've studied the quality of carbon offset programs for the last 20 years looking at a range of programs. And in general, carbon offset programs have worked dismally. It's common for them to over-credit 10 times or more. And over-crediting matters because to the extent that offsets are used, they can undermine the effectiveness of the emissions cap or regulatory system. And when they're used by companies, they can be used by companies to sell carbon neutral products that are not carbon neutral.

Okay, thank you. So for the next 15 minutes or 17 minutes or so, I'm going to make three points. One is that most major offset programs to date have significantly over-credited. I'll explain the common sources of over-crediting over the project types that have generated the most credits over three major carbon offset markets. Second, I'll describe, basically, why I'm having the same conversations today about poor quality as I had 20 years ago when I started doing this research. Why such persistent and deep over-crediting? And I'll argue that poor quality is inherent to the underlying incentive structure of carbon offsets. And then I'll discuss a way forward. And I'll conclude that given the 20-year history of carbon offsets, given the underlying quality issues, I think we need to move from carbon offsets and I'm putting forward an idea of a contributions approach.

So let's discuss the first major carbon offset program which was established under the UN under the Kyoto Protocol. So under the Kyoto Protocol industrialized countries had caps, developing countries didn't have caps and industrialized countries argued greenhouse gasses are well mixed in the atmosphere. Why do they need to reduce emissions domestically? Shouldn't they be allowed to reduce emissions anywhere in the world where it's cheapest? And I did field research in India on the outcomes of the program focusing on grid connected renewables and hydropower which to — I don't know if I can point. Anyway, it's the rightmost. Together they generate the most credits and they both, hydropower and renewable energy, use the same methodology. So I looked at them together and methodologies are the backbone of carbon offset programs. They define what projects are allowed to participate and how to estimate and monitor emissions reductions under them. And I found that the large majority of these projects most likely didn't reduce emissions at all. The program mostly paid project developers to develop projects they were likely to build anyway or they were already building. And the problem was that the UN casts a very wide net in what project types were allowed to participate and required every project developer to prove that they wouldn't have gone forward with their project were it not for the offset incentive, the offset income. And what I saw was that, or what I found in this research, was that it was very easy for project developers to show that cost effective projects were not cost effective, such as by strategically choosing assumptions that

go into a financial assessment or by describing barriers to projects. And what happened was high levels of over crediting and non additional participation kept prices too low for that incentive to really affect, to incentivize new mitigation. Adverse selection happened and that phenomena is adverse selection, right? The first projects to participate are the ones that cost the least. Those are the ones that would have gone ahead anyway.

I concluded that the large majority of the projects are non additional, not just in India but across the world. And another article after mine, Kim et al did a broader review of more project types and puts a number on that estimated that 85% of projects most likely were non additional or over-credited. I then turn attention to California's offset program which was structured in a different way and I believe a much better way. It was structured specifically to address the quality issues with its predecessor program. What California did is narrow, instead of casting a wide net and requiring every project developer to prove the additionality of their project, they defined a narrow set of project types that were unlikely to move forward on their own, that were likely to be affected or incentivized by the offset income. And I studied the improved forest management, which is the project type of 3/4 of California credits on the compliance market, but these credits also generated over a third of all credits from projects in the US including the voluntary market.

And what I and others have found is, again, a better structure but widespread over-crediting. And the way the protocol works. The way the improved forest management protocol works is that it allows any forest landowner anywhere in the US to generate credits if they commit to holding more carbon on their landscape than the baseline, where the baseline for the most part is set at the average for that forest type. Now, there's heterogeneity on the landscape. And what we would expect is, again, adverse selection, where the first forest landowners to participate are the ones that participate and cost the least, that are already holding more carbon on their land, whether it's for climatic reasons, ecological reasons, or the type of timber they're producing, already are holding more carbon on the landscape than the average, so that they can generate credits without any change. And that's exactly what we see. So the first two articles there used remote sensing imagery and found no statistically significant difference in forest management practice in the project areas compared to the past, how they historically managed the lands and compared to control lands.

Now, let's say some of these projects really would have logged aggressively to bring their forest lands down to the average. An earlier study that I did was on leakage, where I found that the protocol systematically underestimated the impacts of when you reduce logging on participating lands, but you don't change the demand for timber products, of course, you get some displacement to other lands. And it dramatically underestimated the impact of leakage. So much so though, that it over-credited five times. It uses a very low leakage rate and it averages leakage over 100 years rather than deducting it at the same time that avoided deforestation is credited. What we see here, in sum, is that it's much better structured, but you still have adverse selection. And the quantification methodologies in several ways are not science aligned.

I then turn attention to the voluntary carbon market, which generates credits for voluntary use, such as by companies, universities, other institutions to meet targets like carbon neutrality. I studied, again, the project type of the most credits, which is red also, that means avoided deforestation. And I also did a study of cookstoves in the purple that is the fastest growing offset project type. I brought together a team of researchers and we comprehensively looked at the major elements of quality of the four main avoided deforestation methodologies. And a few things we found over crediting under every rock we turned. And we were able to explore why, what is happening? Why is there so much over-crediting? And what we found is flexibility. That the protocols were written in a way that allowed a wide range of projects, a wide range of forests to participate across the globe. And project developers, when confronted with flexibility in how they can set the baseline, how they can assess leakage — especially given high levels of uncertainty in both — made methodological choices that led to more credits rather than less. Why wouldn't they? And the third-party verifiers that are the

enforcers of quality in the system, they didn't enforce conservativeness. They didn't even often enforce common sense. They just, they allowed projects to move forward if the quantification methods were allowed by the methodologies.

