

## Accelerating Transition: Carbonomics

With host **Kara Mangone**, global head of Climate Strategy  
and guest **Michele Della Vigna**, head of Natural Resources Research, EMEA

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**Kara Mangone:** Hello and welcome to our new special miniseries on climate sustainability and the path to Net Zero called *Accelerating Transition*. I'm Kara Mangone, global head of Climate Strategy here at Goldman Sachs.

We built this podcast because we wanted to go past the headlines and announcements to report directly from the front lines of decarbonization. We're going to do that by talking to people both here at the firm as well as outside the company to learn about innovation, strategies, and the hard thinking that's happening around the world to accelerate our transition to a sustainable future.

For today's episode. I'm excited to be joined by my colleague Michele Della Vigna, who is head of Natural Resources Research for Goldman Sachs in EMEA. Michele leads our research on what he's called "Carbonomics," which I'm a big fan of, which examines the economics of getting to a net-zero carbon world. He also just hosted our second annual Carbonomics conference, which included representatives from the recent COP26 summit in Glasgow as well as more than 40 CEOs driving decarbonization in power generation, mobility, agriculture and industry, Michele, thank you for joining us today.

**Michele Della Vigna:** Thank you Kara. It's my pleasure. And it's so exciting. Just one day after we've concluded the Carbonomics conference, so we certainly have a lot to talk about.

**KM:** It's incredible! What a whirlwind it must have been. I'd like to start by touching on your latest report in which you examine how capital markets engagement and sustainability is accelerating decarbonization. Can you talk through with us the role that investors are playing in the climate challenge today?

**MDV:** Absolutely Kara. Capital markets are deeply engaged in sustainability, whichever way you look at. Almost all of the growth in active asset management is in sustainability-linked funds. And also when you look at how investors engage with corporates, we've seen a tremendous increase in engagement on decarbonization and climate-change issues. And just to give you a number, the support for climate change shareholder resolution across global corporates has tripled over the last decade.

Now, what does that bring us to? I think it brings us, on one side, to extraordinary pressure from investors towards corporates to embrace an energy transition that is at least consistent with staying well within two degrees of global warming—or

potentially aim to stay within 1.5 degrees. And what this is leading to is a complete change in the cost of capital of high-carbon versus low-carbon solutions.

Let me give you an example: When I look at the energy world 10 years ago, the cost of capital of an oil development or an offshore or wind-power development were pretty much the same—somewhere between 8% and 12%. But since then, all of the engagement on climate change means that the cost of capital for oil developments has now shot up to 20%. But for renewable power developments, the cost of capital is now as low as 3% to 5%. This 15-percentage-point divergence in the cost of capital is an enormous driver to shift capital allocation away from high-carbon towards low-carbon development and has been, I believe, one of the key drivers of this historical moment when this year, suddenly renewable power investment globally has become larger than upstream oil and gas. This is how deep the impact of capital markets is going in driving the energy transition and decarbonization on a global basis.

**KM:** And Michele on that last point, we have seen an incredible reduction in the cost curve, which is really clear in your research around renewables. But we know there's still a pretty significant climate finance gap if you will. So, can you talk us through a little bit more, you know, where do you see the cost curve shifting and flattening over time? And then what are some of those other technologies where there needs to be a substantial reduction in the cost curve over time, where we're *not* there today like we are in renewables?

**MDV:** So when we look at the cost curve, we've seen a very substantial improvement last year, and a good improvement this year as well—about 12% reduction in the average cost. This year, to be fair, most of the reduction was driven not so much by technological innovation in clean tech, but rather by the higher cost of hydrocarbons which make a low-carbon alternative more economic and attractive. This is one of those instances where I would say, if carbon prices don't move, energy prices can move to obtain a similar effect in terms of pressure to the consumer to actually shift its consumption habits.

If we look at energy prices—in the last 12 months, their price increase per ton of CO<sub>2</sub> that those hydrocarbons generate, has increased by \$80 per ton, which has been very material and which has really driven that shift in the cost curve of decarbonization lower. On the other side, if we were to look at global carbon markets, the global weighted average global carbon price is only \$5 per ton, up from \$2 per ton the previous year. So I think a lot of what the energy markets are doing is filling in a policy gap in terms of lack of global agreement and push for carbon prices.

But let me come back more specifically, Kara, to your question on technologies needed to flatten the cost curve. For power generation it's quite clear: It's renewable power and it's working quite well. There's still some problems of seasonality and intermittency, but it's working quite well. In mobility, I think part of it will be

electrification and that really will be linked to ongoing innovation on battery technology, which we think continues despite some inflation in the raw material costs.

