How much money do we need in order to remove a significant amount of carbon dioxide out of our atmosphere? And what are the mechanisms that we should use to spend all of that money? I'm the head of sustainability at Shopify, a company you may not know, but you might interact with every day because our technology powers millions of online retailers. In 2019, we wanted to become a carbon-neutral company and be accountable for all of our historical emissions. Instead of buying typical, traditional carbon offsets that simply pay someone else to not pollute as much as we already had, we actually wanted to delete our emissions. It quickly became obvious that carbon removal, those solutions that pull carbon dioxide out of the atmosphere and store it safely, were very expensive and in short supply. So to kickstart this almost non-existent market, we launched our sustainability fund and committed to spend a minimum of $5 million every year on the most promising solutions. Now obviously we need deep emissions reductions, I'm not disputing that. But alongside this, we also need to build the world's capacity to pull 10 gigatons of carbon dioxide out of the sky every year by 2050. Now at the time, $5 million was a big number. And it was a really big number to spend on something in its infancy. And we thought we were doing something significant. But then we totally hit a wall. We weren't even thinking at the right scale. We need to build massive facilities capable of pulling 1 million tons of carbon dioxide out of the air every year, and we need thousands of them. And in order to do that, we need project financing of about $1 billion per plant. Now to put that into perspective, our $5 million annual budget would probably buy about 10,000 tons of carbon removal every year. That's tiny. That's only 1% of the annual capacity of the size of the facilities we need. And like I said, we need thousands of them. So we've learned that in order to move the dial on climate and to build the necessary infrastructure, we need more money, way more money. And in order to do that, we need collaborations, and we need structures that leverage the significant power of capital to create even bigger effects. So now I'd like to tell you about what we did next. It's a mechanism that we launched alongside four other companies. It's an AMC. AMC stands for Advanced Market Commitment, and this one's designed to help guarantee a future market for carbon removal by trying to de-risk the R&D investment and capital expenditures needed

to scale carbon removal and grow that industry. Now why I think this is such a promising approach is because it's not new. AMCs have been used in the past in the healthcare sector to encourage and accelerate the development of vaccines. It worked by essentially guaranteeing the economic viability of production by setting a price in advance. This meant that companies could justify the R&D resources needed to develop the vaccine as well as the costs associated with bringing it to market. They just needed to know that someone was going to buy their product at a set price. So this AMC borrows the idea of a purchase guarantee to try to accelerate the development and scaling of carbon removal. And to do that, we set up a fund, and it's a pretty big fund. It's nearly $1 billion, and it's called Frontier. But Frontier has to overcome some significant differences between vaccine development and carbon removal. First, vaccine development has been done for a long time, and we've largely worked out the supply chain and infrastructure challenges, the operational issues, and the policy definitions. But for carbon removal, this is essentially still a new industry that faces all of these hurdles. For example, a lot of carbon removal technologies rely on clean power to operate, because if they don't, they'll emit more carbon dioxide than they capture. But clean power does not exist today at the scale and distribution we need. Second, vaccines are developed by established companies with deep R&D teams and experience, whereas today, carbon removal largely exists on paper, in the lab, or at the startup stage. There's only a handful of companies worldwide right now that are any further along. Third, the manufacturing facilities for vaccines already exist at scale. But for carbon removal, the largest facility in operation today is Climeworks' Orca plant in Iceland. It has an annual capacity of 4,000 tons, which is orders of magnitude less than what we need. This means that today, there's no company or facility in operation that can respond to the demand signal of Frontier. So to summarize, for vaccine development, all these companies needed as an incentive was a dollar sign. They had everything they needed to jump into action and respond. But today, carbon removal needs so much more. Even though there's a lot of different ways to approach this, I do believe that this is a significant market signal that Shopify, alongside Stripe, Alphabet, Meta, and McKinsey Sustainability have committed to buying nearly $1

billion combined of the product. But the carbon removal ecosystem is underdeveloped. Even though Frontier is essentially helping to underwrite all of the broad investment needed to scale carbon removal, this is an imperfect application of the advanced market commitment mechanism because the carbon removal ecosystem is underdeveloped. However, this is exactly what we need to do to supercharge progress by accelerating innovation. It is so important to take chances and to experiment. And as buyers of carbon removal, we have an opportunity to stand up and do our part to build for the future. And this commitment does just that. So now we have Frontier, which is the demand pull by providing capital and resources through the advanced market commitment mechanism. But what about the other side of the equation? We also need a supply push. To start, in addition to all of the new climate companies being launched, we also need companies from existing industries with transferable skills to jump in and start developing carbon removal. I'm talking about, now don't get mad, I'm talking about industries like oil and gas, mining, manufacturing, infrastructure, and electricity, who all have deep experience building huge projects. That's the massive scale that we need that I was talking about at the beginning. Alongside this, we also need to build a robust management system to ensure that all of these new carbon removal solutions are in fact capturing more carbon dioxide than they emit. This is kind of along the lines of the quality assurance, quality control, and process trials we rely on to ensure that our vaccines are safe and that they work. But most importantly, we need more practice doing the actual thing rather than trying to get it perfect on paper. If we don't try, we can't learn. And if we don't learn, we cannot iterate and improve. This AMC is technology neutral. It either sends out the demand signal, but we do not specify which technology should be used to meet it. But what we do specify is the quality standard we expect in order to ensure that real permanent carbon removal took place at the agreed upon price. Now this arrangement we're hoping should encourage experimentation and tight iteration cycles that should quickly separate the promising solutions from all of the distractions. Now I'd like to ground this in reality by providing three solid examples of companies who are already on their way and some of them are actually doing the thing. First, we have Climeworks

operating in Iceland. They use direct air capture machines to filter carbon dioxide out of the air and capture it for storage. And they've now since broken ground on their next scale facility, which should be able to pull 36,000 tons of CO2 out of the air. Next, we have Running Tide, who sink kelp deep into the open ocean to lock away carbon dioxide that's been captured through photosynthesis. They're currently working through their first scale deployment and they're building all of the measurement, quantification, and monitoring systems at the same time. And third, we have Heirloom, who plan to accelerate the natural capacity of limestone to react with and capture carbon dioxide and lock it away. And now they plan to do this by accelerating the natural adsorption rates of the rock from approximately a year to just days. They're set to break ground on their first commercial scale facility in the United States in 2023. Now, there are many other companies that are starting to emerge that I could have mentioned here. However, from these three examples, what you can see is the diversity of solutions. And we're agnostic about that. All that matters is that they achieve the result within the set parameters. Now, before I end, I must address the question of our own operations. So to start, Shopify is a carbon neutral company and we've committed to kickstarting the carbon removal market. Our business is all about helping millions of entrepreneurs succeed. And today they're experiencing so many challenges. We have an opportunity to help them become carbon neutral and to leverage carbon removal in order to future proof their businesses, which in turn safeguards ours. Now, not a lot of them have climate teams, but we have the opportunity to share our experience and expertise with them. And so what we're trying to do is take everything we've learned about reducing and managing Shopify's emissions and from vetting and buying high quality carbon removal. And we're trying to take those lessons and put them out on our platform to make them available for all of our merchants. Not only will this help reduce emissions, but this will also help create the very market that all of these new carbon removal companies who are building in response to Frontier's demand signal will rely on. This is a feedback loop that will spur innovation and drive the development of carbon removal at the scale the world needs. Thank you. Thank you. Thank you. Thank you.