And one other factor that I want to mention with red is that your work these projects are working to avoid deforestation around the globe. This project type could not be more important to be effective. What we see is that many of these projects, or most of these projects, target smallholders rather than the major industrial drivers of deforestation because it's cheaper to do so and while they could generate credits against fictitious baselines. And so, most of these projects restricted forest communities from their use of forests. And also, some of these projects came at a real risk of harm to forest communities. So the reason… Oh, and really quickly. So we did a comprehensive assessment of cookstoves offsets looking across all the major factors that go into quantifying emissions reductions across a sample of the projects on the market and found over-crediting of 10 times. So the reasons that I've highlighted over the three generations of offset programs are common among many project types.

The question is why such persistent over-crediting. There's clearly a structural reason why 20 years of learning by doing we get the same outcomes. I believe it's these three things working together. We have high levels of uncertainty. We know how to measure emissions. It's much harder to measure emissions reductions because you have to measure them against a counterfactual scenario that never happened and is unobservable. And information asymmetry, the project developer always knows a lot more about what they would have done without the offset income than any verifier or program administrator. Those high levels of uncertainty are being deliberated by a set of market actors that all benefit from excess crediting. So the whole idea of the market is for buyers to be able to find the least cost emissions reductions. Project developers want to get, earn more credits for doing less, adverse selection. Third party verifiers are hired directly by the project developers, so they have a conflict of interest to be lenient, to be hired again, especially in the context of high levels of uncertainty and subjectivity. And the registries themselves, the program creators on the voluntary market, they're vying for market share. And in compliance markets there's political pressure to keep offset prices low. So what you get is a race to the bottom that if one methodology were to be tightened up and science aligned and not over-credited, the market flows to the other methodologies.

So what is the way forward? And I think I'll argue three things. One is that efforts to create quality offset programs are unlikely to succeed because of the history and the structural reasons. We need to shift from offsetting to contributions claims. And what I'm most excited about going forward is a shift from offset markets to direct contributions. And let me discuss each of those.

So one is, even though I think it is unlikely that we're going to be able to achieve an offset market that is quality and not significantly over-credited, it's still worthwhile to have quality methodologies. They can be used for contributions approaches. They can be used for offset programs. A narrow set of offset project types that we're offsetting, that offsetting really works for. So how do you do that? One is, well, most important, I believe, is to remove conflicts of interest. So that means methodology should be designed and evaluated against clear criteria by independent experts with interdisciplinary scientific and practical expertise. Verifiers should be hired by independent bodies rather than by the project developers themselves. And credit calculations should be released publicly so that independent parties like us can evaluate quality. And then by criteria, I put forward doing a comprehensive over/under-crediting analysis where you compare methodologies and how they're implemented in practice by projects against the scientific literature and best practice in a quantitative analysis. A benefit is that it acknowledges that some projects are going to over-credit, there's going to be some non additional crediting, but you can structure your program so that there's enough conservativeness and under crediting so that programmatically it's a quality program, you're not over-crediting. You want to assess quality elements. I'm going to, okay, assess quality elements,

taking into account the lean towards over-crediting all the things that we've been talking, and treating uncertainty conservatively.

I think it's really important to shift from offsetting to contributions claims. Where offsetting claims are, you treat reducing your own emissions as equivalent to paying someone else to reduce their emissions and you can call it a net number. The problem there is it creates a disincentive to reduce emissions. A company that dramatically reduces their emissions and buys offsets for just the small remainder and another company that emits like crazy and just buys cheap carbon credits, they look the same. They can both claim the same carbon neutral or net zero claim. And if you switch to a contributions claim where you don't let those two numbers be netted and a company can discuss how much it's reduced its own emissions, it can discuss its contributions. It's a more complex claim, but it's more honest. It refocuses attention on direct emissions reductions and it creates flexibility to support a wider range of activities based on a wider set of goals.

My final substantive slide that creates an opportunity through shifting from offset markets to direct contributions. And an offset market writes a set of rules and lets the market go and find the cheapest reductions. Direct contributions moves us out of that marketplace and buying a commodity into a space of what a company would do if they're contracting with a supplier or giving a donation. You would vet organizations, you would vet programs, you would build a relationship with them. So contributions approach would mean giving directly to NGOs, giving directly to government programs, giving directly even to companies such as those distributing very fuel efficient cookstoves. Characteristics of the direct contributions approach are that you directly contribute to those entities. So money is going directly to those entities, not to brokers and consultants, etcetera. You can provide funds up front when they're most needed. You can denominate primarily in money rather than in tons. You can still quantify the greenhouse gas benefits, but you denominate the contribution and money, and that it invites taking many more factors into account, not just cheap carbon. And it also allows for supporting a wider range of activities to drive decarbonization, including some that are hard to quantify the greenhouse gas benefits. For example, like in the agricultural sector, supporting a range of activities to bring farmers into different practices, which can be demonstration projects, technical assistance, incentive programs, outreach activities, and be nimble and adapt over time.

