Steven: Hello, and welcome to the Inequality Podcast. I'm your host, Steven Durlauf, the Director of the Stone Center for Research on Wealth Inequality and Mobility. Thanks for joining us. Today, it's a real pleasure to introduce Matthew Kahn, Provost Professor at the University of Southern California. We'll be talking about inequality, the environment, and many aspects of urban science and urban economics. As you might note, the quality of the recording is a little bit different than in other episodes. The reason for that is I'm in Uzbekistan as we do the recording. Uzbekistan is facing unique and fascinating types of challenges with respect to inequality: as a post-Soviet country, one of the two countries in the world that's doubly landlocked. But the relevance to today's podcast has to do with the environment. Uzbekistan, as is true for every country on this planet, is going to have to address the inequality consequences of climate change. This nation will face specific challenges given its state of development and its particular geography, but the same types of phenomena are going to apply to every other country, including the United States. For that reason, Matt Kahn is a truly ideal person to have this conversation with. Matt is one of the world's leading environmental economists and urban economists. And so in thinking about the distributional consequences of climate change, one is invariably led to questions about space: who's going to live where, who's going to move where. Furthermore, Matt has been one of the leaders in thinking about the consequences of environmental change through the prism of how individuals change their behaviors. That is one of the domains in which Matt has really been the pioneer in recognizing that individuals have agency, and so the full working out of the consequences of climate change has to account for that. Welcome, everyone, to the Inequality Podcast. It's a real pleasure to introduce Matthew Kahn as today's guest. I've been a longtime consumer of Matt's research, and I'm delighted to brag that we are now beginning co-authorships together. Matt, as many of you know, is one of the true Renaissance economists in terms of the breadth, depth, and creativity of his intellectual work. And the work is consistently characterized by deep economic reasoning, exceptional sensitivity to the combination of theory and empirics, and an occasional touch of heterodoxy. Matt, it's a delight to have you with us.

Matt: Steven, thank you. I'm eager to talk.

Steven: Matt, you're an unusually broad economist in many dimensions, one of them being the breadth of your work that moves from urban economics to climate change to labor economics. Given that this is the Inequality Podcast, I thought the first thing we should discuss is your thinking on the interactions between climate change and inequality. Each of them is universally recognized as a major policy question, but I think the links are often not fully appreciated.

Matt: So, I'm an amateur with the climate science, but I take very seriously what the climate scientists are saying to us. And I'm amazed

that this can be a political issue. Every part of the world faces threats from drought to heatwaves to floods. Mother Nature has quite in store for us. There are sort of two questions here. First, our own actions in creating greenhouse gas emissions through our daily lives: from electricity consumption to how we travel, to fossil fuel consumption. In our daily lives, we are creating more and more greenhouse gas emissions, but the poor, because they have the lowest incomes, have contributed the least to this challenge. So there's this horrible irony: that the poor have contributed the least to making climate change worse, but they're going to face the greatest brunt of it, living in the riskiest areas in cities, those poor people who are farmers being exposed to climate shocks, and living in lower quality housing than a Bezos or a Musk. This horrible irony of poor people having produced the least of these emissions but facing the brunt of this challenge is really serious. In short, the climate change challenge puts the inequality issue front and center.

Steven: If I ask you to identify the dimensions of that climate-inequality nexus, where do you see the most significant challenges for society? Could you bring us through a set of axes we should be focused on?

Matt: So maybe we should start on the mitigation side. I am a believer that poor people, especially in the developing world, need to consume more energy to increase their well-being. In the developing world, poor people need to be able to travel, need more electricity, to get where they want to go, to work, and to achieve their goals. So we're actually going to see poor people's emissions rise unless we're successful at decarbonizing our economies. Right now, Tesla is thriving as a company, but electric vehicles continue to be very expensive. If I were to speak to environmentalists at the Harris School, I'd want to ask: when you think 10 years from now, how will poor people move around in ways that allow them to get where they want to go through using low-carbon technology? In terms of carbon emissions, we need to figure out a way as a society to allow poor people to achieve their goals while simultaneously helping them, such that we don't exacerbate the externalities that richer people have been creating through air conditioning and driving fossil fuel cars in the past.