But then we get into the two or three technologies which are really challenging today, but which will be so important as we go into net zero, which are clean hydrogen, especially for heavy transport and industry; carbon capture, especially for heavy industry; and the circular economy, with bioenergy, recycling and also creating more of a circular economy on CO<sub>2</sub> itself, where we capture CO<sub>2</sub> from the atmosphere and with green hydrogen we produce synthetic fuels and then it goes back into a natural cycle. These are all areas that we think could make a tremendous difference in continuing to improve the cost curve for the future.

**KM:** Thanks, Michele. As you just mentioned, sustainable energy: it's not just about new green power companies, right? There's a lot of other sectors that also need to decarbonize. And at your Carbonomics conference you had several big oil and gas companies and CEOs, and they're talking about those technologies that you just mentioned, but maybe more broadly, how are these companies' CEOs thinking about re-imagining themselves in a lower-carbon business, holistically?

**MDV:** It's an important point because these companies come from a business model that will not be sustainable in a net zero world. And so they are trying to lead the energy transition by thinking forward of how they can take some of their competitive advantages today in terms of capital, clients, technological know-how and use that to build a sustainable business in net-zero energy. They are doing it across all of these different technologies, in renewable power and in electric mobility, mostly through the building of charging networks, but also in bioenergy, in carbon capture, in the circular economy, and in some cases offsetting through nature-based carbon removal. And they're trying really to transform their entire business. I think they could be able in the next decade to capture both a material transformation in their business model while also harvesting their existing oil and gas business, which is shrinking, but which we believe can be very profitable in this first phase of the transition where the restraints on supply and investment is creating a strong commodity price cycle.

**KM:** And Michele, transport is another industry where we're seeing significant technological change: Electrification continues to roll out across different sectors, which you talked about, but what are the key opportunities and challenges ahead for that industry and aviation, of course, is a very important one as well.

When we look into transport we need to split transport into its different parts. I have little doubt that for light duty vehicles, electrification is the winning technology. But as we go into heavy duty vehicles, shipping and aviation, I believe we need a solution that gives you more energy intensity, and that's where we will need hydrogen, including a potential transformation of hydrogen like methanol or ammonia for shipping, and biofuel—specifically, sustainable aviation fuels—for aviation. And one day, potentially,

e-fuels that come from merging captured CO<sub>2</sub> from the atmosphere with green hydrogen will be the winning technologies to get transport to net zero.

I don't believe in one technology solution. I believe in an ecosystem of technologies where renewable power and batteries work together with hydrogen and carbon capture to get us to net zero, and where local hubs—especially for industry, but also for heavy transport—need to be created to enable this full decarbonization.

**KM:** And Michele, maybe to take a step back here: The outcomes of COP26 were, of course, top of mind heading into your Carbonomics conference. Part of this podcast is really to dig in on some of the complexities around decarbonization and climate, and this is very apparent in your research in the way that you think about different pathways. We know that national commitments to net zero and further cuts to carbon emissions by 2030 are absolutely critical in our progress towards a low-carbon economy, but there's an important role for policy to play here. So can you talk to us a little bit about how policy impacts the different transition pathways to net zero?

**MDV:** So I personally think the Glasgow climate summit really did two things: On one side, it kept alive the ambition to stay within 1.5 degrees. I'm not sure that we got anywhere close to promises to make it tangible, but it was kept alive and where this is important is because I think it continues to enable investors and corporates to engage on the idea of 1.5 degree, which clearly is a very ambitious target that will require substantial investments and technological innovation.

In a similar way, when I look back to the Paris Agreement, I thought its key success was to bring this framework of Paris alignment for well within 2° of global warming into the dialogue between corporates and investors. But in terms of politics, the world's largest economy, the US left just two years later. So it's difficult to say that the Paris Agreement was a political success, but it certainly was immensely successful in creating a collaborative framework for decarbonization between corporates and capital markets. And I think Glasgow is having a similar positive impact, with the shift towards 1.5 degree—even though the country-by-country pledges clearly did not live up to that.

**KM:** And Michele, one of the other big themes coming out of COP26 which is also an important complexity in the global climate challenges around just transition. How our policymakers thinking through and private sector thinking through the implications of just transition in terms of meeting global climate goals?