And lastly, I think we don't have time to waste on programs that have already disproven themselves. And I'm very excited about shifting the framework from offsets to direct contributions. I think it can have much better impacts.

Somik Lall: Thank you very much, Barbara. That was very insightful and been depressing. So let me turn now to Kaushik for your presentation on India's pollution program in Gujarat.

Kaushik Deb: Thanks, Somik. Let me just grab the water. As my slides come up. I think being the last speaker of the day, it just falls to me to put up whatever little defense I can for economic instruments to deal with environmental problems. This is a piece of work that has been ongoing in a city in India called Surat for the last 15 years. It's an experiment to see whether we can use market-based instruments to deal with environmental issues. And it's an experiment that we've constantly evolved and evaluated and gotten to a point where we think that this is a viable tool that can be used to deal with at least certain environmental problems. And we're trying to deploy it much more extensively in India and elsewhere. So what this presentation does is of course talk about Michael's paper which came out in the Quarterly Journal of Economics a couple of months back, but also talk about what that paper has meant in terms of our activities and actually using a textbook tool to act, to create an economic service that deals with environmental issues. So what's the problem that we are dealing with?

Essentially air quality and pollution. And let me show you exactly what that means. Somik, you talked about what air quality means in terms of lives lost. On an average, air quality causes more damage than tobacco, alcohol, terrorism, HIV, malaria. And this impact is very significant. Two years

or over two years of everyone's life globally. I mean, when you're living in a city in Delhi like I do, it's almost eight years of your life. And that's, I mean, I'd argue a fairly chunky piece of your existence. So you really are dealing with this challenge on a real time basis. We're also dealing with this challenge on a real time basis where this tradeoff between the aspirations of a population of nearly 1.5 billion people wanting to achieve a certain level of prosperity and having to deal with air quality and emissions that come from using fossil fuels as extensively as is happening in a country like India. You have to start to think about these as not necessarily issues that are in tension with each other, but how do you kind of resolve this tension? And that's really where we are trying to use market-based instruments to solve for that problem.

Because historically, everywhere in the world what we've tried to do to deal with air quality and pollution is essentially use a plethora of regulatory instruments, mostly command and control. And these have been so extensively deployed since the early 60s in the developed world and then subsequently in the developing world in the 90s and thereafter that the number of regulatory instruments that even exist in a country like India is really, really incredible to just deal with air quality and pollution. But the impact, as you saw on the previous slide, hasn't been as dramatic as we would like that to be. So there is something missing in this equation that you need to fix. And if you kind of think this through, why is it this a problem? Because how do you deal with air quality and emissions from industrial units in most parts of the world? This is a really, really labor intensive, regulatory capacity intensive process that cannot be deployed at an extensive scale anywhere, even in a very well-equipped regulatory capacity that you might have in the United States or in Europe. It involves essentially a person climbing up a stack, emissions stack, a chimney stack in an industrial unit, collecting a sample of emissions for a certain period of time, taking that sample back to a laboratory and testing whether that actually meets the environmental standards or the concentration emission standards for that particular plant or not. This is something that you clearly can't be doing on a daily or a constant basis. This probably happens once in twice in a year for most locations in the US, in countries like India, perhaps even less frequently. And even if you were able to do that, this does not really solve the problem of air quality and emissions from industrial units on a continuous basis.

So what we've tried to do in India, in Surat, is to try and see whether the use of market-based instruments added to emissions monitoring program that uses the state-of-the-art emission monitoring and control equipment, can that be a way to solve fuel emissions and air quality? And this is the experiment that we carried out in Surat that took over 10 years to set up and develop. This involved right from the initial stages of working with the Ministry of Environment at the federal level in India to identify the role that cap and trade schemes, emission trading schemes, could actually play in dealing with industrial air pollution. Working with the pollution control boards, the pollution regulators in India, to develop standards and regulations of what kind of equipment can be used to measure emissions and how that emission measurement can be put together in a manner that's transparent, above board, without discretion and cannot be tampered with, providing data on a 24/7 basis to a central server sitting with a pollution regulator, identifying folks who will actually go and do the work of installing these emissions control devices, calibrating them, making sure that they run exactly as they are designed to run, and set up trading mechanisms, a trading platform, bring industry partners on board, show them how trading platforms actually work, how they can actually measure their emissions, how they can actually trade their emissions. And then, having launched this program in 2019, go through a fairly extensive process of randomized control evaluations to see whether the emissions training scheme is actually having an impact or not. And coming to a point where the success of the program in this one location in Gujarat in India, has led to a proliferation of using this tool within the state, across pollutants and across locations, but also in other parts of the country as well.