Steven: I wonder if we might talk a bit about internal migration. My mind interacts with what I perceive to be a conventional wisdom among urban economists about the surprising lack of greater internal migration, given the disparities in local labor markets. With reference to climate change, how do you see those patterns changing? And might this be a good place to talk a bit more about work from home?

Matt: So, after Hurricane Katrina, Steven Levitt and co-authors wrote a fascinating paper. They asked: for people displaced from New Orleans

by Hurricane Katrina, what was their subsequent income? Using Internal Revenue Service data, these scholars wrote a great paper documenting that people's incomes actually went up. To say that again: an unintended consequence, a silver lining of Hurricane Katrina, was to raise migrant income, because people actually had to move as properties were destroyed in New Orleans. When they had to re-optimize, they moved to higher ground, to Houston, a more booming local labor market, and their incomes went up.

Steven: More generally, one of the facets of the information economy is that it's broken the requirement that the factors of production are spatially contiguous. That strikes me as a fundamental question in thinking about inequality dynamics. I'd be interested in your thoughts on that.

Matt: So the University of Chicago has just hired a talented young researcher from Princeton who wrote his thesis on automobile manufacturers and how they're locating their supply chains in a world of natural disasters. What he did was estimate how, in the past, suppliers like a Toyota would site the different parts of their supply chains. If a for-profit firm locates its operations in places that face increased natural disaster risk, then such disasters can disrupt supply chains and disrupt the profit of these firms. He documents that these companies are getting ahead of the curve, relocating their supply chains to more resilient areas. What excites me here is that this is evidence of competition. This creates a resilience reason that even those who reject climate change, if you see that your geographic jurisdiction is losing jobs, have an incentive to invest in resilience to increase the profitability of your place. Let me flip this around: if there's a geographic area that fails to be resilient, either due to its topography or due to urban planning, this place is going to have a brain drain, and a poverty magnet effect is going to unfold. Spatial competition is about to play out. We've always had spatial competition: New York versus Chicago, London versus Manchester. Climate change is only going to exacerbate this competition. In a work-from-home economy, the educated are more footloose than ever. For places that fail to adapt and where Mother Nature is punching harder, a poverty trap could become even greater. And there's a question of what a nation as a whole owes these places, as poverty rates rise in areas of disinvestment, as individuals and firms migrate away.

Steven: Those are obviously deep questions. But if we think about work from home and offshoring as breaking the spatial continuity dimension, it means we would have to think about poverty traps in a more complicated fashion. Poverty traps, I'm going to define them relative to affluent traps. Affluent traps are going to be configurations of individuals that, because of their socioeconomic backgrounds or their educations, essentially interact with each other. And so you have the virtuous cycle of complementarities and increasing returns, the usual suspects, that make them extremely prosperous. But by implication, if

we increase the capacity for segregation, we've increased the capacity for an equilibrium configuration that isolates people. So the question you're putting on the table is: if we see the emergence of higher-dimensional poverty traps in which the axes are not defined by longitude and latitude but by the types of co-workers and virtual communities you interact with, we have a dearth of policies to address that type of segregation. Stepping back: if we were to delineate what are the classes of policies that reduce racial and socioeconomic spatial segregation, we talk about mixed-income housing, zoning restrictions, etc. It's not clear what a zoning restriction would mean in an economy where space is defined by the Internet.

Matt: So, staying on that note: in my recent work on adapting to climate change, I talk at length about zoning. The popular media actually talks about climate gentrification and is right about this point. Most of urban America is zoned for single-family housing. Something very exciting in climate science is the growth of climate rating firms. We're all used to Moody's and Standard and Poor's ranking bonds. There are new entities like First Street Foundation, which is a nonprofit providing, based on climate science, a measure of the heat risk, flood risk, and fire risk for every property in America. The climate gentrification hypothesis posits that properties deemed safer by the climate modeling will see home prices rise, and that poor people won't be able to afford to live there. My solution to this potential poverty challenge is that America needs to change our zoning codes to up-zone on higher ground. If we up-zone on higher ground, we can increase our housing supply in relatively safer places, and more and more people of limited means can afford to live in those areas. One solution for reducing poor people's exposure to climate risks is to change our land use and zoning codes to up-zone on higher ground. Steven, your thoughts?