**MDV:** It's, it's a complex area. And I'm not sure one where Glasgow has especially succeeded. Clearly, the western world went into this summit on a deficit towards emerging countries, because they had promised \$100 billion per annum of financing by 2020 and didn't deliver. The best, I believe, was \$80B in 2019. So all that Glasgow effectively achieved was for that promise to be reiterated and that it will be met in the coming years, but it was not substantially upgraded the way that several emerging-

market countries were wishing for. Also, emerging-market countries were asking for a bigger percentage of that to be dedicated to adaptation, which is the most urgent of their needs. There's been a bit of a shift there, with a view over time to go towards 50/50 of those funds being for mitigation and for adaptation. So I would say a bit of progress was achieved, but without doubt, a lot of emerging economies left the summit feeling that one of the core goals of fairness was not achieved during this summit.

**KM:** And Michele your remarks really underscore that one of the key complexities around decarbonization is that it's a global problem, and requires a global solution. Um, but the world is not one place. How are regional differences playing out in the move towards decarbonization?

**MDV:** I think there are enormous local dynamics which can go in favor or against decarbonization. I also think each country has different competitive advantages in the renewable economy, for instance, in its industry, in its know-how, so I'm not surprised different countries will go different ways from a technological perspective, but it's important that everybody embraces the net-zero goal in a way that actually goes through society, goes through investment, and informs both the consumers and the corporates.

I'm not sure this is yet happening at full speed in all continents. Even in Europe, where the EU presented the most detailed strategy to net zero and 1.5 degrees, I don't think we're fully exploiting consumer pressure. For instance, if you go to European supermarket today, you have the right to know the calories and nutritional content of packaged food, but you don't have, as a consumer, the right to know the carbon footprint of that good. And yet, today's technologies can enable us to do it, between blockchain, internet of things, big data, computing capabilities—we can do it. But politicians aren't yet pushing corporates for that full disclosure and I think this misses out on a key driver, which is consumer awareness and pressure towards lower carbon that I think will become one of the key tools of the decarbonization in the coming years.

**KM:** It's such an important point, and you talked earlier in the conversation about the role that investors have been playing in the climate challenge and really accelerating engagement with companies on decarbonization. So much of that conversation and my experience at the firm working with clients on climate and decarbonization has been through a sectoral lens. Why don't you think there's that sort of regional lens that's being applied as much when we think about measuring and managing progress towards net zero?

**MDV:** I think the difficulty is that a sectoral lens allows to discuss about positioning on the cost curve, technological maturity—all factors that we can debate but which are ultimately quite objective. I think when we go through a regional exercise and we start to attribute which regions get bigger or smaller budget of the limited budget to net zero—which for 1.5 degree is only, on our numbers, about 500 gigatons from now—

then we get into ethics and we get into what's right? What's fair? What's politically achievable? It is much more difficult to do that because the judgment is no longer driven by objective economics and engineering problems, but by fairness and income distribution.

**KM:** Thanks Michele. Two of the technologies that you've underscored in your research that are going to be crucial and delivering on global net-zero goals are clean hydrogen and also carbon capture, storage, and sequestration. Can you talk us through where you see those technologies reshaping the cost of decarbonization and what is limiting faster adoption of those technologies?

**MDV:** I think three things are limiting faster adoption of those technologies. The first one is that those technologies need a completely new infrastructure. Wind or solar were so much easier. The moment that you had the power generation that generated power from the sun or from the wind, you then had an existing infrastructure to transport it and to use it. For hydrogen and carbon capture, you need a completely new infrastructure of transport, of storage. In many cases, you need to create a new consumption at the factory, at the building. It's a much more complex process, which requires a bigger infrastructure layout.

The second thing I would say is one of these technologies, specifically carbon capture is still suffering from some public resistance towards it, largely because it's viewed as a bit of an oil and gas field in reverse: You inject instead of extract. And therefore, I think there is a bit of uneasiness in supporting this technology. I don't think it's right: I think we need the carbon capture and storage and I think we understand enough geological storage that we can do it safely, especially if we do it offshore.

And then the final point is safety, I think there's still some concerns about hydrogen use on a global basis. There's concerns for its potential use in shipping, the potential use in heavy trucks. My understanding is that the safety can be well managed there and that it is not materially more dangerous than an internal combustion engine.

But our view is we need both, if we want to get to net zero. Hydrogen and carbon capture together can make up to a quarter of the total decarbonization path.

**KM:** It's a great perspective Michele, and it's clear coming out of COP26 that, to your point, we really are going to need all the tools in the toolkit to deliver on global climate goals. Michele, thank you so much for joining us.

**MDV:** Kara, it's always a pleasure. Thank you for your time.

**KM:** That's a wrap on our first special episode focused on climate transition. We'll be back next week with another look at this vital and fast changing topic featuring more experts from Goldman Sachs as well as its partners and clients. Until then I'm Kara Mangone. Thanks for listening to Accelerating Transition; we'll talk to you next week.

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