And this truly involved a lot of sweat and blood and a lot of grimy effort where going through the process of installing these emissions control devices across 300-odd industrial units in the city of

Surat, making sure that these are providing data on a continuous, regular basis, that data is being evaluated, tested and made sure that is not spurious. Working with the regulator, sitting in their offices, designing and implementing the program in partnership with these officers and their inspectors. Because the idea here is to translate essentially a textbook tool into the regulatory and the legislative framework that exists for emissions management or pollution management in a state in India. So you have to get a work through the entire rule book of how emissions are controlled and regulated at the 115-odd regulatory frameworks that I highlighted earlier that exist to deal with air quality in India. Working with the regulator as well as industry partners to make sure that we are building their capacity, they know exactly what the scheme means, how that scheme is supposed to run, and make sure that they are well equipped to be able to use this tool on a firm basis or on a regulator basis, to be able to run the scheme itself. To the point of taking them through a series of mock simulations of what emissions trading scheme would look like. This is the trading platform that the firms use to carry out trading for particulate matter for these 300-odd firms in Surat.

And just to kind of show this entire process has been evaluated through a fairly rigorous and detailed exercise where we took these 300-odd firms in Surat, divided them into two groups, the treatment group, which were set up in the emissions trading scheme, and a control group, which continue to operate as though it was in the traditional command and control regime. And evaluating the differences of what that meant. And ladies and gentlemen, I mean the results are truly quite dramatic. The first, and this is the reason why we were able to bring the regulator on board. This is why the reason why the government came on board to try out this experiment. Essentially, the problem was noncompliance. Essentially, the problem was that industries were not meeting their emissions standards. And that's something that we can afford, able to establish very, very quickly that the moment you put in place the scheme and you allow the flexibility, something that Barbara pointed out could be a difficult thing to manage. But the moment you provided this flexibility to firms to be able to meet their emissions targets by buying permits and making sure that the firms who were meeting their targets but could do even better than that, you increase the level of compliance in the market to nearly 100% this 1% or less than 1% compliance. Fun story. This was in the first compliance period that we had and essentially two of the most politically well-connected firms in this textile cluster said that "Sue me, what do you do?" And that's interesting when the Chairman of the Pollution Control Board called up Michael and said that "So what do you want me to do in this case?" And essentially the response was that this is your opportunity to draw a line in the sand. If you establish your authority and your ability to manage and run this market, that's what will give you the regulatory credibility that you need to be able to run the market in a manner that you do not have leakages or noncompliance. And subsequently you'd get a... There hasn't been a single compliance period where we've had firms not comply with their emissions targets. And that's really the reason why the Gujarat Pollution Control Board has continued to use this tool and now is trying to deploy it across pollutants and across different industrial clusters to deal with a variety of environmental issues.

But the reason I think for me and for us the scheme was an extremely important success is that firms that were there in the command and control had their emissions, on an average, about 20% to 30% higher depending on which compliance period. So the fact that there was emissions trading scheme that allowed firms to reduce their emissions much more than the standards required them to do and be able to monetize that improved environmental behavior led to their emissions, the market cohort emissions being about 20% to 30% lower. And that I think is a very, very powerful tool, powerful outcome.

Thanks Somik, I'll wind up quickly, but this is the piece that I think makes for the success of the program. When the firms in the command and control regime saw that the compliance cost of the firms in the market was lower by about 11-odd percent, there was a clamor amongst all the firms that were not in the market to join the market. And if you think about it, this is obvious is economics 101. What does a market do? A market achieves a certain outcome at the least cost. And this is that

cost reduction that the market was able to achieve. And that's what's led to the third part of my presentation, the scale up activity that has happened, but just to kind of close this out, the cost benefit ratio here that we've estimated is about 215 to 1. This is an incredible number. This is an incredible number of a population, of a city, of a population, about 20 million people, just under 20 million people. The asset drain program in comparison in the US had a cost benefit ratio of about 50 odd to 1. So the impact that the use of this economic instrument has had in terms of improving the cost, improving the benefit of a society is really, really impactful.

But let me, the last few minutes of my presentation, show what this has actually meant. Having seen this happen in Surat in Gujarat, the Gujarat Pollution Control Board essentially wanted to use this as a tool, and wants to use this as a tool for almost everything that they want to do. Now, clearly you can't use emissions trading scheme for every sort of environmental problem. I mean you clearly won't be able to use this for instance, for dealing with transport sector emissions. You need large power-based emitters to be able and with enough heterogeneity for emissions trading schemes to work. But having done this exercise once in Surat, we've gone through the process of scoping which of these environmental challenges in Gujarat can be solved using a market-based instrument like this.

And the scheme is now expanded to include the textile cluster and in a bigger city in Gujarat called Ahmedabad. And we are now in the process of a designing effluence-based emissions trading scheme for two industrial clusters in Gujarat for the Gujarat Pollution Control Board. A neighboring state, Maharashtra, one of the largest industrial powerhouses in India, is now on its way to develop an SO2 market. So this is going to be a statewide SO2 market. It would cover about 300 industrial units. And this would be truly, truly extensive because this will include electricity, this will include pet chem, this will include fertilizer, this will include pharma, this will include refining, this would include cement and steel. So this is going to be a really, really remarkable experiment. This is a population of 140-odd million people. So you can imagine that the Surat cost-benefit ratio was 215. This could easily, I can imagine, be a four-digit number.