Steven: I think it's a fantastic idea. It's an authentically creative way to think about what zoning can constructively do. The background question is that you're making an argument that, based on the bundles that define housing units, you get degrees of economic segregation because of willingness to pay. If you alter the bundles that constitute the housing units, you get a different level of segregation. As far as I know, that's gotten very little attention in the inequality literature, and that strikes me as a very creative way to proceed. It also addresses the conventional response: you've relaxed zoning restrictions, you've allowed for multi-family dwellings in communities, but somebody has to build them. In other words, there have to be incentives for builders to actually produce these objects, and you need the prices to be such that you achieve authentic socioeconomic integration. So I think it's a lovely idea.

Matt: Two follow-ups, and I agree with you. In my free-market fantasy, insurance rates will rise in risky places in America. California's well-intentioned officials: Governor Newsom has done many great things

for California, but one policy I oppose, if I can be a little bit controversial, is that he's putting price caps on insurance in fire zones. I want prices to signal risk. If we allow prices for insurance to rise in risky places, and if we up-zone in safe places, we can begin to tilt the playing field to encourage all people to move to climatically safer areas. And a new point: we both know that many rich people sometimes fear living with poor people due to the fear of crime. I've argued in my work that if America can figure out how to increase street safety, another benefit of such street safety is that more middle-class and richer people would be willing to live in denser areas and more willing to up-zone. I've been very interested in the synergies here. It's my theory, without any evidence, that good fences make good neighbors: when there's distrust and fear of others, we don't want to live in close proximity with other people. If we can fight through that and come up with ways to improve street safety, I think that could have a causal effect on changing the politics of up-zoning and reducing the NIMBYism in this country. Everyone is coming around to recognizing the challenges that NIMBYism poses in raising the price for the poor to move to better areas.

Steven: I think those points are well taken. The caveat I would put on the table is that the evidence in general is that people grossly exaggerate the probability of being victims of crimes. The question one has to ask, if you improve public safety in certain locations, is to what extent are the subjective beliefs of the people who live there going to be substantively affected? The concern I would have is that if you're dealing with a context of first-order exaggeration of risks, it's not obvious that that exaggeration is sensitive to the actual diminution.

Matt: I agree.

Steven: I was wondering if we could then move to a discussion of prices versus quantities and markets versus regulation. So much of the debate about mitigation or responses to climate change has to do with the choice of policy tools. And there I think there are good-faith disagreements; I've contrasted that from climate denialism, which is a separate topic. Could you say something about your thinking on the prices-versus-quantities dimension of interventions, particularly given the distributional consequences you've put on the table?

Matt: This is a major topic in environmental economics right now. Let's do a couple of examples. If we raise the gasoline tax, every introductory economics student is taught that if we have actions like driving an old car and if that imposes social costs, we economists support taxing that activity. But even President Biden, who is deeply committed to fighting climate change and helping future generations, a carbon tax is not on the table. The reason is the worry about regressivity. We haven't figured out as public finance economists how to tax bads and then recycle the revenue to give it back to the public

in what economists call tax and rebate. Imagine if we doubled the gas tax but gave every person not named Bill Gates or Jeff Bezos a check for $2,000: would the American people vote for that? And to pick up on that, President Biden, in late 2022, signed the Inflation Reduction Act. What has fascinated climate economists is that this focuses on subsidies. It turns out that the American people like subsidies and don't like taxes. With large subsidies for green power, electric cars, and decarbonization of the economy, here's the link to poor people, and this will turn into a question for you. Implicit in the Biden administration's approach, and I hope they're right, is learning by doing. Poor people are not driving Teslas these days. But the underlying logic is: if you subsidize Elon Musk's operations now, we will make breakthroughs, coming back to Paul Romer and Robert Lucas's work on economic growth and endogenous innovation. If we subsidize nascent infant technologies, there will be sufficient learning by doing such that 20 years from now the world's poor can be using green technology to live their lives, living low-carbon lives not because they've agreed to a Greta Thunberg poster but because these are better products. Steven, having had a long, distinguished career, how seriously have you taken the infant industry's learning-by-doing hypothesis?