And similarly, we've kind of started the initial steps of scoping out a similar market for another neighboring state to Gujarat, Rajasthan. And now it's almost like the floodgates have opened. We've been having conversations with a number of states in India and a number of other geographies around the world to see whether this particular tool is viable and a solution and can actually solve for environmental challenges of a particular kind across these different geographies.

That's it. This is what I'm offering. So this is bringing this incredible piece of research, this extremely intense period of design and implementation to getting to a point where my ultimate objective is that this is a plug and play solution. So Surat took 10 years to do. I'm aiming that our market in Maharashtra is up and running in a period of about 18 months. In an ideal world this would be a plug and play solution where I can offer this as a service, as an economic service to any regulator, any pollution regulator around the world where we can go in, sit with them, design the solution and give them the market to run on a period until this environmental challenge is actually dealt with. So just to highlight the fact, this started with this incredible piece of research that the core theorem is to this incredible piece of research that Michael and colleagues published earlier this year to now a solution that we are actually designing and implementing on the ground. Thank you.

Somik Lall: Kaushik. Thanks so much. That was really inspiring. I hope you tell us later about how you're going to plan to scale up the work, but first let me turn to Carolyn. Carolyn, you've heard the three presenters and you've heard about both pollution and emissions using market instruments and regulatory instruments. So give us a little bit of your reflections and your takeaways from this.

Carolyn Fischer: Yeah, thank you. And thanks to all of you. I thought this was a really fascinating session. And so maybe taking it back to the theme here, there is this strong populist opinion that, a mistrust of emissions pricing as a means of actually reducing emissions. There isn't a lot of faith in that. There are a lot of people [who] view carbon pricing as a tax and redistribution scheme, and

not as a driver of decarbonization. In fact, in Canada we saw some backsliding. So Mark Carney, prior to the election, just canceled the carbon tax on households as just too politically toxic. So it was nice to see from Jan, we have really solid evidence that pricing mechanisms do work in the goal of reducing emissions.

So then we get to the question of where, and how, and how to make these feasible. So I thought it was really interesting. And so, one of your insights is that you found that the emissions reductions were larger in industry than in other sectors like households. And I think we do see that emerging. The latest state and trends of carbon pricing by my colleagues here at the Bank show that today a little over half of global emissions in the power sector and approaching half of emissions in the industrial sector are covered by carbon pricing instruments now primarily emissions trading systems. So that may be sort of following this insight that there are more effective drivers but also potentially more politically feasible drivers in these sectors. But also, I reflect from some of your numbers there, I think the design of these systems also matters. So we saw really big reductions from RGGI with pretty small carbon prices. Some of that may be… Like some of the states actually use the revenues to deepen reductions by funding energy efficiency programs and demand reduction. And so, they found that they actually reduced electricity costs in some of these states and deepen emissions. And then, when you had the sort of less effective example of South Africa, which actually has a higher carbon price than, ostensibly, RGGI, but part of the issue there is that up to 90% of emissions from any given facility are exempt. So you're effectively rebating the tax revenues to the firms in proportion to their emissions. So that really undermines the effect of carbon price being carbon price signal. But of course, South Africa is a very different context than northeastern U.S. states.

And so, there are also institutional issues that we need to be cognizant of and thinking about what other, for emissions markets to work, to what extent do we also need power markets to work, to be liberalized and think about other market failures? So I thought that was very interesting. And I know, I think we can also talk some more about policy mixes. I thought those insights were really compelling because showing that in a lot of situations you get bigger emissions reductions with a policy mix. Partly this could be because it's hard to implement a stringent enough carbon price to really send a strong signal. But a lot of other policies, infrastructure investments, can enable, give people the options to respond to the carbon price more effectively. And also, on the flip side, having some carbon pricing makes your other complementary policies more effective too. So for the same renewable subsidy, if you have a little carbon price there, that also increases the return to investments in renewable energy and so amplifies that together.

So okay, so we have evidence that carbon pricing actually works, but popular opinion tends to show greater support for conventional regulation. There's survey evidence across a lot of countries that there's more popular support for standards — upcoming WDR topic — than taxes, for sure. And so we do see. So in the case of India, we see that there actually is quite a bit of demand for regulation because the burden of air pollution is so extraordinary. So there is demand for that. And then, you've ended up with an enormous number of regulations, command and control regulations there. And so, I think this is incredibly important, it's showing that market-based approaches are much more cost effective. So this might be a way of coming full circle and then convincing people, and you also mentioned in the green room that switching to a market-based approach is actually increased enthusiasm of the firms for being regulated because they felt like they were benefiting from this program.

So I guess a couple of questions there. I'm wondering so how important? So my understanding that the scheme, this was not a redistributional schemes so much because the effectively the allowances were all freely allocated to the firm. So like how important is that aspect, at least certainly in getting something going. Other folks, other countries may be looking towards emissions pricing mechanisms also as a source of revenue for other activities that might deepen energy access or low carbon

investments. So there are tradeoffs there in how you use and allocate the revenue. So I'd be curious to hear about that.

And also, often one of the motivations for carbon pricing is the co-benefits, the air pollution co-benefits. And so, I'm wondering here, have you thought about the climate co-benefits of the air pollution regulation? Because if it's more salient to approach that regulation then can that framing help but also help deepen climate ambition because it goes hand in hand with these approaches.

And then finally Barbara, thinking about carbon offsets and we do see in several emerging economies interested in emissions trading systems, a lot of that is also as a way to finance domestic carbon reduction offsetting activities. But more broadly I see within the institution there are big hopes for carbon crediting as a means to generate climate finance.

And so, what do we do? As we switch-- I mean we see that the evidence about the massive over-crediting has really limited demand for credits, especially in compliance systems. So like the EU does not allow crediting against ETS compliance, but there's also voluntary markets. And so thinking about where, where does the demand for credits come from? Because these offset credits, there are a lot of different kinds of offsets. So there's forests, there's cookstoves, renewable energy, there's different things with very-- And actually removals like direct air capture. And they also come with very different characteristics. So in terms of the local community benefits and so as we… But they are hard to quantify especially when you're denominating everything in CO2. And so, I'm wondering as we move, if we can move to more of a contributions approach as you suggest, how do we valorize sort of like in a holistic way all the benefits of these different activities to enhance demand and what do we need to do to understand, like where that demand is coming from especially from the corporate sector and voluntary approaches. So thank you very much, those are my starting [points] for some discussion.

Somik Lall: Thank you very much Carolyn. Those were really insightful comments. So what we will do, we have less than 20 minutes. We're going to turn to each one of you to reflect on Carolyn's comments but I may prompt you with a question as well. Then we'll turn to our friends here who have been patiently waiting and hopefully we'll let you all go by six o'clock, right?

So Jan, Carolyn had a lot of good points on your discussion but one of the things that struck me was the role of policy complementarities and this policy mix, and that carbon pricing is amplified with other market-based policies, particularly structural economic policies are in play. So tell us a little bit about this policy mix of carbon pricing and other structural market policies in thinking about emissions reduction.

Jan Steckel: Yeah, thanks. So one aspect that I think is extremely important and I mean for economists that is straightforward, but I still think it is important to emphasize and it's nice that it comes out of this eclipse agnostic, data driven approach that these price-based instruments are, if you like, kind of an insurance that the other policies do not rebound. So, if you basically just put some subsidies or some building code, etcetera, to make the system more efficient, then we know that, think of the transportation sector, like where we've seen that large scale, particularly probably also in the US, I know more the literature in Europe. Basically, we had those standards, cars got more efficient, engines got more efficient, etcetera like these, but then at the same time actually cars just got heavier, and in terms of fuel consumption, and then hence also emissions, nothing actually happened. And it changes if you in addition of course have a carbon price which then makes sure that those instruments can also kind of really work and do not overflow.

So I think that is an extremely important aspect when it comes to these policy stackings, if you like. And another one is, and this was also mentioned by Carolyn, I think that different instruments, even though they might target emissions, they still might enable specific policies to work. So think of basically I didn't mention that, but part of the policy mix also was financing, instruments in the finance sector. I think this is extremely important. You mentioned the role of alternatives and yeah,

alternatives need to be financed. And think of the electricity sector. It is straightforward. Basically, we put a price on carbon, the coal fired power plant gets more important and countries might actually invest in more renewables. A-ha. But actually, the financing structure of renewables and coal looks very different. For renewables you have to finance everything up front. Whereas for coal, a lot of the costs only occur sometime in the future, that is in the fuel. So now in Europe, where we had — probably the same in the US — where we have been actually in low interest environments for a long time, this doesn't really matter.

But it matters if you actually have weighted average costs of capital that are 10%, 15% as they are, for example in Indonesia or Vietnam, then the effect of such a price is going to zero. If you don't have in parallel a mechanism to de-risk those investments, to bring down the financing costs, etc. So just as a specific example, why I think that there are these two things. At the one hand, side prices might enable the efficiency of the other instruments to work. And then, there are; however, other externalities, if you like, that are addressed by the policy mix.

Somik Lall: Thank you again. I think the point about cost of capital is extremely important in advanced economies. Cost of capital is around 4 and a half, 5% for renewables. In middle-income economies it's close to 14%. I think that's a huge issue that's worth looking into. Let me turn to you Barbara. You pretty much said that carbon offsetting is fundamentally flawed. And so, what's the implication for mechanisms under Article 6 of the Paris Agreement which really rely a lot on these sorts of offsets? Yeah, I think it should work.

Barbara Haya: Okay, great. Yeah, thanks for the question. Yeah, I mean under the Paris Agreement, countries took on NDCs, a suite of targets. And the Article 6 of the Paris Agreement allows for trading among countries and several types of trading and countries don't need to trade. Many countries started off by committing to targets that they would do domestically and without credits, buying credits from other countries. And I think that that is a very positive way forward given the quality challenges that we have seen to date and also some real quality challenges that we see with some decisions that have been made so far under Article 6 of the Paris Agreement, such as allowing in old CDM credits that meet certain characteristics. The total quantity of credits that are in line and have requested transition from the CDM to the Paris Agreement equals close to 1 billion tons. That's huge. Those are some of the projects that I studied 15 years ago and mostly other projects, but that follow a very similar methodology. More than half of those credits are hydropower, wind power project and cookstoves credits. So there we see the program allowing in credits with very known quality issues.