Steven: I think I would say two things. The first is that the overall Romer idea, I think, is of monumental importance and is correct: that the generation of ideas, the generation of science, is a self-reinforcing process. I would take it as given that Paul Romer's general ideas have stood the test of time. The separate question, the usual economist question, is: in the political process as it generates the subsidies, to what extent are they going to be effectively targeted? I would say two things: one is that it's probably okay to make mistakes, and the question about targeting tends to be about the best versus something good. If you ask whether these types of subsidies produce things, I believe the answer is going to be yes, and that doesn't require all that much wisdom on the part of the government. The question, on the other hand, about the right focus of the subsidies, national research laboratories versus universities versus the private sector, is a deeper conflict. I think we tend to underestimate the value of universities as the incubator of ideas. There's a literature that has emerged to make arguments about the role of universities in the national economy, so it's not going to be entirely a self-interested observation. I'm not sure that I think subsidizing Tesla is necessarily the efficient way to proceed.

Matt: I'm very sympathetic. Steven, one more point here before we pivot: The United States is a great nation, but we are a shrinking part of the world's population and the global economy. The action is going to be in the developing world, where billions of poor people still live. We estimated some Engel curves using World Bank data to estimate: as poor people become lower middle class in the developing world, how many are going to have air conditioners, motorcycles, cars,

their own version of the American dream? I actually celebrate this. If it's going to be hotter in Mexico, these individuals need air conditioning to get through their day. It will be wonderful if the Biden administration's investments trigger the growth of a green grid such that Mexican middle-class people can decouple their consumption from producing greenhouse gas emissions. But the developing world's quantity of economic activity is going to boom. What is crucial is: can the United States, Asia, and Western Europe design the blueprints and prototypes of technology that can then be used to help the developing world leapfrog? There's an interesting question of intellectual property: do we in the West give our green technology for free to the developing countries, or do we want to create a market? Do you help poor people more in the developing world by having technology transferred freely, or by encouraging developing nations to pay for this technology to create an even bigger market and thereby generate even greater innovation?

Steven: That touches on considerable controversy about property rights with pharmaceuticals. I think there's been quite compelling arguments that for certain classes of diseases, a tournament structure is more appropriate: having a large prize from an international organization. You're well aware of the arguments Michael Kremer and others have made about vaccine markets. I don't know if there's any analogous thinking that's been worked through for the environment.

Matt: I unfortunately am not at Michael Kremer's level on any level. But Michael's work on vaccines with co-authors is exactly what I have on the brain: how do we create innovation incentives without price-gouging the developing world? How do we increase poor people's menu of strategies: the electric green motorcycle of the future, but also strategies to protect their homes against future flood events, to air-condition on hot days, so their children can learn on extremely hot days. As I think about the poverty and climate change challenge, it's both decarbonization and resilience. 15 years ago, I started my work on climate change adaptation because of my pessimism that a UN-type global agreement would solve the global tragedy of the commons. I was highly skeptical, and remain so, about global negotiators at the UN solving this issue. One of the reasons I started to work on climate change adaptation, which in simple English means: Mother Nature is punching us harder and harder, and we are not passive victims here; how do we use free markets and government to increase our strategies so that people can protect their own families and achieve their own conceptions of the good life? I would love to see China and the US, during a time of tension, figure out what mutual interests we have. Some very exciting work in environmental economics has focused on voluntary restraint: there are people who actively don't like to pollute and don't need an incentive not to pollute. This exciting literature on voluntary restraint, which Matt Kotchen of Yale started and which I've been a member of working on, explores a society that celebrates voluntary restraint: how we use identity, following Akerlof

and Kranton on where does your self-esteem come from. If we have ways to celebrate those who don't free-ride, is this the beginning of building up our virtuousness? I'm not smart enough to see how this affects international relations and solving global treaties, but it interests me how voluntary building up of one's own personal pride in having a low carbon footprint, and celebrating such individuals, which some campuses do, could encourage conservation. Is there a link to the national level, and what goes on at a UN negotiation? I think that micro-to-macro leap may be a little exaggerated.