Somik Lall: So thank you for that. And so, I like also the point you said these offsets are creating a disincentive to reduce emissions at home. So that's a really important point. Kaushik, let me turn to you. And the Surat ETS has been successful, but it takes a lot of capabilities among the institutions in the public sector to be able to roll out such an ETS. And what are the conditions you think have really helped to put this model to scale and what does it mean? You have this long list of other countries you want to work on and other places in India, but they have pretty weak governance and institutional capability. So how do you think about rolling out such a program?

Kaushik Deb: Thanks, Somik. So that's precisely I think the point that I argue against. The whole idea of creating this cap and trade scheme, this emissions trading scheme in Surat, and deploying that as a tool to deal with environmental issues there was to prove the point that you can use sophisticated tool like market-based instruments like a cap and trade scheme in an environment with limited regulatory capacity and still be able to achieve your environmental results or overachieve it or achieve environmental results in a much more effective fashion. This is a certain tautology here. Cap and trade schemes to deal with emission control in developing countries isn't a thing. No one usually has done this. And because no one has ever done this, you don't have any evidence of this actually working or not working. The Surat example, essentially, is one that establishes the fact that the Gujarat Pollution Control Board, with our support, and the use of

emissions control devices was able to roll out an emissions trading scheme that dealt with emissions on a 24/7 basis without increasing even a single employee as staff.

The point here is that to be able to deal with pollution and emissions in this scale and in this particular sector, the use of a cap and trade scheme is a much more effective solution than hiring more inspectors to be able to go and carry out more stack testing and measuring emissions at the tailpipe on a more regular and continuous basis. And that's exactly the point, that doing this as a tool across countries and states with limited regulatory capacity is a much more effective solution than actually having a larger suite of regulatory instruments.

I just also kind of wanted to quick respond to something that Carolyn said. In terms of, I mean one thing that all of this calls for is that you have to be very careful when you're designing the scheme. And when we did design the scheme in Surat, we grandfathered about 85% of the permits and 15% of the permits were part of the initial permit allocation auction where firms participated and bought these permits. The design of the scheme is such that this is not a mechanism for the government to earn more revenue. So the government or the Pollution Control Board is not making money off the scheme. Unlike for instance [what] would be the case with a standard carbon pricing regime. So that motivation we've tried to eliminate so that one potential rent seeking behavior that you would see from government authorities does not corrupt the system in that way.

Somik Lall: You're very optimistic. Great. So I would encourage whoever has to ask a question, please come forward. Govinda, come to the mic. Others just line up behind him and let's have a round of questions, then we'll turn to the panel.

Govinda Timilsina: Yeah, so I'm Govinda Timilsina from the Research Department. So I have a one question for each of the panel members. My first question is for Jan. Jan, you compare the different the ETS and carbon pricing instruments across the countries. But the one challenge is that these instruments have a completely different design and the exposed estimation, they have a completely different approach of the estimation technique they use. So in that context, what you have done to make them comparable, that's one example that in South Africa they don't cover the electricity sector, the main polluter, the main emitter, right? So have you done anything to compare, to make this instrument comparable? That is my question. Barbara, so your presentation is a little bit disappointing. But if we see the CDM what you said, you are right at the very beginning. So I was in the registration issuers team under the CDM executive board from 2004 to 2007. I evaluated 78 projects myself. At the beginning there was an issue of the additionality because those projects might have implemented anyway. But later on, CDM has done a lot of contributions in a way that it gives a kind of momentum. For example, for wind and solar. There is this type of incentive, it gives a kind of market incentive for the different actors. There's also innovation incentive, for example, waste to energy. A lot of new projects came because of the CDM incentives. I don't think if there is no CDM. those types of momentum on wind and solar, and also those types of innovations in terms of this other technology might have come. So for Kaushik, is that it is a fantastic presentation. And this is, I think the first implementation of the market is mechanical PM2.5 right in Surat. So you should, I mean it's a very good comparison because for the implementation or noncompliance, it's reduced to 1%. But have you seen any comparison between the cost? So what is the cost of the regulatory measures versus the cost of this emission trading scheme over there? So that is the question to you. Thank you.

Somik Lall: All right, next please. Come in.

Elizabeth Graff: Hi, I'm Elizabeth, I work at J-PAL. I was wondering how you might use Rachel Glennerster's generalizability framework from 2017 to perhaps replicate the Surat success in the other countries.

Audience Member 1: Hello. I have a question for Barbara. Barbara, your research has been indeed instrumental in exposing the systematic flaws in the offsetting markets, especially on forest credits.

And the contributional model seems like something that might work better. My question is how can I create incentives for companies to rely on these contribution models? Because if they cannot claim the contributions against their emissions and we still live in a world where shareholders value, and net zero are the currency that they are working with. What incentives can be there? And moving one step forward, where will they find those authentic carbon reduction projects that they can contribute? And is there a way we can combine the offsetting with the contributions so we get to a better model than the one we are in? Thank you.

Somik Lall: And we have the last question.