Steven: Well, maybe one can look for analogies in history. Take the Peace Corps. There was a United States in which this was a major action by the American government, done partly for Cold War strategic reasons, but there was something else: idealism, the idea that the pride that Americans took in the country had corollaries in terms of trying to help the rest of the world. And that's a profoundly admirable program. Or think about the Food for Peace program: there was actually competition between the United States and the Soviet Union in providing assistance to poorer countries. That's not the world we live in today, but it was a world that did exist not so long ago. And so there may be dynamics in the way that national identity is associated with leadership and achievement that can be resurrected.

Matt: I want to give a business example of poor people adapting. I just had a very talented student, and his research focused on Bangladesh: for poor rice farmers, they now face soil salinity due to sea level rise: their soil is getting more salty, and rice apparently doesn't grow well when exposed to this salinity. But they could pivot to shrimp farming. Two issues arise for a rice grower to pivot to shrimp. They need more land to have economies of scale to grow shrimp, and the nation doesn't have well-functioning land markets. If there were a world of titling and property rights, where you know who owns the land and can trade with them, that would facilitate adaptation: if we're rice growers, we could acquire the parcelled land next to us and have the economies of scale to pivot to shrimp. And things get even more interesting. Our family has now pivoted to shrimp, and we need to get these shrimp to Dhaka, to the successful people in Dhaka who want to eat them. Shrimp quickly rot. We need access to roads and refrigeration trucks to get the shrimp to the rich buyers in Dhaka. And so my student, now my colleague, is working on this question of free-market environmentalism: what role does government play in building good roads, what role does technology play in getting cold trucks operational, such that this adaptation strategy can help poor people there?

Steven: Matt, I was hoping we could talk about the Lucas critique as it applies to climate change. The key essence of it is that if you implement a policy, people change their behavior; therefore, if you use history to see what the effects of policies would be, because the policy wasn't present, you may end up with misleading results. How do

you see the Lucas critique affecting the discussions we've been having?

Matt: There's a famous paper in climate economics that came out in the Proceedings of the National Academy of Sciences about 10 years ago. In Sub-Saharan Africa, for every nation, the authors observed whether there was a civil war in that nation in a given year between 1960 and around the year 2000, and then correlated that with whether that nation had a very hot summer. They documented that the risk of civil war in Sub-Saharan Africa in the recent past is higher when it's very hot. Very interesting. They then took a climate change model to estimate how many more hot summers Sub-Saharan Africa will have. They then took the historical model of the relationship between a nation's civil war risk and summer heat with the climate model to predict how much higher civil war risk will be in each Sub-Saharan African nation because of climate change. In the final step, they multiplied the extra probability of civil war caused by climate change by the number of people who have died in past civil wars to estimate the number of deaths civil war will cause in the future because of climate change. Now I'll link this back to Professor Lucas. The role that climate econometrics plays is the role of Paul Revere. Paul Revere told us during the Revolutionary War that the British were coming. Climate economists estimate these historical relationships, and now we know that the risk of civil war is higher in Sub-Saharan Africa during summers. Now that we know this, the United Nations can send peacekeepers. Bill Gates can use his foundation income to take steps that might help to diffuse tensions. We can now act on what would happen under business as usual. My interpretation of the Lucas critique is: given that economists have given us these ugly correlations, the future doesn't have to be like the past if we react to these past correlations. I'm an optimist that future heat in Sub-Saharan Africa will cause less civil war unrest because we're aware of what's occurred in the past. So to wrap this up, I view their work as very important, but I don't believe their predictions will be borne out, because I claim that the past evidence has a causal effect on what encourages adaptation.

Steven: If you were appointed the proverbial social planner: which policies would you prioritize in terms of navigating the climate and inequality trade-offs and relationships?

Matt: When you face a known unknown, you need to experiment more. I would like to see a decentralized learning approach. Right now in the American West, there is drought, but we're not raising water prices. I would love it if part of the American West experimented with trying to raise water prices, but using a rebate such that we protect poor people against price gouging. My old friend John Quigley wrote a paper about Stockholm trying road pricing for a year: he said to the people of Stockholm, we're going to pilot road pricing for a year, and then we're going to vote on whether we want to make this permanent policy.

I'd like to live in a world where we pilot more ideas for mitigating carbon emissions and for adapting to physical risk, coming up with a way to try a guinea pig approach to see if it works, trust the nerds to evaluate it, and then let the voters decide whether to make it permanent policy. So what do you think of that? A decentralized learning environment to learn, what are new strategies for increasing our menu to reduce carbon emissions, to protect poor people's dignity and quality of life, and to help us adapt to these serious threats we've unleashed?

Steven: Part of what's appealing in what you said is that it respects learning over time: we don't have a fixed set of options; we have a set of options that themselves will evolve in response to what we learn. That strikes me as far beyond where the thinking is on these topics. So Matt, I want to give you a final word. Are there any areas or dimensions you want to talk about climate that we missed?

Matt: The one final takeaway I'd like to mention is that I'm always interested, as an empiricist, in benchmarking. If we're a poor family and the decarbonization agenda continues, do the food prices we pay go up? What happens to the price of food or the price and quality of transportation? What are these general equilibrium effects? Will poor people face higher prices for the necessities they need for their lives? Will their purchasing power decline because of the green agenda? And if we anticipate this, I think we all know that there's a moral necessity here to address this. So this awkward issue of how we create incentives to decarbonize the economy without reducing the purchasing power of the poor is a central issue going forward. And on the adaptation challenge: if we don't up-zone on higher ground, if we don't build more housing in safe areas, the poor are at great risk. When poor African-American cities in the American Northeast get hit with hurricanes, jobs, and successful people are more likely to move away. The tax base shrinks and expenditures on schooling decline. Natural disasters exacerbate environmental justice challenges.

Steven: Well, Matt, I can't thank you enough. The audience is going to discover that every time I have a conversation with Matt, my mind is spinning for the next three hours because there are so many ideas. It's a true mental jolt of adrenaline, and it's always just a delight to talk. Thank you so much.

Matt: Thank you, Steve.

Eric: Again, that was Dr. Matthew Kahn, Provost Professor of Economics at the University of Southern California. I’m Eric Geber, the producer for the Inequality Podcast. What I found so compelling about Dr. Kahn's interview is how directly he spoke about the links between climate change and inequality. You can essentially summarize the

entire dilemma with this sentence he opened with: “there is this horrible irony that the poor have contributed the least to making climate change worse, but they're going to face the greatest brunt of climate change.” On the world stage, this inequality is playing out against two sides, the Global North and the Global South, and for this episode's Inequality in Perspective segment, we decided to dig more into this divide.

But first, we should provide some definitions, because the terms Global North and Global South are a bit of a misnomer. Very loosely speaking, the Global North refers to countries mostly north of the equator, and the Global South refers to countries mostly south of the equator, but there are a ton of exceptions. Honestly, the best way to visualize this divide is to look up the Brandt Line, which was first drawn by West German Chancellor Willy Brandt in 1980. It's not much more than a squiggly line drawn on a world map, and if you didn't know what it was depicting, you might not even detect the north-south division. North of the line, you can see North America, Europe, and Russia, and that makes sense. South of the line, you see Central America and South America, including Mexico, Africa, and most of the Middle East, say for Israel, and that also mostly makes sense. It gets a little strange as the line curves up and over China, putting that country in the Global South along with India and the rest of Southeast Asia. And then the line makes a series of even stranger twists that put Korea, Japan, and, believe it or not, Australia and New Zealand in the Global North side. As some have pointed out, Global North and Global South are not meant to be taken literally: just think of the north-south divide that we have here in the United States; no one thinks of California as being part of the South. There have been other ways to label these two groups that you may have heard before: developed and developing countries is one, and there's even the more antiquated first world and third world distinction. All of these labels are essentially talking about the same two groups of countries, and what most cleanly distinguishes the Global North from the Global South is the strength of their economies.

The distinction becomes clear when looking at just a few key metrics, such as Gross Domestic Product, or GDP, and Gross National Income, or GNI. When combining the GDP of the major Global North countries, the US, UK, European Union, Canada, Japan, South Korea, Israel, Australia, and New Zealand, we arrive at a total of $55.6 trillion. Gross National Income is similar at $56.2 trillion. In the Global South, the GDP of China, Africa, Mexico, Latin America, the Caribbean, and South Asia is $36.8 trillion, and the GNI is $36.3 trillion. These numbers don't seem too different until we consider them in per capita terms. The per capita GDP for the Global North is just under $50,000, while the GNI is just over $50,000. But for the Global South, the average figures are $7,500 for GDP and $7,200 for GNI. Put another way, per capita GDP and GNI for the Global North are more than six times that of the South.