Caroline: Hi, my name is Caroline. I work at CGD and my question's for Barbara. In your contributions' work, I'm just wondering if you can give some bullet points on how that can go to rectify these traditional issues with the VCM, like, such as over-crediting, leakage. Just curious and I'm sure it's maybe in some of your research that I haven't yet seen, but just want to know like how this contributions-mindset shift can start to affect that. Thanks.

Somik Lall: Thank you very much. We're going to do the following. We have… We're almost out of time, so I'll give each panelist a minute and a half to either answer the questions or give you our big picture takeaway. And after that, Carolyn, you get one minute to summarize. All right, Barbara, let's start with Barbara.

Barbara Haya: Okay, first thing, I'm here for the week and I would be delighted to talk to you. So find me, email me. So I think a lot of the questions are really similar and that is-- So I guess the first question on additionality and that is I think often, yes, I mean the offset program has created incentives to build some new projects. It's also paid a lot of project developers to build projects that they would have built anyway. I think so often we think about offsets like a way to generate climate finance for very worthwhile things. And we often forget about the trade that those credits are being used by someone to make a claim that they've reduced emissions, and if it's an effective incentive, but it's over-credited, you actually can get an increase in global emissions because someone is using those credits. And that's why I think a shift to the contributions approach can really match the way incentives really work. You want to create effective incentive programs to support programs, recognizing that you're going to get non additional projects, recognizing that funding is needed up front. And that if you shift to a contributions framework which refocuses attention on direct emissions reductions because you aren't allowing that trade, it creates transparency, and what a company has done, what a country has done, and what they've purchased. I think just it's a claim, it's words, it's rhetoric, but I think it has power. And I think just by disentangling that claim refocuses attention on direct emissions reductions. And then also it allows, it opens up the possibility for a range of projects, including those that take into account many co-benefits, including those that are needed today in order to drive deep decarbonization going forward.

And in terms of where can we contribute, how do we find those good projects? There are so many amazing nonprofits, amazing organizations, governments with programs. Money is needed. Right? And we need money going to the right places. So I envision a movement towards direct contributions to these organizations that have been working in the ground for a very long time and are effectively able to support decarbonization. That answered some of the questions.

Somik Lall: Thank you. Jan.

Jan Steckel: Yes, thanks. On your question. Yes, basically we have actually done some heterogeneity analysis, like doing some Bayesian modeling analysis really going into the primary analysis and the primary studies and also looking into secondary sources such as the World Bank to get a glance of the specific schemes and then looking actually what is driving the heterogeneity. And then, indeed, actually the… I haven't mentioned this, but the difference in the specific study design is large. So like everything else equal, how a study is actually done also makes a difference, but we can also talk more about this offline because it might get a bit nerdy if I continue.

On the bigger picture, I just wanted to make one final comment which relates to one of the last things that Kaushik said in terms of making actually sure that the government doesn't have an incentive for rent seeking. Because I think this is extremely important based on some theoretical work that we have been doing, we can show that as soon as this actually happens, basically the credibility or the possibility of the government to have a time-consistent, credible signal of this presence, it just crumbles and then you have two options. Either you have prohibitive pricing or no pricing at all. So as long as you can control this in the experiment, it is fine. I wonder whether it can always be controlled out there in the real world, so to say.

Somik Lall: Yeah, and thank you. I've been told by the organizers we are almost out of time. So Kaushik will have the final word and then Carolyn, we will hear from you. Others can email your questions to her. Sorry about that.

Kaushik Deb: That's fine. I only have a 17-minute speech more to go. But I mean just broadly to the point that this is trying to use an economic instrument to solve for a particular problem. So in this case, this is cap and trade scheme, we allocate some permits through grandfathering. Some permits are bought in the initial allocation. In the design of the market, we try and build in this case that at the end of the compliance period, whatever permits remain in the market, have to be bought back by the government. So there is-- So in the design of the scheme itself, you created a situation where the government or the pollution regulator does not make money in this case.

But also, in general, when you think about using a tool like this, you compare it with the alternator. What is the cost of not doing this? Right? In a command and control regime, the cost of polluting is infinite because you shut down. And I mean, for whatever it's worth, economics tells you that everything has a cost, everything has a price. So pollution, so two emissions, carbon, they actually have a price. And that price is not infinity, because if it was infinity, the solution would be to shut down all economic activity that uses any kind of fossil fuel. And to get to that optimal price is a question of having the right design and the right structure that kind of delivers that particular outcome. In designing this particular scheme, we were very, very careful in terms of making sure that the burden of cost in designing the scheme sits with the industry. And that's reflected in the cost-benefit ratio that's estimated in that one paper.

Somik Lall: Thank you very much, panelists. That was fabulous, I think. And thank you very much to the audience for being here till 6pm. We have an exciting day and a big round of applause for our panel.

Before we end for the day, I would like to acknowledge the amazing team who made ABCDE happen. Kenan Karakülah is leading the team. Please, come over. And Indu [Kilaru], and Karolina [Mazurkiewicz], and Lizette [Romo], and a big round of applause to them. This wouldn't have happened without them. And where is Joe [Rebello] and Assem [Kalenova]? All right, thank you, guys. You guys come here for a photo.

[END OF TRANSCRIPT]