But let's now consider pollution, and here we'll find something very interesting. All of these figures are for 2021. If you want to know who the biggest emitter was and looked only at recent data, the culprit would actually appear to be the Global South. China alone emitted almost 31% of all greenhouse gas emissions in 2021, followed by South Asia at 13%. All told, the Global South accounted for 66% of all emissions, meaning the Global North contributed just half of that at 33%. But if you widen the aperture, you get a very different picture. Total recorded emissions for some regions go back all the way to 1750. Europe, for example, is responsible for almost 30% of all recorded emissions, just slightly beating out the United States at 24.3%. In total, the Global North has emitted 63% of greenhouse gas emissions ever, and the Global South has been responsible for only 36%. Let me go back and read those numbers one more time: for 2021 emissions, the Global South led with 66% to the North's 33%. But for all recorded emissions, it's almost the exact opposite: the Global North has emitted 63% while the South has only emitted 36%.

And there's one last depressing irony: climate change has had an especially punishing impact on the Global South, and if left unmitigated, this will only grow more severe. A 2022 working paper from the Brookings Institution details the abundance of research that supports these claims. Rising temperatures have been shown to disproportionately lower the GDP of developing countries, and estimates for future GDP loss by region under different warming scenarios reveal a stark contrast between the developing and developed countries. Under a two-degree Celsius warming scenario, North America, for example, is estimated to see a 7% reduction in GDP. The Middle East and Africa, though, are estimated to experience a drop in GDP of almost 15%. If temperatures rise by 2.6 degrees, the loss in GDP only increases by 1% for North America, from 7 to 8%. But for the Middle East and Africa, the loss jumps from 15% to over 20%. And this region isn't believed to be the hardest hit from a warming planet. Under two-degree, 2.6-degree, and 3.2-degree warming scenarios, the respective estimates in GDP loss for Southeast Asian countries are negative 15%, negative 20%, and a whopping negative 37%.

Climate change also lowers income, and this effect is even more pronounced in regions like Africa, where a high proportion of the population is dependent on natural resources. A 2019 study found that climate-change-related natural events like droughts and floods led to a significant reduction in crop yields, amounting to up to $4 billion in lost income from millet and $2.2 billion for sorghum.

The impacts of climate change in the Global South present problems with no easy solutions, but what has been proposed so far typically centers around one thing: greater funding. According to that aforementioned Brookings Institution paper, there are a few key areas to focus investment. Early warning systems, for example, won't help

reduce greenhouse gas emissions, but they will help reduce loss of life and damage to property as a result of climate change disasters. To address the detrimental impact to agriculture, more investment needs to be made in climate-smart agricultural technologies and techniques that include stress-tolerant seeds, increased recycling and reuse of water, and the development of more drought-resistant crops. Water scarcity is another issue that could be addressed through investment in better access to underground sources, better recycling techniques, or the construction or restoration of dams to improve water storage and irrigation.

But these are things to address the aftermath of climate change. In order to help these countries reduce their emissions, there really are only two solutions: one obvious, and the other a little less obvious. The obvious solution is to incentivize the adoption of clean energy, but the less obvious solution is to actually allow these countries to utilize more fossil fuel, at least for the time being. In the world's poorest regions, like sub-Saharan Africa, access to electricity is desperately lacking and also vital for their development, and so it should not matter what energy sources are used to provide that electricity for now. Renewable energy is the ideal source, but asking Global South countries to utilize only renewable energy would be prohibitively expensive and would actually inhibit their growth. As Dr. Kahn put it, he wants to see poorer countries consume more energy so that they can grow and better fight the impacts of climate change. It's true that we'll all need to reduce our overall emissions, but those timelines are going to differ depending on region. We in the Global North need to support the South in their green transformation without forcing these changes too quickly and stunting their growth. For links to some great resources on this topic, be sure to check the show notes.

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